MUNICIPALITY OF | MUNICIPALITÉ DE
MARKSTAY
WARREN

CONTRACT NO. TMW-2026-08

REPLACEMENT OF LEEFTINK ROAD BRIDGE, NORTH ROAD MIDDLE SECTION CULVERT, AND DUPUIS ROAD CULVERT

CORPORATION OF THE
MUNICIPALITY OF MARKSTAY-WARREN

TMW-2026-08

June 2026

CORPORATION OF THE MUNICIPALITY OF MARKSTAY-WARREN

TENDER FOR
CONTRACT NO. TMW-2026-08

REPLACEMENT OF LEEFTINK ROAD BRIDGE, NORTH ROAD MIDDLE SECTION CULVERT, AND DUPUIS ROAD CULVERT

ELECTRONIC BID SUBMISSIONS ONLY in the form of a password protected pdf document, shall be received via Electronic Submission (email) to The Municipality of Markstay-Warran **until 4:00:00 p.m. (16:00:00 hours) local time on Friday, July 17, 2026**.

Proposals shall be emailed to:	publicworks@markstay-warren.ca
cc:	info@markstay-warren.ca; scormier@rvanderson.com
Subject:	**Contract No. TMW-2026-08 Tender – (Contractor Name)**

CONSTRUCTION WORKS

The construction works generally includes the following approximate quantities:

- Replacement of the existing 33.5 m span Leeftink Rd Bridge with a 36.6 m single-span single-lane modular bridge
- Replacement of a 3.7 x 20 m long multi-plate corrugated steel pipe culvert with a 4.2 m (span) x 3.6 m (rise) pre-cast concrete box culvert on North Rd Middle Section
- Replacement of a 5.5 x 3.4 x 20 m long multi-plate corrugated steel arch pipe culvert with a 5.4 m (span) x 3.6 m (rise) pre-cast concrete box culvert on Dupuis Rd

TENDER DOCUMENTS

Tender documents may be obtained from the Municipality's website under the Tenders and Request for Proposals section at the following link: https://markstay-warren.ca/municipal-services/tenders-rfps/, **on or after 1:00 P.M. Friday, June 26, 2026**. Tender documents may also be viewed at the same location. **For further information, please email Mr. Steven Cormier at R.V. Anderson Associates Limited at scormier@rvanderson.com.**

Deadline for questions is Monday, July 13th, 2026, at 2:00 P.M.

PREQUALIFICATION

Tenderers must prequalify and the deadline to apply for prequalification is **Friday, July 3rd, 2026, at 2:00 P.M.**
Tender forms for bidding purposes will be issued only to contractors who have prequalified.

TENDER INFORMATION MEETING

A **MANDATORY** tender information site meeting will be held at **2:00 P.M., Wednesday, July 8th, 2026.**

TENDER OPENING

There will be no public tender opening. In place of a public opening, bidders will be provided with a summary of bids within three (3) working days of the bid opening.

TENDER AWARD
Lowest or any tender not necessarily accepted.

CORPORATION OF THE
MUNICIPALITY OF MARKSTAY-WARREN

CONTRACT NO. TMW-2026-08

REPLACEMENT OF LEEFTINK ROAD BRIDGE, NORTH ROAD MIDDLE SECTION CULVERT, AND DUPUIS ROAD CULVERT

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Part 1

INSTRUCTIONS TO TENDERERS

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INSTRUCTION TO TENDERERS

1. DESCRIPTION OF THE WORKS

The work consists of the supply of all labour, material, equipment, supervision, and coordination necessary to complete the work shown, or described by, or reasonably inferred from these contract documents. Without limiting the qualifications of the foregoing, the work generally consists of the following:

- Strategic replacement of the Leeftink Road Bridge #9 over the Veuve River, along with approach works, roadside safety features and site restoration. The existing bridge is located on Leeftink Road (5150785.7 N, 536722.5 E), approximately 200 m north of Ratter Lake Road.

- Replacement of North Road Middle Section Culvert (Culvert 111) through the Veuve River, along with approach works, roadside safety features and site restoration. The existing culvert is located on North Road Middle Section (5156459 N, 536491 E), approximately 2.6 Km east of Crerar Rd.

- Replacement of Dupuis Road Culvert (Culvert 11) through the Bear River, along with approach works, roadside safety features and site restoration. The existing culvert is located on Dupuis Road (5136185 N, 546443 E), approximately 1.67 km west of Bedard Road.

2. GENERAL CONDITIONS, STANDARD SPECIFICATIONS & DRAWINGS

All work must be carried out in accordance with current Ontario Provincial Standard Specifications and Drawings and the requirement of these Contract Documents and Drawings. The current Ontario Provincial Standard General Conditions apply to this contract and will be included in the legal documents.

3. OWNER OF THE WORKS

The Owner of the works will be the Corporation of the Municipality of Markstay-Warren. Wherein this contract reference is made to the Municipality of Markstay-Warren, The Municipality, The Corporation of the Municipality of Markstay-Warren, or the Corporation, it will mean the same as the Owner and defined in Section 1.0 of the General Conditions.

4. REGISTER FOR TENDER

All interested bidders are required to register for the tender. **ELECTRONIC BID REGISTRATION ONLY** shall be received by email as follows:

email to: publicworks@markstay-warren.ca
cc: info@markstay-warren.ca; scormier@rvanderson.com
Subject: Contract No. TMW-2026-08 Tender Registration – (Contractor Name)

5. PRE-QUALIFICATION

Tenderers must submit the following documents, prior to the specified deadline for application for pre-qualification:

a) Letter from the Tenderer's bank manager addressed to the Municipality of Markstay-Warren – Markstay-Warren, attesting to the Tenderer's financial capability to complete this contract.

b) Completion of Statement 'A' in Section 36 Tenderer's Experience in Similar Work. A minimum of 5 projects is required within the past 5 years of similar dollar value and scope.

c) A list of all contracts presently undertaken the value of each contract, the scheduling of each contract, and the name of the owner.

d) The name, qualifications, and experience of the proposed superintendent for this contract work.

e) A list of equipment available for this contract work, and whether "owned" or "rented".

Pre-Qualification applications for **Contract No. TMW-2026-08 must be received** by **2:00 P.M. on Friday, July 3rd, 2026. ELECTRONIC PRE-QUALIFICATION SUBMISSIONS ONLY** shall be received by email as follows:

email to:	publicworks@markstay-warren.ca
cc:	info@markstay-warren.ca; scormier@rvanderson.com
Subject:	Contract No. TMW-2026-08 Pre-Qual – (Contractor Name)

No Tenderer will be supplied with a tender form unless the Tenderer has been pre-qualified.

Each Tenderer who has submitted a pre-qualification application, will be notified as soon as they have been pre-qualified. The Tenderer will then be advised how and where they may receive a tender form if required. The Municipality reserves the right to review and approve all final pre-qualified tenders for this project including consideration for past performance on projects.

6. ADDENDA

A copy of all Addenda and/or notices will posted to the Municipality's website under the Tenders and Request for Proposals section at the following link: https://markstay-warren.ca/municipal-services/tenders-rfps/, or by electronic correspondence, to each prospective bidder who has registered for this tender.

Addenda will be issued under the following circumstances:

a) Interpretation of tender documents as a result of queries from prospective

bidders;

b) Revision, deletions, additions, or substitutions of any portion of tender documents.

All such changes as addressed in the addenda must become an integral part of the tender documents and will be allowed for in arriving at the tender price.

Oral instructions will not be considered valid unless they are confirmed in writing by the Engineer.

Tenderers are reminded that they must complete the acknowledgement of Addenda receipt on Page No. 1 of the Form of Tender.

7. DELIVERY AND OPENING OF TENDERS

ELECTRONIC BID SUBMISSIONS ONLY in the form of a password protected pdf document, shall be received via Electronic Submission (email) to The Municipality of Markstay-Warran **until 4:00:00 p.m. (16:00:00 hours) local time on Friday, July 17, 2026**. Bidder shall allow sufficient times for their email transmission to be completed, and documents received by the Municipality prior to the Tender Closing Time. After the official closing time, respondents will be requested to submit the password within 1 hour of bid close. Confirmation of receipt can be requested by calling the Municipal Office at 705-853-4536.

Proposals shall be emailed to: publicworks@markstay-warren.ca
cc: info@markstay-warren.ca; scormier@rvanderson.com
Subject: Contract No. TMW-2026-08 Tender – (Contractor Name)

The date and time recorded by the Municipality upon submission of a Bid will take precedence over any machine-initiated date and time information on Bids or revisions, and no consideration will be given to tenders received after the advertised deadline.

CLOSING LOCATION:
Municipality of Markstay-Warren
21 Main Street, South
P.O. Box 79
Markstay, ON, P0M 2G0

There will be no public tender opening. In place of a public opening, tenders will then be passed to the Owner's Consulting Engineer who will be provide bidders with a summary of bids within three (3) working days of the bid opening and will subsequently check and analyze the tenders and submit a report to the Municipality.

8. DISQUALIFICATION OF TENDERS

Under no circumstances will tenders be considered which:

a) Are received after **4:00 P.M. local time** on the advertised closing date for tenders.

b) Are not accompanied by a tender deposit in an amount not less than that specified.

c) Are not accompanied by an Agreement to Bond in accordance with these documents and acceptable to the Town Solicitor.

9. WITHDRAWAL OR QUALIFYING OF TENDERS

A Tenderer who has already submitted a tender may submit a further tender at any time up to the official closing time. The last tender received will supersede and invalidate all tenders previously submitted by that tender for this contract.

A Tenderer may withdraw or qualify his tender at any time prior to the Tender Closing Time by delivering written notice, signed by an authorized signing officer of the Tenderer, by email as follows:

emailed to:	publicworks@markstay-warren.ca
cc:	info@markstay-warren.ca; scormier@rvanderson.com
Subject:	Contract No. TMW-2026-08 Tender – (Contractor Name) Revision (#)

Such written notice must be received prior to the Tender Closing Time in order to be effective. A notice of revision shall clearly identify the change to the Tender and shall be binding upon the Tenderer. Notices received after the Tender Closing Time shall be of no force or effect.

Withdrawal or revision by telephone, facsimile transmission, or any means other than as expressly provided herein will not be accepted.

10. INFORMAL OR UNBALANCED TENDERS

All entries in the Form of Tender must be made digitally or by clear and legible scanned copy.

Tenders which are incomplete, conditional, illegible, or obscure, or that contain additions not called for, reservations, erasures, alterations (unless properly and clearly made and initialled by the Tenderer's signing officer) or irregularities of any kind, may be rejected as informal.

Tenders that contain prices which appear to be so unbalanced as likely to affect adversely the interests of the owner may be rejected.

Wherever in a tender the amount tendered for an item does not agree with the

extension of the estimated quantity and the tendered unit price, the unit price will govern, and the amount and the Total Tender Price will be corrected accordingly.

A discrepancy in addition or subtraction in a tender will be corrected by the owner by adding or subtracting the items correctly and correcting the Total Tender Price accordingly. Where an error has been made in transferring an amount from one part of the Form of Tender to another, the amount shown before transfer will, subject to any corrections as provided for above, be taken to be correct and the amount shown after transfer and the Total Tender Price will be corrected accordingly.

If a Tenderer has omitted or failed to enter a price for an item of work set out in the Form of Tender, he will, unless he has specifically stated otherwise in his tender, be deemed to have allowed elsewhere in the Form of Tender for the cost of carrying out the said item of work and, unless otherwise agreed to by the Owner, no increase will be made in the total Tender Price on account of such omission.

The Owner reserves the right to waive formalities at its discretion.

The Owner reserves the right to reject any or all tenders.

Tenders that have been rejected by the Owner because of informalities will normally be notified of the reasons for the rejection within ten (10) days after the closing date for tenders.

11. EXAMINATION OF SITE

Each Tenderer may visit each site of the works before submitting his tender and should by personal examination satisfy themselves as to the local conditions to be met with during the construction and conduct of the work. The Tenderer will make their own estimate of the facilities and difficulties that may be encountered including the nature of the subsurface material and conditions. The tenderer is not to claim at any time after submission of the tender that there was any misunderstanding of the terms and conditions of the Contract relating to site conditions.

12. TENDER INFORMATION MEETING

Tenders are invited to attend a **Mandatory** Tender Information Site Meeting at **2:00 P.M. on Wednesday, July 8th, 2026**. An invite via Microsoft Outlook will be sent to all pre-qualified plan takers prior to the meeting. Meeting location will be provided in the Microsoft Outlook invite.

The purpose of the meeting is to provide additional information, if required, and to answer question concerning the project and contract documents. All Tenders are required to attend the **Mandatory** Tender Information Site Meeting.

Any new information or project changes given at the meeting will be covered by an Addendum to the contract which will be issued prior to the tender closing date.

Minutes of the **Mandatory** Tender Information Meeting will be issued to all meeting attendees.

13. QUESTIONS AND CLARIFICATIONS

Deadline for questions is **Monday, July 13th, 2026, at 2:00 P.M. ELECTRONIC QUESTION SUBMISSIONS ONLY** shall be received by email as follows:

email to: publicworks@markstay-warren.ca
cc: info@markstay-warren.ca; scormier@rvanderson.com
Subject: Contract No. TMW-2026-08 Questions

14. GEOTECHNICAL INVESTIGATION

The following report is prepared for design purposes, and provided to the bidders, for information purposes only:

- Geotechnical Investigation and Design Report, Proposed Bridge Replacement, Leeftink Road, Markstay-Warren, Ontario prepared by EXP Services Inc., dated June 01, 2026.
- Geotechnical Investigation and Design Report, Proposed Culvert Replacement, North Road, Markstay-Warren, Ontario prepared by EXP Services Inc., dated February 03, 2026.
- Geotechnical Investigation and Design Report, Proposed Culvert Replacement, Dupuis Road, Markstay-Warren, Ontario prepared by EXP Services Inc., dated January 28, 2026.
- Addendum No. 1 Geotechnical Investigation and Design Report, Proposed Culvert Replacement, Dupuis Road, Markstay-Warren, Ontario prepared by EXP Services Inc., dated June 18, 2026.
- Addendum No. 1 Geotechnical Investigation and Design Report, Proposed Culvert Replacement, North Road, Markstay-Warren, Ontario prepared by EXP Services Inc., dated June 19, 2026.

This report is included in Part #7 of the Contract Document. Contractors bidding on or undertaking the works must rely on their own investigation and interpretation of this information and draw their own conclusions as to how this will affect their bidding and construction techniques.

15. TENDER

Each tender must be in accordance with Section 2 of the General Conditions and must include a completed Form of Tender, an Agreement to Bond, on the form provided, a tender deposit as required herein, together with any further forms or sheets which the Tenderer is instructed elsewhere herein, or in any addendum hereto, to submit with his tender. The Tenderer may retain the rest of the tender documents issued to him.

The Tenderer must give the Total Tender Price both in words and in figures and, except as otherwise specifically permitted in the Form of Tender, fill in all blank spaces for unit prices, lump sums, and other information in the Form of Tender. The tender must be enclosed in the password protected PDF file submitted.

16. OMISSIONS, DISCREPANCIES, AND INTERPRETATIONS

Should a Tenderer find omissions from or discrepancies in any of the tender documents or should he be in doubt as to the meaning of any part of such documents, he should notify the Consulting Engineer, in writing or by fax and not later than seven (7) days before the closing date for tenders. If the Consulting Engineer considers that a correction, explanation, or interpretation is necessary or desirable, he will issue an addendum to all who have registered for the tender.

17. ACCEPTANCE OR REJECTION OF TENDERS

Subject to the General Conditions, except as provided hereunder, neither the Consulting Engineer nor any officer or employee of the Owner has authority to make or accept an offer or to enter into a contract on behalf of the Owner or to create any rights against or to impose any obligations on the Owner. The recommendation of a tender to the Owner for acceptance does not constitute acceptance of the tender by the Owner.

Validity of tenders:

IRREGULARITY		RESPONSE
1	Late Bids	Automatic rejection and not opened or read publicly
2	PDF Submission not password protected	Automatic rejection
3	Insufficient Financial Security (No Bid Security or agreement to bond or insufficient Bid bond or agreement to bond)	Automatic rejection
4	Bids completed and/or signed in erasable medium	Automatic rejection
5	All required sections of Bid documents not completed	Automatic rejection unless, in the opinion of the Owner, the incomplete nature is trivial or insignificant.
6	Qualified Bids (Bids qualified or restricted by an attached statement).	Automatic rejection unless, in the opinion of the Owner, the qualification or restriction is trivial or not significant
7	Bids received on documents other than those provided or specified by the Owner.	Automatic rejection
8	Bids containing minor obvious clerical	24 hours to correct and initial errors

	errors.	
9	Failure to execute Agreement to Bond (Surety's Consent) or Bonding company corporate seal or signature missing from Agreement to Bond.	Automatic rejection
10	Failure to execute bid Bond by Bidder and Bonding Company	Automatic rejection
a)	Corporate seal to the Bidder and Bonding Company, missing.	24 hours to correct
11	Documents - Execution	
a)	Corporate seal or signature missing; signatory's authority to bind the corporation or signature missing.	24 hours to rectify situation
b)	Corporate seal and signature missing; signatory's authority to bind the corporation and signature missing.	Automatic rejection
12	Erasures, Overwriting or Strike-Outs which are not Initialled:	
a)	Uninitialled changes to the Tender documents, other than unit prices, which are trivial or not significant;	24 hours to initial. The determination of what constitutes trivial or insignificant uninitialled changes shall be made by the Owner.
b)	Unit prices in the Schedule of Prices have been changed but not initialled and the Contract totals are consistent with the price as changed;	24 hours to initial change in unit price.
c)	Unit prices in the Schedule of Prices which have been changed but not initialled and the Contract totals are inconsistent with the price as changed;	Automatic rejection
13	Mathematical errors which are not consistent with unit prices.	24 hours to initial corrections to the unit price or to the extension and to the corresponding subtotal, HST and total as made by the Owner.
14	Documents, in which all necessary Addenda, which have financial implication, have not been acknowledged.	Automatic rejection.
15	Any other irregularities	The Owner shall have authority to waive other irregularities or grant 24 hours to initial other irregularities, which it considers to be minor.

A tender is accepted by the Owner when an agreement in the form bound herein is executed by the Owner and by the Tenderer or when the Engineer, with the written authorization of the Owner and within the period referred to in Section 17 hereof, has issued a written order to commence work to the Tenderer and the Owner or anyone acting on its behalf has requested the Tenderer to execute the Agreement and to return it to the Owner and the acceptance of the tender and the execution of the Agreement by the Owner are subject to the express condition that the Owner receive a Performance Bond and a Payment Bond in a form acceptable to the Town Solicitor, and in accordance with the requirements hereof, within seven (7) days after notification of the execution of the Agreement by the Owner has been mailed to the Tenderer whose tender has been accepted as aforesaid.

The Owner will not be responsible for any liabilities, costs, expenses, loss, or damage incurred, sustained, or suffered by any Tenderer prior or subsequent to or by reason of the acceptance or the non-acceptance by the Owner of any tender or by reason of any delay in the acceptance of a tender save as provided in the Contract. Tenders are subject to a formal contract being prepared and executed. The Owner reserves the right to reject any or all tenders and to waive formalities as in the interests of the Owner may require without stating reasons therefore and the lowest or any tender will not necessarily be accepted. If an insufficient number of tenders are received, tenders may be returned unopened.

18. PERIOD OF VALIDITY OF TENDERS

The Tenderers attention is drawn to the Form of Tender, “Standard Tender Requirements”, for the tender validity period.

The prices entered by the Tenderer, in the Form of Tender, will assume that the Engineer’s written order to commence work will be issued to the Tenderer within a 60-day period after the opening date for tenders, unless otherwise noted.

19. TENDER DEPOSIT

Bidders shall submit a Bid Deposit to the Municipality as assurance that, should the Bid be accepted by the Municipality, the Successful Bidder will enter into a Contract in accordance with the terms of the Bid Solicitation within the (7) business days following written notification to the Successful Bidder by the Municipality.

The Bid Deposit shall be in the form of a Bid Bond issued by a surety company authorized to transact the business of suretyship in the Province of Ontario (Surety Company) using the same content as CCDC 220 in an amount no less than fifteen percent (15%) of the Bidder’s Contract Price, exclusive of HST, as per Part 2, Section FT - Schedule of Unit Prices.

A Bid Deposit submitted for any previous Contract is not an acceptable alternative for the Bid Deposit requested.

Bidders shall submit a digital Bid Deposit in an electronically verifiable and enforceable format (eBond).

All eBonds submitted must be verifiable by a third-party bond verification service. If an eBond cannot be verified, the Municipality will have up to four (4) days to verify the eBond(s) submitted by the Bidder. If the Municipality is unable to verify the eBond(s), the Bidder shall be provided four (4) business days to verify the eBond(s), to the satisfaction of the Municipality.

20. AGREEMENT

The Tenderer agrees that, if requested to do so by the Owner or anyone acting on its behalf within sixty (60) days after the date of opening tenders, they will execute in triplicate and return to the Owner the Agreement in the form bound herein within seven (7) days after being so requested. If the Tenderer has not been so requested within the said sixty (60) days or if the Owner's written order to commence work has not been mailed or delivered to the Tenderer or their office or their postal address within the said sixty (60) days, the Tenderer may, unless they have otherwise agreed or offered and accept as otherwise provided herein, withdraw their tender.

21. PERFORMANCE AND PAYMENT BONDS,

The successful Contractor, together with a surety company approved by the Owner and authorized by law to carry on business in the Province of Ontario, will, unless otherwise directed, be required to furnish to the Owner:

a) Performance Bond with a coverage limit of 50% of the Contract Price (Plus all applicable taxes);

b) Labour and Material Bond with a coverage limit of 50% of the Contract Price (Plus all applicable taxes) and

c) Such additional amount, if any, as may be required by the Owner.

The Tenderer must tender for the cost of the bonds in the item provided for that purpose in the Form of Tender on the assumption that the bonds will total the amount of 100% of the total tender price. In the event that the bonds are required to be in an amount more than 100% of the total tender price, the Owner will reimburse the Contractor in the amount of the premium for such excess amount after submission by the Contractor to the Owner of the surety company's relevant receipted invoice. The bonds shall remain in good standing until the end of the warranty and/or maintenance period, whichever is longer.

The Tenderer must include with his tender an Agreement to Bond in a form acceptable to the Town Solicitor (sample can be found in Section 35 of the Information to Tenderers) herewith executed under its corporate seal by the surety company from which he proposed to obtain the required bonds.
The Tenderer will be required to furnish the surety in triplicate as required herein and, in the forms, bound herein within seven (7) days after notification of the execution of the agreement by the Owner has been mailed to him. One copy of the said surety must be bound into each of the three (3) executed sets of the Contract.

The Tenderers attention is drawn to the Form of Tender, “Standard Tender Requirements”, for bonds, which may be required for subcontractors.

22. SUBCONTRACTORS

The Tenderer must give in Statement ‘B’ sheet of the tender document the name and address of each proposed subcontractor used in making up his tender and must state the portion and value of the work allotted to each. Only one subcontractor must be named for each part of the work to be sublet.

If the successful Tenderer wishes to substitute a subcontractor other than the one named in Schedule ‘A’ of the Form of Tender for a specific item of work, he must submit documentation to the Engineer pertaining to the proposed subcontractor’s experience and competence to carry out the work. Employment of the proposed subcontractor on the works is subject to the written approval of the Engineer.

The term “subcontractor” as referred to in this Clause 20 must not include suppliers of pre-selected equipment unless otherwise specifically stated in these documents or directed.

Attention is drawn to Section 3.0 of the General Conditions and to the instructions on Statement A sheet.

The Contractor must arrange that each of his Owner-approved subcontractors whose subcontracts have a value of $250,000 or greater, together with surety companies approved by the Owner, furnish to the Contractor a Performance Bond and a separate Labour and Material Payment Bond each in the amount of fifty percent (50%) of the total value of the respective subcontract.

The Performance Bond is to be in the form of C.C.A. Document No. (S)21 and the Labour and Material Payment Bond in the form of C.C.A. Document (S)22, both as approved by the Insurance Bureau of Canada. The Owner will reimburse the Contractor in the amount of the cost of the bonds, with no mark-up included, upon submission by the Contractor to the Owner of the surety companies’ relevant receipted invoices.

The Owner will not require completed Agreement to Bond forms, for the subcontractor’s bonds mentioned above, to be submitted by the Tenderer at the time of tendering. The Tenderer may, in their discretion, decide to obtain Agreements to Bond from his subcontractors at the time of tendering.

23. WORKPLACE SAFETY AND INSURANCE BOARD

The Contractor must, at the time of entering into any contract with the Owner, make a statutory declaration or furnish a satisfactory clearance letter from the Workplace Safety and Insurance Board, stating that all assessments or compensation payable to the Workplace Safety and Insurance Board have been paid.

The selected Tenderer will submit such statutory declaration or clearance letter to the Owner in triplicate together with the Agreement executed by the said Tenderer. One copy of the statutory declaration or clearance letter must be bound into each of the three (3) executed sets of the Contract.

24. OCCUPATIONAL HEALTH AND SAFETY

To avoid any misunderstanding as to the nature of the work to be performed herein, the Contractor by executing this contract, unequivocally acknowledges that it is the constructor within the meaning of the Occupational Health and Safety Act, and the Contractor undertakes to carry out the duties and responsibilities of a constructor with respect to the work.

It is specifically drawn to the attention of the Tenderer that the Occupational Health and Safety Act provides in addition to other matters that,

“A constructor must ensure, on a project undertaken by the constructor that,

a) the measures and procedures prescribed by this Act and the regulations are carried out on the project;

b) every employer and every worker performing work on the project complies with this Act and the regulation; and,

c) the health and safety of workers on the project is protected”.

25. GOVERNMENT TAXES

The Tender’s attention is drawn to Clause 4-1 of the Supplemental General Conditions.

26. NON-RESIDENT CONTRACTOR

If the Contractor is a non-resident of Ontario, he must, immediately after he has received the Owner’s written order to commence work, obtain from the Retail Sales Tax Branch a certificate showing that the Contractor has registered with the Retail Sales Tax Branch and must submit such certificate to the Owner while he furnishes the Performance Bond.

If the Contractor is non-resident in Ontario, he must not commence work or order any materials or equipment for the Contract until he has registered with the Retail Sales Tax Branch.

The Contractor must ensure that all subcontractors whom he proposes to use for carrying out any of the work required by the Contract and who are non-resident in Ontario have registered with and have complied with the requirements of the Retail Sales Tax Branch before they commence any such work.

27. INSURANCE

The Tender's attention is drawn to the insurance requirements as set forth in Section GC 6.03.02 and 6.03.03 of the General Conditions.

28. RIGHT OF THE OWNER

The Owner reserves the right reject any of all tenders.

The Owner will not accept any inconsistency in the Unit Prices bid for the various items.

The Owner reserves the right to delete any portion or part of the work outlined and the bidder agrees to such cancellation without any claim whatsoever because of such cancellation.

29. CONTRACT AWARD

Lowest or any tender not necessarily accepted.

30. PRE-CONSTRUCTION MEETING

A pre-construction meeting will be scheduled with the successful Tenderer, following contract award. The Contractor will be required to submit to the Contract Administrator the following information at that time, namely;

a) A construction "Progress Schedule" clearly indicating the proposed order and time allowance for various phases of the work in sufficient detail to show weekly progress.

b) A "Traffic Protection Plan" in accordance with Section GC 7-08 in the General Conditions and Requirements outlined in the Special Provisions under Traffic Control.

c) A listing of sub-contractors and suppliers that Contractor wishes to utilize for completing work on the contract in accordance with GC 3.09 "Assignment, Subletting and Renting" in the General Conditions.

d) Silt Mitigation Plan

e) Construction Staging Plan and Methodology

f) 24-Hour Emergency Contact Number(s)

31. SAFETY

In conjunction with GC7.00 of the General Conditions, the Contractor must do all works in conformance with the Occupational Health and Safety Act, and regulations for construction projects.

32. CONSTRUCTOR

Constructor means, for the purpose of, and within the meaning of the Occupational Health and Safety Act, R.S.O. 1990, C.O.1, as amended and amendments thereto, the contractor who executes the Contract.

33. ACCESSIBILITY

The Owner is committed to the accessibility principles of preventing and removing barriers in accessing goods and services for people with disabilities and is bound by the Standards under the Accessibility for Ontarians with Disabilities Act, 2005 as may be amended from time to time.

Regulations enacted under the Act apply to every designated public sector organization and other third parties that provide goods and services to the members of the public.
The contractor, and all sub-contractors hired by the consultant/contractor in the completion of its work, will meet or exceed compliance with all applicable regulations under the Accessibility for Ontarians with Disabilities Act, 2005 as may be amended from time to time.

It is the contractor’s responsibility to ensure they are fully aware of and meet all requirements under the Act.

34. SAMPLE – AGREEMENT TO BOND

AGREEMENT TO BOND

We, the undersigned, hereby agree to become bound as for

_____ a bond totalling
(BIDDER'S NAME)

One Hundred Per Cent (100%) of the Contract amount, and conforming to the Instruments of Contract attached hereto, for the full and due performance of the works shown as described herein, if the tender for

_____
(CONTRACT NUMBER & TITLE)

is accepted by The Corporation of the Municipality of Markstay-Warren.

It is a condition of this Agreement that if the above-mentioned tender is accepted, a 50% Percent Performance Bond and 50% Percent Labour and Material Payment Bond must be completed with the undersigned within seven (7) days of acceptance of the Contract Price (including HST) related thereto, otherwise this Agreement shall be null and void.

DATED this _____ day of _____ 2026.

_____
Name of Bonding Company

SEAL

_____
Signature of Authorized Person
Signing for Bonding Company

35. STATEMENT 'A' TENDERER's EXPERIENCE IN SIMILAR WORK

UNLESS THIS LIST IS PROPERLY COMPLETED, THE TENDER MAY BE DISQUALIFIED

List of All Bridge Projects Done by your Firm within the Last 5 Years	Detailed Description of Your Firm's Part of the Work	Dollar Amount of Your Firm's Work	Date Project Began	Date Project Ended	Name of General Contractor	Name of Consulting/ Engineering Firm	Name of Contact Person From Consulting Engineering Firm

Table may be reproduced and/or altered in other digital formats provided the final submission is in PDF format and must contain all the required headings and information.

PART 2

Part 2

FORMS

INDEX

For tendering purposes, use documents supplied from the Municipality’s webpage and provide via email from attached to successful pre-qualification email notice.

FORM OF TENDER

CONTRACT NO. TMW-2026-08

TENDER FOR

REPLACEMENT OF LEEFTINK ROAD BRIDGE, NORTH ROAD MIDDLE SECTION CULVERT, AND DUPUIS ROAD CULVERT

IN THE MUNICIPALITY OF MARKSTAY-WARREN

Tender by: _____

Residing at (or place of business) _____

and _____

Residing at (or place of business) _____

Comprising of the firm of _____

_____

A company duly incorporated under the laws of _____

And having its head office at _____
Hereinafter called "The Tenderer".

NOTE: The Tenderer's name and residence must be inserted above, and in the case of an incorporated firm, the name and residence of each and every member of the firm must be inserted.

To: **The Municipality of Markstay-Warren**

I (WE) _____
have carefully examined and all contract documents relating to the proposed works, including the: Form of Agreement, Addendum / Addenda No ___ to No ___***** inclusive, Special Provisions, Information for Tenderers, Supplementary General Conditions, General Conditions, Supplementary Specifications, Specifications, Standard Specifications, Contract Drawings, Standard Drawings, Form of Tender, Agreement to Bond relating thereto, hereby tender and offer in accordance therewith to enter into a contract to construct the said works in strict accordance with the contract documents and such further detail drawings as may be supplied from time-to-time and to furnish all materials, labour, tools, plant, matters and things necessary therefore complete and ready for use within the time specified for the sum (including Harmonized Sales Tax) of:

Total Contract Price _____

_____ Dollars ($ _____)

***** The tenderer will insert here the numbers of the Addenda received by them during the

tendering period and considered by them in preparing his tender.

The Tenderer agrees that if this tender is accepted by the Owner:

1. to furnish an approved surety for the proper fulfilment of the Contract as required under the terms of Section 21, Performance and Payment Bonds, Letter of Credit of the Information to Tenderers, and to execute the Agreement in triplicate within seven (7) days after being notified to do so by the Engineer. In the event of default or failure on the Tenderer's part to do so, the Tenderer agrees that the Municipality will be at liberty to retain the deposit for the use of the Municipality, and to accept the next lowest or any Tender, or to advertise for new Tenders, or to carry out the works in any other way it may deem best. The Tenderer agrees that in the event of default or failure and the Municipality retains the deposit, that deposit will be applied by the Municipality to the difference between this Tender and any greater sum which the Municipality may expend or incur by reason of such default or failure, or by reason of such action on the part of the Municipality, including the cost of advertisement for new Tender. In the event that the costs are less than the amount of the deposit, the balance will be returned to the Tenderer. In the event of a shortfall between the amount of the deposit and the costs incurred as a result of the default or failure, then the Tenderer agrees to pay that difference.

2. the Tenderer will carry out any additional or extra work (including the supplying of any additional materials or equipment pertaining thereto) or will delete any work as may be required by the Engineer in accordance with the Contract;

3. the carrying out of any work referred to in paragraph 1) above or the issuance by the Engineer of a Contract Change Order relating to such work or the acceptance by the Tenderer of such Contract Change Order will not, except as expressly stated in such Contract Change Order, waive or impair any of the terms of the Contract or of any Contract Change Order previously issued by the Engineer or any of the rights of the Owner or of the Engineer under the Contract;

4. the Tenderer will pay to the Owner (in addition to amounts payable by the Owner in respect of site supervision of the work) the sum specified in the Contract as liquidated damages for each calendar day that the work under the Contract as expressly modified by all Contract Change Orders issued by the Engineer remains uncompleted after the expiry of the Time for Completion specified in the Contract or the extended time for completion allowed in writing by the Engineer.

The prices applicable to work referred above will be determined as follows:

(a) The Schedule of Unit Prices will apply where applicable:

The Tenderer agrees that he is not entitled to payment of the Contingency Allowance except for the additional work carried out by him in accordance with the Contract and only to the extent of such additional work, as authorized by the Engineer in writing.

The Tenderer agrees that, if so, requested in writing by the Owner, he will enter into a contract with the Owner based upon his tender by jointly in the names of the Tenderer and the Tenderer's parent company, if any. The Tenderer further agrees that any request by the Owner as indicated above is not and will not be deemed to be a counteroffer by the Owner.

The Tenderer agrees that this tender is subject to a formal contract being prepared and executed.

The Tenderer declares that no person, firm, or incorporation other than the Tenderer has any interest in this tender or in the proposed contract for which this tender is made.

The Tenderer further declares that this tender is made without any connection, comparison of figures or arrangements with, or knowledge of, any other corporation, firm or person making a tender for the same work and is in all respects fair and without collusion of fraud.

The Tenderer further declares that no officer or employee of the Consulting Engineer is or will become interested directly or indirectly as a contracting party, partner, surety or otherwise in or in the performance of the Contract or in the supplies, work, or business to which it relates, or in any portion of the profits thereof, or in any of the monies to be derived there from.

The Tenderer thereby agrees to indemnify and save harmless the Corporation and its officers, servants and agents from all loss, damage, cost charges, and expenses which they may suffer or be put to by reason of any such default or failure.

If awarded the Contract, the Tenderer agrees to complete the work in accordance with the contract documents including Part 3 Section 1 (Commencement and Completion) of the Special Provisions.

The Tenderer agrees that he will furnish the Owner with a copy of his latest financial statement within 4 days after being requested to do so by the Owner.

The Tenderer agrees that the Owner reserves the right to reject any or all tenders and that the lowest or any tender will not be accepted.

The Tenderer solemnly declares that the several matters stated in the foregoing tender are in all respect true.

This offer will be irrevocable for a period of sixty (60) days following the date of the Tender closing, and the Municipality may at any time, within the time set forth above, without notice accept this Tender whether any other Tender has been previously accepted.

A Bid Bond in an amount no less than fifteen percent (15%) of the Bidder's Contract Price, exclusive of HST, as per Part 2, Section FT - Schedule of Unit Prices is attached hereto as the required tender deposit.

Dated at _____ this _____ day of 2026.

_____ _____

Signature of Witness Signature of Tenderer

Note: If the tender is submitted by or on behalf of a corporation, it must be signed in the same of such corporation by the duly authorized officers and the seal of the corporation, or wafer seal, must be affixed. If the tender is submitted by or on behalf of an individual or a partnership a seal must be affixed opposite the signature of the individual or of each partner and each signature must be witnessed.

SCHEDULE OF UNIT PRICES
MUNICIPALITY OF MARKSTAY-WARREN
REPLACEMENT OF LEEFTINK ROAD BRIDGE, NORTH ROAD MIDDLE SECTION CULVERT, AND DUPUIS ROAD CULVERT
SUMMARY

Summary			
Part A	Leeftink Road Bridge		
Part B	Dupuis Road Culvert		
Part C	North Road Middle Section Culvert		
		Part A Contingency	**$ 250,000.00**
		Part B Contingency	**$ 150,000.00**
		Part C Contingency	**$ 150,000.00**
		Subtotal	
		13% HST	
		Total =	

SCHEDULE OF UNIT PRICES
MUNICIPALITY OF MARKSTAY-WARREN
REPLACEMENT OF LEEFTINK ROAD BRIDGE, NORTH ROAD MIDDLE SECTION CULVERT, AND DUPUIS ROAD CULVERT
PART A - LEEFTINK ROAD BRIDGE

No.	Spec	Item	Unit	Qty	Unit Price	Total
PART A – Leeftink Road Bridge						
1	201 MUNI, 206 MUNI	Site Preparation - Clearing and Grubbing	m^2	125		
2	206 MUNI, 209MUNI, 501 MUNI, 517 MUNI	Site Preparation - Grading	m^2	125		
3	206 MUNI	Earth Excavation - Grading	m^3	350		
4	314 MUNI, **SP#1**	Granular A – Placed from Municipal-Supplied Material	tonne	150		
5	314 MUNI	Granular B - Type II	tonne	540		
6	510 MUNI, **SP#2**	Removal of Bridge Structure	L.S.	1		
7	510 MUNI	Removal of Steel Beam Guide Rail	m	12.2		
8	511 MUNI	Rip-Rap	m^2	150		
9	511 MUNI	Geotextile, non-woven	m^2	150		
10	539 MUNI,	Protection System	L.S.	1		
11	703 MUNI, **SP#3**	Small Signs, Ground Mounted, New	each	6		
12	721 MUNI	Single Rail Steel Beam Guide Rail, OPSD 912.430 & OPSD 912.530	m	81.8		
13	721 MUNI	Steel Beam Guide Rail Structure Connections OPSD 912.430	each	4		
14	732 MUNI	Steel Beam Energy Attenuating Terminal System OPSD 922.186	each	4		
15	802 MUNI	Topsoil, Imported	m^3	40		
16	804 MUNI	Seed and Mulch, Standard Roadside Mix	m^2	250		
17	902 MUNI	Earth Excavation for Structure	m^3	200		
18	902 MUNI, **SP#4**	Granular Backfill to Structure	tonne	450		
19	903 MUNI	Supply Equipment for Installing Helical Piles	L.S.	1		
20	903 MUNI, **SP#5**	Installation of Helical Piles	m	240		

No.	Spec	Item	Unit	Qty	Unit Price	Total
21	904 MUNI	Concrete in Pile Cap Footing	m^3	18		
22	905 MUNI	Reinforcing Steel Bar	tonne	2.16		
23	916 PROV, **SP#6**	Precast Concrete Ballast Wall	L.S.	1		
24	918 MUNI, **SP#7**	Temporary Modular Bridge – Removable Approach Ramps	L.S.	1		
25	**SP#8**	Permanent Modular Bridge	L.S.	1		
26	**SP#9**	Concrete Sealer	m^2	40		
					PART A Leeftink Bridge Sub-Total	
PART B - Dupuis Rd Culvert						
27	201 MUNI, 206 MUNI	Site Preparation - Clearing and Grubbing	m^2	125		
28	206 MUNI, 209MUNI, 501 MUNI, 517 MUNI	Site Preparation - Grading	m^2	125		
29	314 MUNI **SP#1**	Granular A – Placed from Municipal-Supplied Material	tonne	250		
30	314 MUNI	Granular B - Type II	tonne	500		
31	510 MUNI	Removals - Existing Culvert	L.S.	1		
32	510 MUNI	Removals - Guide Rail Systems - Steel Beam Guide Rail Single Rail	m	50		
33	511 MUNI	Slope Protection - Rip Rap (R-50)	m^2	75		
34	511 MUNI	Geotextile - Terrafix 270R	m^2	500		
35	721 MUNI	Single Rail Steel Beam Guide Rail, OPSD 912.186	m			
36	721 MUNI	Single Rail Steel Beam Guide Rail – Long Span Treatment, OPSD 912.245	each	2		
37	732 MUNI	Steel Beam Energy Attenuating Terminal System OPSD 922.186	each	4		
38	802 MUNI	Topsoil - Imported	m^2	250		
39	804 MUNI	Seed and Mulch, Standard Roadside Mix	m^2	250		
40	804 MUNI	Seed and Cover - Erosion Control Blanket - Provisional	m^2	100		
41	902 MUNI	Dewatering Structure Excavations	L.S.	1		

No.	Spec	Item	Unit	Qty	Unit Price	Total
42	902 MUNI	Earth Excavation for Structure	m^3	200		
43	912 PROV	Precast Concrete Box Culvert - 5400mm x 3600mm, Fabrication	m	20		
44	912 PROV	Precast Concrete Box Culvert - 5400mm x 3600mm, Delivery	m	20		
45	912 PROV	Precast Concrete Box Culvert - 5400mm x 3600mm, Fabrication	m	20		
46	914 MUNI, **SP#10**	Culvert Waterproofing – Provisional	L.S.	1		
					PART B - Dupuis Rd Culvert Sub-Total	
PART C - North Rd Middle Section Culvert						
47	201 MUNI, 206 MUNI	Site Preparation - Clearing and Grubbing	m^2	125		
48	206 MUNI, 209MUNI, 501 MUNI, 517 MUNI	Site Preparation - Grading	m^2	125		
49	180 MUNI	Site Preperation - Management of Excess Material (Includes Removal and Disposal of Material)	L.S.	1		
50	314 MUNI **SP#1**	Granular A – Placed from Municipal-Supplied Material	tonne	250		
51	314 MUNI	Granular B - Type II	tonne	500		
52	510 MUNI	Removals - Existing Culvert	L.S.	1		
53	510 MUNI	Removals - Guide Rail Systems - Steel Beam Guide Rail Single Rail	m	50		
54	511 MUNI	Slope Protection - Rip Rap (R-50)	m^2	100		
55	721 MUNI	Single Rail Steel Beam Guide Rail, OPSD 912.186	m			
56	721 MUNI	Single Rail Steel Beam Guide Rail – Long Span Treatment, OPSD 912.245	each	2		
57	732 MUNI	Steel Beam Energy Attenuating Terminal System OPSD 922.186	each	4		
58	802 MUNI	Topsoil - Imported	m^2	250		

No.	Spec	Item	Unit	Qty	Unit Price	Total
59	804 MUNI	Seed and Mulch, Standard Roadside Mix	m^2	250		
60	804 MUNI	Seed and Cover - Erosion Control Blanket - Provisional	m^2	100		
61	902 MUNI	Dewatering Structure Excavations	L.S.	1		
62	902 MUNI	Earth Excavation for Structure	m^3	200		
63	912 PROV	Precast Concrete Box Culvert - 4200mm x 3600mm, Fabrication	m	20		
64	912 PROV	Precast Concrete Box Culvert - 4200mm x 3600mm, Delivery	m	20		
65	912 PROV	Precast Concrete Box Culvert - 4200mm x 3600mm, Installation	m	20		
66	914 MUNI, **SP#10**	Culvert Waterproofing - Provisional	L.S.	1		
PART C - North Rd Middle Section Culvert Sub-Total						

Abbreviations Used in the Schedule of Unit Prices:

*S.P. = Special Provisions
*L.S. = Lump Sum
*m = meter
*sq.m / m^2 = square meter
*cu.m / m^3 = cubic meter
*OPSS MUNI = Ontario Provincial Standard Specifications, Municipal Specification
*OPSS PROV = Ontario Provincial Standard Specifications, Provincial Specification
*OPSD = Ontario Provincial Standard Drawings

FORM OF TENDER

CONTRACT NO. TMW-2026-08

TENDER FOR

REPLACEMENT OF LEEFTINK ROAD BRIDGE, NORTH ROAD MIDDLE SECTION CULVERT, AND DUPUIS ROAD CULVERT

IN THE MUNICIPALITY OF MARKSTAY-WARREN

STATEMENT 'B' LIST OF PROPOSED SUBCONTRACTORS

Clause 19 of the Information for Tenderers requires the Tenderer to list on this Statement Sheet the name of each proposed subcontractor.

FAILURE BY A TENDERER TO COMPLY WITH THE FOREGOING REQUIREMENTS MAY RESULT IN HIS TENDER BEING DISQUALIFIED BY THE OWNER.

SUBTRADE	PROPOSED SUBCONTRACTOR	PLACE OF BUSINESS	CONTACT INFORMATION
			C: E:
			C: E:
			C: E:
			C: E:
			C: E:

SUBTRADE	PROPOSED SUBCONTRACTOR	PLACE OF BUSINESS	CONTACT INFORMATION
			C: E:
			C: E:
			C: E:
			C: E:
			C: E:
			C: E:
			C: E:
			C: E:
			C: E:

FORM OF AGREEMENT

CONTRACT NO. TMW-2026-08

TENDER FOR

REPLACEMENT OF LEEFTINK ROAD BRIDGE, NORTH ROAD MIDDLE SECTION CULVERT, AND DUPUIS ROAD CULVERT

IN THE MUNICIPALITY OF MARKSTAY-WARREN

THIS AGREEMENT made in Sudbury this _____ day of _____, 2026.

BETWEEN: **The Municipality of Markstay-Warren** (hereinafter called the "Owner")
OF THE FIRST PART

21 Main Street South,
P.O. Box 79
Markstay, ON, P0M 2G0

- AND -

_____ (hereinafter called the "Contractor")
OF THE SECOND PART

_____

_____

_____

WITNESSETH

That the Owner and the Contractor in consideration of the fulfilment of their respective promises and obligations herein set forth covenant and agree with each other as follows:

ARTICLE 1

(a) A general description of the work is:

The work consists of the supply of all labour, material, equipment, and supervision necessary to complete the work shown, or described by, or reasonably inferred from these contract documents. Without limiting the qualifications of the foregoing, the work generally includes, but not limited to:

- Strategic replacement of the Leeftink Road Bridge #9 over the Veuve River, along with approach works, roadside safety features and site restoration. The existing bridge is located on Leeftink Road (5150785.7 N, 536722.5 E), approximately 200 m north of Ratter Lake Road.

- Replacement of North Road Middle Section Culvert (Culvert 111) through the Veuve River, along with approach works, roadside safety features and site restoration. The existing culvert is located on North Road Middle Section (5156459 N, 536491 E), approximately 2.6 Km east of Crerar Rd.

- Replacement of Dupuis Road Culvert (Culvert 11) through the Bear River, along with approach works, roadside safety features and site restoration. The existing culvert is located on Dupuis Road (5136185 N, 546443 E), approximately 1.67 km west of Bedard Road.

(b) The Contractor must, for the prices set out in the Form of Tender and except as otherwise specifically provided, provide at no additional cost of the Owner all and every kind of labour, machinery, plant, structures, roadway materials, appliances, articles and things necessary for the due execution and completion of all the work set out in this Contract and must forthwith according to the instructions of the Contract Administrator, commence the works and diligently execute the respective portions thereof, and deliver the works complete in every particular to the Owner within the time specified in the Contract.

ARTICLE 2

In the event that the Form of Tender provides for and contains a Contingency Allowance, it is understood and agreed that such Contingency Allowance is merely for the convenience of accounting by the Owner, and the Contractor is not entitled to payment thereof except for extra or additional work carried out by him as directed by the Contract Administrator and in accordance with the Contract and only to the extent of such extra or additional work.

ARTICLE 3

In the case of any inconsistency or conflict between the provisions of this Agreement and the Plans or Specifications or General Conditions or Form of Tender or any other document or writing, the provisions of such documents will take precedence and govern in the following order, namely:

1. Agreement
2. Addenda
3. Special Provisions,
4. Information for Tenderers,
5. Contract Drawings,
6. Standard Specifications,
7. Divisional Specifications

8. Form of Tender,
9. Supplementary General Conditions,
10. General Conditions,
11. Working Drawings.

ARTICLE 4

The Contractor will not without the consent in writing of the Engineer and without restricting in any way the provisions of the Section GC 3.09 and GC 3.10 of the General Conditions, make any assignment of any part or the whole of any monies due or to become due under the provisions of this Contract.

ARTICLE 5

The Owner covenants with the Contractor that the Contractor having in all respects complied with the provisions of this Contract, will be paid for and in respect of the works the sum (including Harmonized Sales Tax) of:

Subject to Article 2 hereof and subject to such additions and deductions as may properly be made under the terms hereof, subject to the provision that the Owner may make payments on account monthly or otherwise as may be provided in the General Conditions attached hereto.

ARTICLE 6

Where any notice, direction or other communication is required to be or may be given or made by one of the parties hereto to the other or to the Engineer or his agent, it will be deemed sufficiently given or made if mailed or delivered in writing to such party or to the Engineer at the following addresses:

The Owner:

The Municipality of Markstay-Warren
21 Main Street South,
P.O. Box 79
Markstay, ON, P0M 2G0

The Contractor:

_____

_____

_____

_____

The Contract Administrator:

R.V. Anderson Associates Limited

436 Westmount Avenue, Unit 6

Sudbury, ON

P3A 5Z8

Where any such notice, direction or other communication is given or made to the Contract Administrator, a copy thereof will likewise be delivered to any agent appointed in accordance with the General Conditions of this Contract and where any such notice, direction or other communication is given or made to such agent, a copy thereof will likewise be delivered to the Engineer.

ARTICLE 7

A copy of each of the Specifications, Standard Specifications, Supplementary General Conditions, General Conditions, Special Provisions, Form of Tender, Information for Tenderers and Addenda 1 to 1 , is hereto annexed and together with the Drawings relating thereto and listed in the Specifications are made part of this Contract as fully to all intents and purposes as though recited in full herein.

ARTICLE 8

No implied contract of any kind whatsoever by or on behalf of the Owner will arise or be implied by or inferred from anything in this Contract contained, nor from any position or situation of the parties at any time, it being clearly understood that the express covenants and agreements herein contained made by the Owner will be the only covenants and agreements upon which any rights against the Owner may be founded.

ARTICLE 9

The Contractor declares that in tendering for the works and in entering into this Contract he has either investigated for himself the character of the work and all local conditions that might affect his tender or his acceptance or performance of the work, or that not having so investigated, he acknowledges that his responsibility under the Contract is in no way reduced or limited thereby and, in either case, he is willing to assume and does hereby assume all risk of conditions arising, developing, or being revealed in the course of the work which might or could make the work, or any items thereof, more expensive in character, or more onerous to fulfil, than was contemplated or known when the tender was made or the Contract signed. The Contractor also declares that he did not and does not rely upon information furnished by any methods whatsoever by the Owner or its officers, employees or agents, being aware that any information from such sources was and is approximate and speculative only and was not in any manner warranted or guaranteed by the Owner.

ARTICLE 10

The Contract will apply to and be binding on the parties hereto and their successors, administrators, executors and assigns and each of them.

IN WITNESS WHEREOF the parties hereto have hereunto set their hands and seals the day and year first above written or caused their corporate seals to be affixed, attested by the signature of their proper officers, as the case may be.

Owner

Per: _____

Per: _____

(seal)

_____

* Witness as to Signature of Contractor

Address _____

_____

Occupation: _____

Contractor

Per: _____

Per: _____

(seal)

* Not necessary if corporate seal is affixed.

PART 3

Part 3

SPECIAL PROVISIONS

INDEX

SPECIAL PROVISIONS

1. COMMENCEMENT AND COMPLETION

a) Progress of the Work and Time for Completion

The Contractor must begin work within one week of written instructions to do so and must diligently prosecute his work on this Contract to be substantially performed in accordance with the Construction Act, before the following dates:

PART A – Leeftink Road Bridge:..... Friday, October 30th, 2026

PART B – Dupuis Road Culvert: ..... Friday, October 30th, 2026

PART C – North Rd Middle Section Culvert:.....Friday, August 13th, 2027

The completion date described above must be considered satisfied at the time of Substantial Performance as described in **Section GC 1.05**.

All work outstanding at the time of substantial completion must be deemed as completed in accordance with the Construction Act before before the following completion dates:

PART A – Leeftink Road Bridge:.....Friday, December 18th, 2026

PART B – Dupuis Road Culvert: .....Friday, December 18th, 2026

PART C – North Rd Middle Section Culvert:.....Friday, September 24th, 2027

If this time limit above specified is not sufficient to permit completion of the work by the Contractor working a normal number of hours each day or week on a single daylight shift basis, it is expected that additional and/or augmented daylight shifts will be required throughout the life of the Contract to the extent deemed necessary by the Contractor to ensure that the work will be completed within the time limit specified. Any additional costs occasioned by compliance with these provisions will be included in the prices bid for the various items of work and no additional compensation will be allowed. However, the requirement remains standing for the Contractor to obtain written approval from the Contract Administrator or the Municipality for extending beyond the specified working hours, to fulfil the provisions of this Contract.

No premium will be paid for night or weekend work. No additional payments will be allowed for incidentals such as lighting, extra signage and barricading, etc.

b) Liquidated Damages

It is agreed by the parties to the Contract that in case all the work called for under the Contract is not finished or completed within the date of completion specified aforementioned or as revised in accordance with Section GC 3.07 of the General Conditions of Contract, a loss or damage will be sustained by the Owner. Since it is and will be impracticable and extremely difficult to ascertain

and determine the actual loss or damage which the Owner will sustain in the event of and by reason of such delay, the parties hereto agree that the Contractor will pay to the Owner the sum of **one thousand five hundred dollars ($1,500.00)** as liquidated damages for each and every calendar day's delay in finishing the work beyond the date of completion prescribed. It is agreed that this amount is an estimate of actual damage to the Owner, which will accrue during the period in excess of the prescribed date of completion. The Owner may deduct any amount under this paragraph from any monies that may be due or payable to the Contractor on any account whatsoever.

Liquid damages will also apply to any delays in finalizing outstanding works as per paragraph 1a), above.

c) Working Days

Working days will not apply to this Contract.

2. PAYMENT AND HOLDBACK

The Municipality may hold up to five percent (5%) of the total value of Work completed to date for the uncompleted testing and restoration. This holdback will be released as testing and restoration work is completed to the satisfaction of the Municipality & Contract Administrator.

In addition to the Lien Holdback, the Municipality will be entitled to retain up to five percent (5%), from the amounts otherwise due to the contractor such amounts as it sees fit to retain for deficiencies in the Work (the “deficiency holdback”) as well as for any warranty issues (“maintenance security”). The Municipality will retain the deficiency holdback until the end of the warranty period and all deficiencies have been rectified. All deficiencies must be corrected, and all warranty issues must be resolved to the satisfaction of the Municipality and Contract Administrator before the Town will issue a Completion Certificate and final payment.

3. PUBLIC RELATIONS

a) Public Enquiries/Complaints

It is crucial in undertaking this contract that good public relations be maintained between the Municipality and the Public. All efforts shall be made by the Contractor so that enquiries, complaints and problems can be responded to immediately.

The Contractor shall demonstrate a commitment to respectful engagement and good public relations with the Public and minimize disruptions throughout the project to the extent possible. Responsibilities include:

- Limit unnecessary disturbances to private property and local businesses,

maintaining access for vehicles, deliveries, and pedestrians.

- Communicate and engage with the public in a polite and respectful manner always.
- Be mindful of language barriers, accessibility needs, and cultural considerations when communicating with the public.
- Direct any enquiries about project specifics to designated or appropriate personnel.
- Obey traffic laws at all times and remain aware of local traffic conditions.
- Provide safe pedestrian and cycling routes around the site with appropriate signage and protections, where warranted.
- Keep the worksite clean and orderly. Waste materials must be properly disposed of. Trash should never be left in an excavation and/or buried.

b) Resident Notices

The Contractor must notify residents by written notice of any disruption or impacts to services. All notices shall be translated in French Language and submitted to the Contract Administrator for review at least two (2) business days in advance of distribution.

The following notices and timelines for distribution must be followed:

- Disruption to Driveway/Property Access – forty-eight 48hrs in advance of disruption
- Full Road Closures at both culvert replacement sites – Two (2) weeks in advance of disruption.
- Intermittent Daily Road Closures at Leeftink Rd. Bridge Replacement site – Two (2) weeks in advance of disruption.

c) Non-Regulatory Signage

All non-regulatory signage shall be posted in English and French languages.

The Bidder shall include all costs necessary, within the tender prices, to ensure that the contract is carried out in accordance with the above requirements.

4. DESIGNATED DUMP SITES

The designated dump site for Contract No. TMW-2026-08 will be as follows;

In accordance with O.Reg 406/19 and OPSS.MUNI 180, The Municipality has determined a designated dump site for all waste materials shall be the Warren Landfill Site at **405 Gervais Road**. The contractor will at no additional cost to the Owner, provide access to all excavated material and assistance as required for all

additional testing required to satisfy the requirements as set out in the O.Reg. 406/19 and OPSS.MUNI 180.

For all clearing and grubbing refuse there will be no designated dump site. All material associated with the clearing and grubbing will be the responsibility and under ownership of the general contractor and will be the contractor's responsibility for disposing it at an accepted disposal site.

Extra payment for hauling disposal material will not apply to this contract. The - Contractor will pay all tipping fees at the landfill site for disposal of clearing, grubbing and refuse.

5. ENVIRONMENTAL CONSTRAINTS

a) General Environmental Protection Requirements

The Contractor must comply with applicable Federal, Provincial and Municipal laws, orders, and regulations concerning the control and abatement of water pollution. All required permits and approvals will be the Contractor's responsibility.

The Contractor's construction activities must be performed by methods that will prevent entrance, or accidental spillage, of solid matter, contaminants and waste into streams, water sources, including but not restricted to, refuse, garbage, cement, concrete, industrial waste, oil and other petroleum products, heavily mineralized rock, and thermal pollution. Sanitary wastes must be disposed of on land by burial at approved sites or by other approved methods.

The Contractor must apply sediment control measures, in order to prevent sediment from reaching the environment. In addition, no construction materials are to be temporarily stored unless suitable siltation fencing is erected around the storage area perimeter.

Dewatering work for structure foundations or earthwork operations adjacent to, or encroaching on, a body of water shall be conducted in a manner to prevent muddy water and eroded materials from entering the body of water by construction of intercepting ditches, bypass channels, barriers, settling ponds, or by other approved means. Dewatering works shall conform to the requirements of OPSS.MUNI 517. DFO's Code of Practice: End-of-Pipe Fish Protection Screens shall be followed (https://www.dfo-mpo.gc.ca/pnw-ppe/codes/screen-ecran-eng.html).

Turbidity increases in a stream that are caused by construction activities must be limited to the increases above the natural turbidity permitted under prescribed water quality standards. When necessary, to perform required construction work in the stream channel, the prescribed turbidity limits may be exceeded, if approved by the Ontario Ministry of Natural Resources and

Forestry, for the shortest “practicable” period required to complete such work. This required construction work may include such work as diversion of a stream channel, and construction of turbidity control structures. Mechanized equipment must not be operated in flowing water except as necessary to construct crossings or to perform the required construction.

Wastewater from all construction operations must not enter streams, watercourses, or other surface water without the use of such turbidity control methods as settling ponds, gravel-filter entrapment dikes, approved flocculating processes which are not harmful to fish, recirculation systems for washing of aggregates, or other approved methods. Any such wastewater discharged into surface water must be essentially free of settleable material. For the purpose of these specifications, settleable material is defined as that material which will settle from the water by gravity during a 1-hour quiescent detention period.

Spills or discharges of pollutants or contaminants under the control of the Contractor, and spills or discharges of pollutants or contaminants that are a result of the Contractor’s operations that cause or are likely to cause adverse effects must forthwith be reported to the Municipality of Markstay-Warren as well the Ministry of the Environment, Conservation and Parks (MECP). Such spills or discharges and their adverse effects must be as defined in the Environmental Protection Act R.S.O. 1980.

All spills or discharges of liquid, other than accumulated rainwater, from luminaries, internally illuminated signs, lamps, and liquid type transformers under the control of the Contractor, and all spills or discharges from this equipment that are a result of the Contractor’s operations must, unless otherwise indicated in the Contract, be assumed to contain PCB’s and will forthwith be reported to the Municipality of Markstay-Warren as well as the MECP.

Notification of the MECP must be provided to:

- 199 Larch Street, Sudbury, Ontario, and (705) 675-4501
- For 24-hour environmental spill reporting, phone 1-800-268-6060.

This reporting will not relieve the Contractor of his legislated responsibilities regarding such spills or discharges.

At the **pre-construction meeting**, the Contractor will be required to outline his sequence of operations and proposed environmental protection measures.

Payment to comply with the above requirements will be deemed to be included in the tender items requiring such environmental protection and must include all costs associated with acquiring permits and approvals.

b) In-Water Works Restriction

i. Leeftink Rd Bridge Replacement Site

No in-water work (i.e. below the high-water mark) is permitted to replace the bridge.

ii. Dupuis Rd Culvert Replacement Site

All in-water works shall be restricted from April 1st to June 15th. This includes cofferdam installation, operation and removal.

iii. North Road Middle Section Culvert Replacement Site

All in-water works shall be restricted from September 1st to June 15th. This includes cofferdam installation, operation and removal.

c) Migratory Birds Protection – General

All works shall be completed in accordance with the Migratory Birds Conventions Act. Contractor shall avoid distrusting nests of migratory birds.

d) Protection of Trees

Where equipment or vehicles must be operated within the dripline of a tree not designated for removal, protection of the subject trees shall be in accordance with OPSS 801 with a protective barrier installed as per OPSD 220.010.

There shall be no separate payment for this work as it shall be deemed inclusive of the tender prices for the items requiring the Work. Any trees designated for removal shall be identified on the contract drawings and paid under the appropriate item

e) Temporary Erosion and Sediment Control Measures

i. Scope

This special provision covers the requirements for erosion and sediment control for operations other than the item specific erosion and sediment control measures of the contract.

ii. Erosion and Sediment Control

A plan shall be prepared for the control of erosion and sediment. The plan shall complement the erosion and sediment control measures specified elsewhere in the Contract. The plan shall be comprehensive, and shall provide descriptions and schedules, as well as sketches and/or plans and/or

drawings and shall include all required materials. The plan shall be designed to control erosion and sediment for a 5-year Design Storm Event. Any work to correct ineffective erosion and sediment control measures, that is caused by a storm event, not exceeding that specified in this special provision, shall be at the Contractor's expense.

The Contractor will provide the Contract Administrator with a copy of the plan prior to undertaking any work covered by the plan.

Implementation, inspection, maintenance and removal of erosion and sediment control measures, identified in the plan, shall be in accordance with OPSS MUNI 805.

iii. Materials

Materials may include, but are not limited to, those specified in OPSS MUNI 805, Construction Specification for Temporary Erosion and Sediment Control Measures. Alternative materials or methods are acceptable provided they meet industry standards and protect the environment from the impacts of erosion and sedimentation.

iv. Payment

Payment at the Contract price for tender items in which erosion and sediment controls are made necessary shall include full compensation for all labour, Equipment and Material to control erosion and sediment. No additional payment shall be made.

f) Control Measures to Prevent Spreading of Invasive Species

To prevent spreading of invasive species, Contractor shall ensure all construction gears and equipment are cleaned prior to mobilizing to Townline Bridge site. All equipment, including work boot bottoms, shall be free of plant material and seeds, including mud that may contain seeds.

Before transporting any boats or watercraft to construction site, clean any mud, aquatic plants, algae, mussels or any other animals from the boats, motors, and trailers. Any standing water in the boats shall be drained prior to transportation.

6. OPERATIONAL CONSTRAINTS

a) Maintaining Roadways and Detour

Operations shall be carried out in such a manner as to minimize disruptions to traffic and pedestrians.

i. Full road closures will be permitted on the following road sections:

- Dupuis Road at culvert construction site within project limits, and
- North Road Middle Section at culvert construction site within project limits.

ii. Intermittent Daily Road Closures at Leeftink Rd Bridge

The existing Leeftink Road Bridge is a conventional military-style modular truss (Bailey) bridge with approach ramps at both ends. The proposed foundation work is anticipated to occur while the approach ramps at both ends of the bridge are temporarily removed.

The Contractor shall remove and reinstate the approach ramps as required to construct the foundations. The approach ramps shall be fully reinstated and open to traffic between 6:00 a.m. and 9:00 a.m. and between 3:00 p.m. and 6:00 p.m., Monday to Friday, and at all times on weekends, in order to accommodate public access during morning and evening peak travel periods.

Continuous pedestrian access across the bridge shall be maintained for first responders in the event of an emergency. The Municipality will arrange for emergency service vehicles to be stationed on the isolated side of the bridge. In the event of an emergency, first responders shall cross the bridge on foot and continue using the emergency service vehicles positioned on the opposite side.

A one-time planned full road closure of up to seven (7) consecutive days is anticipated for the removal of the existing modular bridge and the installation of the new modular bridge. During this period the shall provide pedestrian access across for first responders to access the emergency service vehicles positioned on the opposite side.

All Streets to remain open to local traffic and emergency vehicles during full road closures.

There shall be no separate payment for this work as it shall be deemed inclusive of the tender prices for the items requiring the Work.

b) Dewatering

The Contractor is hereby notified, that groundwater is present at both culvert replacement sites. Elevation and measures shall be taken by the Contractor to complete dewatering as required to complete the installation of the infrastructure. All work to conform to OPSS.MUNI 517 and comply with O.Reg 903 and/or O.Reg 632/05.

Refer to the Geotechnical Reports provided in the Contract. Due to the nature of the existing soils and the groundwater levels in the soils, it is anticipated that the Contractor will encounter variable degrees of groundwater conditions depending on depth, weather conditions and seasonal changes. The Contractor shall be aware of the variable groundwater conditions that might be encountered during the Work and include the cost of all dewatering and groundwater pumping and control Work into the appropriate items in the Schedule of Unit Prices. No extra payments or claims will be considered by the Municipalityrelated to groundwater seepage or control, pumping, or dewatering whether it be by sump pumps or deep wells or any other method required to control groundwater.

The Contractor can anticipate that dewatering will be required during excavations for the culvert replacements.

Section 517.04, “Submission and Design Requirements” is amended by the addition of the following:

The Contractor shall submit Working Drawings at least two (2) weeks prior to commencement of work, for the dewatering system indicating the materials, equipment, methods employed, and procedures to be followed to maintain the excavation or work area free of water. Location of the dewatering trap is to be indicated on the Working Drawings.

The Contractor shall also be responsible for obtaining an MECP Environmental Activity and Sector Registry (EASR) to allow for dewatering during construction. Dewatering activities shall not occur until the permit has been received. The application shall be based on the information provided in the geotechnical report provided in the appendices. The design of the dewatering system shall adequately satisfy the actual quantity of groundwater found during the excavation or work.

c) Required Permits

Bidders are advised that work at the culvert replacement sites are contingent upon obtaining formal approval from the Ministry of Natural Resources and Forestry (MNRF) by means of an Approved Work Permit. At the pre-construction meeting, the Contractor shall be required to outline the sequence of the proposed environmental protection measures for the purposes of obtaining the Work Permit. The Contractor shall submit their final plan/methods of siltation mitigation to the Municipality before any work proceeds near the watercourse.

The Contractor shall obtain permit approvals from the appropriate agency prior to performing any works at the following locations:

- North Road Middle Section – Jurisdiction of MNRF

Note: The Municipality will help facilitate with these permits.

The Municipality anticipates to include the draft permits through an addendum once they are received.

The contractor shall acknowledge that all work associated with the North Road Middle Section Culvert Replacement is conditional upon obtaining an MNRF work permit.

The Contractor shall refer to the draft Work Permit issued by MNRF. The contractor shall review the requirements noted in the draft permit and are required to submit the plan in the draft permit to obtain a full permit. The submitted plan shall be implemented as specified in the final permit. The contractor shall accept responsibility for the adequacy of the plan. The plan shall include written notice confirming that the plan is in conformance with applicable laws and regulations. Permission to proceed with the work will be provided if the Contract Administrator and MNRF determine that the details of the notice meet the requirements of this special provision.

Payment to comply with the above requirements will be deemed to be included in the tender items requiring such environmental protection and must include all costs associated with acquiring permits and approvals.

7. FIELD OFFICE

A site office will not be required for this project.

8. UTILITIES

The Contractor, in accordance the **Section GC 7.01.9** of the General Conditions, will assume full responsibility for the protection of all utilities.

Should some utility poles require temporary support during excavation, contractor must coordinate his work with the utility companies. Contract unit price must include the cost of the temporary support of the utility poles for each applicable contract item. No Additional Payment will be made for the temporary support of utilities.

9. RESTORATION

Restoration shall be as follows and paid for under the applicable contract items.

a) Grassed Areas

The restoration of grassed areas shall be in accordance with OPSS.MUNI 802 and paid for under the appropriate items.

10. WARRANTY

The Contractor warrants to the Municipality that all of the Work will be in conformance with the Contract documents.

The Contractor agrees to correct, at his own expense, any defects or deficiencies in the Work which appear during the period of 24 months from the date of Substantial Performance or such longer period as may be specified for certain products or Work provided (the "maintenance period"). Where a date of Substantial Performance is not established, the maintenance period shall commence on the date of completion.

Where the Contractor performs Work or supplies Materials, Equipment, or machinery subsequent to the date of Substantial Performance, or where the Contractor corrects deficiencies subsequent to the date of Substantial Performance, then in any such case the warranty for such Work, supply of Materials, Equipment, machinery, or correction of deficiencies shall commence and run from the date that the same was completed.

The Municipality shall promptly give the Contractor written notice in accordance with Subsection GC 7.18.02 of observed defects and deficiencies. The Municipality may specify a time within which the corrections are to be completed in which case the Contractor shall complete the corrections within the period of time set out.

The Contractor acknowledges and agrees that he shall be responsible to correct or pay for any damage to other Works resulting from any correction required under the conditions of this clause.

Neither the Municipality's Final Acceptance Certificate nor payment thereunder shall relieve the Contractor from his responsibility hereunder

Nothing in these General Conditions is intended to, or shall restrict or modify any liability of the Contractor for damages arising out of any law in force in the Province and in particular any liability for damages arising from defects or deficiencies in the Work which were not apparent prior to the expiration of the maintenance period.

11. PHASING OF WORK

The Contractor must co-ordinate all work with the Municipality of Markstay-Warren.

The Municipality reserves the right to stop work at this site at any time due to changes in weather, demand conditions, or worker safety. The Contractor will not hold the Municipality responsible for lost time and/or costs associated with the stoppage of work.

12. SALVAGED GOODS

If the Work herein involves the removal or replacement of any Goods, material or equipment that may be of some continuing value, such Goods, material or equipment shall remain the property of the Municipality unless otherwise stated herein and the successful Bidder shall return or provide such Goods, material or equipment to the Warren Landfill Site at **405 Gervais Road** or as directed by the Municipality withing the municipal limits.

Items to be salvaged and delivered to the Warren Landfill Site from **Contract TMW-2026-08** include, but may not be limited to:

- Existing modular bridge and ancillary components and hardware.
- Existing multiplate corrugated steel pipe culverts shall be savaged for scrap metal.
- Steel Beam Guide Rails – Rail Components.

There shall be no separate payment for this work as it shall be deemed inclusive of the tender prices for the items requiring the Work.

13. CONSTRUCTION STAGING AND SCHEDULE

Prior to the Pre-Construction Meeting, the Contractor must prepare and submit a detailed construction staging plan, traffic control plan, silt mitigation plan and schedule to the Municipality for review for all construction operations. Updated staging plans, traffic control plans, and silt mitigation plan must be submitted to the Town in any event of deviation from the most recent submission. Updated schedules will be submitted bi-weekly, a minimum of 72 hrs. prior to construction progress meetings.

The Contractor must, at points of junction with other Contracts or Municipality projects, jointly span and coordinate their separate work. The Contractor must provide a minimum space separation of 50 m between his work and the other Contractor’s equipment and staff when working in the vicinity of the project junction points, in accordance with Ministry of Labour Requirements.

Any additional costs occasioned by compliance with these provisions will be included in the prices bid for the various items of work and no additional compensation will be allowed, therefore.

14. CONTRACT ITEMS

The items in the Schedule of Unit Prices are intended to cover and include the supplying of all labour, plant, and materials (except as noted in the Instructions to Tenderers and Special Provisions) necessary for the completion of the various works called for in this contract. The prices set out in the Schedule of Unit Prices for

the said items will be full compensation for the labour, plant, material, and equipment supplied to do all the work covered by the said items.

Where in the Schedule of Unit Prices an Item is identified by the word “provisional”, it will be defined to mean an item provided for in the Contract for which the quantity is not accurately known, an item for which the quantity may change as a result of information gathered from the field during the progress of the work, or an item / quantity that may be deleted (quantity reduced to zero) from the Contract. The Contractor agrees that they are not entitled to payment for “provisional” items except for work carried out in accordance with the Contract and as directed by the Contract Administrator.

The Standard Specifications referred to in this Contract are the “Ontario Provincial Standard Specifications” (OPSS). The Contractor will be responsible for obtaining a copy of the applicable specifications, which are not bound here in this document.

Where in the Form of Tender, Schedule of Unit Prices, and Breakdown of Schedule of Unit Prices an OPSS number has been listed, the work must conform to and be paid for in accordance with that OPSS, and any related standards or specifications as noted in OPSS, and as may be amended by the Special Provisions, noted SP in the Schedule of Unit Prices.

Following is special information pertaining to certain items listed in the Schedule of Unit Prices.

SPECIAL PROVISIONS – ITEMS

SPECIAL PROVISIONS – ITEMS

S.P. #1 GRANULAR A

Spec. 314 MUNI

Section 314.05 MATERIALS is amended by the addition of the following:

All Granular A required for the Work under this Contract shall be supplied by the Municipality. The Granular A material will be made available at the Municipality's Pat McDonald Pit located on North Road, at the Southwest of the intersection with Hunter Road in the Municipality of Markstay-Warren.

The Contractor shall coordinate with the Municipality and the Contract Administrator for the scheduling, pickup, delivery, and use of the Municipality-supplied Granular A material. The Contractor shall provide not less than 48 hours' notice, or such other notice period as directed by the Contract Administrator, prior to requiring material from the Municipality.

Municipality-supplied Granular A shall be obtained only from the locations identified in the Contract Documents or as directed by the Contract Administrator.

The Contractor shall be responsible for all labour, equipment, loading, hauling, handling, placing, and all other incidentals necessary to incorporate the Municipality-supplied Granular A into the Work in accordance with OPSS.MUNI 314 and the Contract Documents.

The Contractor shall handle the Municipality-supplied Granular A in a manner that prevents segregation, contamination, wastage, or loss. Any material wasted, contaminated, or rendered unsuitable due to the Contractor's operations shall be replaced by the Contractor at no additional cost to the Municipality.

314.07 CONSTRUCTION

Section 314.07.01 Granular Subbase, Base, and Surface is amended by the addition of the following:

Use of Municipality-supplied Granular A shall be coordinated with the Municipality and carried out in a manner that does not interfere with municipal operations. The Contractor shall sequence the Work to suit the Municipality's material availability and stockpile access requirements.

Section 314.07.04 Shoulders is amended by the addition of the following:

Where Granular A is required for shoulder work, the Granular A shall be Municipality-supplied and shall be coordinated with the Municipality in accordance with this special provision.

314.09 MEASUREMENT FOR PAYMENT

Section 314.09.01 Actual Measurement and 314.09.02 Plan Quantity Measurement is deleted in its entirety and replaced with the following:

The measurement for payment shall be made of material measured in place with no allowance for shrinkage and computed in cubic metres by the method of average end areas.

314.10 BASIS OF PAYMENT

Section 314.10.01 is amended by the addition of the following:

The Municipality will not consider additional payment for double handling of material if the Contractor re-uses approved excavated materials for structural backfill.

S.P. #2 REMOVAL OF BRIDGE STRUCTURE

Spec. 510 MUNI

Payment at the Contract price for this tender item shall be full compensation for all labour, equipment and material to:

- Remove entire bridge superstructure, and
- Remove top portion of the existing timber crib abutments to 500 mm below finished grade.

S.P. #3 SMALL SIGNS, GROUND MOUNTED, NEW

Spec. 703 MUNI

The Contractor shall supply all signs and supports specified on the Contract Drawing. Multiple signs on the same support (Wa-24 Narrow Structure sign and Wa-70t Narrow Bridge tab sign, Wz-2 Oversized Snow Plow Marker and Wa-33L or Wa-33R Object Marker) shall be considered as one (1) sign for payment purposes.

S.P. #4 GRANULAR BACKFILL TO STRUCTURE

Spec. 902 MUNI

Payment at the Contract price for this tender item shall include full compensation for all labour, equipment and material to construct engineered granular pad beddings underneath culverts and footings.

All as detailed on the Contract Drawings.

S.P. #5 HELICAL PILES FOR BRIDGE FOUNDATIONS

Spec. 903 MUNI

1. SCOPE

This Special Provision covers the requirements for the design, supply and installation of helical piles /anchors as specified within the Contract Documents.

2. REFERENCES

This Special Provision refers to the following standards, specifications, or publications:

- CSA S6-19 Canadian Highway Bridge Design Code
- CSA S16-19 Design of Steel Structures
- CSA A23.3-19 Design of Concrete Structures
- Canadian Foundation Engineering Manual
- ASTM D1143 Quick Test Method
- ASTM A153 Hot Dipped Galvanizing
- OPSS 1002 Aggregates - Concrete
- OPSS 1301 Cementing Materials
- OPSS 1302 Water
- OPSS 1350 Concrete - Materials and Production
- Definitions

For the purpose of this Special Provision, the following definitions apply:

Certificate of Conformance means a document issued by the Quality Verification Engineer confirming that the specified components of the Work are in General Conformance with the requirements of the Contract Documents.

Engineer means a professional engineer licensed by the Professional

Engineers Ontario to practice in the Province of Ontario, retained by the Contractor to provide engineering services for this tender item.

Quality Verification Engineer means an Engineer retained by the Contractor qualified to provide the services specified in the Contract Documents.

3. APPROVED HELICAL PILE / ANCHOR MANUFACTURER

Helical piles/anchors are to be supplied by Chance Civil Construction:

210 North Allen Street,
Centralia, MO, 65240,
Phone (573) 682-8414,
Fax (573) 682-8660,
Email: civilconstruction@hps.hubbell.com

Due to the special requirements for design and manufacturing of helical piles/anchors, only piles approved for installation by Chance Civil Construction are acceptable.

A request to substitute any other manufactured helical product must be submitted to the owner/owner's representative for review not less than seven (7) calendar days prior to the tender closing date. If a substitution of helical pile/anchor material is not approved in writing from the owner/owner's representative prior to closing that manufactured helical product cannot be included in the final tender submission. Inclusion of a non-approved helical manufacturer may result in tender disqualification. The request must include **all** the following information to be considered:

- Documentation of at least five (5) years of production experience manufacturing helical piles,
- Documentation that the manufacturer's helical piles have been used successfully in at least five engineered construction projects within the last three years,
- Certificate that the helical pile/anchor components shall be manufactured by a facility whose quality systems comply with ISO (International Organization of Standards) 9001 requirements, and
- Documentation that the helical pile/anchor components shall be hot-dipped galvanized in accordance with ASTM A153
- Design drawings sealed by a professional engineer of Ontario stating the proposed helical pile and associated geotechnical resistance factor. It is recommended that the geotechnical resistance factor be taken from the most recent version of the Canadian Foundation Engineering manual.

- Documentation that all materials meet the requirements specified elsewhere within the contract documents.

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1. Design Requirements

4.1.1. General

The Contractor is responsible for the complete design of the helical pile system as required to support the culvert.

The piles and associated connection brackets shall be designed to the specified loading on the Contract Document. Design shall conform to the latest editions of CSA S6-19, CSA S16, CSA S23.3, Canadian Foundation Engineering Manual and other applicable codes and standards.

4.1.2. Designer Qualifications

The design Engineer and design-checking Engineer shall have demonstrated expertise for the work. As well, the design Engineer and design-checking Engineer shall have a minimum of 5 years' experience in designing helical pile systems of similar nature and scope to the required work.

One person shall not perform both the design Engineer and design-checking Engineer roles for a helical pile system.

4.1.3. Manufacturer Qualifications

Helical pile manufacturer shall meet the following requirements:

- At least five (5) years of production experience manufacturing helical piles,
- manufacturer's helical piles have been used successfully in at least five engineered construction projects within the last three years,
- Manufacturer's facility comply with ISO (International Organization of Standards) 9001 requirements

4.1.4. Installer Qualifications

Installation shall be completed by a contractor who is certified by Chance Civil Construction to install the manufacturer's material.

- EBS Geostructural Inc.,
  Phone (519) 648-3613
  Fax (519) 648-2526
  ebs@ebsgeo.com
- AJ Mini Excavator & Bobcat Services Inc.

Phone (416) 990-1169
info@ajmini.ca

- Desjardins House Movers
  Phone (519) 979-0033
  Fax (519) 979-0049
  randy@desjardinshousemovers.com

4.2. Submission

4.2.1. Working Drawings

The Contractor shall submit 3 sets of Working Drawings to the Contract Administrator at least 7 Days prior to commencement of the helical pile installation, for information purposes only. Prior to making a submission, the seals and signatures of a design Engineer and a design-checking Engineer shall be affixed on the Working Drawings verifying that the drawings are consistent with the Contract Documents.

The Contractor shall have a copy of the Working Drawings at the site during pile installation.

The following information and details shall be shown on the Working Drawings:

- Helical Pile/Anchor number, location, and pattern by assigned identification number,
- Helical Pile/Anchor design load,
- Assumed geotechnical resistance factor,
- Type and Size of Helical Pile/Anchor shaft,
- Helical configuration (number and diameter of helical plates),
- Minimum effective torque requirement,
- Grout column diameter and length,
- Connection and connection bracket details, and
- Installation sequence and procedure.

4.2.2. Other Submissions

The following documentation shall be submitted for information purposes only:

- Design calibrations sealed and signed by the design Engineer and the design-checking Engineer.
- Calibration reports for installation equipment utilized on the project. The calibration tests shall have been completed within one year of the date submitted.

- Plan for pre-production test(s) for the helical piles/anchors including site preparation and the details of load application, components, equipment, testing apparatus and method of monitoring. The purpose of the test is to determine the load versus displacement response of the helical pile/anchor in general conformance with ASTM D1143 Quick Test Method and provide an estimation of ultimate capacity.
- After completion of the test(s) piles/anchors the Contractor shall submit the results to the Owner for approval to begin production helical pile/anchor installation.
- After completion of the installation of the helical piles/anchors, the Contractor shall provide the Owner with a Certificate of Conformance certifying the ultimate load capacity of the piles/anchors installed, sealed by the Quality Verification Engineer (QVE).

5. MATERIALS

All pile shafts and helices shall be hot dipped galvanized in accordance with ASTM A153 after fabrication.

- SS5 1-1/2” (38 mm) Material: Hot rolled Round-Cornered-Square (RCS) solid steel bars meeting dimensional and workmanship requirements of ASTM A29. The bar is a modified medium carbon steel grade (similar to AISI 1044) with improved strength due to fine grain size. Torque strength rating = 5,700 ft-lb (7730 N-m); Minimum yield strength = 70 ksi (483 MPa).
- SS175 1-3/4”(44 mm); SS200 2”(51 mm); SS225 2-1/4”(57 mm) Material: Hot rolled Round-Cornered-Square (RCS) solid steel bars meeting the dimensional and workmanship requirements of ASTM A29. The bar is a High Strength Low Alloy (HSLA), low to medium carbon steel grade with improved strength due to fine grain size. Torque strength rating: SS175 = 11,000 ft-lb (14,900 N-m); SS200 = 16,000 ft-lb (21,700 N-m); SS225 = 21,000 ft-lb (28,475 N-m); Minimum yield strength = 90 ksi (621 MPa).

6. FABRICATION

Helix shall be welded to the central steel shaft using a continuous fillet weld on both sides of the helix to pipe connection. Any raw material shaft splice welding shall be full strength complete penetration groove welds.

Welding procedures and welder qualifications shall conform to CSA W47.1 and CSA W59. Welding electrodes shall confirm to CSA W48.

Unless otherwise specified, all piles shall be open ended and the pile tip shall be cut at 45 degrees.

The leading edge of the first helix shall be sharpened to minimize soil

disturbance during installation.

Helices shall be mechanically formed by suitable means to ensure “true-pitch” shape is formed. The helix shall be formed such that the surface of the helix remains perpendicular to the central shaft (within 2 degrees) along entire distance around the shaft. This is critical to ensure the helix cuts cleanly through the soil with minimal soil disturbance and to provide representative torque measurements to achieve the specified pile capacities.

All edges on piles shall be ground and clear of slag, burrs or sharp edges.

Hot-dipped galvanizing shall be completed by a qualified supplier complying with ASTM A123. The piles shall be galvanized inside and out and free from any galvanizing slag.

7. CONSTRUCTION

7.1. Transporting, Storing and Handling Piles

Piles, casings, liners, and steel reinforcement shall be transported, stored, and handled in such a manner that damage is prevented and the strength of the components is not affected by deterioration or deformation. Components shall be lifted and placed using appropriate lifting equipment, temporary bracing, guys, or stiffening devices so that the components are at no time overloaded, unstable, or unsafe. Material shall be supported to prevent unequal settlement when stacked.

7.2. Installation

Torque indicator shall be used during helical pile/anchor installation. The torque indicator can be an integral part of the installation equipment or externally mounted in-line with the installation tooling. Torque indicators shall meet requirements set forth by helical pile/anchor manufacturer. A copy of annual calibration certificates for any torque monitoring devices used and/or hydraulic pressure transducers shall be available on site during the pile installation operation to ensure accurate correlation between hydraulic pressure and applied torque. Torque shall be monitored continuously during entire installation.

If the helical pile/anchor is refused or deflected by a subsurface obstruction, the installation shall be terminated, and the pile removed. The obstruction shall be removed, if feasible, and the helical pile/anchor re-installed. If the obstruction cannot be removed, the helical pile/anchor shall be installed at an adjacent location, subject to review and acceptance of the design engineer.

If the torsional strength rating of the central steel shaft and/or installation equipment has been reached prior to proper positioning of the last plain extension section relative to the final elevation, the contractor may remove the

last plain extension and replace it with a shorter length extension. If it is not feasible to remove the last plain extension, the Contractor may cut said extension shaft to the correct elevation. The Contractor shall not reverse (back-out) the helical pile/anchor to facilitate extension removal.

The Contractor shall record the torque values for each individual helical pile/anchor at 300mm (1 foot) increments during installation. The Contractor's Engineer shall confirm the pile capacity based on the installation torques recorded. These records shall be submitted to the Contract Administrator for information only.

7.3. Tolerances

- Centerline of helical pile/anchor shall not be more than 75 mm (3 inches) from indicated plan location.
- Helical pile/anchor plumbness shall be within 2° of design alignment
- Top elevation of helical pile/anchor shall be within ±50mm (2 inches) of the design vertical elevation.

8. LOAD TEST

Perform two (2) load tests in compression and two (2) load tests in tension. All load tests shall be completed according to ASTM D1143 Quick Test Method.

Tested helical piles shall not exceed 25 mm of total movement when loaded to ULS capacity, and no more than 40 mm total movement when loaded to ultimate resistance capacity.

9. CERTIFICATE OF CONFORMANCE

A completed Certificate of Conformance shall be submitted to the Contract Administrator upon completion of the helical piles. The Certificate of Conformance shall be sealed and signed by the Quality Verification Engineer and shall state that the deep foundation work has been carried out in general conformance with the Contract Documents and Working Drawings.

10. BASIS FOR PAYMENT

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

S.P. #6 PRECAST CONCRETE BALLAST WALL

Spec. 916 PROV

Payment at the Contract price for this tender item shall be full compensation for all labour, equipment and material to:

- fabricate, deliver and install precast concrete ballast wall
- fabricate, supply and install embedded tie rods and hardware
- grout all tie rod pockets with approved non-shrink grout

All as detailed on the Contract Drawings.

S.P. #7 TEMPORARY MODULAR BRIDGE – REMOVABLE APPROACH RAMPS

Spec. 918

918.03 Definitions

Section 918.03 Definitions is amended by the addition of the following:

Modular Bridge shall also mean **Temporary Removable Approach Ramps**.

918.10 BASIS OF PAYMENT

Section 918.10.01 Temporary Modular Bridge is amended by the addition of the following:

Payment at the Contract price for the above tender item shall be full compensation for all labour, equipment, and materials for the design, fabrication, supply and installation, removal, and reinstatement of the ramps.

The Contractor shall remove and reinstate the ramps as necessary to carry out the Work, ensuring that ramps are in place during the required morning and evening commuter periods as defined elsewhere in the Contract, and whenever the Contractor is not actively on site.

S.P. #8 PERMANENT MODULAR BRIDGE

Spec. nil

1. SCOPE

This specification covers the requirements for the design, supply, delivery and construction of a new steel modular bridge and all new associated hardware components, including guide rail post pockets, bearing plates and anchor bolts.

2. REFERENCES

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

- OPSS MUNI 180 Management of Excess Material

- OPSS MUNI 906 Structural Steel for Bridges
- OPSS MUNI 911 Coating Structural Steel System

Ontario Ministry of Transportation Publications

- Structural Manual

CSA Standards

- CSA S6-19 Canadian Highway Bridge Design Code
- CSA W47.1-09 (R2019) Certification of companies for Fusion Welding of Steel

ASTM International

- F436/F436M Standard Specification for Hardened Steel Washers Inch and Metric Dimensions
- F1554-20 Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
- A563/A563M-21 Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric)

3. DEFINITIONS

For the purpose of this specification, the following definitions apply:

Certificate of Conformance means a form issued by an Engineer confirming that the specified components of the Work are in conformance with the Contract Documents.

Engineer means a professional engineer licensed by the Professional Engineers Ontario to practice in the Province of Ontario, who has a minimum of five (5) years of experience in the design and erection of modular bridge structures.

Modular Bridge means a superstructure comprised of commercially available standard proprietary prefabricated components that can be assembled and disassembled on site.

Qualified Foreperson means a person with a minimum of five (5) years construction experience with supervisory experience and significant knowledge of modular bridge assembly and installation.

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1. Design Requirements

The modular bridge structure shall be designed according to the Contract

Documents, CSA S6 and the MTO Structural Manual except that:

The following requirements of the CSA S6 are not mandatory:

- Traffic lane widths, side clearance, and sidewalks.
- Deck crossfall and drain outlets.
- Designing floor beam and diaphragms for jacking.
- Camber.

The following are additional requirements:

- Single load path structure shall not be used.
- Deflection limit may be reduced to Span Length / 360 in accordance with the MTO Structural Manual – Guideline for the Design of Bridges on Low Volume Roads.
- Structure shall be designed in accordance with the requirements for a minimum Class “D” for Fatigue Limit States as outlined in CSA S6.
- Traffic lanes and side clearances shall be as specified in the Contract Drawings.
- Anchor bolts shall be designed by the modular bridge vendor in accordance with the Contract Drawings, CSA S6 and the Structural Manual.
- Provide for TL-1 steel beam guide rail.
- Bridge Deck shall consist of an orthotropic steel decking complete with aggregate anti-skid epoxy coating.

The Contract Drawings provide geometric requirements of the modular bridge, including span arrangement, cross-section and end of deck requirements. The width of the modular bridge between the traffic barrier shall not be less than shown on the Contract Drawings.

The modular bridge installed shall conform to these requirements. The Contractor is responsible for reviewing the information and details shown on the Contract Drawings and design the modular bridge accordingly.

Working Drawings shall clearly indicate any proposed modifications to the Contract Drawings, including impacts to the foundation elements (footings, etc.) and bear the seals and signatures of the design engineer and design checking engineer. All modifications to the Contract Drawings shall be subjected to approval of the Contract Administrator.

4.2. Submission Requirements

4.2.1. Working Drawings, Procedures & Certifications

The following documents, bearing the seal and signature of a design Engineer and a design-checking Engineer, shall be submitted to the Contract Administrator at least 7 Days prior to commencement of the installation of the modular bridge, for information purposes only:

- Design and Working Drawings of the modular bridge including bearing anchor bolts.
- Geotechnical crane pad design.
- Crane hoisting and installation procedures,
- A letter and design calculations certifying that the modular bridge has been designed according to CSA S6 and the Contract Documents.
- Where modular bridge components are fabricated outside of Canada, a letter shall be submitted certifying that the materials used, and the fabrication of the modular bridge components are according to the Contract Documents.

4.2.2. Notice of Installation

A written notice shall be submitted to the Contract Administrator at least 7 Days prior to the installation of the modular bridge superstructure.

4.2.3. Certification of Conformance

Submit a certificate of conformance bearing the seal and signature of an engineer, to the Contract Administrator, upon completion of the construction of the modular bridge and prior to opening to traffic. The certificate shall state that the modular bridge has been constructed in general conformance with the Working Drawings, procedures and Contract Documents.

5. MATERIALS

5.1. General

Only new material shall be used. All materials and components shall be according to the Working Drawings.

5.2. Modular Bridge Components

All modular bridge steel components shall be fabricated according to the requirements of OPSS MUNI 906. The use of modular bridge components that have been used previously is not permitted.

The fabricator shall be certified according to CSA W47.1, Division 1 or 2 for steel fabrication or certified according to an equivalent recognized National Standard effective in the jurisdiction in which the modular bridge is fabricated.

All components of the modular bridge shall be new material and shall comply with the details specified and as shown in the Contract Documents. Protective coating shall consist of hot dip galvanizing in conformance with OPSS.MUNI 911.

5.3. Hardware

The hardware used in the assembly and installation of the modular bridge shall be according to the modular bridge manufacturer's requirements.

Anchor bolts shall conform to ASTM F1554 Grade 55 hot dip galvanized with ASTM A563 Grade A Heavy Hex nut or approved equal and ASTM F436 hardened washers.

5.4. Structural Steel

Any structural steel components that are not part of the modular bridge shall be designed and constructed according to OPSS 906.

6. CONSTRUCTION

6.1. General

At least 7 Days prior to installation of the modular bridge, documentation indicating that the modular bridge supervisor who shall be in charge of the installation of the modular bridge has had experience and has successfully performed these duties on at least 3 similar bridges shall be submitted to the Contract Administrator.

6.2. Installation of Modular Bridge

The modular bridge shall be assembled, and installed according to the Working Drawings, procedures and Contract Documents.

Provide in writing, a detailed installation procedure to the Contract Administrator for information purposes only.

Ensure bridge manufacturer on-site representation during installation/launch of the new modular bridge.

The permanent modular bridge including all appurtenances shall be erected/launched and assembled in accordance with OPSS 906, the manufacturer’s recommendations and the Contract Drawings, whichever is most stringent.

Installation of anchor bolts shall conform to OPSS 922. Cementitious grout for the installation of the anchor bolts shall be supplied from a source named on the MTO’s DSM and shall be handled and placed according to the

manufacturer's recommendations.

6.3. Inspection after the Completion of the Construction of the Modular Bridge

Survey the top of the deck at the 4 corners of the structure at the centerline of abutment bearings, immediately upon opening the modular bridge to traffic and at least once a day thereafter for one week, and shall be increased if needed at the request of the Contract Administrator. The Contractor shall, at the request of the Contract Administrator, restore the original deck elevations and maintain a smooth ride across the structure. The survey elevations shall be reported in writing to the Contract Administrator.

A Certificate of Conformance shall be submitted to the Contract Administrator upon the completion of construction of the modular bridge structure.

6.4. Management of Excess Material

Management of excess material shall be according to OPSS MUNI 180.

7. MEASUREMENT FOR PAYMENT

Measurement for payment shall be lump sum.

8. BASIS OF PAYMENT

8.1. Permanent Modular Bridge - Item

Payment at the Contract price for the above item shall be full compensation for all labour, Equipment, and Material to do the work.

Payment at the Contract price for the above item shall also be full compensation for all related site preparation and construction of crane pads as required.

For payment purposes, the fabrication and delivery of the modular bridge to project site shall constitute 50% of the work of the tender item.

S.P. #9 **CONCRETE SEALER**

Spec. **nil**

1. Material

Penetrating sealer shall be an approved penetrating silane and/or siloxane based sealer.

2. Construction

Penetrating sealer shall be applied on all vertical faces and top face of the ballast walls, and all vertical faces and top face of pile cap, but excluding surfaces in contact with precast concrete bearing areas. The application and the application rate of the sealer shall be as per the manufacturer's specifications.

3. Measurement for Payment

Measurement of Penetrating Sealer shall be by area in square metres of concrete surfaces sealed.

4. Basis of Payment

Payment at the contract price for the above tender items shall be full compensation for all labour, equipment and materials required to complete the work.

S.P. #10 PRECAST CONCRETE CULVERT WATERPROOFING

Special Provision No. 599S30January 2021

REQUIREMENTS FOR WATERPROOFING OF PRECAST CONCRETE CULVERTS

1.0 SCOPE

This specification covers waterproofing of joints between precast concrete culvert elements and waterproofing of the top surface of precast concrete culverts.

2.0 REFERENCES

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 912	Precast Concrete Culverts with Spans Greater than 3.0 m
OPSS 914	Waterproofing Bridge Decks with Hot Applied Asphalt Membrane
OPSS 929	Abrasive Blast Cleaning - Concrete Construction

Ontario Provincial Standard Specifications, Material

OPSS 1215	Protection Board

MTO Publications

MTO Forms:

PH-CC-340 Field Sample Data Sheet – Concrete

3.0 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Deck means as defined in OPSS 914.

Protection Board means as defined in OPSS 914.

4.0 DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

Seven Days prior to commencement of waterproofing of the joints, three copies of the product name and data sheet of the self-adhering waterproofing membrane and the primer, and any product-specific instructions or other applicable details, shall be submitted to the Contract Administrator.

5.0 MATERIALS

5.1 Self-Adhering Waterproofing Membrane

Self-adhering waterproofing membrane shall be a product specified in Table 1.

5.2 Hot Applied Rubberized Waterproofing Membrane

Materials for hot applied rubberized waterproofing membrane shall be according to the Materials section of OPSS 914.

5.3 Protection Board

Protection board shall be according to OPSS 1215.

6.0 EQUIPMENT

Equipment for application shall be according to the Equipment section of OPSS 914.

7.0 CONSTRUCTION

7.1 Operational Constraints

All waterproofing materials shall be properly stored and maintained at the waterproofing manufacturer's recommended temperatures.

Waterproofing shall be completed after the culvert has been installed according to the Contract Documents.

Prior to the application of waterproofing:

a) Concrete curing shall be completed according to the Contract Documents.
b) Concrete cured using burlap and water or moisture vapour barrier shall be air cured for at least 72 hours.
c) Any voids or spalls in the concrete shall be repaired as specified in the Contract Documents.
d) The concrete surface shall be clean and smooth with any sharp projections or fins removed.
e) The surface of the concrete shall be abrasive blast cleaned according to OPSS 929 to expose sound, laitance-free concrete.

7.2 Self-Adhering Waterproofing Membrane

7.2.1 Extent of Coverage

Except as specified below, joints on the top surface of the culvert and 50% of the vertical portion of the joints, from the top of the culvert to the culvert mid-height, shall be waterproofed using the self-adhering waterproofing membrane. The membrane shall go over top of steel connector plates, where present, and shall be extended to cover the entire connector plate.

Self-adhering waterproofing membrane shall not be applied to joints located in portions of the culvert that will not be covered with earth or granular material, as specified in the Contract Documents.

When the Contract Documents specify the placement of a protection or distribution slab on the top surface of the culvert, the self-adhering waterproofing membrane placement on the joints shall be limited to the 50% vertical portion plus a minimum 200 mm width on each side of the top surface of the culvert, measured from the culvert top edges.

The width of the self-adhering waterproofing membrane at the joints shall be a minimum of 900 mm.

Protection board shall be applied to cover the membrane applied to the vertical surfaces of the culvert.

7.2.2 Application of Self-Adhering Waterproofing Membrane

The self-adhering waterproofing membrane shall be installed according to the waterproofing manufacturer's recommendations, and the following:

a) The minimum air and concrete surface temperature at the time of primer/adhesive and membrane application shall be 5 °C.
b) The concrete surface shall be dry at the time of application of the primer/adhesive.
c) Immediately prior to the application of the primer the concrete surface shall be cleaned with a jet of oil-free compressed air to remove all dust and other foreign material.
d) The primer/adhesive shall be evenly applied with a roller or brush at a rate of 6.2 to 7.4 m²/L, or at a higher rate if recommended by the waterproofing manufacturer.
e) The primer/adhesive shall be prevented from entering the culvert joint.
f) If the primer/adhesive is left exposed for more than 12 hours, the primer/adhesive shall be evenly reapplied prior to application of the membrane.
g) Release paper shall be removed prior to placement of the membrane.
h) The membrane shall be installed with a minimum overlap between sheets of 65mm for both horizontal and vertical applications and shall be firmly bonded to the concrete surface.
i) All terminations of the membrane shall be sealed against moisture ingress with the joint sealant listed in Table 1, with a minimum thickness of 3 mm and minimum width of 25mm.
j) Protection board applied to the membrane on the vertical surfaces of the culvert shall be secured to the membrane using the joint sealant listed in Table 1.

Prior to applying hot applied rubberized asphalt waterproofing to the top surface of the culvert, an inspection of the self-adhering waterproofing membrane installation shall be undertaken in the presence of the Contract Administrator. Any required repairs shall be carried out, to the satisfaction of the Contract Administrator, prior to proceeding with hot applied rubberized asphalt waterproofing of the top surface of the culvert.

Defects or deficiencies affecting the performance of the self-adhering waterproofing membrane including but not limited to tears in the membrane or inadequate overlaps, shall be repaired by removal of the membrane in the affected area and reapplication to meet the requirements of this specification.

7.2.3 Sampling

The following samples of the primer/adhesive, self-adhering waterproofing membrane and protection board shall be taken in the presence of the Contract Administrator:

a) Self-adhering waterproofing membrane (1 m in length).
b) Protection board (700 mm x 500 mm).
c) Primer/adhesive (approximately 500 ml).

The samples shall be placed in a bag along with Form PH-CC-340 and given to the Contract Administrator.

7.3 Waterproofing of Precast Concrete Culvert

After application of self-adhering waterproofing membrane to the joints, hot applied rubberized asphalt waterproofing membrane with protection board shall be applied to the top surface of the culvert or, when a protection or distribution slab is specified, to the top of the protection or distribution slab.

The application shall be according to the Construction section of OPSS 914, with the following amendments and additions:

a) All references to deck in OPSS 914 shall mean the top surface of the culvert, or, when a protection or distribution slab is specified, the top surface of the protection of distribution slab.
b) The application shall be to the top surface of the culvert that will be covered with fill material and extend to 1000 mm beyond the limit of the fill material specified in the Contract Documents.
c) The application shall also cover the self-adhering waterproofing membrane applied to the joints.
d) Membrane reinforcement shall be applied at the joints between precast concrete culvert elements. The membrane reinforcement shall be placed directly over the waterproofing membrane and pressed in while it is still tacky. The membrane reinforcement shall then be covered with an additional layer of waterproofing membrane.
e) The application, including the protection board, shall extend 300 mm down the vertical faces from:
    a. the top of the culvert or, when specified,
    b. the top of the protection or distribution slab.
f) If a headwall is specified in the Contract Documents, the application shall extend a minimum of 50 mm up the headwall.

Protection board shall extend over all areas of waterproofing on the horizontal and vertical surfaces of the culvert.

Backfilling shall not proceed until the conditions specified in the Inspection After the Waterproofing of the Culvert and Prior to Backfilling clause of OPSS 912 have been met.

8.0 QUALITY ASSURANCE

8.1 Acceptance of Waterproofing of the Top Surface of the Culvert

Acceptance of hot applied rubberized waterproofing shall be according to the Quality Assurance section of OPSS 914.

9.0 MEASUREMENT FOR PAYMENT

9.01 Actual Measurement

9.01.01 Precast Concrete Culvert Waterproofing

Measurement of precast concrete culvert waterproofing shall be by area in square metres of the top surface, with no measurement of any vertical surfaces or overlap of or between self-adhering and hot applied waterproofing.

9.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clause under Actual Measurement.

10.0 BASIS OF PAYMENT

10.01 Precast Concrete Culvert Waterproofing – Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

TABLE 1
Waterproofing Materials for Joints

Manufacturer	Self-Adhering Waterproofing Membrane	Primer / Adhesive	Joint Sealant
WR Meadows	MEL-ROL	Mel-prime	Pointing mastic
Henry	Blueskin WP200	Blueskin Primer	570-05 Polybitume
Grace Construction Products	Bituthene System 4000	Bituthene System 4000 Surface Conditioner	Bituthene Liquid Membrane

Notes:
1. The membrane shall be applied with the primer/adhesive.
2. The self-adhering waterproofing membrane, the primer/adhesive, and the joint sealant shall be from the same manufacturer.

S.P. #11 CONTINGENCY ALLOWANCE

Spec. nil

The Contractor shall not be entitled to payment of the contingency allowance except for Extra Work carried out in accordance with Section GC 3.10.02 of OPSS PROV 100 General Conditions of Contract. No Extra Work under the contingency allowance is contemplated.

PART 4

SUPPLEMENTAL GENERAL CONDITIONS

Part 4

SUPPLEMENTAL GENERAL CONDITIONS

INDEX

SUPPLEMENTAL GENERAL CONDITIONS

1. AMENDMENTS TO GENERAL CONDITIONS OF CONTRACT

The Ontario Provincial Standards "OPSS MUNI GENERAL CONDITIONS OF CONTRACT" are amended or expanded as follows:

GC 1.04 Definitions – "Warranty Period"

"Warranty Period" will be amended to read "means a period of 24 months from the date of substantial performance.

GC 2.01 Reliance on Contract Documents

Sub-section GC 2.01 is hereby deleted in its entirety.

GC. 2.02 Conflicts and Omissions

The "Order of Precedence" as described in Section GC 2.02 of the General Conditions will be replaced as follows:

The "Order of Precedence" as described in Section GC 2.02 of the General Conditions will be replaced as follows:

1. Agreement
2. Addenda
3. Special Provisions,
4. Information for Tenderers,
5. Contract Drawings,
6. Standard Specifications,
7. Divisional Specifications,
8. Form of Tender,
9. Supplementary General Conditions,
10. General Conditions,
11. Working Drawings.

The following additional clauses will apply to this section:

Dimensions on the Contract Drawings, when accompanied by lines and arrows, will take precedence over measurement by scale.

In case of discrepancy between the Drawings and Specifications, figures and dimensions on the Drawings will govern except where the dimensions depend on the dimensions of a specified product; the dimensions of the product will then govern.

The location of un-dimensioned fixtures, outlets, conduits, piping, etc., is shown approximate. Actual location will be made to suit job condition, as approved by the Contract Administrator.

The Contract Drawings and Specifications are complementary to each other and what is called for by either will be as binding as if called for by both. It is the intention to provide for a finished piece of work, complete in all essentials, notwithstanding that every item necessarily involved may not be particularly mentioned. The Contractor will not take advantage, to the detriment of the Corporation, of any manifestly unintentional error or omission should such exist. Where the quality of workmanship or materials is not specifically stated, the best quality will be provided.

GC 3.13.03. Claims Procedure

This section is revised as follows:

"The Contractor must submit detailed claims as soon as reasonably possible in any event no later than 30 days after completion of the work affected by the situation…" will be changed to read "The Contractor must submit detailed claims as soon as reasonably possible in any event no later than 30 days after Substantial Performance of the project…"

GC 4.02 Approvals and Permits

This section is hereby deleted and replaced with the following.

The Contractor will be responsible for obtaining all required for this project. All costs associated with these permits will be borne by the Contractor.

GC 6.03.02 General Liability Insurance

01) This section is amended in that the General Liability insurance will name the Contractor, the Owner, and the Contract Administrator (R.V. Anderson Associates Limited). The minimum insurance coverage with respect to any one accident will be $5,000,000.00 (five million dollars)

GC 6.03.03 Automobile Liability Insurance

This section is amended in that Automobile Liability Insurance will have limits of not less than $5,000,000.00 (five million dollars) inclusive per occurrence.

GC 7.03 Condition of the Working Area

Clause GC 7.03 "Working Area" is amended by the addition of the following:

The Contractor must take such steps as may be necessary to control dust resulting from the Contractor's operations, or by public traffic where it is the Contractor's responsibility to maintain a road through the Work, such that it does not:

1. affect traffic;
2. enter surface water; or
3. escape beyond the right-of-way to cause a nuisance to residents, businesses, or utilities.

GC 7.16 Warranty

The Contractor must correct promptly, at no additional cost to the Owner, defects, or deficiencies in the work, which appear prior to and during the period of 24 months from the issue of substantial performance. The Contract Administrator will promptly give the Contractor written notice of observed defects or deficiencies. Should the Contractor fail to comply with the directions of the Contract Administrator, the Contract Administrator may, after giving the Contractor forty-eight (48) hours written notice, perform the necessary work, and the cost may be deducted, or collected by the Owner as provided in the Contract.

The Contract Administrator may, in cases of danger or public safety, make such immediate arrangement for repair as he sees fit, and the Contract Administrator will inform the Contractor of such action. The cost of such emergency work will be borne by the Contractor.

GC 8.01.02 Variations in Tender Quantities

Section GC 8.01.02 "Variation in Tender Quantities" of the General Conditions will be replaced as follows:

The Contract Administrator has the right to increase or reduce the quantities required or to suspend or omit any item or portion of the work at any time, as he may deem advisable. The Contractor will not be entitled to any compensation for loss of anticipated profit as a result of the deletion of any item or part of an item from the Form of Tender, unless the actual quantity of work performed on a major item of the Contract exceeds or is less than twenty percent (20%) of a quantity shown in the Form of Tender for such major item, and if there is a resulting change in the cost of work or material, then either party to the Contract upon written request of the other, can request the negotiations be held to establish the increase or decrease in the compensation for the affected items of work. Under this provision, the definition of a major item will be any individual bid tender that has a tendered cost equal to or greater than five percent (5%) of the total tender price.

GC 8.01.01 Quantities

Section GC 8.01.01 “Quantities” of the General Conditions will be replaced as follows:

“Estimated Quantities” not set forth in the Schedule of Unit Prices. The Contractor must make his own estimate of the quantities of material, time, labour, etc., required to perform the Items of Work in each Section. No adjustments in payment will be made for overruns or underruns in estimated quantities except as it relates to specific changes made to the scope of work described in the Contract.

“Estimated Quantities” set forth in the Schedule of Unit Prices are approximate only. If the quantity of work to be done and material to be furnished exceeds or is less than the estimated quantity, the Contractor will proceed with the work and payment will be made for the actual amount of the work done and materials furnished at the unit prices set forth in the contract.

GC 8.02.03 Advance Payment for Materials

Section GC 8.02.03 “Advance Payment for Material” of the General Conditions will be replaced as follows:

The Owner will not make any advanced payment to the Contractor for material delivered to, stockpiled, or stored on site, unless otherwise agreed to by the Owner and Contract Administrator.

Payment for material will be based on the material being supplied and installed.

GC 8.02.08 Taxes and Duties

This Section is amended by the addition of the following:

a) Gasoline and Fuel Taxes

The Contractor will pay all taxes under the Gasoline Tax Act and the Motor Vehicle Fuel Tax Act on gasoline and diesel fuel used by him in the performance of the contract. The Contractor undertakes not to make any claim for refund of tax paid by him or any sub-contractor and acknowledges that no refund of tax will be granted to him or to any Sub-contractor on gasoline or diesel fuel used for any purpose whatsoever in the performance of the contract unless such refund is specifically authorized under the provision of the Gasoline Tax Act and the Motor Vehicle Fuel Tax Act respectively.

b) Harmonized Sales Tax (HST)

Applicable Federal Goods and Services Tax will not be included in the unit prices tendered. HST will be added at the end of the Schedule of Unit Prices to arrive at the Total Contract Price.

The successful tenderer must provide their HST Registration Number, which will be indicated on each Payment Certificate along with the applicable HST.

c) Changes to Government Taxes

Where a change in Canadian Federal or Provincial taxes occur after the Tender Closing Date for this contract, and this change could not have been anticipated at the time of bidding, the Owner will increase or decrease contract payments to account for the exact amount of tax change involved.

2. INSURANCE CLAIMS

Claims received by the Contractor will be dealt with immediately by the Contractor. If a claim is settled to the satisfaction of the claimant, the Contractor will submit to the Contract Administrator a copy of the claimant's release.

If a claim is rejected by the Contractor and/or his insurance company, the Contractor will report this fact in writing to the Contract Administrator.

Should the Contractor be unable to resolve the claim within two weeks after receipt of such claims, he will report to the Contract Administrator the steps being taken with respect to the claim.

3. CONTRACTORS RESPONSIBILITY FOR DAMAGES

The Contractor will assume the defense of and indemnify and save harmless the Owner and its officers and agents from all claims relating to labour and materials furnished for the work, and to inventions, copyrights, trademarks, royalties or patents, and rights thereto, relating to or used in doing the work, or the subsequent use and operation of the work or any part thereof upon completion. In carrying out the works from their inception, and until the final acceptance of the same, the Contractor must be careful to cause as little injury or damage as possible to any adjacent property, public or private, or to any sidewalks, roadways, curbs, gutters, drains, hydrants, manholes, frames, covers or street gullies, boulevards, grass plots, sodding, trees, shrubs, or structures, works or things on or near the line or in the vicinity of the works or elsewhere, and, except as in this Contract is otherwise provided, if injury or damage is done, he must make good the same, at his own expense, in the manner directed by, and to the satisfaction of the Contract Administrator. The

Contractor will be responsible for any and all damages, or claims for damages for injury or accidents done or caused by him or his employees or agents, or resulting from the prosecution of the works, or any of his operations, or caused by reason of the existence or location or condition of the works, or any materials, plant or machinery used thereon or therein, or which may happen by reason thereof, or arising from any act of commission or omission on his part, or on the part of any of his agents or employees, in connection with the Contract, and covenants and agrees to hold the Owner harmless and indemnified from all such damages and claims for damage; and in case of the Contractor's failure, neglect or omission to observe and perform faithfully and strictly, all the provision of the Contract, the Contract Administrator may, either with or without notice (except where in this Contract, notice is specially provided for, and then upon giving the notice therein provided for), take such steps, procure such material, plant, trucks and men, and do such work or things as he may deem advisable toward carrying out the enforcing the same, and any and all expenses to incurred by be deducted or collected by the Owner from the monies due to the Contractor, and any such action by the Contract Administrator as he is herein empowered to take, will not in any way relieve the Contractor or his surety from any liability under the Contract.

4. THE OCCUPATIONAL HEALTH AND SAFETY ACT, ARTICLE 13, RSO 1990, CHAPTER O.1

Notwithstanding Section GC 7.01 in the General Conditions of the Contract, the Contractor, by executing the contract, unequivocally acknowledges that he is the constructor within the meaning of The Occupational Health and Safety Act, and amendments thereto.

5. THE CONSTRUCTION ACT RSO 1990, CHAPTER C.30

Notwithstanding Section GC 8.02 of the General Conditions of Contract, payments to the Contractor, holdbacks and their release, and certificate of substantial performance and completion under this contract will be in full compliance with the provisions of The Construction Lien Act.

In his tender price, the Contractor will be deemed to have made do allowance for the publication of a copy of the certificate of substantial performance of the contract in the Daily Commercial News within seven (7) days of receipt of the said certificate in order to facilitate the holdback release under the substantial performance certificate.

PART 5

LIST OF PLANS AND SPECIFICATIONS

Part 5

LIST OF PLANS AND SPECIFICATIONS

INDEX

CONTRACT TMW-2026-08

Municipality of Markstay-Warren

Replacement Of Leeftink Road Bridge, North Road Middle Section Culvert, And Dupuis Road Culvert

CONTRACT PLAN LISTING

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CONTRACT TMW-2026-08

Municipality of Markstay-Warren

Replacement Of Leeftink Road Bridge, North Road Middle Section Culvert, And Dupuis Road Culvert

SPECIFICATIONS LISTING

OPSS DATE	SPEC NO.	TITLE
Nov 2024	100 (MUNI)	General Conditions of Contract
NOV 18	102 (MUNI)	Weighing of Materials
APR 24	127 (PROV)	Schedule of Rental Rates for Construction Equipment including Model and Specification Reference
NOV 21	180 (MUNI)	Management and Disposal of Excess Material
NOV 21	182 (MUNI)	Environmental Protection for Construction in Waterbodies and Waterbody Banks
APR 19	206 (MUNI)	Grading
NOV 19	212 (MUNI)	Earth Borrow
NOV 23	314 (MUNI)	Untreated Granular Subbase, Base, Surface, Shoulder, and Stockpiling
NOV 21	401 (MUNI)	Trenching, Backfilling, and Compacting
NOV 18	421 (MUNI)	Pipe Culvert Installation in Open Cut
NOV 17	491 (MUNI)	Preservation, Protection, and Reconstruction of Existing Facilities
NOV 17	501 (MUNI)	Compacting
NOV 17	506 (MUNI)	Dust Suppressants
NOV 18	510 (MUNI)	Removal
NOV 19	511 (MUNI)	Rip-Rap, Rock Protection and Granular Sheeting
NOV 21	517 (MUNI)	Control of Water from Dewatering Operations
NOV 21	539 (MUNI)	Temporary Protection Schemes

See also the Instructions to Tenderers and Schedule of Unit Prices for additional Specifications that may not be included here.

CONTRACT TMW-2026-08

Municipality of Markstay-Warren

Replacement Of Leeftink Road Bridge, North Road Middle Section Culvert, And Dupuis Road Culvert

STANDARD DRAWINGS LISTING

OPSS NO.	REV.	TITLE
200.010		Earth Grading – Undivided Rural
205.060		Frost Heave Treatment
206.010		Granular Course B – Undivided Rural
210.010		Tangent Shoulders – Rural
210.070		Granular Sealing
212.010		Resurfacing With Crossfall Correction, With Hot Mix Asphalt, Tangent Section
212.020		Resurfacing With Crossfall Correction, With Hot Mix Asphalt, Superelevated Section
219.000		Silt Mitigation Series of Drawings
300.010		Side Road Intersection – Fill
300.020		Side Road Intersection - Cut
301.010		Rural Entrances to Roads on Fill
301.020		Rural Entrances to Roads in Cut
803.030		Frost Treatment – Pipe Culverts Frost Penetration Line Below Bedding Grade
810.010		General Rip-Rap Layout for Sewer and Culvert Outlets
810.020		General Rip-Rap Layout for Ditch Inlets
200.010		Earth Grading – Undivided Rural
205.060		Frost Heave Treatment
206.010		Granular Course B – Undivided Rural
210.010		Tangent Shoulders – Rural
210.070		Granular Sealing

See also the Schedule of Unit Prices and Contract Plans for additional Standard Drawings that may not be included here.

PART 6

OPSS MUNI
GENERAL CONDITIONS
OF CONTRACT

Part 6

Municipality of Markstay-Warren

Replacement Of Leeftink Road Bridge, North Road Middle Section Culvert, And Dupuis Road Culvert

ONTARIO PROVINCIAL STANDARD GENERAL CONDITIONS

The Ontario Provincial Standard MUNI GENERAL CONDITIONS OF CONTRACT (OPSS.MUNI 100 NOV 2024) are in effect and will be bound with the contract documents to be executed between the Municipality of Markstay-Warren and the successful Tenderer.

OPSS MUNI GENERAL CONDITIONS OF CONTRACT

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SECTION GC 4.0 - OWNER'S RESPONSIBILITIES AND RIGHTS

SECTION GC 5.0 - MATERIAL

SECTION GC 6.0 - INSURANCE, PROTECTION AND DAMAGE

SECTION GC 7.0 - CONTRACTOR'S RESPONSIBILITIES AND CONTROL OF THE WORK

SECTION GC 8.0 - MEASUREMENT AND PAYMENT

PART 7

GEOTECHNICAL REPORTS

Part 7

Municipality of Markstay-Warren

Replacement Of Leeftink Road Bridge, North Road Middle Section Culvert, And Dupuis Road Culvert

GEOTECHNICAL REPORTING

Report Prepared By:

- Geotechnical Investigation and Design Report, Proposed Bridge Replacement, Leeftink Road, Markstay-Warren, Ontario prepared by EXP Services Inc., dated June 01, 2026.
- Geotechnical Investigation and Design Report, Proposed Culvert Replacement, North Road, Markstay-Warren, Ontario prepared by EXP Services Inc., dated February 03, 2026.
- Geotechnical Investigation and Design Report, Proposed Culvert Replacement, Dupuis Road, Markstay-Warren, Ontario prepared by EXP Services Inc., dated January 28, 2026.
- Addendum No. 1 Geotechnical Investigation and Design Report, Proposed Culvert Replacement, Dupuis Road, Markstay-Warren, Ontario prepared by EXP Services Inc., dated June 18, 2026.
- Addendum No. 1 Geotechnical Investigation and Design Report, Proposed Culvert Replacement, North Road, Markstay-Warren, Ontario prepared by EXP Services Inc., dated June 19, 2026.

Geotechnical Investigation and Design Report

R.V. Anderson Associates Ltd.

Type of Document:
Final Report

Project Name:
Proposed Bridge Replacement
Leeftink Road
Markstay-Warren, Ontario

Project Number:
SUD-24002582-B0

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2026-06-01

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Further to our Proposal No. 25/133/GPC dated November 6, 2025, and your subsequent authorization to proceed, EXP Services Inc. (EXP) has completed the field investigation and geotechnical engineering evaluation for the proposed bridge replacement. Our comments and recommendations, based on the results of the field investigation and our understanding of the project scope, are provided in this report.

1. Introduction

It is understood by EXP that an existing bridge located on Leeftink Road in Markstay-Warren, Ontario is be replaced. To assist with the design and construction of the proposed bridge replacement, EXP has completed a geotechnical investigation at the site, with the results of the investigation and associated recommendations included within this report.

The existing bridge is located on Leeftink Road in Markstay-Warren, Ontario, approximately 200 m north of Ratter Lake Road. The bridge coordinates are 5150785.7N, 536722.5E (UTM 17T), with the location shown on Dwg. No. A-1, included in Appendix A.

The existing bridge consists of a single lane Bailey Bridge. At the bridge location, Leeftink Road is a two-lane gravel surfaced roadway, travelling in a north-south direction. The Veuve river crosses below the bridge, with flow in an east to west direction. The river was partially frozen at the time of EXP's investigation. The top of ice within the existing river was measured at roughly 6 m below the bridge deck (Approx. Local Elev. 93 m) at the time of the investigation.

No existing geotechnical information is understood to be available for the existing bridge.

2. Field Investigation

The field investigation for this project consisted of the advancement of two (2) sampled boreholes through the roadway, one at each end of the existing bridge. The boreholes were advanced on December 18, 2025 at locations free of buried and overhead services as shown on Dwg. No. A-1, included in Appendix A. Note the boreholes were advanced just off the roadway as the road was too narrow at the bridge location to maintain traffic while drilling.

The sampled boreholes were advanced using a power auger drill rig equipped with 200 mm diameter Hollow Stem Augers (HSA) to depths shown on the attached borehole logs, Figures B-2 and B-3, in Appendix B. Soil samples were obtained directly from the augers and using a 51 mm (2 inch) outside diameter split spoon sampler in conjunction with Standard Penetration Tests (ASTM D1586), at depths noted on the attached borehole logs. The Standard Penetration Test (SPT) "N" values were recorded and used to provide an assessment of the in-situ compactness condition of the encountered soils. Field vane tests were also completed to determine the undrained shear strengths of encountered cohesive soils. At the sampling termination depth of 11.6 m within Borehole BH-L2, a Dynamic Cone Penetration Test (DCPT) was advanced to refusal on suspected very dense till.

Groundwater measurements were attempted within the open boreholes upon completion. The boreholes were backfilled with auger cuttings and sealed with bentonite.

The retained soil samples were logged in the field and then carefully packaged and transported to our laboratory for detailed examination and testing.

The borehole locations were determined in the field using a handheld GPS. The borehole elevations were surveyed to a local temporary benchmark (TBM), established on the top of an existing post at the southwest corner of the existing Bailey Bridge. The TBM was given a local, non-geodetic elevation of 100.0 m. The borehole elevations and locations are considered accurate only to the degree implied by the methods used and are used for geotechnical purposes of this report. These locations and elevations should not be used for detailed design purposes.

3. Laboratory Testing

A routine geotechnical laboratory testing program was performed on representative soil samples and consisted of moisture content determinations, grain/particle size analyses, and Atterberg Limits Tests. The geotechnical laboratory test results are summarized on the attached borehole logs in Appendix B, with detailed results included in Appendix C.

In addition, two (2) representative samples were submitted to a CALA Certified Laboratory operated by SGS Canada Inc. to complete chemical corrosivity testing. The corrosivity test results are included in Appendix D.

4. Physiography and Soils Data

4.1 Geological Setting

Based on the Northern Ontario Engineering Geology Terrain Study (NOEGTS) mapping, the local geology at the site consists of sandy, silty glaciolacustrine plain overlying bedrock plain. Relief is low (<15 m) and planer, with mixed wet and dry drainage. Ministry of Northern Development and Mines (MNDM) Map 2543, Bedrock Geology of Ontario East-Central Sheet indicates the bedrock at the site consists of migmatitic rocks and gneisses of undetermined protolith, commonly layered biotite gneisses and migmatites; locally includes quartzofeldspathic gneisses, orthogneisses, paragneisses.

4.2 Frost Conditions

In accordance with "Figure 11 – Freezing Index Map of Northern Ontario", from the Ministry of Transportation Report No. RR225, "Aspects of Prolonged Exposure of Pavements to Sub-Zero Temperatures," 1981, the freezing index for the investigated area is estimated to be 1,250 C degree-days. As indicated in the referenced report, and consistent with OPSD 3090.100, the proposed design frost penetration depth is 2.1 m beneath a paved roadway.

5. Subsurface Conditions

Details of the soils encountered during the field investigation are summarized on the attached log in Appendix B. The log includes textural descriptions of the subsoil and indicates the soil boundaries inferred from non-continuous sampling and observations during the field investigation. These boundaries reflect approximate transition zones for the purpose of geotechnical design and should not be interpreted as exact planes of geological change. When reading this report, the explanatory notes and definitions provided in Figures B-1A and B-1B in Appendix B should be referenced.

5.1 South Abutment – BH-L1

Borehole BH-L1 was advanced near the south abutment of the existing bridge. In general, the borehole encountered 50 mm of topsoil overlying fill materials and native sandy silt; gravelly sand; clay and silt; and silty sand.

Below the topsoil was an approximately 1.5 m thick layer of brown silty sand fill containing some gravel and trace clay. The fill was moist to wet, with measured moisture contents ranging from 14 to 21%. One SPT performed within the silty sand fill resulted in an uncorrected "N" value of 7 blows per 300 mm, classifying the silty sand fill as loose in compactness condition.

Underlying the silty sand fill was an approximately 0.7 m thick layer of brown sand fill containing some gravel, some silt, and trace clay. The fill was moist to wet, with a measured moisture content of 12%. One SPT performed within the sand fill resulted in an uncorrected "N" value of 4 blows per 300 mm, classifying the sand fill as loose in compactness condition.

Below the fill materials was native brown sandy silt that extended to 6.1 m depth. The sandy silt contained some clay and occasional sand seams. The sandy silt was wet, with measured moisture contents ranging from 21 to 24%. Uncorrected SPT "N" values within the sandy silt ranged from 2 to 5 blows per 300 mm, classifying the sandy silt as very loose to loose in compactness condition. An Atterberg Limits test was completed on a representative sample of the sandy silt from BH-L1 resulting in a Liquid Limit of 26.6%, a Plastic Limit of 20.8%, and a Plasticity Index of 5.8%.

Underlying the sandy silt was a layer of grey gravelly sand that extended to 7.6 m depth. The gravelly sand contained some silt and trace clay. The gravelly sand was wet, with a measured moisture content of 18%. One SPT performed within the gravelly sand resulted in an uncorrected "N" value of 8 blows per 300 mm, classifying the soil as loose in compactness condition.

Native grey cohesive clay and silt, containing trace to some sand, was encountered below the gravelly sand and extended to 10.7 m depth. Frequent sand seams were encountered within the clay and silt below 9.1 m depth. The clay and silt was wet, with measured moisture contents ranging from 37 to 39%. Uncorrected SPT "N" values within the clay and silt ranged from 0 to 3 blows per 300 mm. A field vane test performed within the clay and silt resulted in an undrained shear strength of 44 kPa. As such, the clay and silt is classified as firm in consistency.

Below the clay and silt was native grey silty sand that extended to auger refusal on suspected very dense till or boulders at 11.6 m depth. The silty sand contained some gravel and was wet, with a measured moisture content of 17%. One SPT performed within the silty sand resulted in an uncorrected "N" value of 55 blows per 300 mm, classifying the soil as very dense in compactness condition.

Groundwater was encountered within the open borehole during the short term the borehole was left open upon completion at 10.1 m depth (Local Elev. 88.4 m). Seasonal variations in the water table should be anticipated, with higher levels occurring during wet weather conditions (spring thaw and late fall) and lower levels occurring during dry weather conditions.

5.2 North Abutment – BH-L2

Borehole BH-L2 was advanced near the north abutment of the existing bridge. In general, the borehole encountered fill materials overlying native clayey silt; clay and silt; gravelly sand; and sand.

Brown silty sand fill was encountered at the surface of the borehole and extended to 1.5 m depth. The fill contained trace to some gravel and boulders and cobbles. The fill was moist, with measured moisture contents ranging from 10 to 13%. One SPT performed within the fill resulted in an uncorrected "N" value of 20 blows per 300 mm, classifying the fill as compact in compactness condition.

Below the fill was brown native clayey silt containing some sand that extended to 3.1 m depth. The clayey silt was wet, with measured moisture contents ranging from 23 to 36%. Uncorrected SPT "N" values within the clayey silt ranged from 7 to 13 blows per 300 mm, classifying the clayey silt as loose to compact in compactness condition.

Underlying the clayey silt was brown to grey cohesive clay and silt that extended to 7.6 m depth. The clay and silt contained trace sand and was moist to wet, with measured moisture contents ranging from 32 to 37%. Uncorrected SPT "N" values within the clay and silt ranged from 2 to 6 blows per 300 mm. Field vane tests performed within the clay and silt resulted in undrained shear strengths ranging from 52 to 86 kPa. As such, the clay and silt is classified as firm to stiff in consistency. An Atterberg Limits test completed on a representative sample of the clay and silt resulted in a Liquid Limit of 39.4%, a Plastic Limit of 20.9%, and a Plasticity Index of 18.5%. As such, the clay and silt is considered to have medium plasticity.

A layer of brown gravelly sand was encountered below the clay and silt and extended to 9.1 m depth. The gravelly sand contained some silt was wet, with a measured moisture content of 18%. One SPT performed within the gravelly sand resulted in an uncorrected "N" value of 17 blows per 300 mm, classifying the soil as compact in compactness condition.

Below the gravelly sand was native grey sand that extended to the sampling termination depth of 11.6 m. The sand contained trace gravel, some silt and was wet, with measured moisture contents ranging from 19 to 20%. Uncorrected SPT "N" values within the sand ranged from 16 to 38 blows per 300 mm, classifying the sand as compact to dense in compactness condition.

A DCPT was advanced from the sampling termination depth and extended to refusal on suspected very dense till at 16.8 m depth. Based on the DCPT values, the cohesionless compact to dense soils appear to continue to the refusal depth.

Groundwater was encountered within the open borehole at 7.0 m depth (Local Elev. 92.4 m). Seasonal variations in the water table should be anticipated, with higher levels occurring during wet weather conditions (spring thaw and late fall) and lower levels occurring during dry weather conditions.

6. Corrosivity Potential of On-Site Soils

Two (2) representative soil samples were submitted to a CALA Certified Laboratory operated by SGS Canada Inc. to complete chemical corrosivity testing. The results of the chemical testing are summarized below, with detailed results included in Appendix D.

Table 6-1: Summary of Corrosivity Test Results

Parameter	Borehole, Sample No., Depth	
	BH-L1, SS4, 2.3 to 2.9 m	BH-L2, SS3, 1.5 to 2.1 m
Chloride (µg/g)	190	82
Sulphate (µg/g)	14	10
Sulfide (%)	< 0.01	< 0.01
pH	5.15	6.7
Electrical Conductivity (µS/cm)	254	121
Resistivity (ohm.cm)	3940	8260
Redox Potential (mV)	16	89
Corrosivity Index	5	4

The soil corrosivity test results were compared to the ANSI/AWWA Corrosivity Rating System. Based on the rating system, a point total of ten or greater (≥10) indicates the soil is corrosive to gray or ductile cast iron. As noted on the table above, the tested samples had a Corrosivity Index of 5 and 4 and as such the soil should not be considered corrosive to gray or ductile cast iron.

In addition, chloride ions can lead to corrosion of steel reinforcement in concrete and steel structures by breaking down the normally present protective layer of oxides present on the steel surface. Chloride concentrations greater than 500 ppm (µg/g) are generally considered corrosive. As noted above, the tested samples did not have chloride concentrations exceeding 500 ppm (µg/g).

Based on the above, the soil should be considered non-corrosive to steel at the site, and to reinforcing steel within concrete below the ground surface. Based on the results of the tested sample and given that the structure is located adjacent to the roadway and will be exposed to de-icing salt, consideration should be given to designing concrete for a "C" type exposure class as defined by Table 1 of CAN/CSA A23.1.

Sulphate contents were compared to Table 3 of CAN/CSA A23.1. Sulphate contents within the tested soil samples were 14 and 10 µg/g. As such, there is negligible potential for sulphate attack from the encountered soils on concrete based on Table 3 of CAN/CSA A23.1 and sulphate resistant concrete would not be required if concrete structures are constructed.

7. Foundation Recommendations

The following foundation recommendations are based on interpretation of the factual data obtained from the borehole advanced during the subsurface investigation at the site by EXP. The interpretation and recommendations provided are intended solely to permit designers to assess foundation alternatives and design the new bridge replacement. Comments on construction are only provided to highlight issues that could affect the design. Contractors bidding on the works should make their own assessments of the factual data and how it might affect construction means and methods, scheduling, and the like.

This report addresses the geotechnical design of the foundation for the proposed bridge replacement structure by providing geotechnical design parameters at the Ultimate Limit State (ULS) and Serviceability Limit States (SLS), as well as other geotechnical parameters that may be required in accordance with the latest edition of the Canadian Highway Bridge Design Code (CHBDC) (CSA S6:25), the Guideline for Professional Engineers Providing Geotechnical Engineering Service (1992), the Canadian Foundation Engineering Manual (CFEM) (2023), and good practice. The proposed structure and its foundation system are interpreted to be classified as having a “typical” consequence level associated with exceeding limits states design. Given the level of foundation investigation completed, the level of confidence for design is interpreted to be “typical” degree of site and prediction model understanding. Table 6.1 and 6.2 of the CHBDC, CAN/CSA-S6-19, 2019 have been used in the design to establish the appropriate consequence factor and geotechnical resistance factors.

The report provides discussion about the structure foundation type as well as other geotechnical and construction considerations such as assessment of lateral earth pressure, site preparation, excavation, dewatering, and frost and scour protections.

7.1 Discussion

The following ground conditions at the bridge location are evident from the current investigation:

- On the south side at Borehole BH-L1, roughly 2.3 m of loose granular fill materials were encountered overlying native soils.
- Native soils below the fill on the south side consisted of 5.4 m of loose cohesionless soils overlying 3.0 m of firm cohesive clay and silt, followed by very dense cohesionless silty sand that extended to auger refusal.
- Borehole BH-L1 encountered auger refusal on suspected very dense soils or boulders at 11.6 m depth (Local Elev. 86.9 m).
- One the north side at Borehole BH-L2, roughly 1.6 m of compact granular fill materials were encountered overlying native soils.
- Native soils below the fill on the north side consisted of 1.5 m of loose to compact clayey silt overlying 4.6 m of firm to stiff cohesive clay and silt, followed by compact cohesionless gravelly sand to sand to extended to the sampling termination depth where a DCPT was then advanced.
- Borehole BH-L2 encountered DCPT refusal on suspected very dense soils at 16.8 m depth (Local Elev. 82.6 m).
- Groundwater was encountered upon completion at 10.1 m depth (Local Elev. 88.36 m) and 7.0 m depth (Local Elev. 92.35 m) within Boreholes BH-L1 and BH-L2, respectively. The top of ice elevation within the existing river was measured at approximately Local Elev. 93.0 m at the time of the investigation. As such, groundwater should be expected for excavations approaching or exceeding roughly 6 to 7 m depth. Seasonal variations in the water level should be expected, with higher levels occurring during wetter periods of the year and lower levels during drier periods.
- No grade raises are anticipated at the bridge location.

Based on the anticipated soil conditions, shallow spread footings bearing on native soils would be possible at this site to support the replacement bridge. If higher capacities are required, the spread footings can bear on a compacted engineered fill pad overlying the native soils as well. Furthermore, it is understood that bridge designers are also considering deep foundations, consisting of helical piles, as the use of helical piles will support a rapid construction staging approach currently being considered for construction. As such, helical pile foundation recommendations have also been included.

7.2 Shallow Foundations

Outlined on Table 7-1 below are the recommended factored geotechnical resistances at Ultimate Limit States (ULS) and bearing pressures at Serviceability Limit States (SLS) for assumed 2 m x 9 m spread footings. The geotechnical resistances were factored with a typical consequence factor of 1.0 at ULS and SLS and typical degree of understanding (factor of 0.5 at ULS and factor of 0.8 at SLS) in accordance with Table 6.1 and 6.2 of the CHBDC S6:25. The geotechnical resistances provided in Table 7-1 are for vertical loading conditions only; load eccentricity and load inclination effects should be addressed in accordance with the CHBDC and its commentary.

Table 7-1: Foundation Recommendations – Spread Footings

Structure Unit	Est. Footing Size	Footing Depth Below Grade (m)	Factored Resistance at ULS (kPa)	Bearing Pressure at SLS to Limit Total Settlement to 25 mm (kPa)
North and South Abutment	2.0 m x 9.0 m Spread Footing	2.5	300	110
	2.0 m x 9.0 m Spread Footing over 1.0 m thick Engineered Fill Pad	2.5	400	200

If the selected footing size or founding depths differ from those given in Table 7-1, the geotechnical resistances given in Table 7-1 should be reviewed and updated.

The proposed abutment locations and final bearing depth of the foundations are not finalized at this time, nor is a topographic survey of the site available. Once topographic survey information is available and the preliminary abutment locations and depths are finalized, it is recommended that a slope stability assessment be completed to confirm stability of the river embankments, unless the abutments are set back far enough or deep enough so that the stability of the embankments are not impacted.

It is assumed that minimal (< 0.3 m) to no vertical grade changes are anticipated for the new bridge and approaches beyond existing surface elevations.

Prior to placing any engineered upfill or concrete, all in-situ topsoil and any insitu fill or other deleterious materials that may be present must be removed down to native soils. Exposed subgrades must be proof rolled to identify any soft or unstable areas. The exposed subgrade and proof rolling are to be inspected by a representative from EXP prior to placing fill materials or concrete. Any soft or loose areas encountered below the foundation locations or any areas that are subject to softening/loosening when exposed to water and construction activities should be excavated down to a firm subgrade and replaced with Granular “A” or Granular “B” Type II in accordance with Ontario Provincial Standards and Specifications (OPSS) 1010. A non-woven geotextile separator (Terrafix 270R or equivalent) is to be used between the subgrade soils and any engineered fill.

Once the subgrade is approved, a minimum of 150 mm thick layer of compacted Granular “A” should be placed over the subgrade and geotextile, below the footings, to protect the subgrade from disturbance during construction.

Where an engineered fill pad is required, or significant upfill is anticipated, the engineered fill is to consist of Granular “B” Type II in accordance with OPSS 1010 placed and compacted over the subgrade and geotextile. A final 150 mm thick layer of Granular “A” (OPSS 1010) should be placed directly below the foundations.

All engineered fill placed below the foundations is to extend horizontally a minimum of 300 mm beyond the edges of the foundation and slope down to the native soils at 1H:1V to ensure the foundation loads are properly transferred to the underlying subgrade. All engineered fill must be placed in maximum 150 mm thick lifts and be compacted to 100% Standard Proctor Maximum Dry Density (SPMDD) within 1.5% of optimum moisture content. Engineered fill placement and compaction below foundations is to be continuously monitored on a full-time basis by a qualified geotechnical representative from EXP.

The location of any foundation on an engineered fill pad is critical and certification by a qualified surveyor that the foundations are within the stipulated boundaries is mandatory. Since layout stakes are often damaged or removed during fill placement, offset stakes must be installed and maintained by the surveyors during the course of fill placement so that the contractor and engineering staff are continually aware of where the engineered fill limits lie.

7.2.1 Resistance to Lateral Loads

Resistance to lateral forces/sliding resistance between the concrete footings and the compacted granular fill should be calculated in accordance with Section 6.10.4 of the CHBDC S6:25. The unfactored values of the coefficient of friction, tan δ, between the base of concrete footings and the granular pad for construction in-the-dry are included in Table 7-2. These values represent unfactored values. A factor of 0.8 should be applied in calculation of the horizontal resistance in accordance with the CHBDC.

Table 7-2: Coefficient of Friction

Interface	Coefficient of Friction, tan δ
Cast-in-place concrete over compacted Granular "A"	**0.6**
Precast concrete over compacted Granular "A"	**0.5**

7.3 Deep Foundations – Helical Piles

The proposed bridge can be founded on deep foundations consisting of helical piles. For helical pile foundations at this site, it is recommended that the helices be established within the dense to very dense cohesionless soils encountered below approximately 10.7 m depth at the borehole locations.

As helical systems are typically proprietary, the recommendations outlined below are intended to assist the designers in developing the foundation system. Note that any other design considerations including, but not limited to, pile spacing, depth, size, etc. are the responsibility of the designer. For installation, EXP recommends utilizing a contractor who specializes in helical pile foundations, particularly one with experience in Northern Ontario. It is also recommended that Chance Helical Piles be used due to their superior capacity and corrosive protection.

Helical piles must be designed as end bearing and the friction from any surficial fill soils must be ignored. The helical pile capacity can be calculated using the following equation from the Canadian Foundation Engineering Manual. Note that a geotechnical resistance factor of 0.4 for piles in compression and 0.3 for uplift must be applied to the calculated capacities.

$$Q_h = A_h(s_u N_c + \gamma D_h N_q + 0.5\gamma B N_\gamma)$$

where

Q_h = Individual helix bearing capacity (kN)
A_h = Projected helix area (m^2)
S_u = Undrained shear strength (kPa)
γ = Unit weight of the soil (kN/m^3)
D_h = Depth to helical bearing plate (m)
B = Diameter of helical plate (m)
N_c = $(N_q - 1)\cot\phi$
N_q = $e^{(\pi \tan\phi)}\tan^2(45 + 0.5\phi)$
N_γ = $0.0663\, e^{0.1623\phi}$

The above capacity equation assumes that helices are vertically spaced at a minimum distance of three (3) times the largest helix diameter in order to avoid overlapping soil stresses.

For the encountered dense to very dense cohesionless sand to silty sand below approximately 10.7 m depth at the borehole locations, the following soil parameters may be used:

Table 7-3: Soil Parameters – Helical Pile Design

Material	Friction Angle ø´ (unfactored)	Undrained Shear Strength (Su)	Unit Weight γ (kN/m^3)
Silty Sand, some gravel (very dense)	32°	0	18
Sand, trace gravel, trace silt, (dense)	35°	0	21

Lateral loads may be resisted by installing the helical piles at a batter.

It is recommended that a load testing program (compression and tension) be performed on several of the helical piles to verify that design capacities are being achieved.

Boulders and cobbles were generally encountered within the surficial fills at Borehole BH-L2. The helical pile contractor must be prepared to deal with the possibility of encountering these materials, even where they are not indicated by the borings.

7.4 Backfill

All imported backfill material used for surrounding the bridge abutments should consist of Granular “A”, Granular “B” Type I, or Granular “B” Type II (OPSS 1010) material, with a maximum aggregate size not exceeding 120 mm. The granular material used against the bridge abutments must be placed in lifts no greater than 150 mm in thickness and must be compacted to 98% of the Standard Proctor Maximum Dry Density (SPMDD). Care must be taken to ensure over compaction and damage to the foundations does not occur.

7.5 Frost Protection

Ontario Provincial Standard Drawing (OPSD) 3090.100 indicates that the frost penetration for the Markstay-Warren area is roughly 2.1 m. Foundations should be provided with a minimum of 2.1 m of earth cover frost protected. Where sufficient earth cover frost protection is not provided for the foundations, insulation will be required. Insulation should consist of rigid extruded polystyrene, have a minimum compressive strength of 415 kPa, and an R-Value of 5 for every 25.4 mm of thickness, (i.e. Styrofoam HIGHLOAD 60). Any exposed insulation is to be protected against sunlight and physical damage. A rough estimate for cost evaluation purposes can be made by assuming that 25.4 mm of rigid insulation designed for below grade installation is equivalent to 300 mm of soil cover. Note that insulation for unheated structures must extend below the entire foundation. Higher compressive strength insulation (i.e., Styrofoam HIGHLOAD 100, etc.) may be required, depending on foundation loading conditions.

Detailed insulation recommendations can be provided by EXP, if necessary, once the final foundation designs have been determined.

7.6 Seismic Considerations

Seismic characterization of the site should be compliant with the CHBDC. Table 4.2 in CHBDC shows site classification for seismic site response based on average soil properties in the top 30 m. As the Site Classification for Seismic Response is based on soil conditions in the upper 30 m, assumptions were made by EXP for the soil conditions below the borehole termination depths.

Based on EXP's assumptions and the anticipated foundation conditions and subsurface characteristics, the site class for this site is estimated to be Class "E" according to Table 4.2 of the CHBDC. From the Natural Resources Canada website, 2025-2020 NBCC seismic hazard values are obtained using the site location coordinates and Site Class "E" are shown in Table 7-4 below.

Table 7-4: Seismic Design Values for Footings (Lat. 46.510, Long. -80.521)

Probability of Exceedance in 50 Years (Return Period)	Sa (0.2)	Sa (0.5)	Sa (1.0)	Sa (2.0)	PGA (g)
2%	0.319	0.332	0.203	0.0971	0.184
5%	0.196	0.203	0.119	0.0548	0.113
10%	0.124	0.128	0.0731	0.0323	0.0713

These values are associated with an earthquake having a 2 percent, 5 percent, and 10 percent probability of exceedance in a 50-year period.

7.7 Lateral Earth Pressures

The lateral earth pressures acting on abutment stems and any associated wing walls/retaining walls will depend on the type and method of placement of the backfill material, the nature of the soils behind the backfill, the magnitude of surcharge including construction loadings, the freedom of lateral movement of the structure, and the drainage conditions behind the walls.

The following recommendations are made concerning the design of any abutment/retaining walls at this site. It should be noted that these design recommendations and parameters assume level backfill and ground surface behind the walls. Where there is sloping ground behind the walls, the coefficient of lateral earth pressure must be adjusted to account for the slope.

Backfill behind the abutments/walls should consist of Granular "A" or Granular "B" Type II in accordance with OPSS.PROV 1010. Longitudinal drains and weep holes should be installed to provide positive drainage of the granular backfill in accordance with OPSD 3102.100 and OPSD 3190.100. Compaction (including type of equipment, target densities, etc.) should be carried out in accordance with OPSS.PROV 501. Other aspects of the granular backfill requirements with respect to sub drains and frost taper should be in accordance with OPSD 3101.150 and OPSD 3121.150.

A minimum compaction surcharge of 12 kPa should be included in the lateral earth pressures for the structural design of the wall stem, in accordance with CHBDC Section 6.12.3 and Figure 6.8. Other surcharge loadings should be accounted for in the design as required.

Earth pressures based on the proposed backfill materials are outlined on Table 7-5 below.

Table 7-5: Earth Pressure Properties

Material	Friction Angle ø´ (unfactored)	Coefficient of Active Earth Pressure (k_a)	Coefficient of Passive Earth Pressure (k_p)	Coefficient of Earth Pressure at Rest (k_o)	Unit Weight γ (kN/m^3)
Granular "A"	38°	0.24	4.2	0.38	22
Granular "B" Type II	38°	0.24	4.2	0.38	21
Granular "B" Type I	35°	0.27	3.7	0.43	21

If the wall support and superstructure allow lateral yielding of the stem, active earth pressures may be used in the geotechnical design of the structure. If the abutment support does not allow lateral yielding, at-rest earth pressures should be assumed for geotechnical design.

7.8 Scour/Erosion Protection

Foundation systems supporting bridge structures in flood plains, close to rivers are very likely to be exposed to potentially harmful effects of stream flow, with particular concern during more significant storm events and where the river bed/valley is set in erodible soils. The need for and nature of scour and erosion protection systems must be assessed and where required, must be designed, implemented and remain effective over the design life of the bridge.

Structures close to the river which contain spread footings founded on highly erodible/scourable soils (sand, silt, or fine gravel) are very vulnerable to failure caused by scour and undermining by water flow and should not be used without appropriate protection. Spread footings can be protected against structural undermining by locating the foundations at an appropriate depth by providing scour protection blankets.

Typically, abutment forward slopes and side slopes adjacent to river require protection. The erosion/scour protection should be designed by a specialist Hydraulic Engineer (as erosion and scour largely depend on the velocity of water in the watercourse and its regime) who is familiar with the findings of this report.

In general, rip-rap protection should be provided on riverbanks and adjacent to abutments and fore slopes. A non-woven geotextile (Terrafix 360R or equivalent) should be placed between the rip-rap and native soils to prevent migration of the fine-grained native soils into the rip-rap.

Geotechnical soil parameters necessary for the scour analyses are: SPT N-value, in-situ moisture content, percent passing the No. 200 sieve (% 200), and mean grain size diameter (d_{50}). These parameters are determined based on the soils encountered at the site, and are presented on the borehole logs attached in Appendix B and the graphs included in Appendix C.

8. Excavations

All excavations at this site must be conducted in accordance with the Occupational Health and Safety Act (OHSA) and Regulations for Construction (O. Reg. 213/91). The existing fill materials and native soils may be classified as a Type 3 soil above the groundwater table in conformance with the OHSA. The soils below the groundwater table may be classified as a Type 4 soil. The ingress of surface water must be controlled using a suitable system.

Temporary excavation side slopes for Type 3 soils should not exceed 1H:1V in accordance with OHSA, while temporary excavation side slopes for Type 4 soils should not exceed 3H:1V where applicable.

The need to excavate flatter side slopes if excessively wet or soft/loose materials, or concentrated seepage zones are encountered, should not be overlooked. Water (i.e. surface water runoff) should not be permitted to enter and/or pond within the construction area.

Where excavations cannot be safely sloped to maintain stability during construction, suitably designed temporary shoring must be used. It will be the contractor's responsibility to design a suitable temporary shoring system. The design and installation procedures should be reviewed by the Prime Consultant prior to construction.

Cobbles and boulders were encountered in the fill materials at the north abutment (BH-L2). These potential obstructions may impact excavations and/or elements of temporary protection systems (if required) and the Contractor should be made aware of their presence prior to construction.

All excavations must be completed in accordance with the most recent regulations in the Ontario Occupational Health and Safety Act. The contractor should be aware that slope height, slope inclination, or excavation depths, should in no case, exceed those specified in local, provincial or federal safety regulations. Such regulations are strictly enforced and, if not followed, the owner, the contractor or earthwork or utility subcontractor could be liable for substantial penalties.

8.1 Re-use of Excavated Material

The insitu fill materials and native soils have too high of a fines content to be reused as free draining engineered fill. These materials may be reused for general landscaping purposes away from the structures provided it is environmentally safe to do so.

Excavated soils to be removed off site are likely considered to be Excess Soils and disposal of such soils should follow O.Reg. 406/19. Once the final site plan has been determined, and the known volume of soils to be excavated and removed off site is known, additional excess soil field studies can be completed.

9. Dewatering

Groundwater was encountered upon completion at 10.1 m depth (Local Elev. 88.36 m) and 7.0 m depth (Local Elev. 92.35 m) within Boreholes BH-L1 and BH-L2, respectively. The top of ice elevation within the existing river was measured at approximately Local Elev. 93.0 m at the time of the investigation. As such, groundwater should be expected for excavations approaching or exceeding roughly 6 to 7 m depth.

Based on the encountered groundwater levels, assumed shallow foundation depths within the reports, and the assumption that construction will be completed during drier times of the year, it is assumed that excavations will not approach or exceed the groundwater depth, and as such, significant dewatering is not anticipated. Above the groundwater table, any potential perched water or ingress of surface water should be possible to control using conventional construction pumps.

Dewatering requirements to keep the construction site dry will be impacted by water levels in the creek at the time of construction activities. Seasonal variations in the water table should be expected, with higher levels occurring during wetter periods of the year and lower levels during drier periods. It is the responsibility of the Contractor to propose a suitable dewatering system based on the time of construction, water levels and flow conditions in the creek. The method used should not undermine the existing roadway or adjacent side slopes. The Contractor should verify groundwater conditions prior to construction.

The estimated hydraulic conductivity (K) of the in-situ fill and soils is shown on Table 9-1 below.

Table 9-1: Hydraulic Conductivity of Encountered Soils

Soil Material	K (cm/sec)
Silty Sand Fill, Sandy Silt, Silty Sand	10^{-3} to 10^{-5}
Sand Fill, Sand	10^{-1} to 10^{-4}
Gravelly Sand	10^{-1} to 10^{-4}
Clayey Silt	10^{-5} to 10^{-6}
Clay and Silt	10^{-6} and less

A Permit to Take Water (PTTW) is not likely required. Based on the groundwater levels observed, water taking is not anticipated to exceed 50,000 L/day. If at the time of construction, groundwater levels are found to be high and water taking will exceed 50,000 L/day, an Environmental Activity and Sector Registry (EASR) for Construction Site Dewatering would likely be required (pumping less that 400,000 L/day).

Erosion and sediment control during bridge construction should be as per the MTO Drainage Manual, Volume 2. Silt fences and other sediment control measures should be included to protect the downstream environment from the construction activities.

10. Construction Constraints Under Cold Weather Conditions

For all construction activities at this site, the following applies:

- During excavations, all subgrade soils must be maintained at a minimum temperature of 5° C.
- No granular material may be placed under frozen conditions, with all fill material maintained at a minimum temperature of 5° C prior to and during installation. If granular fill is to be placed in freezing conditions, the granular fill must be restricted to Granular “B” Type II material. Since Granular “B” Type II has a larger aggregate size, care should be taken to prevent point loading on the underside of the concrete.
- Soils and granular fill material that are in direct contact with fresh concrete must be at a minimum temperature of 5° C prior to pouring the concrete and must be free of snow and ice fragments.
- All granular fill, prior to placement of concrete, must be reviewed by this office to ensure that it is free of frost, buried ice and snow.
- All reinforcing steel in the concrete forms must be free of ice and snow, and must be maintained at a minimum temperature of 5° C.
- During the placement of concrete in cold weather conditions, a field cured cylinder should be placed beside the heated form for a period of 6 days. The field cured cylinder should be returned to a designated laboratory on the sixth day for 7-day compressive strength testing.
- All heated and tarped areas should be monitored for temperature using a max/min thermometer.
- All concrete is to have a minimum of 6% to 8% air entrainment to prevent cracking and shall be maintained at a minimum temperature of 10° C for a period of 4 to 7 days.

The 6% to 8% air entrained concrete during cold weather placement is to prevent significant strength loss of concrete as a result of freezing and thawing. The air entrainment will provide the capacity to absorb stresses during freeze/thaw action.

11. Construction Quality Control

Construction quality control of the “earthworks” should be provided throughout the project by a representative of EXP to verify all design assumptions, recommendations, and confirmation of the subsurface soil conditions. This includes inspection of the excavation and subgrade prior to the placement of any structural fill and foundations, to ensure that any and all deleterious materials have been removed and to ensure that the actual conditions are not markedly different than those on which the recommendations made herein are based. Compaction control of structural fill is also recommended as standard practice, as is sampling and testing of aggregates and concrete.

12. Design Review

The recommendations made in this report are in accordance with our present understanding of the project and are provided solely for the design team responsible for the project. If there are any changes, such as relocation of any structures or other features which may affect our analysis, the information obtained during this investigation may be inadequate and additional field work and reporting may be required.

13. Limitations

A subsurface investigation is a limited sampling of a site. Should any conditions at the site be encountered that differ from those reported at the test locations, we require that we be notified immediately in order to allow reassessment of our recommendations.

Whereas this investigation has estimated the groundwater level at the time of the fieldwork, and commented on general construction problems, the presence of conditions, which would be difficult to establish from our test holes, may affect the type and nature of dewatering procedures which should be used in practice. These conditions include local and seasonal fluctuations in the groundwater table, erratic changes in the soil profile between the tests, and thin layers of soil with large or small permeabilities compared with the general soil mass, etc.

The comments given in this report are intended only for the guidance of the design team responsible for the project. The number of test holes required to determine the localized underground conditions between test holes affecting construction costs, techniques, sequencing, equipment, scheduling, etc. could be greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual test hole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

The investigation and comments are necessarily ongoing as new information of underground conditions becomes available. For example, more specific information is available with respect to in-situ subsurface conditions between test locations once construction is underway. Subsurface soil interpretation between test holes, as well as the recommendations of this report, should be verified through field inspections provided by EXP to validate the current information for use during the construction stage.

Virtually no scope of work, no matter how exhaustive, can identify all contaminants or all conditions above or below ground. For example, conditions elsewhere at the site may differ from those encountered, and conditions may change with time. Therefore, no warranty is provided that the entire site condition is represented by those identified at specific borehole locations.

This report in no way reflects onsite environmental considerations.

14. Closure

We trust that these comments provide you with sufficient information to proceed with design. Should you have any questions, please do not hesitate to contact this office.

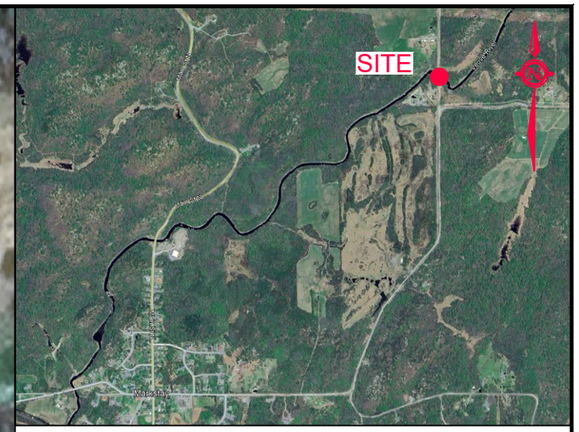
Yours truly,

EXP Services Inc.

Ian MacMillan, P.Eng.
Project Manager, Earth & Environmental Services
Northeastern Ontario

Yves Beauparlant, P.Eng.
Manager, Earth & Environmental Services
Northeastern Ontario

Appendix A – Drawing



KEYPLAN - N.T.S.

LEGEND

EXP BOREHOLE

TEMPORARY BENCHMARK

— NOTES —

1) The boundaries and soil types have been established only at Test Hole locations. Between Test Holes, they are assumed and may be subject to considerable error.
2) Do not use Test Hole elevations for design purposes.
3) Soil samples will be retained in storage for 3 month and then destroyed unless client advises that an extended time period is required.
4) Quantities should not be established from the information provided at the Test Hole locations.
5) This drawing forms part of the report, project number as referenced, and should be used only in conjunction with this report.

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REVISIONS

No.	DESCRIPTION	DATE

CLIENT: R.V. ANDERSON ASSOCIATES LTD.

PROJECT: PROPOSED BRIDGE REPLACEMENT
LEEFTINK ROAD, MARKSTAY-WARREN, ON

PROJECT NO.: SUD-24002582-B0

TITLE: BOREHOLE LOCATION PLAN

DATE: FEBRUARY 2026

SCALE: NTS

DWG NO.: A-1

Appendix B – Borehole Logs

Notes on Sample Descriptions

1. All sample descriptions included in this report follow the International Society for Soil Mechanics and Foundation Engineering (ISSMFE), as outlined in the Canadian Foundation Engineering Manual. Note, however, that behavioral properties (i.e. plasticity, permeability) take precedence over particle gradation when classifying soil. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

UNIFIED SOIL CLASSIFICATION

CLAY (PLASTIC) TO	FINE	MEDIUM	CRS.	FINE	COARSE
SILT (NONPLASTIC)	SAND			GRAVEL	

EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		

2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.

3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (75 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

Notes On Soil Descriptions

4. The following table gives a description of the soil based on particle sizes. With the exception of those samples where grain size analyses have been performed, all samples are classified visually. The accuracy of visual examination is not sufficient to differentiate between this classification system or exact grain size.

Soil Classification		Terminology	Proportion
Clay and Silt	<0.060 mm	"trace" (e.g. Trace sand)	1% to 10%
Sand	0.060 to 2.0 mm	"some" (e.g. Some sand)	10% to 20%
Gravel	2.0 to 75 mm	adjective (e.g. sandy, silty)	20% to 35%
Cobbles	75 to 200 mm	"and" (e.g. and sand)	35% to 50%
Boulders	>200 mm		

The compactness of Cohesionless soils and the consistency of the cohesive soils are defined by the following:

Cohesionless Soil		Cohesive Soil		
Compactness	**Standard Penetration Resistance "N" Blows / 0.3 m**	**Consistency**	**Undrained Shear Strength (kPa)**	**Standard Penetration Resistance "N" Blows / 0.3 m**
Very Loose	0 to 4	Very soft	<12	<2
Loose	4 to 10	Soft	12 to 25	2 to 4
Compact	10 to 30	Firm	25 to 50	4 to 8
Dense	30 to 50	Stiff	50 to 100	8 to 15
Very Dense	Over 50	Very Stiff	100 to 200	15 to 30
		Hard	>200	>30

5. **ROCK CORING**

Where rock drilling was carried out, the term RQD (Rock Quality Designation) is used. The RQD is an indirect measure of the number of fractures and soundless of the rock mass. It is obtained from the rock cores by summing the length of the core covered, counting only those pieces of sound core that are 100 mm or more length. The RQD value is expressed as a percentage and is the ratio of the summed core lengths to the total length of core run. The classification based on the RQD value is given below.

RQD Classification	RQD (%)
Very Poor Quality	<25
Poor Quality	25 to 50
Fair Quality	50 to 75
Good Quality	75 to 90
Excellent Quality	90 to 100

$$\text{Recovery Designation \% Recovery} = \frac{\text{Length of Core Per Run}}{\text{Total Length of Run}} \times 100$$

Log of Borehole BH-L1

Project No. SUD-24002582-B0 | Figure No. B-2

Project: Proposed Bridge Replacement, Leeftink Road | Sheet No. 1 of 2

Location: Markstay-Warren, Ontario

5150763N; 536727E

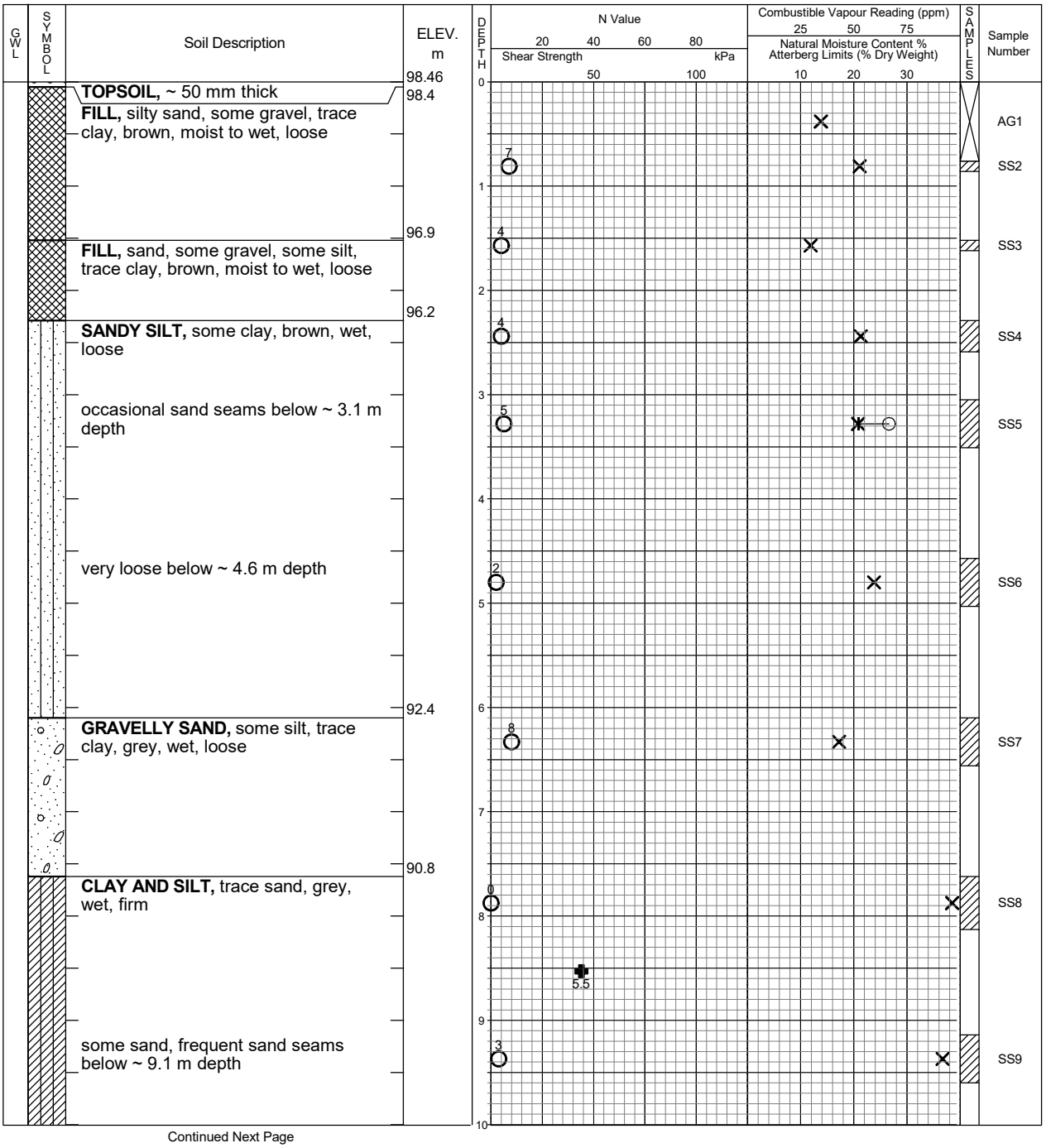
Date Drilled: December 18, 2025

Drill Type: CME55 Track Mount

Datum: Local (non-geodetic)

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer



SUDBURY GEO SUD-24002582-B0 - MARKSTAY-WARREN - LEEFTINK BRIDGE.GPJ NEW.GDT 2/25/26

Continued Next Page

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Borehole data requires interpretation assistance from EXP before use by others.

See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	10.1	Open

Log of Borehole BH-L1

Project No. SUD-24002582-B0 Figure No. B-2

Project: Proposed Bridge Replacement, Leeftink Road Sheet No. 2 of 2

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Sample Number
▼			88.46		20 40 60 80	25 50 75		
			88.36	10	Shear Strength 50 100 kPa	Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30		
			87.8					
		SILTY SAND, some gravel, grey, wet, very dense		11	55	×		SS10
			86.9					
		BOREHOLE TERMINATED AT ~ 11.6 m DEPTH DUE TO AUGER REFUSAL ON SUSPECTED BOULDERS OR VERY DENSE TILL						

SUDBURY GEO SUD-24002582-B0 - MARKSTAY-WARREN - LEEFTINK BRIDGE.GPJ NEW.GDT 2/25/26

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See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	10.1	Open

Log of Borehole BH-L2

Project No. SUD-24002582-B0 | Figure No. B-3

Project: Proposed Bridge Replacement, Leeftink Road | Sheet No. 1 of 2

Location: Markstay-Warren, Ontario

5150809N; 536718E

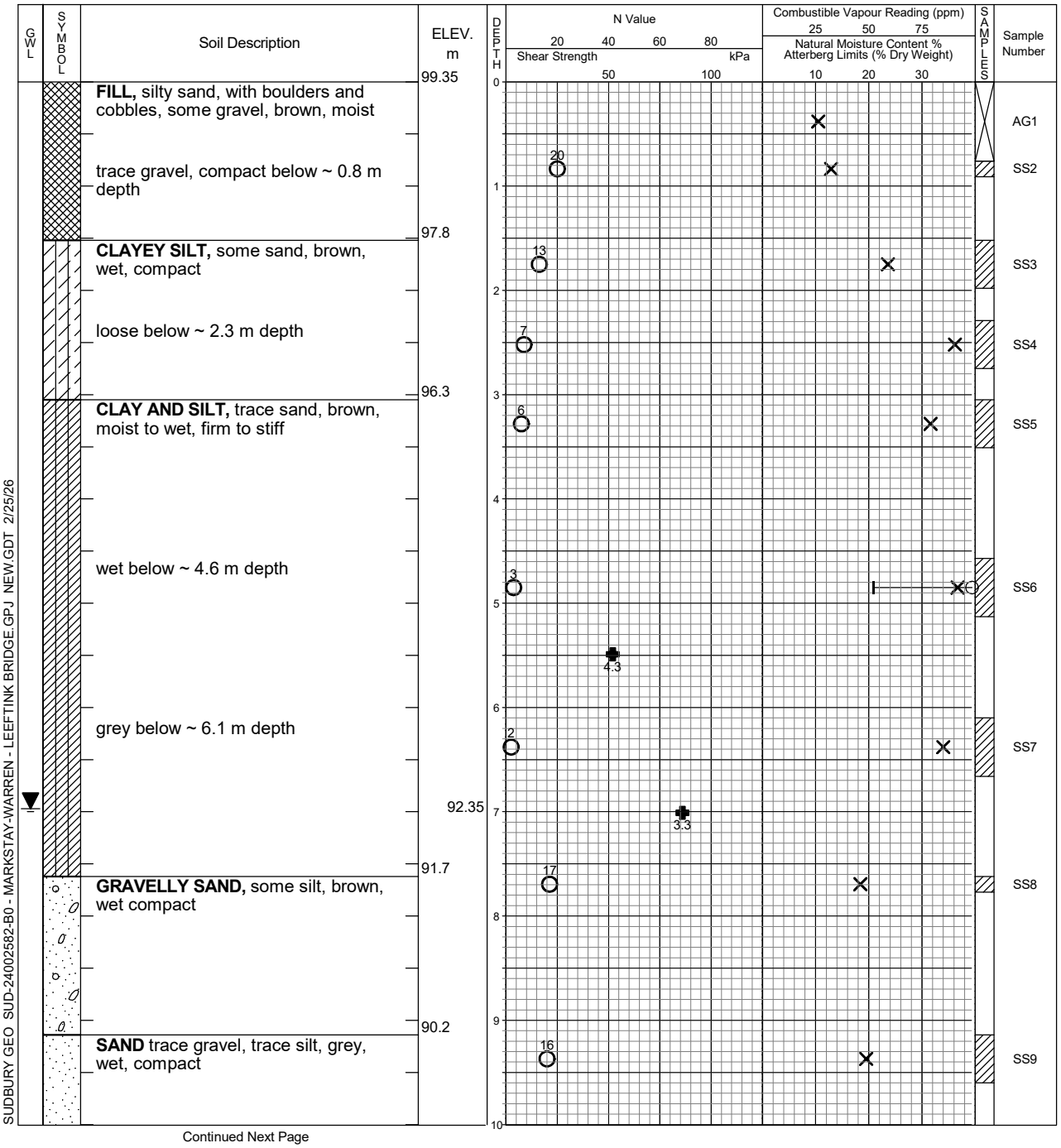
Date Drilled: December 18, 2025

Drill Type: CME55 Track Mount

Datum: Local (non-geodetic)

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer



SUDBURY GEO SUD-24002582-B0 - MARKSTAY-WARREN - LEEFTINK BRIDGE.GPJ NEW.GDT 2/25/26

Continued Next Page

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Borehole data requires interpretation assistance from EXP before use by others.

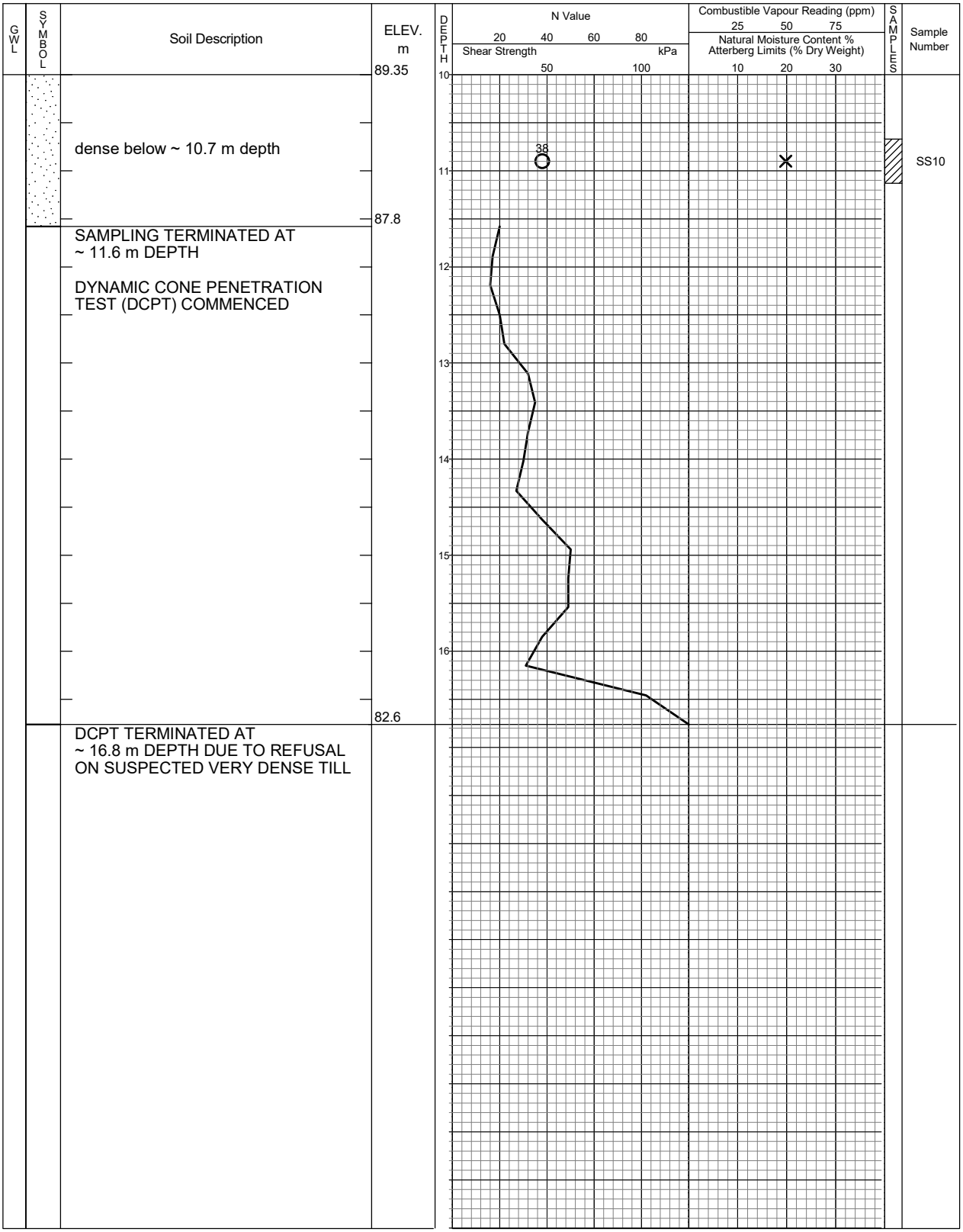
See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	7.0	7.6

Log of Borehole BH-L2

Project No. SUD-24002582-B0 Figure No. B-3

Project: Proposed Bridge Replacement, Leeftink Road Sheet No. 2 of 2



SUDBURY GEO SUD-24002582-B0 - MARKSTAY-WARREN - LEEFTINK BRIDGE.GPJ NEW.GDT 2/25/26

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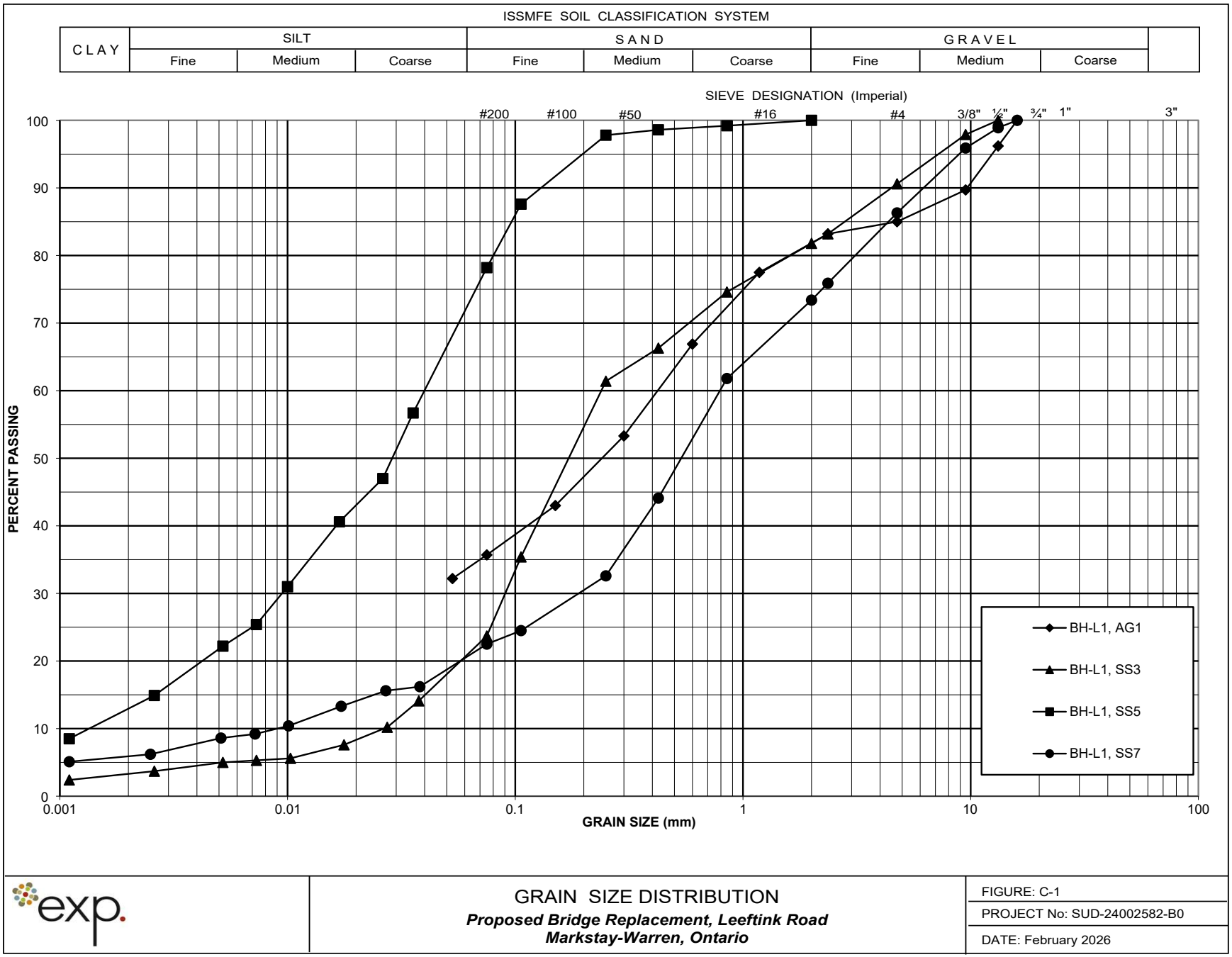
Borehole data requires interpretation assistance from EXP before use by others.

See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	7.0	7.6

Appendix C – Laboratory Testing



exp.

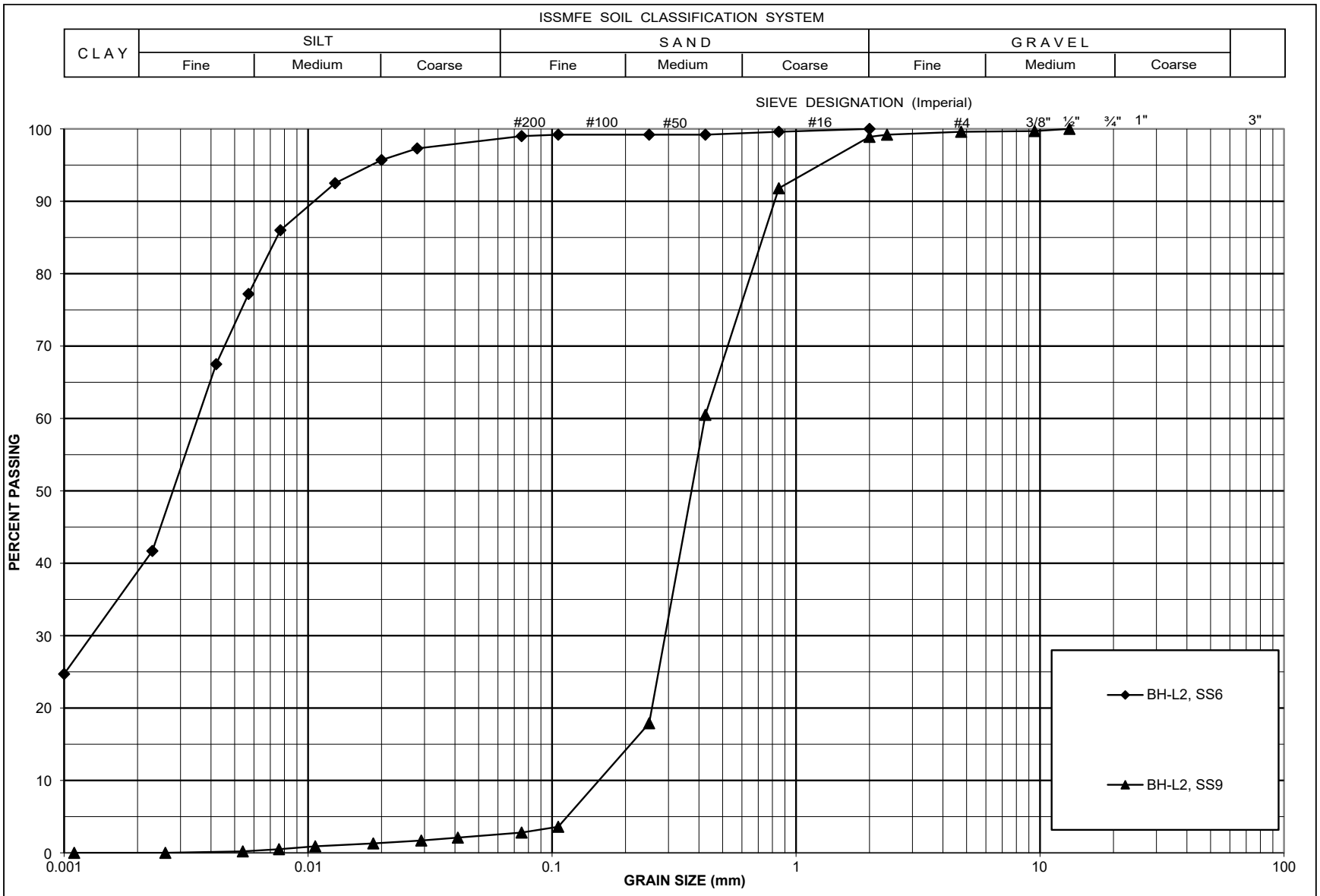
GRAIN SIZE DISTRIBUTION

Proposed Bridge Replacement, Leeftink Road
Markstay-Warren, Ontario

FIGURE: C-1

PROJECT No: SUD-24002582-B0

DATE: February 2026



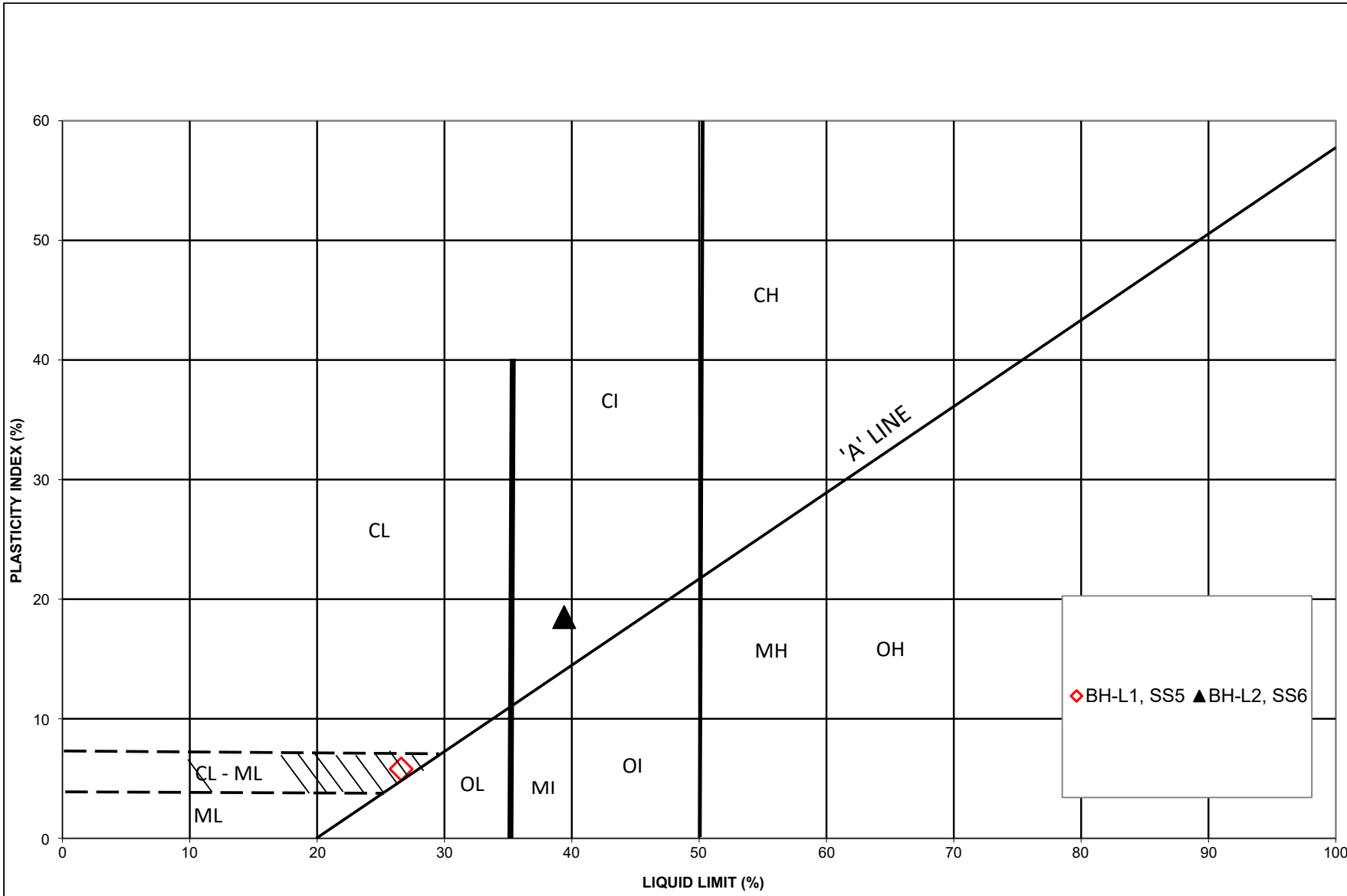
GRAIN SIZE DISTRIBUTION

Proposed Bridge Replacement, Leeftink Road
Markstay-Warren, Ontario

FIGURE: C-2

PROJECT No: SUD-24002582-B0

DATE: February 2026



exp.

PLASTICITY CHART

Proposed Bridge Replacement, Leeftink Road
Markstay-Warren, Ontario

FIGURE: C-3

PROJECT No: SUD-24002582-B0

DATE: February 2026

Appendix D – Corrosivity Test Results

FINAL REPORT

CA15497-JAN26 R1

SUD-24002582-B0

Prepared for

EXP Services Inc.

FINAL REPORT

First Page

CLIENT DETAILS

Client	EXP Services Inc.
Address	885 Reagent Street Sudbury, Ontario P3E 5M4, Canada
Contact	Ian MacMillan
Telephone	705-674-9681
Facsimile	705-674-5583
Email	ian.macmillan@exp.com
Works #	
Project	SUD-24002582-B0
Reference	
Batch	
Samples	SOIL (8)

LABORATORY DETAILS

Project Specialist	Maarit Wolfe, Hon.B.Sc
Laboratory	SGS Canada Inc.
Address	185 Concession St., Lakefield ON, K0L 2H0
Telephone	705-652-2000
Facsimile	705-652-6365
Email	Maarit.Wolfe@sgs.com
SGS Reference	CA15497-JAN26
Received	2026-01-09
Approved	01/15/2026
Report Number	CA15497-JAN26 R1
Date Reported	01/15/2026

COMMENTS

Temperature of Sample upon Receipt: 6.3 degrees C

Chain of Custody Number: N/A

Corrosivity Index is based on the American Water Works Corrosivity Scale according to AWWA C-105. An index greater than 10 indicates the soil matrix may be corrosive to cast iron alloys.

SIGNATORIES

Maarit Wolfe, Hon.B.Sc

TABLE OF CONTENTS

FINAL REPORT

CA15497-JAN26 R1

Client: EXP Services Inc.
Project: SUD-24002582-B0
Project Manager: Ian MacMillan
Samplers: Patrick Lachance

MATRIX: SOIL

Parameter	Units	RL	Sample Number	5	6	7	8	9	10	11	12
			Sample Name	23083 BHD1 SS5	23075 BHN1 SS5	23123 BHL1 SS4	23046 BHS1 SS4	23081 BHD1 SS3	23073 BHN1 SS3	23132 BHL2 SS3	23059 BHS2 SS3
			Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
			Sample Date	2026-12-15 00:00	2026-12-15 00:00	2026-12-15 00:00	2026-12-15 00:00	2026-12-15 00:00	2026-12-15 00:00	2026-12-15 00:00	2026-12-15 00:00
				Result	Result	Result	Result	Result	Result	Result	Result
Corrosivity Index											
Corrosivity Index	none	1		Test results for this sample included in separate report.	Test results for this sample included in separate report.	5	Test results for this sample included in separate report.	Test results for this sample included in separate report.	Test results for this sample included in separate report.	4	Test results for this sample included in separate report.
pH	pH Units	0.05				5.15				6.70	
Soil Redox Potential	mV	no				16				89	
Sulphide (Na2CO3)	%	0.01				< 0.01				< 0.01	
Resistivity (calculated)	ohms.cm	-9999				3940				8260	
General Chemistry											
Conductivity	uS/cm	2				254				121	
Metals and Inorganics											
Sulphate	µg/g	0.4				14				10	
Other (ORP)											
Chloride	µg/g	0.4				190				82	

QC SUMMARY

Anions by IC

Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-[ENV]IC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0276-JAN26	µg/g	0.4	<0.4	2	35	104	80	120	102	75	125
Sulphate	DIO0276-JAN26	µg/g	0.4	<0.4	5	35	102	80	120	97	75	125

Carbon/Sulphur

Method: ASTM E1915-07A | Internal ref.: ME-CA-[ENV]ARD-LAK-AN-020

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide (Na2CO3)	ECS0052-JAN26	%	0.01	< 0.01								

Conductivity

Method: SM 2510 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0249-JAN26	uS/cm	2	3	0	20	99	90	110	NA		

QC SUMMARY

pH

Method: SM 4500 I Internal ref.: ME-CA-[ENV]EWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0249-JAN26	pH Units	0.05	NA	0		100			NA		

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

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

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS	Insufficient sample for analysis.
RL	Reporting Limit.
↑	Reporting limit raised.
↓	Reporting limit lowered.
NA	The sample was not analysed for this analyte
ND	Non Detect

Results relate only to the sample tested.

Data reported represent the sample as submitted to SGS.

Test method information available upon request.

"Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

SGS Canada Inc. statement of conformity decision rule does not consider uncertainty when analytical results are compared to a specified standard or regulation.

-- End of Analytical Report --

5.4, 6.3, 7.2

SGS

Request for Laboratory Services and CHAIN OF CUSTODY (Mining)

SGS Environmental Services - Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Toll Free: 877-747-7658 Fax: 705-652-6365 Web: www.ca.sgs.com {4}

SGS Environmental Services - London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361 Web: www.ca.sgs.com {4}

Laboratory Information Section

Received Date (mm/dd/yyyy): JAN 09 2026

Skid # (if applicable): Temperature Upon Receipt (°C):

LAB LIMS #: CA 15497 JAN26 LA

Billing & Reporting Information

Invoice/Receipt to {3}:

Company: EXP

Attention: Ian Macmillan

Address: 885 Regent St. Suite 3-6A, Sudbury, ON, P3E 5M4

Email: ian.macmillan@exp.com

Quote #:

Attached Parameter List: ☐ YES ☐ NO

Turnaround Time

Is *Rush Turnaround Time Required? ☐ YES ☑ NO

Specify:

* Rush TA Requests Require Lab Approval

Project Name/Number: SUD-24002582-B0 | P.O. #: SUD-24002582-B0

Client Information/Report To:

Client Lab #:

Company Name:	EXP	**Phone Number:**	
Contact Name:	Ian Macmillan	**Fax Number:**	
Address:		**E-mail:**	ian.macmillan@exp.com
Copy to:			

Samples will be sent to paid storage after 3 months unless otherwise requested. Additional storage and shipping costs will be charged to the client. If the samples should be returned, please provide courier account information.

After analysis samples are to be:	Disposed ☑	Stored (At client's cost) ***Default** ☐	Multi-phase project (Automatic storage) ☐
Returned to client ☐	Return courier:	Acct:	

IMPORTANT: If samples contain known Hazards, please label accordingly and identify below:

☐ **NORM (Normally Occuring Radioactive Material)** ☐ **Asbestos** ☐ **Other:**

Special Instructions : ☐ **See Attached or:**

Sample Information

Sample Identifier	Date Sampled (mm/dd/yy)	Time Sampled	# of Containers	Analysis Requested (please enter the analysis required below and check off which analysis applies to each sample) — corrosivity package							
23083 BHD1 SS5	15-Dec-25	N/A	1 Bag	x							
23075 BHN1 SS5	15-Dec-25	N/A	1 Bag	x							
23123 BHL1 SS4	15-Dec-25	N/A	1 Bag	x							
23046 BHS1 SS4	15-Dec-25	N/A	1 Bag	x							
23081 BHD1 SS3	15-Dec-25	N/A	1 Bag	x							
23073 BHN1 SS3	15-Dec-25	N/A	1 Bag	x							
23132 BHL2 SS3	15-Dec-25	N/A	1 Bag	x							
23059 BHS2 SS3	15-Dec-25	N/A	1 Bag	x							

Sampled By {1}:	(Name)	(Signature)	**Date:**	___ ___ / ___ ___ ___	(mm/dd/yy)
Relinquished by {2}:	Patrick Lachance	(Signature)	**Date:**	8 1 2026	(mm/dd/yy)

Note: {1} Submission of samples to SGS is acknowledgement that you have been provided direction on sample collection/handling and transportation of samples. {2} Submission of samples to SGS is considered authorization for completion of work. Signatures may appear on this form or be retained on file in the contract, or in an alternative format (e.g. shipping documents). {3} Results may be sent by email to an unlimited number of addresses for no additional cost. Fax is available upon request. {4} Completion of work may require the subcontracting of samples between the London and Lakefield laboratories.

This document is issued by the Company under its General Conditions of Service accessible at http://www.sgs.com/terms_and_conditions.htm. (Printed copies are available upon request.) Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

RTN 335667283824 KA 10:15

Geotechnical Investigation and Design Report

R.V. Anderson Associates Ltd.

Type of Document:
Report

Project Name:
Proposed Culvert Replacement
North Road
Markstay-Warren, Ontario

Project Number:
SUD-24002582-B0

Prepared By:
Ian MacMillan, P.Eng.
Project Manager, Earth and Environmental, Northeastern Ontario
EXP
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Sudbury, Ontario, P3E 5M4
t: +1.705.674.9681
f: +1.705.674.5583

Date Submitted:
2026-02-03

Table of Contents

Further to our Proposal No. 25/133/GPB dated September 2, 2025, and your subsequent authorization to proceed, EXP Services Inc. (EXP) has completed the field investigation and geotechnical engineering evaluation for the proposed culvert replacement. Our comments and recommendations, based on the results of the field investigation and our understanding of the project scope, are provided in this report.

1. Introduction

It is understood by EXP that an existing culvert located on North Road in Markstay-Warren, Ontario is be replaced. To assist with the design and construction of the proposed culvert replacement, EXP has completed a geotechnical investigation at the site, with the results of the investigation and associated recommendations included within this report.

The existing culvert is located on North Road in Markstay-Warren, Ontario. The culvert coordinates are 5156457.7N, 536496.5E (UTM 17T), with the location shown on Dwg. No. A-1, included in Appendix A. The existing culvert is a Corrugated Steel Pipe (CSP) culvert with a 3.7 m diameter. Cover at the culvert location is understood to be approximately 1.0 m. The top of culvert was at Local Elev. 98.36 m on the east side and Local Elev. 98.39 m on the west side.

At the culvert location, North Road is a two-lane gravel surfaced roadway, travelling in an north-south direction. Guardrails are present on both sides of roadway. An existing river crosses North Road perpendicularly at the culvert, with flow in a west to east direction. The river was partially frozen at the time of EXP's investigation. The top of water elevation within the existing river was measured at Local Elev. 95.8 m (west side) at the time of the investigation.

No existing geotechnical information is understood to be available for the existing culvert.

2. Field Investigation

The field investigation for this project consisted of the advancement of one (1) sampled borehole through the roadway, adjacent to the existing culvert location. The boreholes was advanced on December 17, 2025 at a location free of buried and overhead services as shown on Dwg. No. A-1, included in Appendix A.

The sampled borehole was advanced using a power auger drill rig equipped with 200 mm diameter Hollow Stem Augers (HSA) to depths shown on the attached borehole log, Figures B-2, in Appendix B. Soil samples were obtained directly from the augers and using a 51 mm (2 inch) outside diameter split spoon sampler in conjunction with Standard Penetration Tests (ASTM D1586), at depths noted on the attached borehole log. The Standard Penetration Test (SPT) "N" values were recorded and used to provide an assessment of the in-situ compactness condition of the encountered soils. At the sampling termination depth of 7.3 m within the borehole, a Dynamic Cone Penetration Test (DCPT) was advanced to refusal on suspected bedrock or boulders.

A groundwater measurement was attempted within the open borehole upon completion. The borehole was backfilled with auger cuttings and sealed with bentonite.

The retained soil samples were logged in the field and then carefully packaged and transported to our laboratory for detailed examination and testing.

The borehole location was determined in the field using a handheld GPS. The borehole elevation was surveyed to a local temporary benchmark (TBM), established on the top of an existing guardrail post. The guardrail post is the eleventh (11th) post from the north, on the east side of the roadway. The TBM was given a local, non-geodetic elevation of 100.0 m. The borehole elevations and locations are considered accurate only to the degree implied by the methods used and are used for geotechnical purposes of this report. These locations and elevations should not be used for detailed design purposes.

3. Laboratory Testing

A routine geotechnical laboratory testing program was performed on representative soil samples and consisted of moisture content determinations and grain/particle size analyses. The geotechnical laboratory test results are summarized on the attached borehole logs in Appendix B, with detailed results included in Appendix C.

In addition, two (2) representative samples were submitted to a CALA Certified Laboratory operated by SGS Canada Inc. to complete chemical corrosivity testing. The corrosivity test results are included in Appendix D.

4. Physiography and Soils Data

4.1 Geological Setting

Based on the Northern Ontario Engineering Geology Terrain Study (NOEGTS) mapping, the local geology at the site consists of a veneer of sandy glaciolacustrine plain overlying ground moraine till and bedrock plain. Relief is low (<15 m) and planer, with dry drainage. Ministry of Northern Development and Mines (MNDM) Map 2543, Bedrock Geology of Ontario East-Central Sheet indicates the bedrock at the site consists of anorthosite and alkalic igneous rocks, anorthosite, anorthositic gabbro, gabbro and related gneisses, nepheline syenite, and alkalic syenite

4.2 Frost Conditions

In accordance with “Figure 11 – Freezing Index Map of Northern Ontario”, from the Ministry of Transportation Report No. RR225, “Aspects of Prolonged Exposure of Pavements to Sub-Zero Temperatures,” 1981, the freezing index for the investigated area is estimated to be 1,250 C degree-days. As indicated in the referenced report, and consistent with OPSD 3090.100, the proposed design frost penetration depth is 2.1 m beneath a paved roadway.

5. Subsurface Conditions

Details of the soils encountered during the field investigation are summarized on the attached log in Appendix B. The log includes textural descriptions of the subsoil and indicates the soil boundaries inferred from non-continuous sampling and observations during the field investigation. These boundaries reflect approximate transition zones for the purpose of geotechnical design and should not be interpreted as exact planes of geological change. When reading this report, the explanatory notes and definitions provided in Figures B-1A and B-1B in Appendix B should be referenced.

In general, Borehole BH-N1 encountered 3.8 m of granular fill overlying cohesionless native soil layers that extended to auger refusal on suspected boulders or bedrock at approximately 9.0 m depth.

At surface of Borehole BH-N1, the roadway structure surface consisted of a 200 mm base layer of brown sand and gravel fill with trace silt. The sand and gravel fill was moist.

Underlying the base layer was an approximately 3.6 m thick subbase layer consisting of brown sand and gravel fill containing trace silt and occasional cobbles. The sand and gravel fill was dry to moist, with measured moisture contents ranging from 3.0 to 10.5%. Uncorrected SPT “N” values within the sand and gravel fill ranged from 22 to >100 blows per 300 mm, classifying the fill as compact to very dense in compactness condition. A grain size analysis completed on a representative sample of the sand and gravel fill indicated the material met the gradation requirements of a Granular “B” Type I in accordance with Ontario Provincial Standards and Specifications (OPSS.MUNI) 1010.

Underlying the fill materials was an approximately 0.8 m thick layer of brown native silt containing some organics and some sand. Measured moisture content within the silt was 48.4%. One SPT performed within the silt resulted in an uncorrected "N" value of 7 blows per 300 mm, classifying the silt as loose in compactness condition.

Below the silt was dark brown to brown sand and silt that extended to the sampling termination depth of 7.3 m. The sand and silt contained trace to some gravel, trace clay, and some organics near the surface of the layer. The sand and silt was wet, with measured moisture contents ranging from 15.3 to 24.2%. Uncorrected SPT "N" values within the sand and silt ranged from 9 to 28 blows per 300 mm, classifying the soil as loose to compact in compactness condition. A particle size analysis completed on a representative sample of the sand and silt indicated 36.3% material between 5 and 75 µm. As such, the sand and silt is considered to have a low susceptibility to frost heaving, approaching medium susceptibility to frost heaving (LSFH to MSFH) in accordance with the MTO Pavement Design and Rehabilitation Manual (PDRM). The Wischmeier Nomograph "K" value of the sand and silt was 0.27, indicating the sand and silt is moderately erodible in accordance with the MTO PDRM.

A DCPT was advanced from the sampling termination of 7.3 m and extended to auger refusal on suspected boulders or bedrock at 9.0 m depth (Local Elev. 90.4 m).

Groundwater was not observed within the open borehole during the short term it was left open upon completion. Completed moisture content testing on obtained soil samples suggests, however, that the groundwater level may be at roughly 3 to 4 m depth (Local Elev. 96.38 to 95.38 m). Seasonal variations in the water table should be anticipated, with higher levels occurring during wet weather conditions (spring thaw and late fall) and lower levels occurring during dry weather conditions.

6. Corrosivity Potential of On-Site Soils

Two (2) representative soil samples were submitted to a CALA Certified Laboratory operated by SGS Canada Inc. to complete chemical corrosivity testing. The results of the chemical testing are summarized below, with detailed results included in Appendix D.

Table 6-1: Summary of Corrosivity Test Results

Parameter	Borehole, Sample No., Depth	
	BH-N1, SS3, 1.5 to 2.1 m	BH-N1, SS5, 3.1 to 3.8 m
Chloride (µg/g)	16	49
Sulphate (µg/g)	4.3	6.3
Sulfide (%)	< 0.01	< 0.01
pH	7.47	7.97
Electrical Conductivity (µS/cm)	198	205
Resistivity (ohm.cm)	5050	4880
Redox Potential (mV)	-65	100
Corrosivity Index	6	4

The soil corrosivity test results were compared to the ANSI/AWWA Corrosivity Rating System. Based on the rating system, a point total of ten or greater (≥10) indicates the soil is corrosive to gray or ductile cast iron. As noted on the table above, the tested samples had a Corrosivity Index of 6 and 4 and as such the soil should not be considered corrosive to gray or ductile cast iron.

In addition, chloride ions can lead to corrosion of steel reinforcement in concrete and steel structures by breaking down the normally present protective layer of oxides present on the steel surface. Chloride concentrations greater than 500 ppm (µg/g) are generally considered corrosive. As noted above, the tested samples did not have chloride concentrations exceeding 500 ppm (µg/g).

Based on the above, the soil should be considered non-corrosive to steel at the site, and to reinforcing steel within concrete below the ground surface. Based on the results of the tested sample and given that the structure is located adjacent to the roadway and will be exposed to de-icing salt, consideration should be given to designing concrete (if required), for a "C" type exposure class as defined by Table 1 of CAN/CSA A23.1.

Sulphate contents were compared to Table 3 of CAN/CSA A23.1. Sulphate contents within the tested soil samples were 4.3 and 6.3 µg/g. As such, there is negligible potential for sulphate attack from the encountered soils on concrete based on Table 3 of CAN/CSA A23.1 and sulphate resistant concrete would not be required if concrete structures are constructed.

7. Foundation Recommendations

The following foundation recommendations are based on interpretation of the factual data obtained from the borehole advanced during the subsurface investigation at the site by EXP. The interpretation and recommendations provided are intended solely to permit designers to assess foundation alternatives and design the new culvert replacement. Comments on construction are only provided to highlight issues that could affect the design. Contractors bidding on the works should make their own assessments of the factual data and how it might affect construction means and methods, scheduling, and the like.

This report addresses the geotechnical design of the foundation for the proposed culvert replacement structure by providing geotechnical design parameters at the Ultimate Limit State (ULS) and Serviceability Limit States (SLS), as well as other geotechnical parameters that may be required in accordance with the latest edition of the Canadian Highway Bridge Design Code (CHBDC) (CAN/CSA-S6-19), the Guideline for Professional Engineers Providing Geotechnical Engineering Service (1992), the Canadian Foundation Engineering Manual (CFEM) (2023), and good practice. The proposed structure and its foundation system are interpreted to be classified as having a "typical" consequence level associated with exceeding limits states design. Given the level of foundation investigation completed, the level of confidence for design is interpreted to be "typical" degree of site and prediction model understanding. Table 6.1 and 6.2 of the CHBDC, CAN/CSA-S6-19, 2019 have been used in the design to establish the appropriate consequence factor and geotechnical resistance factors.

The report provides discussion about the structure foundation type as well as other geotechnical and construction considerations such as assessment of lateral earth pressure, site preparation, excavation, dewatering, and frost and scour protections.

7.1 Expected Ground Conditions

The following ground conditions at the culvert location are evident from the current investigation:

- At Borehole BH-N1, roughly 3.8 m of compact to very dense granular fill materials were encountered overlying native soils.
- Cohesionless native soils were encountered at BH-N1 at approximately 3.8 m depth (Local Elev. 95.6 m) and consisted of a 0.8 m thick layer of loose silt overlying loose to compact sand and silt that extended to the sampling termination depth of 7.3 m.
- Organics were encountered within upper roughly 1.0 m of the encountered native soil layers.
- DCPT refusal on suspected boulders or bedrock was encountered at 9.0 m depth (Local Elev. 90.4 m).

- Groundwater was not encountered within the open boreholes, however, moisture content testing on obtained samples suggests the groundwater may be at roughly 3 to 4 m depth (Local Elev. 96.38 to 95.38 m). The top of water elevation within the existing river was measured at Local Elev. 95.8 m (west side) at the time of the investigation. Seasonal variations in the water level should be expected, with higher levels occurring during wetter periods of the year and lower levels during drier periods.
- No grade raises are anticipated at the culvert location.

7.2 Culvert Foundation

The choice of culvert type and size depends on hydraulic performance, staging requirements, geotechnical resistance available in the foundation soils, initial cost, maintenance costs, ease of construction, soil corrosiveness, salvageability and local availability of material and equipment. It has been assumed that the culvert will be replaced with a new CSP culvert of similar size to existing.

Regardless of the option selected, the existing culvert is to be removed. This will require excavation down to the existing native soils. In addition, the upper portions of the native soils containing organics should be removed from below the culvert. As such, excavations to 5.0 m depth (Approx. Local Elev. 94.4 m) should be anticipated. This suggests the need for surface/groundwater control as discussed in Section 9 below.

Exposed subgrade soils should be immediately protected following excavation to prevent disturbance and provide a stable working surface. In general, any loose and/or soft soils encountered should be excavated and replaced with engineered fill. If the depth of excavation to remove unstable soils is excessive, using a geotextile fabric in accordance with OPSS.MUNI 1860, Class II Non-Woven (OPSS 1860 II-N), in conjunction with engineered fill can be considered to assist in providing a stable base for the new culvert. Based on previous experience, typically it should consist of Granular A or Granular B Type II (OPSS.MUNI 1010) with a minimum thickness of 300 mm beneath the culvert bedding and extend a minimum of 500 mm horizontally on either side of the foundation/culvert edges. The fabric should be installed in a manner to mitigate the migration of fines from adjacent material. Alternatively, a thin, 75 mm thick, layer of lean mix concrete (10 MPa) can be placed over the exposed subgrade to provide protection. The lean mix concrete should extend a minimum of 500 mm horizontally on either side of the foundation/culvert edges.

7.3 Culvert Shallow Foundations

7.3.1 Geotechnical Resistance

Based on the subsurface stratigraphy encountered at this site and the proposed invert elevation of the new culvert, the following Table 7-1 summarizes the recommended resistances at the founding elevation for the anticipated type of culvert. The geotechnical resistance provided is for vertical loading condition only; load eccentricity and load inclination effects should be addressed in accordance with the CHBDC and its commentary. The geotechnical resistances provided below were factored with a typical consequence factor of 1.0 at ULS and SLS; and typical degree of understanding (factor of 0.5 at ULS and factor of 0.8 at SLS) in accordance with Table 6.1 and 6.2 of the CHBDC S6-19.

Table 7-1: Recommended Resistances and Founding Elevations

Culvert Type	Founding Local Elevation (m)	Assumed Span (m)	Founding Soil Type	Factored Geotechnical Resistance at ULS (kPa)	Factored Geotechnical Resistance at SLS [1] (kPa)
CSP	~ 94.4	3.4	Loose native sand and silt	250	150

Notes:
1. For maximum settlement of 25 mm

It is assumed that, if any, underlying organic soils and any other soft or very loose materials are to be replaced with clean and compactable soil such as Granular A or Granular B Type II. Given that no grade raise, nor widening is planned, the anticipated maximum total settlements for the new proposed culvert are not expected to exceed 25 mm for construction done in accordance with these design parameters and assuming good construction practice including sound base preparation.

7.3.2 Resistance to Lateral Loads

Resistance to lateral forces/sliding should be calculated in accordance with Section 6.10.4 of the CHBDC. The coefficient of friction, tan δ, may be taken as 0.47 between the replacement steel culvert and Granular "A" bedding. These values represent unfactored values; in accordance with the CHBDC, a factor of 0.8 is to be applied in calculating the horizontal resistance.

7.4 Culvert Bedding

OPSD 802.010 provides the bedding, embedment, cover and backfill standards for CSP culverts. Culvert bedding should consist of Granular A (OPSS.MUNI 1010) with a minimum thickness of 300 mm beneath the culvert and extend a minimum of 500 mm horizontally on either side of the culvert edge. The bedding material should be placed in layers not exceeding 150 mm in thickness, loose measurement, and compacted to 100% Standard Proctor Maximum Dry Density (SPMDD) within 2% of optimum moisture content.

Prior to placing any fill material, the exposed native subgrade should be inspected by a qualified geotechnical engineer. A non-woven geotextile separator is to be placed between the approved subgrade and the compacted fill to assist in material placement and maintain the integrity of the founding soil along the entire length of the culvert. The geotextile separator is to be a Class II non-woven material with an equivalent opening size of 75-150 µm.

Engineered upfill, if required below the culvert bedding, should consist of Granular B Type I or II (OPSS.MUNI 1010). The engineered upfill should be placed in layers not exceeding 150 mm in thickness, loose measurement, and compacted to 100% SPMDD within 2% of optimum moisture content.

For the site area, a frost penetration depth of approximately 2.1 m can occur in open, unheated areas without snow cover. At the culvert inlet and outlet, and beneath the proposed culvert, the soils are anticipated to consist of clayey silt soil based on the advanced borehole. As noted previously, this soil has low to medium susceptibility to frost heaving based upon the MTO Frost Classification guidelines. Therefore, non-frost susceptible materials such as sand and gravel might be considered to be provided to the limit of frost penetration beneath the inlet and outlet of the culvert. However, considering that cold air blowing through the culvert during the winter season will freeze soil next to the culvert, a minimum 300 mm thick layer of non-susceptible material should be considered to be placed as bedding along the entire culvert length.

7.5 Culvert Backfill

The selection and placement of the backfill and cover should be in accordance with OPSS.MUNI 902, OPSS.MUNI 421, and OPSD 802.010 for CSP culverts. The cover material should consist of Granular A (OPSS.MUNI 1010). Backfill above the cover material and below the roadway structure may consist of Granular A, Granular B Type I or II, or SSM (OPSS.MUNI 1010).

Less than 2.1 m (the frost depth) of earth cover is anticipated above the top of the culvert and as such, a frost taper should be included as per OPSD 803.031.

The existing gravel roadway structure above the culvert backfill should be reconstructed to generally match existing conditions as follows:

- Surface/Base Layer (Granular "A", OPSS.MUNI 1010) – 200 mm
- Subbase Layer (Granular "B" Type I, OPSS MUNI 1010) – Thickness to match existing (minimum 800 mm)

All cover, backfill, and roadway structure materials should be placed in layers not exceeding 200 mm in thickness, loose measurement, and compacted to 98% SPMDD within 2% of optimum moisture content.

The use of heavy compaction equipment should be avoided immediately adjacent and above the culvert. The minimum height of fill cover above the crown of the culvert before power operated tractors or rolling equipment shall be 900 mm, unless otherwise noted by the Structural Engineer. During backfill placement, the height of the backfill should be maintained at approximately the same level on both sides of the structure, to avoid lateral displacement of the structure.

7.6 Lateral Earth Pressures

Culvert walls, temporary shoring, or any retaining structures should be designed to resist lateral earth pressure. The expression for calculating lateral earth pressure "p" at any depth "h" is given by the following:

$$\mathbf{p = K(\gamma h + q) + \gamma_w h_w}$$

where

	p	=	Lateral earth pressure (kPa)
	K	=	Coefficient of earth pressure
	γ	=	Unit weight of backfill (kN/m^3)
	γ_w	=	Unit weight of water (kN/m^3)
	h	=	Depth to point of interest (m)
	h_w	=	Depth of water above point of interest (m)
	q	=	Surcharge load acting adjacent to the wall at the ground surface (kPa)

Table 7-2, below, list various earth pressure properties for given materials.

Table 7-2: Earth Pressure Properties

Material	Friction Angle ø´ (unfactored)	Coefficient of Active Earth Pressure (k_a)	Coefficient of Passive Earth Pressure (k_p)	Coefficient of Earth Pressure at Rest (k_o)	Unit Weight γ (kN/m^3)
Granular "A"	38°	0.24	4.2	0.38	22
Granular "B" Type I	35°	0.27	3.7	0.43	21
Granular "B" Type II	38°	0.24	4.2	0.38	21
Sand and Gravel Fill	35°	0.27	3.7	0.43	21
Silt	28°	0.36	2.8	0.53	18
Sand and Silt	32°	0.31	3.3	0.47	19

Note: Values given for horizontal earth pressures are for horizontal backfill. For sloping backfill, the design requirements outlined in the Canadian Foundation Engineering Manual should be used.

The mobilization of full active or passive resistance requires a measurable and perhaps significant wall movement or rotation. Therefore, unless the structural element can tolerate these deflections, the at-rest earth pressure should be used in design.

The effects of compaction surcharge should be taken into account in the calculations of active and at rest earth pressures. The lateral pressure due to compaction should be taken as at least 12 kPa at the surface, and its magnitude should be assumed to diminish linearly with depth to zero at the depth where the active (or at rest) pressure is equal to 12 kPa. This pressure distribution should be added to the calculated active (or at rest) pressure. Notwithstanding, lighter compaction equipment and smaller lifts should be used adjacent to walls to prevent overstressing.

7.7 Site Classification for Seismic Response

Seismic characterization of the site should be compliant with the Canadian Highway Bridge Design Code (CHBDC, CAN/CSA-S6-19). Table 4.1 in CHBDC (see Clause 4.4.3.2) shows site classification for seismic site response based on average soil and bedrock properties in the top 30 m. As the Site Classification for Seismic Response is based on soil conditions in the upper 30 m, assumptions were made by EXP for the soil and bedrock conditions below the borehole termination depth. Assuming the boulders or bedrock continues past the auger refusal depth encountered through 30 m depth, the site would be classified as Site Class D.

These earthquake/seismic design parameters should be reviewed in detail by the structural engineer and incorporated into the design as required. As this site class is based on an assumption of the soil conditions, the site class may not be sufficient, and it may result in an overdesign of the structure. If a precise Site Classification is required, EXP can provide a quote to perform the necessary testing.

7.8 Scour/Erosion Protection

Foundation systems supporting culverts in flood plains, close to creeks, channel or rivers are very likely to be exposed to potentially harmful effects of stream flow, with particular concern during more significant storm events and where the creek bed/valley is set in erodible soils. The need for and nature of scour and erosion protection systems must be assessed and where required, must be designed, implemented and remain effective over the design life of the culvert.

Scour/erosion protection should be provided at the culvert inlet and outlet (including the side slopes). The erosion/scour protection should be designed by a specialist Hydraulic Engineer (as erosion and scour largely depend on the velocity of water in the watercourse and its regime) who is familiar with the findings of this report.

Rip-rap protection should be provided for culvert inlets and outlets, both upstream and downstream of the culvert openings. The rip-rap should begin approximately 5 m upstream of the culvert inlet and extend 5 m downstream of the culvert outlet, and line the embankment slope to the spring line of the culvert. The size of the rip-rap is a function of the local hydrology. As a rule of thumb, the thickness of the rip-rap should be a minimum of twice the median particle size, and 300 mm thick as a minimum. The rip-rap configuration at the creek bed should generally follow OPSD 810.010. The slope of the riprap shall follow the embankment fill slope.

7.9 Seepage Cut-off Recommendations

For new culvert installation, a clay seal or cut-off wall should be placed at the inlet of the proposed culvert, to prevent the migration of material along the exterior sidewalls of the culvert, the formation of flow paths, and any potential internal erosion within the roadway embankment. The type and design of cut-off utilized will be based on the local hydraulics at the site and should be designed by the structural engineer.

Should a clay seal be utilized, OPSS.MUNI 1205 specifies that material used for clay seals shall be natural clay, clay mixture (1 part Bentonite powder and 3.5 parts Granular “A”) or a Geosynthetic Clay Liner (GCL). The coefficient of permeability shall not exceed 1 x 10-6 cm/s.

The following outlines the installation procedures and minimum material requirements of the clay seal:

- The clay seal should be placed along the sides and top of the culvert a minimum of 1.0 m along the side of the culvert and extending out laterally 1.0 m from the culvert. The thickness of the clay seal should be a minimum of 500 mm. However, it is the responsibility of the designer to select the dimensions of the clay seal.
- The clay should be placed along the top and side of the culvert only. The clay must not be placed below the culvert.
- The clay should have a Liquid Limit greater than 40% and a Plasticity Index greater than 0.73 x (Liquid Limit – 20%).
- The clay seal is to be placed in maximum 150 mm thick lifts and compacted to 95% SPMDD within 2% of the optimum moisture content.

If a GCL is used as a clay seal, its material specifications containing the physical, mechanical and hydraulic properties shall be obtained from the manufacturer.

8. Excavations

All excavations at this site must be conducted in accordance with the Occupational Health and Safety Act (OHSA) and Regulations for Construction (O. Reg. 213/91). The existing fill materials and native soils may be classified as a Type 3 soil above the groundwater table in conformance with the OHSA. The soils below the groundwater table may be classified as a Type 4 soil. To avoid disturbance of the founding subgrade and to allow placement of backfill in dry conditions, groundwater must be controlled to below the proposed invert excavation levels prior to digging to final levels. The ingress of surface water must be controlled using a suitable system as well.

Temporary excavation side slopes for Type 3 soils should not exceed 1H:1V in accordance with OHSA, while temporary excavation side slopes for Type 4 soils should not exceed 3H:1V where applicable.

The need to excavate flatter side slopes if excessively wet or soft/loose materials, or concentrated seepage zones are encountered, should not be overlooked. There is a potential for sloughing to occur if the trench remains open for an extended period of time (i.e. > 24 hours) or during a rainfall event. In addition, some localized surficial sloughing may be experienced in areas of perched groundwater seepage. Water (i.e. surface water runoff) should not be permitted to enter and/or pond within the construction area.

All excavations must be completed in accordance with the most recent regulations in the Ontario Occupational Health and Safety Act. The contractor should be aware that slope height, slope inclination, or excavation depths, should in no case, exceed those specified in local, provincial or federal safety regulations. Such regulations are strictly enforced and, if not followed, the owner, the contractor or earthwork or utility subcontractor could be liable for substantial penalties.

8.1 Re-use of Excavated Material

A grain size analysis on the insitu sand and gravel fill met the OPSS.MUNI 1010 gradation requirements of an Granular B Type I. As such, if this granular fill can be segregated and stockpiled, it can likely be reused where Granular B Type I is specified provided it is environmentally safe to do so. Further testing during construction is recommended for stockpiled material intended for reuse to confirm acceptability of the material.

Materials containing organics or other deleterious materials, or the insitu native soils, cannot be reused as free draining engineered fill.

Excavated soils to be removed off site are likely considered to be Excess Soils and disposal of such soils should follow O.Reg. 406/19. Once the final site plan has been determined, and the known volume of soils to be excavated and removed off site is known, additional excess soil field studies can be completed.

9. Dewatering

Groundwater was not encountered within the open boreholes, however, moisture content testing on obtained samples suggests the groundwater may be at roughly 3 to 4 m depth (Local Elev. 96.38 to 95.38 m). The top of water elevation within the existing river was measured at Local Elev. 95.8 m (west side) at the time of the investigation. Based on the anticipated excavation depth to 5.0 m (Local Elev. 94.4 m) to remove insitu fill materials and organics below the culvert, dewatering and surface water control will be required.

A temporary cofferdam upstream and downstream of the culvert will likely be required control surface water during construction. The groundwater level needs to be controlled to 0.5 m below the excavation level to avoid disturbance, and any surface or groundwater seepage should be removed from the excavation prior to the placement of granular backfill in the dry. Dewatering for the excavation and cofferdam shall be carried out in accordance with OPSS.MUNI 517 and SP 517F01.

Temporary cofferdams will likely be required at both the upstream and downstream ends of the culvert to envelop the construction site and keep it free of water during culvert replacement. The type and design of the cofferdam will depend on the erosion potential, stream flow velocity, high-water level, etc. which would be determined by the Hydraulic Engineer. Design and construction specifications for the chosen temporary cofferdam system should be prepared in accordance with OPSS.MUNI 539 (Construction Specification for Temporary Protection Systems) by the Contractor.

In addition to design and construction of the temporary cofferdam system, the Contractor is also responsible for its materials, maintenance, monitoring, and removal. The temporary cofferdam shall be fully removed, unless it is specified in the Contract Documents that the cofferdam system may be partially left in place. The method and sequence of removal shall be so that there shall be no damage to the new work, existing work, and facility being protected.

Dewatering requirements behind the cofferdams to keep the construction site dry will be impacted by water levels in the creek at the time of construction activities. Seasonal variations in the water table should be expected, with higher levels occurring during wetter periods of the year and lower levels during drier periods. It is the responsibility of the Contractor to propose a suitable dewatering system based on the time of construction, water levels and flow conditions in the creek. The method used should not undermine the existing roadway or adjacent side slopes. The Contractor should verify groundwater conditions prior to construction.

The estimated hydraulic conductivity (K) of the in-situ fill and soils is shown on Table 9-1:

Table 9-1: Hydraulic Conductivity of Encountered Soils

Soil Material	K (cm/sec)
Sand and Gravel Fill	10^{-1} to 10^{-4}
Silt	10^{-5} and less
Sand and Silt	10^{-3} to 10^{-5}

A Permit to Take Water (PTTW) is not likely required. Based on the hydraulic conductivity of the founding clayey silt soils and the groundwater levels observed, water taking is not anticipated to exceed 50,000 L/day. If at the time of construction, groundwater levels are found to be high and water taking will exceed 50,000 L/day, an Environmental Activity and Sector Registry (EASR) for Construction Site Dewatering would likely be required (pumping less that 400,000 L/day).

Erosion and sediment control during culvert construction should be as per the MTO Drainage Manual, Volume 2. Silt fences and other sediment control measures should be included to protect the downstream environment from the construction activities.

10. Construction Constraints Under Cold Weather Conditions

For all construction activities at this site, the following applies:

- During excavations, all subgrade soils must be maintained at a minimum temperature of 5° C.
- No granular material may be placed under frozen conditions, with all fill material maintained at a minimum temperature of 5° C prior to and during installation. If granular fill is to be placed in freezing conditions, the granular fill must be restricted to Granular “B” Type II material. Since Granular “B” Type II has a larger aggregate size, care should be taken to prevent point loading on the underside of the concrete.
- Soils and granular fill material that are in direct contact with fresh concrete must be at a minimum temperature of 5° C prior to pouring the concrete and must be free of snow and ice fragments.
- All granular fill, prior to placement of concrete, must be reviewed by this office to ensure that it is free of frost, buried ice and snow.
- All reinforcing steel in the concrete forms must be free of ice and snow, and must be maintained at a minimum temperature of 5° C.
- During the placement of concrete in cold weather conditions, a field cured cylinder should be placed beside the heated form for a period of 6 days. The field cured cylinder should be returned to a designated laboratory on the sixth day for 7-day compressive strength testing.
- All heated and tarped areas should be monitored for temperature using a max/min thermometer.

- All concrete is to have a minimum of 6% to 8% air entrainment to prevent cracking and shall be maintained at a minimum temperature of 10° C for a period of 4 to 7 days.

The 6% to 8% air entrained concrete during cold weather placement is to prevent significant strength loss of concrete as a result of freezing and thawing. The air entrainment will provide the capacity to absorb stresses during freeze/thaw action.

11. Construction Quality Control

Construction quality control of the "earthworks" should be provided throughout the project by a representative of EXP to verify all design assumptions, recommendations, and confirmation of the subsurface soil conditions. This includes inspection of the excavation and subgrade prior to the placement of any structural fill and foundations, to ensure that any and all deleterious materials have been removed and to ensure that the actual conditions are not markedly different than those on which the recommendations made herein are based. Compaction control of structural fill is also recommended as standard practice, as is sampling and testing of aggregates and concrete.

12. Design Review

The recommendations made in this report are in accordance with our present understanding of the project and are provided solely for the design team responsible for the project. If there are any changes, such as relocation of any structures or other features which may affect our analysis, the information obtained during this investigation may be inadequate and additional field work and reporting may be required.

13. Limitations

A subsurface investigation is a limited sampling of a site. Should any conditions at the site be encountered that differ from those reported at the test locations, we require that we be notified immediately in order to allow reassessment of our recommendations.

Whereas this investigation has estimated the groundwater level at the time of the fieldwork, and commented on general construction problems, the presence of conditions, which would be difficult to establish from our test holes, may affect the type and nature of dewatering procedures which should be used in practice. These conditions include local and seasonal fluctuations in the groundwater table, erratic changes in the soil profile between the tests, and thin layers of soil with large or small permeabilities compared with the general soil mass, etc.

The comments given in this report are intended only for the guidance of the design team responsible for the project. The number of test holes required to determine the localized underground conditions between test holes affecting construction costs, techniques, sequencing, equipment, scheduling, etc. could be greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual test hole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

The investigation and comments are necessarily ongoing as new information of underground conditions becomes available. For example, more specific information is available with respect to in-situ subsurface conditions between test locations once construction is underway. Subsurface soil interpretation between test holes, as well as the recommendations of this report, should be verified through field inspections provided by EXP to validate the current information for use during the construction stage.

Virtually no scope of work, no matter how exhaustive, can identify all contaminants or all conditions above or below ground. For example, conditions elsewhere at the site may differ from those encountered, and conditions may change with time. Therefore, no warranty is provided that the entire site condition is represented by those identified at specific borehole locations.

This report in no way reflects onsite environmental considerations.

14. Closure

We trust that these comments provide you with sufficient information to proceed with design. Should you have any questions, **please do not hesitate to contact this office.**

Yours truly,

EXP Services Inc.

Ian MacMillan, P.Eng.
Project Manager, Earth & Environmental Services
Northeastern Ontario

Yves Beauparlant, P.Eng.
Manager, Earth & Environmental Services
Northeastern Ontario

Appendix A – Drawing

KEYPLAN - N.T.S.

LEGEND

EXP BOREHOLE

— NOTES —

1) The boundaries and soil types have been established only at Test Hole locations. Between Test Holes, they are assumed and may be subject to considerable error.
2) Do not use Test Hole elevations for design purposes.
3) Soil samples will be retained in storage for 3 month and then destroyed unless client advises that an extended time period is required.
4) Quantities should not be established from the information provided at the Test Hole locations.
5) This drawing forms part of the report, project number as referenced, and should be used only in conjunction with this report.

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Canada
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REVISIONS

No.	DESCRIPTION	DATE

CLIENT: R.V. ANDERSON ASSOCIATES LTD.

PROJECT: PROPOSED CULVERT REPLACEMENT NORTH ROAD, MARKSTAY-WARREN, ON

PROJECT NO.: SUD-24002582-B0

TITLE: BOREHOLE LOCATION PLAN

DATE	SCALE:	DWG NO.
JANUARY 2026	NTS	A-1

Appendix B – Borehole Logs

Notes on Sample Descriptions

1. All sample descriptions included in this report follow the International Society for Soil Mechanics and Foundation Engineering (ISSMFE), as outlined in the Canadian Foundation Engineering Manual. Note, however, that behavioral properties (i.e. plasticity, permeability) take precedence over particle gradation when classifying soil. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

UNIFIED SOIL CLASSIFICATION

CLAY (PLASTIC) TO	FINE	MEDIUM	CRS.	FINE	COARSE
SILT (NONPLASTIC)	SAND			GRAVEL	

EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		

2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.

3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (75 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

Notes On Soil Descriptions

4. The following table gives a description of the soil based on particle sizes. With the exception of those samples where grain size analyses have been performed, all samples are classified visually. The accuracy of visual examination is not sufficient to differentiate between this classification system or exact grain size.

Soil Classification		Terminology	Proportion
Clay and Silt	<0.060 mm	"trace" (e.g. Trace sand)	1% to 10%
Sand	0.060 to 2.0 mm	"some" (e.g. Some sand)	10% to 20%
Gravel	2.0 to 75 mm	adjective (e.g. sandy, silty)	20% to 35%
Cobbles	75 to 200 mm	"and" (e.g. and sand)	35% to 50%
Boulders	>200 mm		

The compactness of Cohesionless soils and the consistency of the cohesive soils are defined by the following:

Cohesionless Soil		Cohesive Soil		
Compactness	**Standard Penetration Resistance "N" Blows / 0.3 m**	**Consistency**	**Undrained Shear Strength (kPa)**	**Standard Penetration Resistance "N" Blows / 0.3 m**
Very Loose	0 to 4	Very soft	<12	<2
Loose	4 to 10	Soft	12 to 25	2 to 4
Compact	10 to 30	Firm	25 to 50	4 to 8
Dense	30 to 50	Stiff	50 to 100	8 to 15
Very Dense	Over 50	Very Stiff	100 to 200	15 to 30
		Hard	>200	>30

5. **ROCK CORING**

Where rock drilling was carried out, the term RQD (Rock Quality Designation) is used. The RQD is an indirect measure of the number of fractures and soundless of the rock mass. It is obtained from the rock cores by summing the length of the core covered, counting only those pieces of sound core that are 100 mm or more length. The RQD value is expressed as a percentage and is the ratio of the summed core lengths to the total length of core run. The classification based on the RQD value is given below.

RQD Classification	RQD (%)
Very Poor Quality	<25
Poor Quality	25 to 50
Fair Quality	50 to 75
Good Quality	75 to 90
Excellent Quality	90 to 100

$$\text{Recovery Designation \% Recovery} = \frac{\text{Length of Core Per Run}}{\text{Total Length of Run}} \times 100$$

Log of Borehole BH-N1

Project No. SUD-24002582-B0 | Figure No. B-3

Project: Proposed Culvert Replacement, North Road | Sheet No. 1 of 1

Location: Markstay-Warren, Ontario

5156453N; 536494E

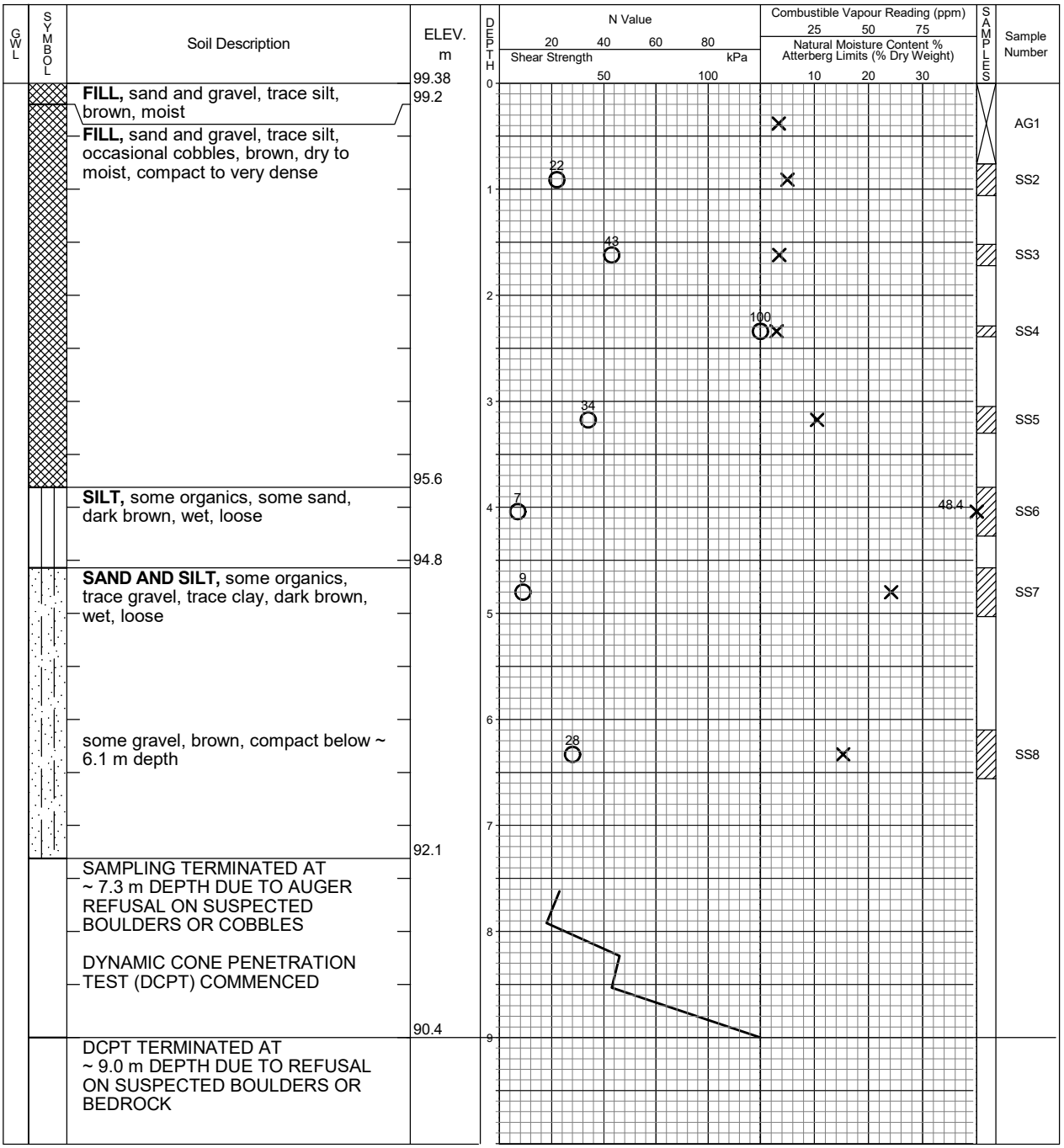
Date Drilled: December 17, 2025

Drill Type: CME55 Track Mount

Datum: Local (non-geodetic)

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer



SUDBURY GEO SUD-24002582-B0 - MARKSTAY-WARREN - NORTH RD. CULVERT.GPJ NEW.GDT 1/29/26

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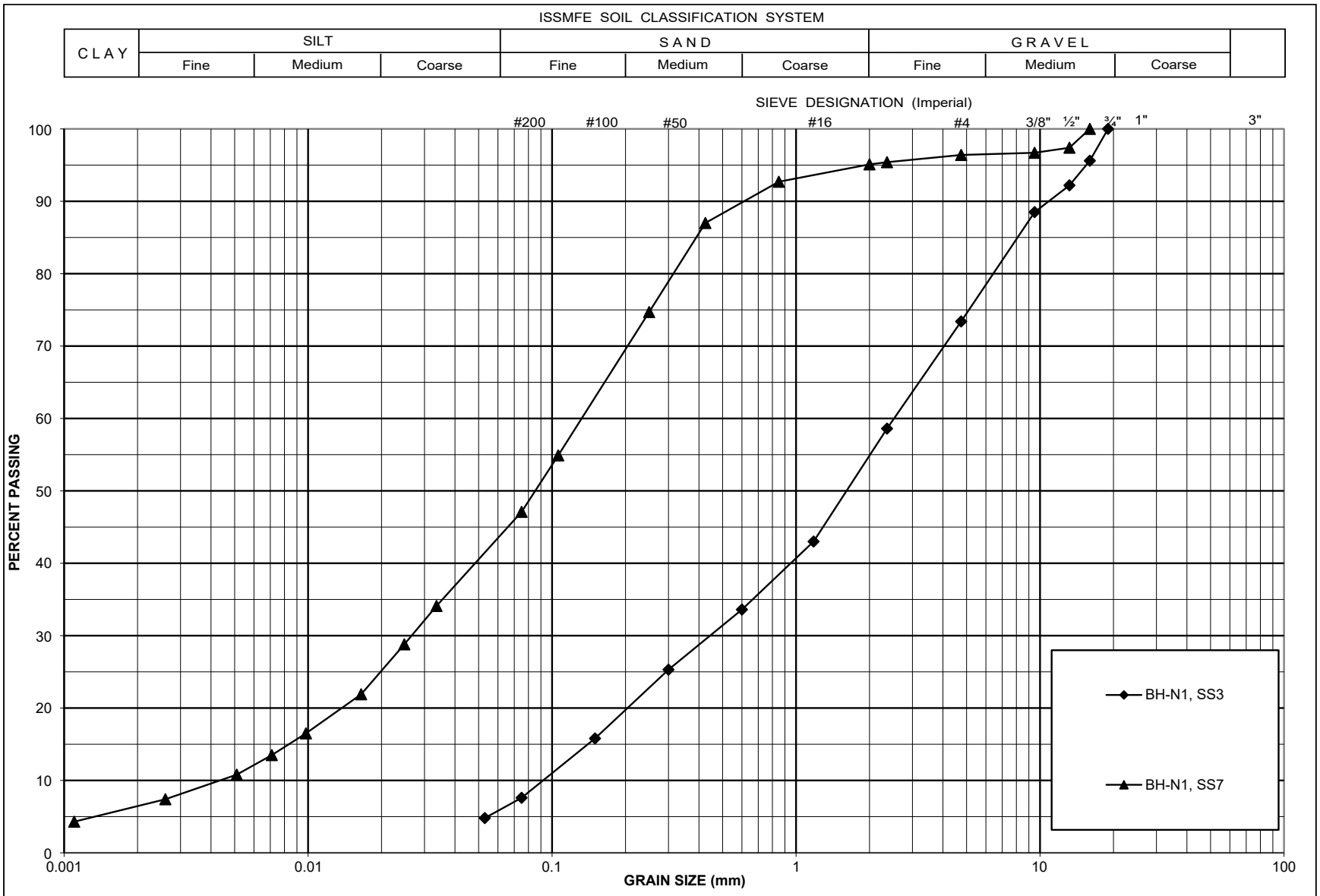
Borehole data requires interpretation assistance from EXP before use by others.

See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	Dry	Open

Appendix C – Laboratory Testing



exp.

GRAIN SIZE DISTRIBUTION

Proposed Culvert Replacement, North Road
Markstay-Warren, Ontario

FIGURE: C-1

PROJECT No: SUD-24002582-B0

DATE: January 2026

Appendix D – Corrosivity Test Results

FINAL REPORT

CA15497-JAN26 R1

SUD-24002582-B0

Prepared for

EXP Services Inc.

FINAL REPORT

First Page

CLIENT DETAILS

Client	EXP Services Inc.
Address	885 Reagent Street Sudbury, Ontario P3E 5M4, Canada
Contact	Ian MacMillan
Telephone	705-674-9681
Facsimile	705-674-5583
Email	ian.macmillan@exp.com
Works #	
Project	SUD-24002582-B0
Reference	
Batch	
Samples	SOIL (8)

LABORATORY DETAILS

Project Specialist	Maarit Wolfe, Hon.B.Sc
Laboratory	SGS Canada Inc.
Address	185 Concession St., Lakefield ON, K0L 2H0
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SGS Reference	CA15497-JAN26
Received	2026-01-09
Approved	01/15/2026
Report Number	CA15497-JAN26 R1
Date Reported	01/15/2026

COMMENTS

Temperature of Sample upon Receipt: 6.3 degrees C

Chain of Custody Number: N/A

Corrosivity Index is based on the American Water Works Corrosivity Scale according to AWWA C-105. An index greater than 10 indicates the soil matrix may be corrosive to cast iron alloys.

SIGNATORIES

Maarit Wolfe, Hon.B.Sc

TABLE OF CONTENTS

FINAL REPORT

CA15497-JAN26 R1

Client: EXP Services Inc.
Project: SUD-24002582-B0
Project Manager: Ian MacMillan
Samplers: Patrick Lachance

MATRIX: SOIL

Sample Number			5	6	7	8	9	10	11	12
Sample Name			23083 BHD1 SS5	23075 BHN1 SS5	23123 BHL1 SS4	23046 BHS1 SS4	23081 BHD1 SS3	23073 BHN1 SS3	23132 BHL2 SS3	23059 BHS2 SS3
Sample Matrix			Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date			2026-12-15 00:00	2026-12-15 00:00	2026-12-15 00:00	2026-12-15 00:00	2026-12-15 00:00	2026-12-15 00:00	2026-12-15 00:00	2026-12-15 00:00
Parameter	**Units**	**RL**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Corrosivity Index										
Corrosivity Index	none	1	Test results for this sample included in separate report.	Test results for this sample included in separate report.	Test results for this sample included in separate report.	8	Test results for this sample included in separate report.	Test results for this sample included in separate report.	Test results for this sample included in separate report.	8
pH	pH Units	0.05				8.52				8.82
Soil Redox Potential	mV	no				60				63
Sulphide (Na2CO3)	%	0.01				< 0.01				< 0.01
Resistivity (calculated)	ohms.cm	-9999				4740				8550
General Chemistry										
Conductivity	uS/cm	2				211				117
Metals and Inorganics										
Sulphate	µg/g	0.4				11				3.3
Other (ORP)										
Chloride	µg/g	0.4				10.0				4.8

QC SUMMARY

Anions by IC

Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-[ENV]IC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0276-JAN26	µg/g	0.4	<0.4	2	35	104	80	120	102	75	125
Sulphate	DIO0276-JAN26	µg/g	0.4	<0.4	5	35	102	80	120	97	75	125

Carbon/Sulphur

Method: ASTM E1915-07A | Internal ref.: ME-CA-[ENV]ARD-LAK-AN-020

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide (Na2CO3)	ECS0052-JAN26	%	0.01	< 0.01								

Conductivity

Method: SM 2510 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0249-JAN26	uS/cm	2	3	0	20	99	90	110	NA		

QC SUMMARY

pH

Method: SM 4500 I Internal ref.: ME-CA-[ENV]EWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0249-JAN26	pH Units	0.05	NA	0		100			NA		

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

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

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS	Insufficient sample for analysis.
RL	Reporting Limit.
↑	Reporting limit raised.
↓	Reporting limit lowered.
NA	The sample was not analysed for this analyte
ND	Non Detect

Results relate only to the sample tested.

Data reported represent the sample as submitted to SGS.

Test method information available upon request.

"Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

SGS Canada Inc. statement of conformity decision rule does not consider uncertainty when analytical results are compared to a specified standard or regulation.

-- End of Analytical Report --

5.4, 6.3, 7.2

SGS

Request for Laboratory Services and CHAIN OF CUSTODY (Mining)

SGS Environmental Services - Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Toll Free: 877-747-7658 Fax: 705-652-6365 Web: www.ca.sgs.com {4}

SGS Environmental Services - London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361 Web: www.ca.sgs.com {4}

Laboratory Information Section

Received Date (mm/dd/yyyy): JAN 09 2026

Skid # (if applicable): Temperature Upon Receipt (°C):

LAB LIMS #: CA 15497 JAN26 LA

Billing & Reporting Information

Invoice/Receipt to {3}:

Company: EXP

Attention: Ian Macmillan

Address: 885 Regent St. Suite 3-6A, Sudbury, ON, P3E 5M4

Email: ian.macmillan@exp.com

Quote #:

Attached Parameter List: ☐ YES ☐ NO

Turnaround Time

Is *Rush Turnaround Time Required? ☐ YES ☑ NO

Specify:

* Rush TA Requests Require Lab Approval

Project Name/Number: SUD-24002582-B0 | P.O. #: SUD-24002582-B0

Client Information/Report To:

Client Lab #:

Company Name:	EXP	**Phone Number:**	
Contact Name:	Ian Macmillan	**Fax Number:**	
Address:		**E-mail:**	ian.macmillan@exp.com
Copy to:			

Samples will be sent to paid storage after 3 months unless otherwise requested. Additional storage and shipping costs will be charged to the client. If the samples should be returned, please provide courier account information.

After analysis samples are to be:	Disposed ☑	Stored (At client's cost) ***Default** ☐	Multi-phase project (Automatic storage) ☐
Returned to client ☐	Return courier:	Acct:	

IMPORTANT: If samples contain known Hazards, please label accordingly and identify below:

☐ **NORM (Normally Occuring Radioactive Material)** ☐ **Asbestos** ☐ **Other:**

Special Instructions : ☐ **See Attached or:**

Sample Information

Sample Identifier	Date Sampled (mm/dd/yy)	Time Sampled	# of Containers	Analysis Requested (please enter the analysis required below and check off which analysis applies to each sample) — corrosivity package							
23083 BHD1 SS5	15-Dec-25	N/A	1 Bag	x							
23075 BHN1 SS5	15-Dec-25	N/A	1 Bag	x							
23123 BHL1 SS4	15-Dec-25	N/A	1 Bag	x							
23046 BHS1 SS4	15-Dec-25	N/A	1 Bag	x							
23081 BHD1 SS3	15-Dec-25	N/A	1 Bag	x							
23073 BHN1 SS3	15-Dec-25	N/A	1 Bag	x							
23132 BHL2 SS3	15-Dec-25	N/A	1 Bag	x							
23059 BHS2 SS3	15-Dec-25	N/A	1 Bag	x							

Sampled By {1}:	(Name)	(Signature)	**Date:**	___ ___ / ___ ___ ___	(mm/dd/yy)
Relinquished by {2}:	Patrick Lachance	(Signature)	**Date:**	8 1 2026	(mm/dd/yy)

Note: {1} Submission of samples to SGS is acknowledgement that you have been provided direction on sample collection/handling and transportation of samples. {2} Submission of samples to SGS is considered authorization for completion of work. Signatures may appear on this form or be retained on file in the contract, or in an alternative format (e.g. shipping documents). {3} Results may be sent by email to an unlimited number of addresses for no additional cost. Fax is available upon request. {4} Completion of work may require the subcontracting of samples between the London and Lakefield laboratories.

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RTN 335667283824 KA 10:15

Geotechnical Investigation and Design Report

R.V. Anderson Associates Ltd.

Type of Document:
Report

Project Name:
Proposed Culvert Replacement
Dupuis Road
Markstay-Warren, Ontario

Project Number:
SUD-24002582-B0

Prepared By:
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Date Submitted:
2026-01-28

Project Number: SUD-24002582-B0
Date: January 28, 2026

Table of Contents

Further to our Proposal No. 25/133/GPA dated September 2, 2025, and your subsequent authorization to proceed, EXP Services Inc. (EXP) has completed the field investigation and geotechnical engineering evaluation for the proposed culvert replacement. Our comments and recommendations, based on the results of the field investigation and our understanding of the project scope, are provided in this report.

1. Introduction

It is understood by EXP that an existing culvert located on Dupuis Road in Markstay-Warren, Ontario is be replaced. To assist with the design and construction of the proposed culvert replacement, EXP has completed a geotechnical investigation at the site, with the results of the investigation and associated recommendations included within this report.

The existing culvert is located on Dupuis Road, approximately 1.5 km east of the intersection with Highway 535 in Markstay-Warren, Ontario. The culvert coordinates are 5136187.4N, 546443.5E (UTM 17T), with the location shown on Dwg. No. A-1, included in Appendix A. The existing culvert is a Structural Plate Corrugated Steel Pipe (SPCSP) Arch culvert with a 5.5 m span and 3.4 m height. Cover at the culvert location is understood to be approximately 1.0 m. The top of culvert was at Local Elev. 98.26 m on the north side and Local Elev. 98.21 m on the south side.

At the culvert location, Dupuis Road is a two-lane gravel surfaced roadway, travelling in an east-west direction. Guardrails are present on both sides of roadway. An existing creek crosses Dupuis Road perpendicularly at the culvert. The creek was frozen at the time of EXP's investigation, with the top of ice at Local Elev. 95.87 m on the north side, and Local Elev. 95.92 m on the south side. As the creek was frozen, it is unclear what the flow direction is at the culvert.

No existing geotechnical information is understood to be available for the existing culvert.

2. Field Investigation

The field investigation for this project consisted of the advancement of one (1) sampled borehole through the roadway, adjacent to the existing culvert location. The boreholes was advanced on December 17, 2025 at a location free of buried and overhead services as shown on Dwg. No. A-1, included in Appendix A.

The sampled borehole was advanced using a power auger drill rig equipped with 200 mm diameter Hollow Stem Augers (HSA) to depths shown on the attached borehole log, Figures B-2, in Appendix B. Soil samples were obtained directly from the augers and using a 51 mm (2 inch) outside diameter split spoon sampler in conjunction with Standard Penetration Tests (ASTM D1586), at depths noted on the attached borehole log. The Standard Penetration Test (SPT) "N" values were recorded and used to provide an assessment of the in-situ compactness condition of the encountered soils.

Groundwater was measured within the open borehole upon completion. The borehole was backfilled with auger cuttings and sealed with bentonite.

The retained soil samples were logged in the field and then carefully packaged and transported to our laboratory for detailed examination and testing.

The borehole location was determined in the field using a handheld GPS. The borehole elevation was surveyed to a local temporary benchmark (TBM), established on the top of an existing guardrail post. The guardrail post is the fourteenth (14th) post from the west, on the south side of the roadway. The TBM was given a local, non-geodetic elevation of 100.0 m. The borehole elevations and locations are considered accurate only to the degree implied by the methods used and are used for geotechnical purposes of this report. These locations and elevations should not be used for detailed design purposes.

3. Laboratory Testing

A routine geotechnical laboratory testing program was performed on representative soil samples and consisted of moisture content determinations, grain/particle size analyses, and Atterberg Limits Tests. The geotechnical laboratory test results are summarized on the attached borehole logs in Appendix B, with detailed results included in Appendix C.

In addition, two (2) representative samples were submitted to a CALA Certified Laboratory operated by SGS Canada Inc. to complete chemical corrosivity testing. The corrosivity test results are included in Appendix D.

4. Physiography and Soils Data

4.1 Geological Setting

Based on the Northern Ontario Engineering Geology Terrain Study (NOEGTS) mapping, the local geology at the site consists of clayey silty glaciolacustrine plain with subordinate bedrock knob. Relief is low (<15 m) and planer, with mixed wet and dry drainage. Ministry of Northern Development and Mines (MNDM) Map 2543, Bedrock Geology of Ontario East-Central Sheet indicates the bedrock at the site consists of migmatitic rocks and gneisses of undetermined protolith, commonly layered biotite gneisses and migmatites; locally includes quartzofeldspathic gneisses, orthogneisses, paragneisses

4.2 Frost Conditions

In accordance with "Figure 11 – Freezing Index Map of Northern Ontario", from the Ministry of Transportation Report No. RR225, "Aspects of Prolonged Exposure of Pavements to Sub-Zero Temperatures," 1981, the freezing index for the investigated area is estimated to be 1,250 C degree-days. As indicated in the referenced report, and consistent with OPSD 3090.100, the proposed design frost penetration depth is 2.1 m beneath a paved roadway.

5. Subsurface Conditions

Details of the soils encountered during the field investigation are summarized on the attached log in Appendix B. The log includes textural descriptions of the subsoil and indicates the soil boundaries inferred from non-continuous sampling and observations during the field investigation. These boundaries reflect approximate transition zones for the purpose of geotechnical design and should not be interpreted as exact planes of geological change. When reading this report, the explanatory notes and definitions provided in Figures B-1A and B-1B in Appendix B should be referenced.

In general, Borehole BH-D1 encountered 3.8 m of granular fill and 2.3 m of mixed wood/granular fill overlying varying cohesionless native soil layers that extended to auger refusal on suspected boulders or bedrock at approximately 10.4 m depth.

At surface of Borehole BH-D1, the roadway structure surface consisted of a 200 mm base layer of brown sand and gravel fill with trace silt. The base layer was frozen at the time of the investigation.

Underlying the base layer was an approximately 2.9 m subbase layer consisting of brown sand fill containing trace to some gravel and trace silt. The sand fill was moist with measured moisture contents ranging from 4.4 to 5.8%. Uncorrected SPT "N" values within the sand fill ranged from 3 to 20 blows per 300 mm, decreasing with depth. As such, the sand fill is classified as very loose to compact in compactness condition. A grain size analysis completed on a representative sample of the sand fill indicated the material generally met the gradation requirements of a Granular "B" Type I in accordance with Ontario Provincial Standards and Specifications (OPSS.MUNI) 1010, except for material passing a 75 µm sieve (12.6%). As such, the sand fill met the gradation requirements of a Select Subgrade Material (SSM, OPSS.MUNI 1010).

Underlying the sand fill was an approximately 0.7 m thick layer of brown sand and gravel fill containing some silt. This lower sand and gravel fill layer was moist with a measured moisture content of 3.8%. One SPT performed within the lower sand and gravel fill resulted in an uncorrected "N" value of 16 blows per 300 mm, classifying the fill as compact in compactness condition.

Below the granular fill materials was an approximately 2.3 m thick layer of wood fill mixed with sand, gravel, silt, and clay. Measured moisture contents within returned samples of the material ranged from 36.5 to 99.7%.

Below the fill materials at approximately 6.1 m depth was an approximately 1.5 m thick layer of cohesionless brown clayey silt that contained some sand and trace gravel. The clayey silt was wet, with a measured moisture content of 29.9%. One SPT performed within the clayey silt resulted in an uncorrected "N" value of 8 blows per 300 mm, classifying the soil as loose in compactness condition. An Atterberg Limits test completed on a sample of the soil resulted in a Liquid Limit of 19.5%, a Plastic Limit of 16.8%, and a Plasticity Index of 2.7%. As such, the sample is considered to have low plasticity. A particle size analysis completed on a representative sample of the clayey silt indicated 50.9% material between 5 and 75 µm. As such, the clayey silt is considered to have a medium susceptibility to frost heaving (MSFH) in accordance with the MTO Pavement Design and Rehabilitation Manual (PDRM). The Wischmeier Nomograph "K" value of the clayey silt was 0.40, indicating the clayey silt is moderately erodible in accordance with the MTO PDRM.

Below the clayey silt was an approximately 1.6 m thick of brown cohesionless silt and sand. The silt and sand was wet, with a measured moisture content of 24.0%. One SPT performed within the silt and sand resulted in an uncorrected "N" value of 16 blows per 300 mm, classifying the soil as compact in compactness condition. A particle size analysis completed on a representative sample of the silt and sand indicated 27.7% material between 5 and 75 µm. As such, the silt and sand is considered to have a low susceptibility to frost heaving (LSFH) in accordance with the MTO Pavement Design and Rehabilitation Manual (PDRM). The Wischmeier Nomograph "K" value of the silt and sand was 0.18, indicating the silt and sand is relatively non-erodible in accordance with the MTO PDRM.

Below the silt and sand was layer of brown cohesionless silty sand that extended to auger refusal on suspected boulders or bedrock at 10.4 m depth. The silty sand was wet, with a measured moisture content of 26.1%. One SPT performed within the silty sand resulted in an uncorrected "N" value of 4 blows per 300 mm, classifying the soil as very loose in compactness condition.

As noted above, auger refusal on suspected boulders or bedrock was encountered at 10.4 m depth (Local Elev. 89.1m).

Groundwater was measured within the open borehole at 4.9 m depth (Local Elev. 94.58 m) upon completion. Completed moisture content testing on obtained soil samples suggests, however, that the groundwater level may be slightly higher between 3 to 4 m depth (Local Elev. 96.48 to 95.48 m). Seasonal variations in the water table should be anticipated, with higher levels occurring during wet weather conditions (spring thaw and late fall) and lower levels occurring during dry weather conditions.

6. Corrosivity Potential of On-Site Soils

Two (2) representative soil samples were submitted to a CALA Certified Laboratory operated by SGS Canada Inc. to complete chemical corrosivity testing. The results of the chemical testing are summarized below, with detailed results included in Appendix D.

Table 6-1: Summary of Corrosivity Test Results

Parameter	Borehole, Sample No., Depth	
	BH-D1, SS3, 1.5 to 2.1 m	BH-D1, SS5, 3.1 to 3.8 m
Chloride (µg/g)	69	11
Sulphate (µg/g)	11	6.1
Sulfide (%)	< 0.01	< 0.01
pH	7.84	7.22
Electrical Conductivity (µS/cm)	662	48
Resistivity (ohm.cm)	1510	20800
Redox Potential (mV)	79	40
Corrosivity Index	12	5

The soil corrosivity test results were compared to the ANSI/AWWA Corrosivity Rating System. Based on the rating system, a point total of ten or greater (≥10) indicates the soil is corrosive to gray or ductile cast iron. As noted on the table above, the tested samples had a Corrosivity Index of 12 to 5 and as such the upper soil layers should be considered corrosive to gray or ductile cast iron.

Resistivity was measured at 1510 ohm.cm within sample SS3, which suggests a severe potential for corrosion of buried metallic elements in accordance with MTO Gravity Pipe Design Guidelines, April 2014. The higher resistivity of 20800 ohm.cm, measured at sample SS5, suggests very low potential for corrosion.

In addition, chloride ions can lead to corrosion of steel reinforcement in concrete and steel structures by breaking down the normally present protective layer of oxides present on the steel surface. Chloride concentrations greater than 500 ppm (µg/g) are generally considered corrosive. As noted above, the tested samples did not have chloride concentrations exceeding 500 ppm (µg/g).

Based on the chemical results, corrosion protection for buried metallic elements will be required. It is up to the designer to determine the requirements of appropriate protective coating measures to ensure that all aspects of CHBDC 2019, Section 2 “Durability” requirements are followed. The test results provided in Table 6-1 may be used to aid in the selection of coatings and corrosion protection systems for buried steel objects. Based on the results of the tested sample and given that the structure is located adjacent to the roadway and will be exposed to de-icing salt, consideration should be given to designing concrete (if required), for a “C” type exposure class as defined by Table 1 of CAN/CSA A23.1.

Sulphate contents were compared to Table 3 of CAN/CSA A23.1. Sulphate contents within the tested soil samples were 11 and 6.1 µg/g. As such, there is negligible potential for sulphate attack from the encountered soils on concrete based on Table 3 of CAN/CSA A23.1 and sulphate resistant concrete would not be required if concrete structures are constructed.

7. Foundation Recommendations

The following foundation recommendations are based on interpretation of the factual data obtained from the borehole advanced during the subsurface investigation at the site by EXP. The interpretation and recommendations provided are intended solely to permit designers to assess foundation alternatives and design the new culvert replacement. Comments on construction are only provided to highlight issues that could affect the design. Contractors bidding on the works should make their own assessments of the factual data and how it might affect construction means and methods, scheduling, and the like.

This report addresses the geotechnical design of the foundation for the proposed culvert replacement structure by providing geotechnical design parameters at the Ultimate Limit State (ULS) and Serviceability Limit States (SLS), as well as other geotechnical parameters that may be required in accordance with the latest edition of the Canadian Highway Bridge Design Code (CHBDC) (CAN/CSA-S6-19), the Guideline for Professional Engineers Providing Geotechnical Engineering Service (1992), the Canadian Foundation Engineering Manual (CFEM) (2023), and good practice. The proposed structure and its foundation system are interpreted to be classified as having a “typical” consequence level associated with exceeding limits states design. Given the level of foundation investigation completed, the level of confidence for design is interpreted to be “typical” degree of site and prediction model understanding. Table 6.1 and 6.2 of the CHBDC, CAN/CSA-S6-19, 2019 have been used in the design to establish the appropriate consequence factor and geotechnical resistance factors.

The report provides discussion about the structure foundation type as well as other geotechnical and construction considerations such as assessment of lateral earth pressure, site preparation, excavation, dewatering, and frost and scour protections.

7.1 Expected Ground Conditions

The following ground conditions at the culvert location are evident from the current investigation:

- At Borehole BH-D1, roughly 3.8 m of very loose to compact granular fill materials were encountered overlying 2.3 m of wood fill mixed with granular fill, silt, and clay.
- Cohesionless native soils were encountered at BH-D1 at approximately 6.1 m depth (Local Elev. 93.4 m) and consisted of a 1.5 m thick layer of loose clayey silt overlying 1.6 m of compact silt and sand, followed by very loose to loose silty sand that extended to auger refusal on suspected boulders or bedrock at 10.4 m depth.
- Groundwater was measured at 4.9 m depth (Local Elev. 94.58 m) within BH-D1 upon completion. Moisture content testing on obtained samples suggests the groundwater may be shallower at 3 to 4 m depth (Local Elev. 96.48 to 95.48 m). The top of ice elevations within the existing creek were measured at Local Elev. 95.87 m (north side) and 95.92 m (south side) at the time of the investigation. Seasonal variations in the water level should be expected, with higher levels occurring during wetter periods of the year and lower levels during drier periods.
- No grade raises are anticipated at the culvert location.
- Upfill is expected between the native soils and the base of the culvert bedding.

7.2 Culvert Foundation

The choice of culvert type and size depends on hydraulic performance, staging requirements, geotechnical resistance available in the foundation soils, initial cost, maintenance costs, ease of construction, soil corrosiveness, salvageability and local availability of material and equipment. It has been assumed that the culvert will be replaced with a new SPCSP Arch culvert of similar size to existing.

Regardless of the option selected, the existing culvert is to be removed. This will require excavation down to the existing native soils at approximately 6.1 m depth (Approx. Local Elev. 93.4 m), past the mixed wood fill deposit. This suggests the need for surface/groundwater control as discussed in Section 9 below.

The in-situ clayey silt founding soils we be easily disturbed by construction traffic or inclement weather. As such, exposed subgrade soils should be immediately protected following excavation to prevent disturbance and provide a stable working surface. In general, any loose and/or soft soils encountered below the existing embankment should be excavated and replaced with engineered fill. If the depth of excavation to remove unstable soils is excessive, using a geotextile fabric in accordance with OPSS.MUNI 1860, Class II Non-Woven (OPSS 1860 II-N), in conjunction with engineered fill can be considered to assist in providing a stable base for the new culvert. Based on previous experience, typically it should consist of Granular A or Granular B Type II (OPSS.MUNI 1010) with a minimum thickness of 300 mm beneath the culvert bedding and extend a minimum of 500 mm horizontally on either side of the foundation/culvert edges. The fabric should be installed in a manner to mitigate the migration of fines from adjacent material. Alternatively, a thin, 75 mm thick, layer of lean mix concrete (10 MPa) can be placed over the exposed subgrade to provide protection. The lean mix concrete should extend a minimum of 500 mm horizontally on either side of the foundation/culvert edges.

7.3 Culvert Shallow Foundations

7.3.1 Geotechnical Resistance

Based on the subsurface stratigraphy encountered at this site and the proposed invert elevation of the new culvert, the following Table 7-1 summarizes the recommended resistances at the founding elevations for the anticipated type of culvert. The geotechnical resistance provided is for vertical loading condition only; load eccentricity and load inclination effects should be addressed in accordance with the CHBDC and its commentary. The geotechnical resistances provided below were factored with a typical consequence factor of 1.0 at ULS and SLS; and typical degree of understanding (factor of 0.5 at ULS and factor of 0.8 at SLS) in accordance with Table 6.1 and 6.2 of the CHBDC S6-19.

Table 7-1: Recommended Resistances and Founding Elevations

Culvert Type	Founding Local Elevation (m)	Assumed Span (m)	Founding Soil Type	Factored Geotechnical Resistance at ULS (kPa)	Factored Geotechnical Resistance at SLS [(1)] (kPa)
SPCSP Arch	~ 94.5	5.5	Engineered upfill over loose native clayey silt	250	140

Notes:
1. For maximum settlement of 25 mm

It is assumed that, if any, underlying organic soils and any other soft or very loose materials are to be replaced with clean and compactable soil such as Granular A or Granular B Type II. Given that no grade raise, nor widening is planned, the anticipated maximum total settlements for the new proposed culvert are not expected to exceed 25 mm for construction done in accordance with these design parameters and assuming good construction practice including sound base preparation.

7.3.2 Resistance to Lateral Loads

Resistance to lateral forces/sliding should be calculated in accordance with Section 6.10.4 of the CHBDC. The coefficient of friction, tan δ, may be taken as 0.47 between the replacement steel culvert and Granular “A” bedding. These values represent unfactored values; in accordance with the CHBDC, a factor of 0.8 is to be applied in calculating the horizontal resistance.

7.4 Culvert Bedding

OPSD 802.020 provides the bedding, embedment, cover and backfill standards for arch culverts. Culvert bedding should consist of Granular A (OPSS.MUNI 1010) with a minimum thickness of 300 mm beneath the culvert and extend a minimum of 500 mm horizontally on either side of the culvert edge. The bedding material should be placed in layers not exceeding 150 mm in thickness, loose measurement, and compacted to 100% Standard Proctor Maximum Dry Density (SPMDD) within 2% of optimum moisture content.

Prior to placing any fill material, the exposed native subgrade should be inspected by a qualified geotechnical engineer. A non-woven geotextile separator is to be placed between the approved subgrade and the compacted fill to assist in material placement and maintain the integrity of the founding soil along the entire length of the culvert. The geotextile separator is to be a Class II non-woven material with an equivalent opening size of 75-150 µm.

Engineered upfill below the culvert bedding should consist of Granular B Type I or II (OPSS.MUNI 1010). The engineered upfill should be placed in layers not exceeding 150 mm in thickness, loose measurement, and compacted to 100% SPMDD within 2% of optimum moisture content.

For the site area, a frost penetration depth of approximately 2.1 m can occur in open, unheated areas without snow cover. At the culvert inlet and outlet, and beneath the proposed culvert, the soils are anticipated to consist of clayey silt soil based on the advanced borehole. As noted previously, this soil has moderate frost susceptibility based upon the MTO Frost Classification guidelines. Therefore, non-frost susceptible materials such as sand and gravel might be considered to be provided to the limit of frost penetration beneath the inlet and outlet of the culvert. However, considering that cold air blowing through the culvert during the winter season will freeze soil next to the culvert, a minimum 300 mm thick layer of non-susceptible material should be considered to be placed as bedding along the entire culvert length.

7.5 Culvert Backfill

The selection and placement of the backfill and cover should be in accordance with OPSS.MUNI 902, OPSS.MUNI 421, and OPSD 802.020 for arch culverts. The cover material should consist of Granular A (OPSS.MUNI 1010). Backfill above the cover material and below the roadway structure may consist of Granular A, Granular B Type I or II, or SSM (OPSS.MUNI 1010).

Less than 2.1 m (the frost depth) of earth cover is anticipated above the top of the culvert and as such, a frost taper should be included as per OPSD 803.031.

The existing gravel roadway structure above the culvert backfill should be reconstructed to generally match existing conditions as follows:

- Surface/Base Layer (Granular “A”, OPSS.MUNI 1010) – 200 mm
- Subbase Layer (Granular “B” Type I, OPSS MUNI 1010) – Thickness to match existing (minimum 800 mm)

All cover, backfill, and roadway structure materials should be placed in layers not exceeding 200 mm in thickness, loose measurement, and compacted to 98% SPMDD within 2% of optimum moisture content.

The use of heavy compaction equipment should be avoided immediately adjacent and above the culvert. The minimum height of fill cover above the crown of the culvert before power operated tractors or rolling equipment shall be 900 mm, unless otherwise noted by the Structural Engineer. During backfill placement, the height of the backfill should be maintained at approximately the same level on both sides of the structure, to avoid lateral displacement of the structure.

7.6 Lateral Earth Pressures

Culvert walls, temporary shoring, or any retaining structures should be designed to resist lateral earth pressure. The expression for calculating lateral earth pressure "p" at any depth "h" is given by the following:

$$p = K(\gamma h + q) + \gamma_w h_w$$

where
- p = Lateral earth pressure (kPa)
- K = Coefficient of earth pressure
- γ = Unit weight of backfill (kN/m^3)
- γ_w = Unit weight of water (kN/m^3)
- h = Depth to point of interest (m)
- h_w = Depth of water above point of interest (m)
- q = Surcharge load acting adjacent to the wall at the ground surface (kPa)

Table 7-2, below, list various earth pressure properties for given materials.

Table 7-2: Earth Pressure Properties

Material	Friction Angle ø´ (unfactored)	Coefficient of Active Earth Pressure (k_a)	Coefficient of Passive Earth Pressure (k_p)	Coefficient of Earth Pressure at Rest (k_o)	Unit Weight γ (kN/m^3)
Granular "A"	38°	0.24	4.2	0.38	22
Granular "B" Type I	35°	0.27	3.7	0.43	21
Granular "B" Type II	38°	0.24	4.2	0.38	21
Sand fill, sand and gravel fill	35°	0.27	3.7	0.43	21
Clayey Silt	28°	0.36	2.8	0.53	17
Silt and sand	30°	0.33	3.0	0.50	18
Silty Sand	30°	0.33	3.0	0.50	18

Note: Values given for horizontal earth pressures are for horizontal backfill. For sloping backfill, the design requirements outlined in the Canadian Foundation Engineering Manual should be used.

The mobilization of full active or passive resistance requires a measurable and perhaps significant wall movement or rotation. Therefore, unless the structural element can tolerate these deflections, the at-rest earth pressure should be used in design.

The effects of compaction surcharge should be taken into account in the calculations of active and at rest earth pressures. The lateral pressure due to compaction should be taken as at least 12 kPa at the surface, and its magnitude should be assumed to diminish linearly with depth to zero at the depth where the active (or at rest) pressure is equal to 12 kPa. This pressure distribution should be added to the calculated active (or at rest) pressure. Notwithstanding, lighter compaction equipment and smaller lifts should be used adjacent to walls to prevent overstressing.

7.7 Site Classification for Seismic Response

Seismic characterization of the site should be compliant with the Canadian Highway Bridge Design Code (CHBDC, CAN/CSA-S6-19). Table 4.1 in CHBDC (see Clause 4.4.3.2) shows site classification for seismic site response based on average soil and bedrock properties in the top 30 m. As the Site Classification for Seismic Response is based on soil conditions in the upper 30 m, assumptions were made by EXP for the soil and bedrock conditions below the borehole termination depth. Assuming the boulders or bedrock continues past the auger refusal depth encountered through 30 m depth, the site would be classified as Site Class D.

These earthquake/seismic design parameters should be reviewed in detail by the structural engineer and incorporated into the design as required. As this site class is based on an assumption of the soil conditions, the site class may not be sufficient, and it may result in an overdesign of the structure. If a precise Site Classification is required, EXP can provide a quote to perform the necessary testing.

7.8 Scour/Erosion Protection

Foundation systems supporting culverts in flood plains, close to creeks, channel or rivers are very likely to be exposed to potentially harmful effects of stream flow, with particular concern during more significant storm events and where the creek bed/valley is set in erodible soils. The need for and nature of scour and erosion protection systems must be assessed and where required, must be designed, implemented and remain effective over the design life of the culvert.

Scour/erosion protection should be provided at the culvert inlet and outlet (including the side slopes). The erosion/scour protection should be designed by a specialist Hydraulic Engineer (as erosion and scour largely depend on the velocity of water in the watercourse and its regime) who is familiar with the findings of this report.

Rip-rap protection should be provided for culvert inlets and outlets, both upstream and downstream of the culvert openings. The rip-rap should begin approximately 5 m upstream of the culvert inlet and extend 5 m downstream of the culvert outlet, and line the embankment slope to the spring line of the culvert. The size of the rip-rap is a function of the local hydrology. As a rule of thumb, the thickness of the rip-rap should be a minimum of twice the median particle size, and 300 mm thick as a minimum. The rip-rap configuration at the creek bed should generally follow OPSD 810.010. The slope of the riprap shall follow the embankment fill slope.

7.9 Seepage Cut-off Recommendations

For new culvert installation, a clay seal or cut-off wall should be placed at the inlet of the proposed culvert, to prevent the migration of material along the exterior sidewalls of the culvert, the formation of flow paths, and any potential internal erosion within the roadway embankment. The type and design of cut-off utilized will be based on the local hydraulics at the site and should be designed by the structural engineer.

Should a clay seal be utilized, OPSS.MUNI 1205 specifies that material used for clay seals shall be natural clay, clay mixture (1 part Bentonite powder and 3.5 parts Granular “A”) or a Geosynthetic Clay Liner (GCL). The coefficient of permeability shall not exceed 1 x 10-6 cm/s.

The following outlines the installation procedures and minimum material requirements of the clay seal:

- The clay seal should be placed along the sides and top of the culvert a minimum of 1.0 m along the side of the culvert and extending out laterally 1.0 m from the culvert. The thickness of the clay seal should be a minimum of 500 mm. However, it is the responsibility of the designer to select the dimensions of the clay seal.
- The clay should be placed along the top and side of the culvert only. The clay must not be placed below the culvert.

- The clay should have a Liquid Limit greater than 40% and a Plasticity Index greater than 0.73 x (Liquid Limit – 20%).
- The clay seal is to be placed in maximum 150 mm thick lifts and compacted to 95% SPMDD within 2% of the optimum moisture content.

If a GCL is used as a clay seal, its material specifications containing the physical, mechanical and hydraulic properties shall be obtained from the manufacturer.

8. Excavations

All excavations at this site must be conducted in accordance with the Occupational Health and Safety Act (OHSA) and Regulations for Construction (O. Reg. 213/91). The existing fill materials and native soils may be classified as a Type 3 soil above the groundwater table in conformance with the OHSA. The soils below the groundwater table may be classified as a Type 4 soil. To avoid disturbance of the founding subgrade and to allow placement of backfill in dry conditions, groundwater must be controlled to below the proposed invert excavation levels prior to digging to final levels. The ingress of surface water must be controlled using a suitable system as well.

Temporary excavation side slopes for Type 3 soils should not exceed 1H:1V in accordance with OHSA, while temporary excavation side slopes for Type 4 soils should not exceed 3H:1V where applicable.

The need to excavate flatter side slopes if excessively wet or soft/loose materials, or concentrated seepage zones are encountered, should not be overlooked. There is a potential for sloughing to occur if the trench remains open for an extended period of time (i.e. > 24 hours) or during a rainfall event. In addition, some localized surficial sloughing may be experienced in areas of perched groundwater seepage. Water (i.e. surface water runoff) should not be permitted to enter and/or pond within the construction area.

All excavations must be completed in accordance with the most recent regulations in the Ontario Occupational Health and Safety Act. The contractor should be aware that slope height, slope inclination, or excavation depths, should in no case, exceed those specified in local, provincial or federal safety regulations. Such regulations are strictly enforced and, if not followed, the owner, the contractor or earthwork or utility subcontractor could be liable for substantial penalties.

8.1 Re-use of Excavated Material

A grain size analysis on the insitu sand fill met the OPSS.MUNI 1010 gradation requirements of an SSM. As such, if this granular fill can be segregated and stockpiled, it can likely be reused as upfill between the culvert cover and the pavement structure provided it is environmentally safe to do so. Further testing during construction is recommended for stockpiled material intended for reuse to confirm acceptability of the material.

Materials containing organics or other deleterious materials (i.e. the encountered wood fill), or the insitu native soils, cannot be reused as free draining engineered fill.

Excavated soils to be removed off site are likely considered to be Excess Soils and disposal of such soils should follow O.Reg. 406/19. Once the final site plan has been determined, and the known volume of soils to be excavated and removed off site is known, additional excess soil field studies can be completed.

9. Dewatering

Groundwater was measured within the open borehole at 4.9 m depth (Local Elev. 94.58 m) upon completion. Completed moisture content testing on obtained soil samples suggests, however, that the groundwater level may be slightly higher between 3 to 4 m depth (Local Elev. 96.48 to 95.48 m). The creek was frozen at the time of EXP's investigation, with the top of ice at Local Elev. 95.87 m on the north side, and Local Elev. 95.92 m on the south side. Based on the anticipated excavation depth to 6.1 m (Local Elev. 93.4 m) to remove insitu fill materials below the culvert, dewatering and surface water control will be required.

A temporary cofferdam upstream and downstream of the culvert will likely be required control surface water during construction. The groundwater level needs to be controlled to 0.5 m below the excavation level to avoid disturbance, and any surface or groundwater seepage should be removed from the excavation prior to the placement of granular backfill in the dry. Dewatering for the excavation and cofferdam shall be carried out in accordance with OPSS.MUNI 517 and SP 517F01.

Temporary cofferdams will likely be required at both the upstream and downstream ends of the culvert to envelop the construction site and keep it free of water during culvert replacement. The type and design of the cofferdam will depend on the erosion potential, stream flow velocity, high-water level, etc. which would be determined by the Hydraulic Engineer. Design and construction specifications for the chosen temporary cofferdam system should be prepared in accordance with OPSS.MUNI 539 (Construction Specification for Temporary Protection Systems) by the Contractor.

In addition to design and construction of the temporary cofferdam system, the Contractor is also responsible for its materials, maintenance, monitoring, and removal. The temporary cofferdam shall be fully removed, unless it is specified in the Contract Documents that the cofferdam system may be partially left in place. The method and sequence of removal shall be so that there shall be no damage to the new work, existing work, and facility being protected.

Dewatering requirements behind the cofferdams to keep the construction site dry will be impacted by water levels in the creek at the time of construction activities. Seasonal variations in the water table should be expected, with higher levels occurring during wetter periods of the year and lower levels during drier periods. It is the responsibility of the Contractor to propose a suitable dewatering system based on the time of construction, water levels and flow conditions in the creek. The method used should not undermine the existing roadway or adjacent side slopes. The Contractor should verify groundwater conditions prior to construction.

The estimated hydraulic conductivity (K) of the in-situ fill and soils is shown on Table 9-1:

Table 9-1: Hydraulic Conductivity of Encountered Soils

Soil Material	K (cm/sec)
Sand fill, sand and gravel fill	10^{-1} to 10^{-4}
Clayey Silt	10^{-5} and less
Silt and sand	10^{-3} to 10^{-5}
Silty Sand	10^{-3} to 10^{-5}

A Permit to Take Water (PTTW) is not likely required. Based on the hydraulic conductivity of the founding clayey silt soils and the groundwater levels observed, water taking is not anticipated to exceed 50,000 L/day. If at the time of construction, groundwater levels are found to be high and water taking will exceed 50,000 L/day, an Environmental Activity and Sector Registry (EASR) for Construction Site Dewatering would likely be required (pumping less that 400,000 L/day).

Erosion and sediment control during culvert construction should be as per the MTO Drainage Manual, Volume 2. Silt fences and other sediment control measures should be included to protect the downstream environment from the construction activities.

10. Construction Constraints Under Cold Weather Conditions

For all construction activities at this site, the following applies:

- During excavations, all subgrade soils must be maintained at a minimum temperature of 5° C.
- No granular material may be placed under frozen conditions, with all fill material maintained at a minimum temperature of 5° C prior to and during installation. If granular fill is to be placed in freezing conditions, the granular fill must be restricted to Granular "B" Type II material. Since Granular "B" Type II has a larger aggregate size, care should be taken to prevent point loading on the underside of the concrete.
- Soils and granular fill material that are in direct contact with fresh concrete must be at a minimum temperature of 5° C prior to pouring the concrete and must be free of snow and ice fragments.
- All granular fill, prior to placement of concrete, must be reviewed by this office to ensure that it is free of frost, buried ice and snow.
- All reinforcing steel in the concrete forms must be free of ice and snow, and must be maintained at a minimum temperature of 5° C.
- During the placement of concrete in cold weather conditions, a field cured cylinder should be placed beside the heated form for a period of 6 days. The field cured cylinder should be returned to a designated laboratory on the sixth day for 7-day compressive strength testing.
- All heated and tarped areas should be monitored for temperature using a max/min thermometer.
- All concrete is to have a minimum of 6% to 8% air entrainment to prevent cracking and shall be maintained at a minimum temperature of 10° C for a period of 4 to 7 days.

The 6% to 8% air entrained concrete during cold weather placement is to prevent significant strength loss of concrete as a result of freezing and thawing. The air entrainment will provide the capacity to absorb stresses during freeze/thaw action.

11. Construction Quality Control

Construction quality control of the "earthworks" should be provided throughout the project by a representative of EXP to verify all design assumptions, recommendations, and confirmation of the subsurface soil conditions. This includes inspection of the excavation and subgrade prior to the placement of any structural fill and foundations, to ensure that any and all deleterious materials have been removed and to ensure that the actual conditions are not markedly different than those on which the recommendations made herein are based. Compaction control of structural fill is also recommended as standard practice, as is sampling and testing of aggregates and concrete.

12. Design Review

The recommendations made in this report are in accordance with our present understanding of the project and are provided solely for the design team responsible for the project. If there are any changes, such as relocation of any structures or other features which may affect our analysis, the information obtained during this investigation may be inadequate and additional field work and reporting may be required.

13. Limitations

A subsurface investigation is a limited sampling of a site. Should any conditions at the site be encountered that differ from those reported at the test locations, we require that we be notified immediately in order to allow reassessment of our recommendations.

Whereas this investigation has estimated the groundwater level at the time of the fieldwork, and commented on general construction problems, the presence of conditions, which would be difficult to establish from our test holes, may affect the type and nature of dewatering procedures which should be used in practice. These conditions include local and seasonal fluctuations in the groundwater table, erratic changes in the soil profile between the tests, and thin layers of soil with large or small permeabilities compared with the general soil mass, etc.

The comments given in this report are intended only for the guidance of the design team responsible for the project. The number of test holes required to determine the localized underground conditions between test holes affecting construction costs, techniques, sequencing, equipment, scheduling, etc. could be greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual test hole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

The investigation and comments are necessarily ongoing as new information of underground conditions becomes available. For example, more specific information is available with respect to in-situ subsurface conditions between test locations once construction is underway. Subsurface soil interpretation between test holes, as well as the recommendations of this report, should be verified through field inspections provided by EXP to validate the current information for use during the construction stage.

Virtually no scope of work, no matter how exhaustive, can identify all contaminants or all conditions above or below ground. For example, conditions elsewhere at the site may differ from those encountered, and conditions may change with time. Therefore, no warranty is provided that the entire site condition is represented by those identified at specific borehole locations.

This report in no way reflects onsite environmental considerations.

14. Closure

We trust that these comments provide you with sufficient information to proceed with design. Should you have any questions, please do not hesitate to contact this office.

Yours truly,

EXP Services Inc.

LICENSED PROFESSIONAL ENGINEER
I. B. MACMILLAN
100157509
PROVINCE OF ONTARIO

Ian MacMillan, P.Eng.
Project Manager, Earth & Environmental Services
Northeastern Ontario

Yves Beauparlant, P.Eng.
Manager, Earth & Environmental Services
Northeastern Ontario

Appendix A – Drawing

KEYPLAN - N.T.S.

LEGEND

EXP BOREHOLE

— NOTES —

1) The boundaries and soil types have been established only at Test Hole locations. Between Test Holes, they are assumed and may be subject to considerable error.
2) Do not use Test Hole elevations for design purposes.
3) Soil samples will be retained in storage for 3 month and then destroyed unless client advises that an extended time period is required.
4) Quantities should not be established from the information provided at the Test Hole locations.
5) This drawing forms part of the report, project number as referenced, and should be used only in conjunction with this report.

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REVISIONS

No.	DESCRIPTION	DATE

CLIENT: R.V. ANDERSON ASSOCIATES LTD.

PROJECT: PROPOSED CULVERT REPLACEMENT DUPUIS ROAD, MARKSTAY-WARREN, ON

PROJECT NO.: SUD-24002582-B0

TITLE: BOREHOLE LOCATION PLAN

DATE: JANUARY 2026 | SCALE: NTS | DWG NO.: A-1

Appendix B – Borehole Logs

Notes on Sample Descriptions

1. All sample descriptions included in this report follow the International Society for Soil Mechanics and Foundation Engineering (ISSMFE), as outlined in the Canadian Foundation Engineering Manual. Note, however, that behavioral properties (i.e. plasticity, permeability) take precedence over particle gradation when classifying soil. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

UNIFIED SOIL CLASSIFICATION

CLAY (PLASTIC) TO	FINE	MEDIUM	CRS.	FINE	COARSE
SILT (NONPLASTIC)	SAND			GRAVEL	

EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		

2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.

3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (75 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

Notes On Soil Descriptions

4. The following table gives a description of the soil based on particle sizes. With the exception of those samples where grain size analyses have been performed, all samples are classified visually. The accuracy of visual examination is not sufficient to differentiate between this classification system or exact grain size.

Soil Classification		Terminology	Proportion
Clay and Silt	<0.060 mm	"trace" (e.g. Trace sand)	1% to 10%
Sand	0.060 to 2.0 mm	"some" (e.g. Some sand)	10% to 20%
Gravel	2.0 to 75 mm	adjective (e.g. sandy, silty)	20% to 35%
Cobbles	75 to 200 mm	"and" (e.g. and sand)	35% to 50%
Boulders	>200 mm		

The compactness of Cohesionless soils and the consistency of the cohesive soils are defined by the following:

Cohesionless Soil		Cohesive Soil		
Compactness	**Standard Penetration Resistance "N" Blows / 0.3 m**	**Consistency**	**Undrained Shear Strength (kPa)**	**Standard Penetration Resistance "N" Blows / 0.3 m**
Very Loose	0 to 4	Very soft	<12	<2
Loose	4 to 10	Soft	12 to 25	2 to 4
Compact	10 to 30	Firm	25 to 50	4 to 8
Dense	30 to 50	Stiff	50 to 100	8 to 15
Very Dense	Over 50	Very Stiff	100 to 200	15 to 30
		Hard	>200	>30

5. **ROCK CORING**

Where rock drilling was carried out, the term RQD (Rock Quality Designation) is used. The RQD is an indirect measure of the number of fractures and soundless of the rock mass. It is obtained from the rock cores by summing the length of the core covered, counting only those pieces of sound core that are 100 mm or more length. The RQD value is expressed as a percentage and is the ratio of the summed core lengths to the total length of core run. The classification based on the RQD value is given below.

RQD Classification	RQD (%)
Very Poor Quality	<25
Poor Quality	25 to 50
Fair Quality	50 to 75
Good Quality	75 to 90
Excellent Quality	90 to 100

$$\text{Recovery Designation \% Recovery} = \frac{\text{Length of Core Per Run}}{\text{Total Length of Run}} \times 100$$

Log of Borehole BH-D1

Project No. SUD-24002582-B0 | Figure No. B-2

Project: Proposed Culvert Replacement, Dupuis Road | Sheet No. 1 of 1

Location: Markstary-Warren, Ontario

5136182N; 546446E

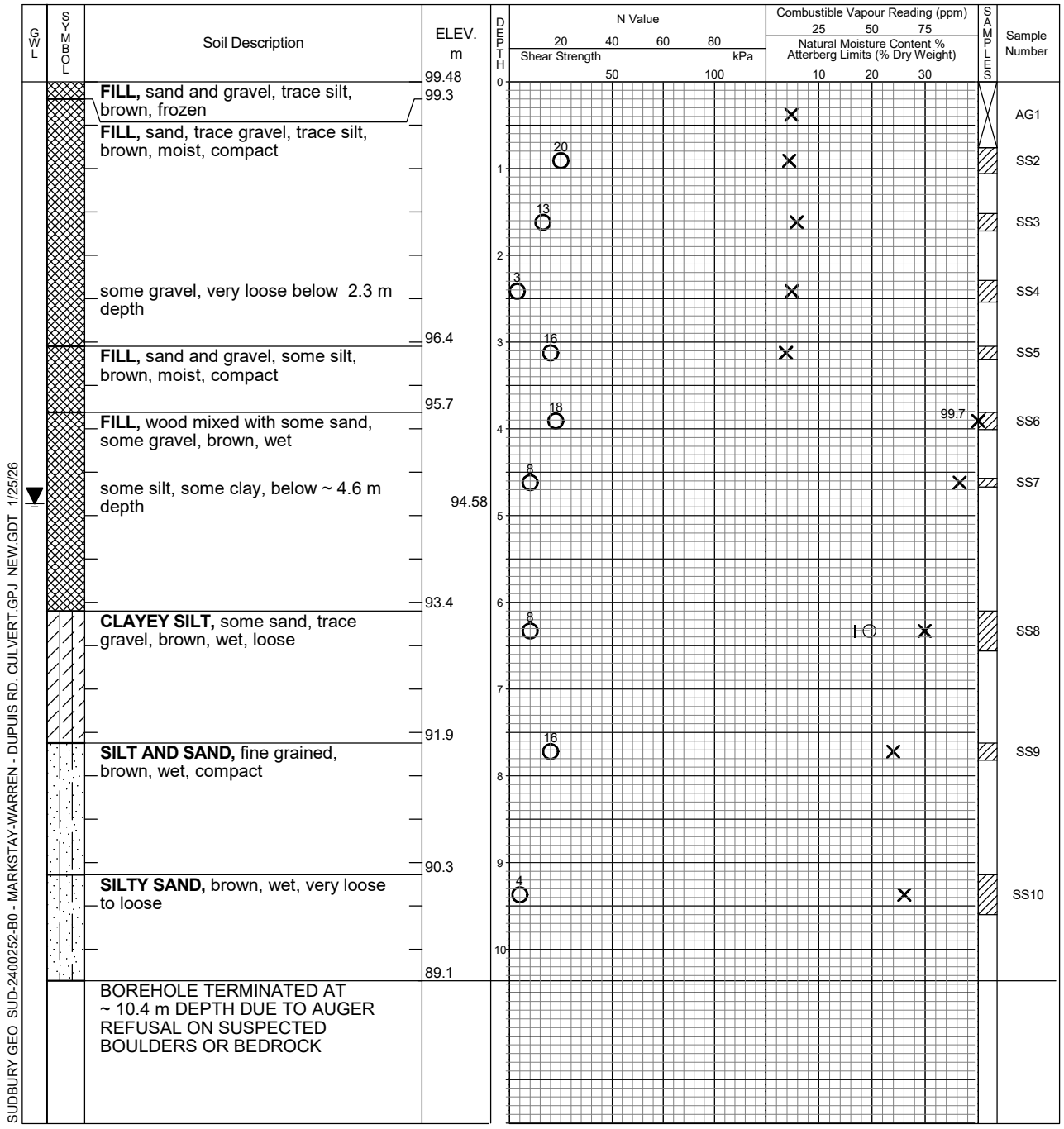
Date Drilled: December 17, 2025

Drill Type: CME55 Track Mount

Datum: Local (non-geodetic)

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer



SUDBURY GEO SUD-2400252-B0 - MARKSTAY-WARREN - DUPUIS RD. CULVERT.GPJ NEW.GDT 1/25/26

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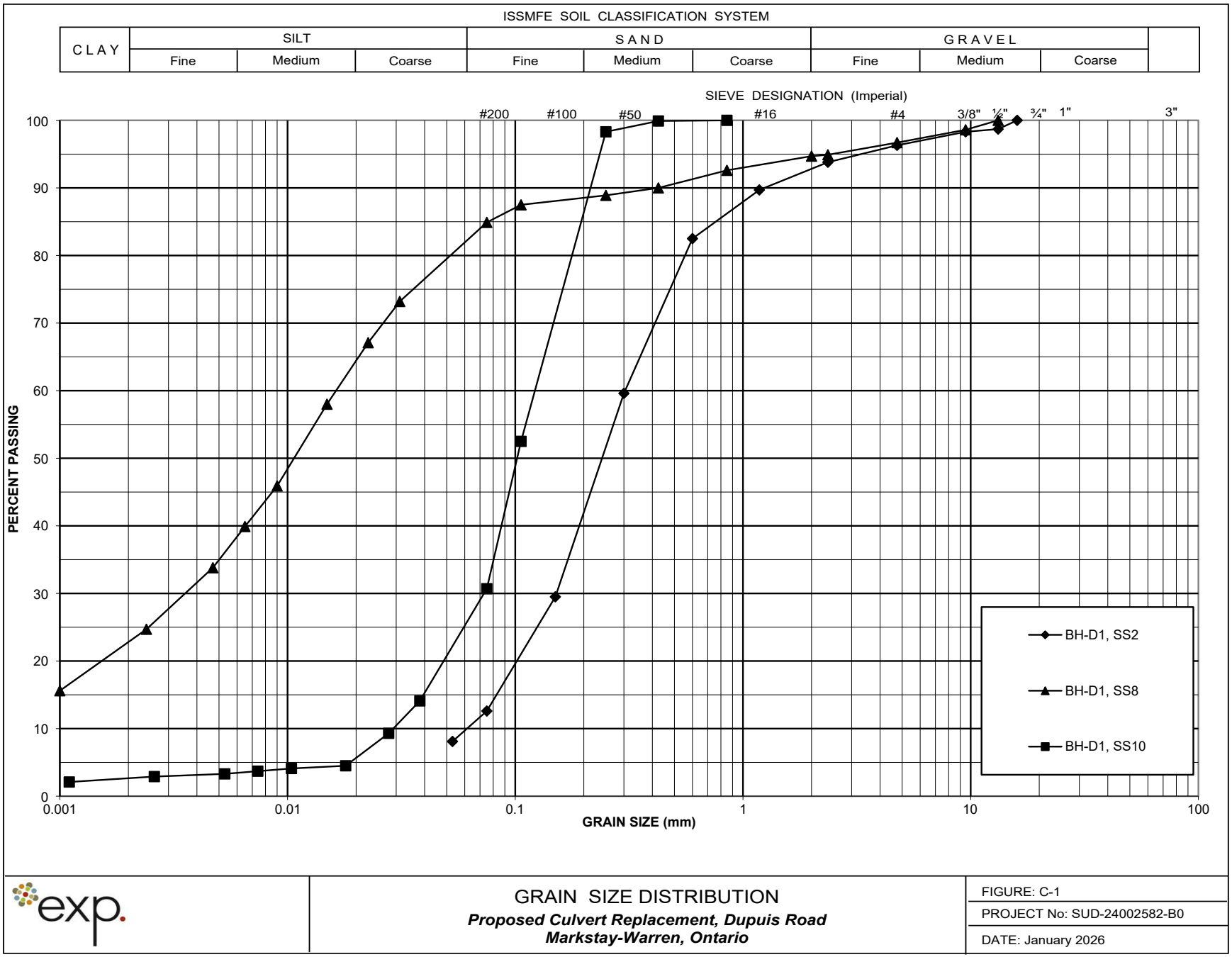
Borehole data requires interpretation assistance from EXP before use by others.

See Figures B-1A and B-1B for Notes on Sample Description

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	4.9	5.2

Appendix C – Laboratory Testing



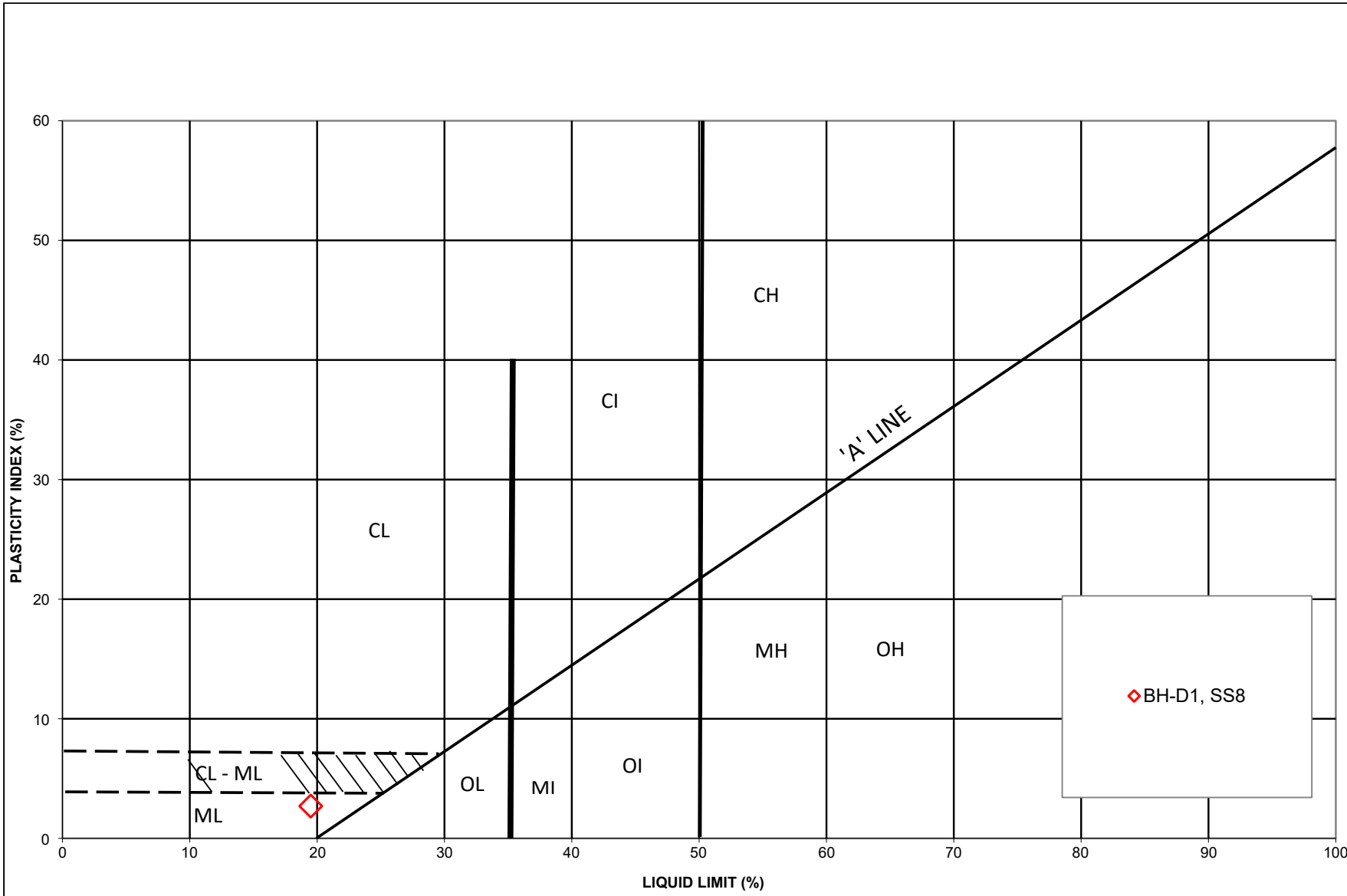
GRAIN SIZE DISTRIBUTION

Proposed Culvert Replacement, Dupuis Road
Markstay-Warren, Ontario

FIGURE: C-1

PROJECT No: SUD-24002582-B0

DATE: January 2026



PLASTICITY CHART

Proposed Culvert Replacement, Dupuis Road
Markstay-Warren, Ontario

FIGURE: C-2

PROJECT No: SUD-24002582-B0

DATE: January 2026

Appendix D – Corrosivity Test Results

FINAL REPORT

CA15497-JAN26 R1

SUD-24002582-B0

Prepared for

EXP Services Inc.

FINAL REPORT

First Page

CLIENT DETAILS

Client	EXP Services Inc.
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Facsimile	705-674-5583
Email	ian.macmillan@exp.com
Works #	
Project	SUD-24002582-B0
Reference	
Batch	
Samples	SOIL (8)

LABORATORY DETAILS

Project Specialist	Maarit Wolfe, Hon.B.Sc
Laboratory	SGS Canada Inc.
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SGS Reference	CA15497-JAN26
Received	2026-01-09
Approved	01/15/2026
Report Number	CA15497-JAN26 R1
Date Reported	01/15/2026

COMMENTS

Temperature of Sample upon Receipt: 6.3 degrees C

Chain of Custody Number: N/A

Corrosivity Index is based on the American Water Works Corrosivity Scale according to AWWA C-105. An index greater than 10 indicates the soil matrix may be corrosive to cast iron alloys.

SIGNATORIES

Maarit Wolfe, Hon.B.Sc

TABLE OF CONTENTS

FINAL REPORT

CA15497-JAN26 R1

Client: EXP Services Inc.
Project: SUD-24002582-B0
Project Manager: Ian MacMillan
Samplers: Patrick Lachance

MATRIX: SOIL

Sample Number	5	6	7	8	9	10	11	12	
Sample Name	23083 BHD1 SS5	23075 BHN1 SS5	23123 BHL1 SS4	23046 BHS1 SS4	23081 BHD1 SS3	23073 BHN1 SS3	23132 BHL2 SS3	23059 BHS2 SS3	
Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	
Sample Date	2026-12-15 00:00	2026-12-15 00:00	2026-12-15 00:00	2026-12-15 00:00	2026-12-15 00:00	2026-12-15 00:00	2026-12-15 00:00	2026-12-15 00:00	
Parameter	**Units**	**RL**		**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Corrosivity Index									
Corrosivity Index	none	1		5	Test results for this sample included in separate report.	Test results for this sample included in separate report.	Test results for this sample included in separate report.	12	Test results for this sample included in separate report.	Test results for this sample included in separate report.	Test results for this sample included in separate report.
pH	pH Units	0.05		7.22				7.84			
Soil Redox Potential	mV	no		40				79			
Sulphide (Na2CO3)	%	0.01		< 0.01				< 0.01			
Resistivity (calculated)	ohms.cm	-9999		20800				1510			
General Chemistry									
Conductivity	uS/cm	2		48				662			
Metals and Inorganics									
Sulphate	µg/g	0.4		6.1				11			
Other (ORP)									
Chloride	µg/g	0.4		11				69			

QC SUMMARY

Anions by IC

Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-[ENV]IC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0276-JAN26	µg/g	0.4	<0.4	2	35	104	80	120	102	75	125
Sulphate	DIO0276-JAN26	µg/g	0.4	<0.4	5	35	102	80	120	97	75	125

Carbon/Sulphur

Method: ASTM E1915-07A | Internal ref.: ME-CA-[ENV]ARD-LAK-AN-020

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide (Na2CO3)	ECS0052-JAN26	%	0.01	< 0.01								

Conductivity

Method: SM 2510 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0249-JAN26	uS/cm	2	3	0	20	99	90	110	NA		

QC SUMMARY

pH

Method: SM 4500 I Internal ref.: ME-CA-[ENV]EWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0249-JAN26	pH Units	0.05	NA	0		100			NA		

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

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

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS	Insufficient sample for analysis.
RL	Reporting Limit.
↑	Reporting limit raised.
↓	Reporting limit lowered.
NA	The sample was not analysed for this analyte
ND	Non Detect

Results relate only to the sample tested.

Data reported represent the sample as submitted to SGS.

Test method information available upon request.

"Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

SGS Canada Inc. statement of conformity decision rule does not consider uncertainty when analytical results are compared to a specified standard or regulation.

-- End of Analytical Report --

5.4, 6.3, 7.2

SGS

Request for Laboratory Services and CHAIN OF CUSTODY (Mining)

SGS Environmental Services - Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Toll Free: 877-747-7658 Fax: 705-652-6365 Web: www.ca.sgs.com {4}

SGS Environmental Services - London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361 Web: www.ca.sgs.com {4}

Laboratory Information Section

Received Date (mm/dd/yyyy): JAN 09 2026

Skid # (if applicable): Temperature Upon Receipt (°C):

LAB LIMS #: CA 15497 JAN26 LA

Billing & Reporting Information

Invoice/Receipt to {3}:

Company: EXP

Attention: Ian Macmillan

Address: 885 Regent St. Suite 3-6A, Sudbury, ON, P3E 5M4

Email: ian.macmillan@exp.com

Quote #:

Attached Parameter List: ☐ YES ☐ NO

Turnaround Time

Is *Rush Turnaround Time Required? ☐ YES ☑ NO

Specify:

* Rush TA Requests Require Lab Approval

Project Name/Number: SUD-24002582-B0 | P.O. #: SUD-24002582-B0

Client Information/Report To:

Client Lab #:

Company Name:	EXP	**Phone Number:**	
Contact Name:	Ian Macmillan	**Fax Number:**	
Address:		**E-mail:**	ian.macmillan@exp.com
Copy to:			

Samples will be sent to paid storage after 3 months unless otherwise requested. Additional storage and shipping costs will be charged to the client. If the samples should be returned, please provide courier account information.

After analysis samples are to be:	Disposed ☑	Stored (At client's cost) ***Default** ☐	Multi-phase project (Automatic storage) ☐
Returned to client ☐	Return courier:	Acct:	

IMPORTANT: If samples contain known Hazards, please label accordingly and identify below:

☐ **NORM (Normally Occuring Radioactive Material)** ☐ **Asbestos** ☐ **Other:**

Special Instructions : ☐ **See Attached or:**

Sample Information

Sample Identifier	Date Sampled (mm/dd/yy)	Time Sampled	# of Containers	Analysis Requested (please enter the analysis required below and check off which analysis applies to each sample) — corrosivity package							
23083 BHD1 SS5	15-Dec-25	N/A	1 Bag	x							
23075 BHN1 SS5	15-Dec-25	N/A	1 Bag	x							
23123 BHL1 SS4	15-Dec-25	N/A	1 Bag	x							
23046 BHS1 SS4	15-Dec-25	N/A	1 Bag	x							
23081 BHD1 SS3	15-Dec-25	N/A	1 Bag	x							
23073 BHN1 SS3	15-Dec-25	N/A	1 Bag	x							
23132 BHL2 SS3	15-Dec-25	N/A	1 Bag	x							
23059 BHS2 SS3	15-Dec-25	N/A	1 Bag	x							

Sampled By {1}:	(Name)	(Signature)	**Date:**	___ ___ / ___ ___ ___	(mm/dd/yy)
Relinquished by {2}:	Patrick Lachance	(Signature)	**Date:**	8 1 2026	(mm/dd/yy)

Note: {1} Submission of samples to SGS is acknowledgement that you have been provided direction on sample collection/handling and transportation of samples. {2} Submission of samples to SGS is considered authorization for completion of work. Signatures may appear on this form or be retained on file in the contract, or in an alternative format (e.g. shipping documents). {3} Results may be sent by email to an unlimited number of addresses for no additional cost. Fax is available upon request. {4} Completion of work may require the subcontracting of samples between the London and Lakefield laboratories.

This document is issued by the Company under its General Conditions of Service accessible at http://www.sgs.com/terms_and_conditions.htm. (Printed copies are available upon request.) Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

RTN 335667283824 KA 10:15

June 18, 2026

R.V. Anderson Associates Ltd.
Attn. Steven Cormier, P.Eng.
Via email: scormier@rvanderson.com

RE: SUD-24002582-B0

Addendum No. 1
Geotechnical Investigation and Design Report
Proposed Culvert Replacement
Dupuis Road, Markstay-Warren, Ontario

Included in the following is Addendum No. 1 to EXP Services Inc. (EXP) Report No. SUD-24002582-B0, titled "Geotechnical Investigation and Design Report, Proposed Culvert Replacement, Dupuis Road, Markstay-Warren, Ontario", dated January 28, 2026. This Addendum must be read in conjunction with, and forms part of, the noted report and all recommendations and limitations found within the noted report are applicable unless superseded by those noted herein.

Background

Subsequent to the submission of EXP's above noted report, it is understood that the Dupuis Road culvert will no longer be replaced with a new SPCSP Arch Culvert. The culvert will now be replaced with a 5,400 mm x 3,600 mm precast concrete box culvert, with a length of 20.3 m.

Geotechnical Resistance

Based on the subsurface stratigraphy encountered at this site and the proposed invert elevation of the new culvert, the following Table 1-1 summarizes the recommended resistances at the founding elevation for the anticipated concrete box culvert. The geotechnical resistance provided is for vertical loading condition only; load eccentricity and load inclination effects should be addressed in accordance with the CHBDC and its commentary. The geotechnical resistances provided below were factored with a typical consequence factor of 1.0 at ULS and SLS; and typical degree of understanding (factor of 0.5 at ULS and factor of 0.8 at SLS) in accordance with Table 6.1 and 6.2 of the CHBDC S6-19.

Table 1-1: Recommended Resistances and Founding Elevations

Culvert Type	Founding Local Elevation (m)	Assumed Span (m)	Founding Soil Type	Factored Geotechnical Resistance at ULS (kPa)	Factored Geotechnical Resistance at SLS [1] (kPa)
5400 x 3600 mm Precast Concrete Box Culvert	~ 94.9	5400	Engineered upfill over loose native clayey silt	250	140

Notes:
1. For maximum settlement of 25 mm

It is assumed that, if any, underlying organic soils and any other soft or very loose materials are to be replaced with clean and compactable soil such as Granular A or Granular B Type II. Given that no grade raise, nor widening is planned, the anticipated maximum total settlements for the new proposed culvert are not expected to exceed 25 mm for construction done in accordance with these design parameters and assuming good construction practice including sound base preparation.

Resistance to Lateral Loads

Resistance to lateral forces/sliding should be calculated in accordance with Section 6.10.4 of the CHBDC. The coefficient of friction, tan δ, may be taken as 0.55 between the replacement precast concrete culvert and Granular "A" bedding. This value represents an unfactored value; in accordance with the CHBDC, a factor of 0.8 is to be applied in calculating the horizontal resistance.

Culvert Bedding and Backfill

OPSD 803.010 provides the bedding, embedment, cover and backfill standards for concrete culverts. Culvert bedding and cover should consist of Granular A (OPSS.MUNI 1010) with a minimum thickness of 300 mm beneath the culvert and extend a minimum of 500 mm horizontally on either side of the culvert edge.

Closure

As noted previously, This Addendum must be read in conjunction with, and forms part of, the noted report and all recommendations and limitations found within the noted report are applicable unless superseded by those noted herein.

We trust that this information is sufficient for your present requirements. Should you have any questions, please do not hesitate to contact this office.

Yours truly,

EXP Services Inc.

LICENSED PROFESSIONAL ENGINEER
I.B. MACMILLAN
100157509
PROVINCE OF ONTARIO

Ian MacMillan, P.Eng.
Project Manager, Earth & Environmental Services
Northeastern Ontario

Yves Beauparlant, P.Eng.
Manager, Earth & Environmental Services
Northeastern Ontario

June 19, 2026

R.V. Anderson Associates Ltd.
Attn. Steven Cormier, P.Eng.
Via email: scormier@rvanderson.com

RE: SUD-24002582-B0_R1

Addendum No. 1
Geotechnical Investigation and Design Report
Proposed Culvert Replacement
North Road, Markstay-Warren, Ontario

Included in the following is Addendum No. 1 to EXP Services Inc. (EXP) Report No. SUD-24002582-B0, titled "Geotechnical Investigation and Design Report, Proposed Culvert Replacement, North Road, Markstay-Warren, Ontario", dated February 3, 2026. This Addendum must be read in conjunction with, and forms part of, the noted report and all recommendations and limitations found within the noted report are applicable unless superseded by those noted herein.

Background

Subsequent to the submission of EXP's above noted report, it is understood that the North Road culvert will no longer be replaced with a new CSP Culvert. The culvert will now be replaced with a 4,200 mm x 3,600 mm precast concrete box culvert, with a length of 28.2 m.

Geotechnical Resistance

Based on the subsurface stratigraphy encountered at this site and the proposed invert elevation of the new culvert, the following Table 1-1 summarizes the recommended resistances at the founding elevation for the anticipated concrete box culvert. The geotechnical resistance provided is for vertical loading condition only; load eccentricity and load inclination effects should be addressed in accordance with the CHBDC and its commentary. The geotechnical resistances provided below were factored with a typical consequence factor of 1.0 at ULS and SLS; and typical degree of understanding (factor of 0.5 at ULS and factor of 0.8 at SLS) in accordance with Table 6.1 and 6.2 of the CHBDC S6-19.

Table 1-1: Recommended Resistances and Founding Elevations

Culvert Type	Founding Local Elevation (m)	Assumed Span (m)	Founding Soil Type	Factored Geotechnical Resistance at ULS (kPa)	Factored Geotechnical Resistance at SLS (kPa)
4200 x 3600 mm Precast Concrete Box Culvert	~ 94.9	4200	Loose native sand and silt	250	110 (1) 135 (2)

Notes:
1. For maximum settlement of 25 mm
2. For maximum settlement of 40 mm

It is assumed that, if any, underlying organic soils and any other soft or very loose materials are to be replaced with clean and compactable soil such as Granular A or Granular B Type II. Given that no grade raise, nor widening is planned, the anticipated maximum total settlements for the new proposed culvert are not expected to exceed 25 mm for construction done in accordance with these design parameters and assuming good construction practice including sound base preparation.

Resistance to Lateral Loads

Resistance to lateral forces/sliding should be calculated in accordance with Section 6.10.4 of the CHBDC. The coefficient of friction, tan δ, may be taken as 0.55 between the replacement precast concrete culvert and Granular "A" bedding. This value represents an unfactored value; in accordance with the CHBDC, a factor of 0.8 is to be applied in calculating the horizontal resistance.

Culvert Bedding and Backfill

OPSD 803.010 provides the bedding, embedment, cover and backfill standards for concrete culverts. Culvert bedding and cover should consist of Granular A (OPSS.MUNI 1010) with a minimum thickness of 300 mm beneath the culvert and extend a minimum of 500 mm horizontally on either side of the culvert edge.

Closure

As noted previously, This Addendum must be read in conjunction with, and forms part of, the noted report and all recommendations and limitations found within the noted report are applicable unless superseded by those noted herein.

We trust that this information is sufficient for your present requirements. Should you have any questions, please do not hesitate to contact this office.

Yours truly,

EXP Services Inc.

Ian MacMillan, P.Eng.
Project Manager, Earth & Environmental Services
Northeastern Ontario

Yves Beauparlant, P.Eng.
Manager, Earth & Environmental Services
Northeastern Ontario