FOUNDATION INVESTIGATION REPORT
FARLEY CREEK CULVERT REPLACEMENT
HIGHWAY 124
TOWNSHIP OF HAGERMAN
AGREEMENT NO.: 5010-E-0007
WP: 5424-06-01
GWP: 5424-06-00
GEOCRES NO.: 31E-306

March 28, 2011
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Prepared for:
Ministry of Transportation of Ontario
Northeastern Region Office
447 McKeown Avenue, Suite 301
North Bay, ON P1B 9S9

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1 Copy - Genivar, Ottawa, ON
1 copy – DST Consulting Engineers Inc., Thunder Bay

DST CONSULTING ENGINEERS INC.
605 Hewitson Street, Thunder Bay, Ontario P7B 5V5
Phone: 1-807-623-2929 Fax: 1-807-623-1792

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PART 1: FACTUAL INFORMATION

1. INTRODUCTION

DST Consulting Engineers Inc. (DST) has been subcontracted by Genivar which was retained by Ministry of Transportation (MTO), Northeastern Region, to conduct a geotechnical investigation for the replacement a culvert on Highway 124. This work was carried out under Agreement No.: 5010-E-0007, Detailed Design for the Replacement/Rehabilitation of various culverts.

This report addresses the field investigation, laboratory test program, factual report on conditions (Part 1) and recommendations for the design and construction for the proposed culvert replacement (Part 2).

2. SITE DESCRIPTION

The site is located on Highway 124, approximately 3.36 km west of junction Highway 520, in Hagerman Township, Huntsville Area. The structural site number is 44-288.

The existing culvert is a 3000 mm × 30 m corrugated steel pipe (CSP) culvert with approximately 1.6 m of cover (Figure 2.1). It was determined to be in poor condition with severe corrosion, flaking below the waterline, few perforations and cracks at the bolt locations as well as some deformation of the culvert shape. It is understood that the existing structure will be replaced by a 3.0 x 2.1 x 29.4 m precast box culvert.

The outlet and inlet of the existing culvert are grassed (Figures 2.3 and 2.4). The embankment slopes at this location vary from 2H:1V to 3H:1V and include rockfill (Figure 2.2). Figures 2.1 to 2.4 were taken during DST drilling activities on October 06, 2010.

Figure 2.1 Corrugated Steel Pipe (CSP) culvert (looking south)

Figure 2.2 Rockfill along the embankment (looking north)

Figure 2.3 Outlet of the existing culvert (looking west)

Figure 2.4 Inlet of the existing culvert (looking west)

3. INVESTIGATION PROCEDURES AND LABORATORY TESTING

Site work was carried out in the period of three days (October 06, 2010 to October 08, 2010) utilizing a CME 750 drill rig that was operated by DST personnel. Two (2) hydraulically powered boreholes and two (2) hand auger boreholes were put down for foundation design purpose. The boreholes were put down using hollow stem augers.

According to the given specification in Request For Quotation (RFQ) by MTO, three boreholes (one at the inlet, one at the outlet, one at the embankment), were recommended for the purpose of the foundation design. However, the field investigation plan was slightly altered due to the inaccessibility to the inlet and outlet by the hydraulically powered drill rig.

The two hand auger boreholes were advanced at either side of the existing culvert (inlet and outlet). The two hydraulically powered boreholes that were close to the existing culvert were advanced at either side of the embankment shoulder. Borehole locations and stratigraphic sections are shown on the Borehole Location Plans (Drawings 1 to 4). All boreholes were abandoned using suitable abandonment barrier as described in O. Reg. 903 and its amendments.

The borehole locations are referenced to the MTO Station numbering system as indicated in the RFQ. The ground surface elevations at the borehole locations were surveyed by DST personnel. A nail in a hydro pole was assigned as temporary benchmark with elevation of 259.0 m (Drawing 1). Elevations were subsequently correlated to survey data provided by Genivar. A station on the highway marked as Station 21+000 was chosen as referenced station (Figure 3.1). According to the referenced station, the existing culvert was identified at Station 21+030. Table 3.1 summarizes the detail of borehole locations and depths.

The fieldwork was supervised on a full-time basis by DST personnel who located the boreholes in the field, performed sampling and in-situ testing and logged the boreholes. In-situ tests included standard penetration test (SPT) and field vane shear test (FVST). The soil samples collected during drilling were identified in the field, placed in labelled containers and transported to DST's laboratory in Thunder Bay for further analysis.

Classification and index tests were subsequently performed in the laboratory on samples collected from the boreholes to aid in the selection of engineering properties. Laboratory tests included moisture contents, particle size analyses and Atterberg limits including plastic limit and

liquid limit. A total of thirty (30) moisture contents, five (5) sieve analyses, nine (9) particle analyses, and five (5) Atterberg limits have been carried out for this assignment. Laboratory test results are presented in the Boreholes Logs (Enclosures 1 to 4), and Plots (Enclosures 5 to 8).

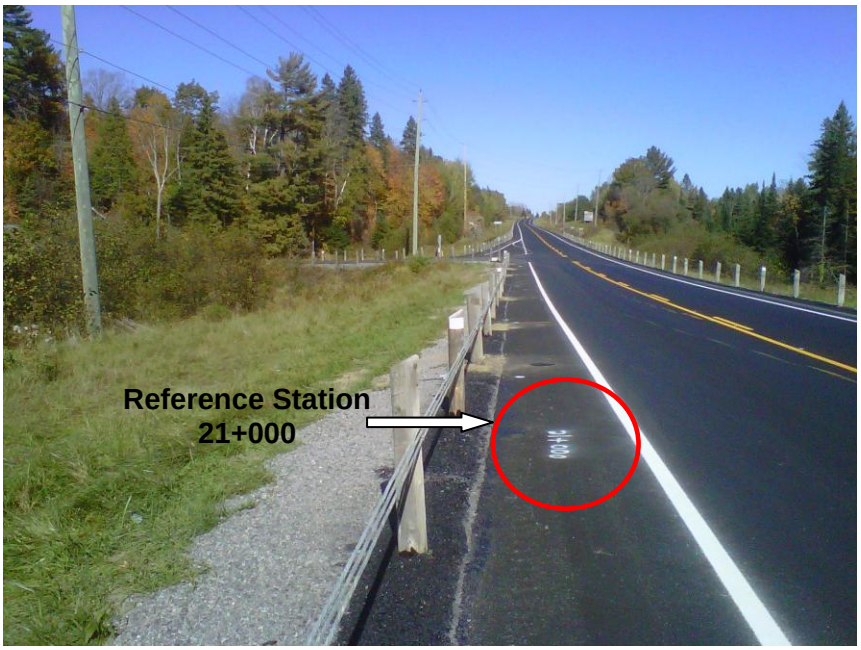


Figure 3.1 Reference station (looking north)

Table 3.1 Detail of borehole locations

Borehole ID	Station	Elevation (m)	Depth (m)	Offset (m)
BH1	21+029	255.3	4.0	15.0 Lt
BH2	21+030	255.4	5.5	10.0 Rt
BH3	21+030	259.1	9.1	5.5 Lt
BH4	21+029	259.1	12.0	4.8 Rt

4. DESCRIPTION OF SUBSURFACE CONDITIONS

The subsurface conditions are presented based on the information obtained during field and laboratory testing.

The generalized stratigraphy of the existing embankment, based on the conditions encountered in boreholes, consists of asphalt overlying a fill material that is underlain by a silt material overlying a clay material. The fill consists of a sand material underlying sand and crushed gravel. Table 4.1 summarizes the elevations and depths of boreholes, in which auger refusal was encountered during drilling. In Boreholes 1 and 2, auger refusal was not encountered within the capable depth of drilling by the hand auger.

Table 4.1 Depths and elevations of auger refusals

Borehole ID	Depth of auger refusal (m)	Elevation of auger refusal (m)
BH3	9.1	250.0
BH4	12.0	247.1

4.1 Asphalt

Asphalt was encountered in Borehole 4. The thickness of the asphalt is about 70 mm.

4.2 Embankment Fill

A fill material was indentified in Boreholes 3 and 4 that were drilled on the embankment. The thickness of the fill is about 3.7 m. Occasional cobbles were identified within the fill material. Although boulders were not identified at the advanced borehole locations, site photographs indicate the presence of some rock fill and the potential for boulders to be present. Grain size distributions of the fill material are reported in borehole logs (Enclosures 3 and 4) and plots (Enclosure 5).

A sand and crushed gravel material was identified below the asphalt in Borehole 4 and at upper layer in Borehole 3. The thickness of this material is about 0.1 m.

A sand fill, based on main fraction of the material, was identified below the sand and crushed gravel. The thickness of the sand fill varies from 3.5 to 3.6 m. The fill consists of gravel varying from 7 to 32%, sand varying from 63 to 81% and fines varying from 5 to 14%. SPT values of this fill vary

from 3 to 16 and indicate the compactness varying from very loose to compact. The moisture contents vary from 4 to 16%.

4.3 Silt

A silt material was identified beneath the fill in Boreholes 3 and 4. The thickness of the silt material varies from 0.8 to 1.5 m. In Borehole 3, some organics were identified within the silt material.

According to the particle size analysis results, the silt material consists of sand varying from 3 to 8%, silt varying from 79 to 81% and clay varying from 13 to 16%. The Atterberg limits test (Enclosure 8) indicates that the silt material has a liquid limit of 30% and plasticity index of 11%, indicating low plasticity. SPT values vary from 1 to 6 and indicate consistency from very soft to firm. The moisture contents of the fill material vary from 28 to 30%.

4.4 Sand

A sand material was identified below topsoil in Boreholes 1 and 2. The thickness of the sand material is about 0.1 m. Trace amount of organics were identified within the sand material during the geotechnical investigation.

4.5 Clay

A clay material was indentified below the silt material in Boreholes 3 and 4 (Enclosures 3 and 4) and below the sand material in Boreholes 1 and 2 (Enclosures 1 and 2). According to the Boreholes 3 and 4, the thickness of the clay material varies from 3.9 to 5.5 m. The Atterberg limit tests indicate that the clay has a liquid limit varying from 25 to 44% and plasticity index varying from 5 to 24%, indicating low plasticity to intermediate plasticity (Enclosure 8). The moisture contents of the clay vary from 23 to 55%.

According to the field vane shear tests, the clay exhibits intact undrained strength varying from 20 and 130 kPa, indicating consistency from soft to very stiff. The clay material shows sensitivity S_t varying from 2 to 7 and it indicates medium sensitivity to sensitive.

4.6 Sandy Silt

A sandy silt material was identified beneath the clay material in Borehole 4. The thickness of the sandy silt material is about 2.0 m.

According to the particle size analysis results, the silt material consists of 21% sand, 75% silt and 4% clay. SPT value of this material is about 4 and indicates compactness as very loose. The moisture content of this material is 21%.

4.7 Groundwater

The groundwater table was identified below the ground surface during the field investigation and visual identification of soil samples. The estimated depth of groundwater level below the ground surface elevation is given in Table 4.2. The water level at the culvert was at an elevation of 255.3 m during the field investigation. The groundwater levels can be expected to vary with season and precipitation events.

Table 4.2 Probable depth of water table at boreholes

Borehole ID	Depth of water table (m) below the ground surface	Water table elevation (m)
BH1	0.0	255.3
BH2	0.0	255.4
BH3	3.2	255.9
BH 4	3.1	256.0

5. REFERENCES

Canadian Highway Bridge Design Code (2006), CAN/CSA-S6-06, A National Standard of Canada, Canadian standards Association.

Municipal and Provincial Common, Volume 1 - General & Construction Specifications, "*Ontario Provincial Standard for Roads & Public Work*s" Spec No. *OPSS* 510, 511, 518, 577, 902.

Municipal and Provincial Common, Volume 3 - Drawings for Roads, Barriers, Drainage, Sanitary Sewers, Watermains and Structures, "*Ontario Provincial Standard for Roads & Public Work*s" Spec No. *OPSD* 203.040, 803.010, 810.010, 810.020, 3090.100.

Municipal and Provincial Common, Volume 2 - Material Specifications, "*Ontario Provincial Standard for Roads & Public Work*s" Spec No. *OPSS* 1010, 1860.

Special Provisions, Ontario Provincial Standards, SP110S13, SP105S10, SP511S01.

6. LIMITATIONS OF REPORT

A description of limitations which are inherent in carrying out site investigation studies is given in Appendix 'A', and this forms an integral part of this report.

For DST CONSULTING ENGINEERS INC.

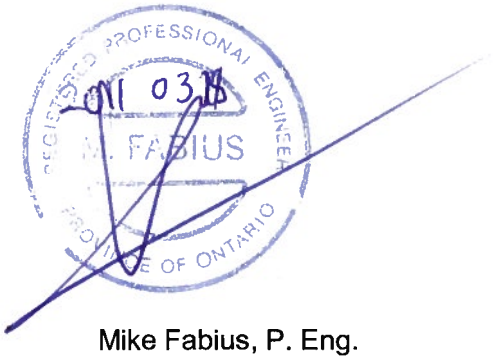
Prepared by:

for Loges Paramaguru, PhD.
Geotechnical Specialist

Reviewed by:

Dr. M W Bo, PhD., P. Eng, P.Geo, Int PE,
C.Geol, C. Eng, Eur Geol, Eur Eng
Principal / Director (GeoServices)

Reviewed by:



Mike Fabius, P. Eng.
Principal

APPENDIX ‘A’

LIMITATIONS OF REPORT

L I M I T A T I O N S O F R E P O R T

GEOTECHNICAL STUDIES

The data, conclusions and recommendations which are presented in this report, and the quality thereof, are based on a scope of work authorized by the Client. Note that no scope of work, no matter how exhaustive, can identify all conditions below ground. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the specific locations tested, and conditions may become apparent during construction which were not detected and could not be anticipated at the time of the site investigation. Conditions can also change with time. It is recommended practice that DST Consulting Engineers be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered in the testholes. The benchmark and elevations used in this report are primarily to establish relative elevation differences between the testhole locations and should not be used for other purposes, such as grading, excavation, planning, development, etc.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with details stated in this report. Since all details of the design may not be known, we recommend that we be retained during the final stage to verify that the design is consistent with our recommendations, and that assumptions made in our analysis are valid.

Unless otherwise noted, the information contained herein in no way reflects on environmental aspects of either the site or the subsurface conditions.

The comments given in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of testholes may not be sufficient to determine all the factors that may affect construction methods and costs, e.g. the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusion as to how the subsurface conditions may affect their work.

Any results from an analytical laboratory or other subcontractor reported herein have been carried out by others, and DST Consulting Engineers Inc. cannot warranty their accuracy. Similarly, DST cannot warranty the accuracy of information supplied by the client.

APPENDIX ‘B’

NONSTANDARD PROVISIONS

DEWATERING STRUCTURE EXCAVATION - Item No.

Non-Standard Special Provision

902.01 SCOPE

Section OPSS 902.01 of OPSS 902 is amended by the addition of the following:

As part of the work under this item, the Contractor shall:

- Carry out any additional field investigation the Contractor deems necessary in order to engineer the unwatering systems;
- Design and install dewatering systems to construct the work in the dry;
- Carry out works necessary for the dewatering system that may include sheet piling, tremie concrete seal, sand bagging, etc.;

The Contractor is advised that the use of a suitable sump and pump system is required for working under dry conditions and to prevent disturbance of the excavation base through hydraulic heave. It should be noted that depending on the season, depth of excavation and amount of water flow through the creek may vary.

The Contractor shall provide a continuous dewatering operation to keep the excavation stable and free of water. The excavation must be monitored daily throughout the duration of excavation until the completion of backfilling to confirm this. The dewatering system must be maintained and the surrounding area monitored for impacts to items such as, but not limited to, settlement and groundwater usage.

Section OPSS 902.01 of OPSS 902 is amended by the following subsection:

902.01.01 Flow Rates

The Contractor must satisfy himself with the local conditions and anticipated water flows, levels and flow velocity to be met with during construction. He shall make his own estimate of the facilities required and difficulties to be encountered including the nature of subsurface materials and conditions. For the protection scheme water flows, the average daily flow rate is 5.44 m^3/s.

902.03 DEFINITIONS

Section OPSS 902.03 of OPSS 902 is amended by the addition of the following:

Stamped: Refers to drawings or details that have been reviewed and stamped "Conforms With Contract Documents". The stamp shall include the date and signature of the Quality Verification

Engineer (QVE).

Quality Verification Engineer (QVE):	An Engineer licensed to practice in the Province of Ontario who has a minimum of five (5) years of experience in the field of design and/or construction of dewatering systems. The Contractor shall retain the QVE to ensure conformance with the contract document.
Dewatering System Design Engineer:	An Engineer licensed to practice in the Province of Ontario who has a minimum of five (5) years of experience in the field of design and/or construction of bridges. In addition, the Dewatering System Design Engineer shall have had responsible experience in the design of at least 5 other dewatering systems. The Contractor shall retain the Dewatering System Design Engineer to ensure conformance with the contract documents and issue certificate(s) of conformance for the design.

902.04 SUBMISSION AND DESIGN REQUIREMENTS

Section OPSS 902.04 of OPSS 902 is amended by the addition of the following:

Design of components of the dewatering systems shall be in accordance with CAN/CSA-S6-00 and standard referenced therein.

Submission of Shop Drawings

All shop drawings submissions shall bear the seal and signature of the Dewatering System Design Engineer.

The Contractor shall submit to the Quality Verification Engineer shop drawings for review and stamping.

At least two weeks prior to the commencement of dewatering system construction, the Contractor shall submit to the Contract Administrator, for information purposes only, four (4) sets of stamped drawings/calculations of the dewatering system.

The Contractor shall, at least three (3) weeks prior to the commencement of the dewatering system installation, submit to the QVE for review, four sets of drawings and calculations indicating:

- the dewatering system design, including design criteria and loading;
- the location, type and dimensions of each dewatering system to be used;
- a schematic showing the configuration of all dewatering systems;
- the material and dimensions of dewatering system components to ensure stability of the design excavation and the dewatering system, and the construction sequence and schedule of each component for which the dewatering system is designed.

The QVE shall review all calculations, construction details, shop drawings and procedures.

All submissions shall bear the seal and signature of the Dewatering System Design Engineer and QVE.

Certificates of Conformance

The Dewatering System Design Engineer shall inspect the installation of each component prior to the executing of the next stage in that dewatering system. After the installation/construction of each component, the Contractor shall submit a Certificate of Conformance to the Contract Administrator, sealed and signed by the Dewatering System Design Engineer. The Certificates of Conformance shall state that the dewatering system is in place, and has been installed in conformance with the stamped shop drawings and the Contract Drawings.

The Contractor will note that several Certificates of Conformance may be required, each to coincide with each dewatering system installation.

902.07 CONSTRUCTION

Section OPSS 902.07 of OPSS 902 is amended by the addition of the following:

All concrete work must be carried out in the dry.

Minimum dimensions for the inside face of the dewatering system shall be sufficient for installation of the new culvert.

902.10 BASIS OF PAYMENT

Section OPSS 902.10 of OPSS 902 is amended by the addition of the following:

Payment at the contract price for the dewatering systems shall be full compensation for all labour, equipment and materials to carry out the work.

NOTICE TO CONTRACTOR

Special Provision

FOUNDATION CONDITIONS

The Contractor is advised of the following foundation conditions:

Occasional cobbles were identified within the fill material. Although boulders were not identified at the advanced borehole locations, site photographs indicate the presence of some rock fill and the potential for boulders to be present.

The foundation soils, sensitive clay in particular, will be very susceptible to disturbance and weakening as a result of traffic, standing water and frost. Any foundation soils that could be disturbed should be protected. The bottom of the excavation on which the culvert or granular pad is to rest shall not be disturbed. The bedding placement shall commence immediately after the final removal of material to the foundation level has been completed.

DRAWINGS

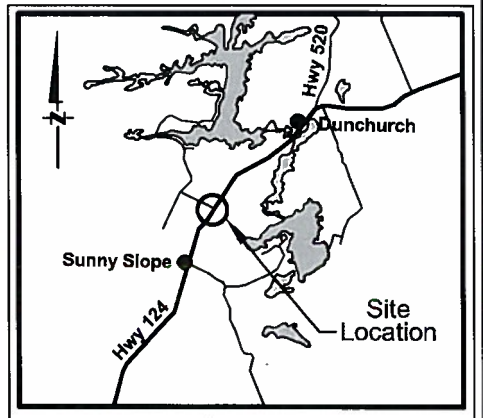
METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLES OTHERWISE SHOWN. STATIONS IN KILOMETERS + METERS

CONT	No	5010-E-0007
GWP	No	5424-06-00
WP	No	5424-06-01
Site	No	44-288

CULVERT REPLACEMENT
AT FARLEY CREEK
Highway 124 – Hagerman Twp.
Borehole Location Plan

SHEET



KEY PLAN
0 8
SCALE IN KILOMETRES

FARLEYS ROAD
Asphalt
Gravel
Bush
Creek
Beaver Dam
450 x 17.14 CSP
750 x 20.45 CSP
3000 mm x 150.0 m CSP
Inlet
Outlet
TSP 225
TSP 226
21+100
21+000
20+900
P-2441-22
P-2441-23
P-2441-23 Bush
BH1
BH2
BH3
BH4
H&B
2.0 RC
OH
OB
CGR
FG
LOT 53
CON A

LEGEND

- Borehole
- Borehole with DCPT
- Dynamic Cone Penetration Test (DCPT)
- Rock Probe
- 'N' Blows/0.3m (Std. Pen Test, 475 J/Blow)
- Water level at time of investigation.
- Benchmark
- Fill
- Organics
- Topsoil
- Till
- Bedrock
- Sand
- Silt
- Clay
- Sand & Gravel
- Boulders

No.	Elevation	Northing	Easting	Station	Offset
BH1	255.308	5054582	275306	21+029	15.0 LT
BH2	255.388	5054570	275328	21+030	10.0 RT
BH3	259.143	5054578	275315	21+030	5.5 LT
BH4	259.068	5054572	275323	21+029	4.8 RT

NOTE: Coordinates based on MTM Zone 10

SCALE
10m 0 20m

LICENSED PROFESSIONAL ENGINEER
28th/03/11
M. W. BO
100126834
PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER
2011 03 28
M. FABIUS
PROVINCE OF ONTARIO

NOTE:
The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed by interpolation and may not represent actual conditions.

DST consulting engineers
DST Consulting Engineers Inc.
605 Hewitson Street
Thunder Bay, ON P7B 5V5
Ph: (807) 623-2929
Fx: (807) 623-1792
Email: thunderbay@dstgroup.com

DRAWING 1

MINISTRY OF TRANSPORTATION, ONTARIO RR-5-707 85-05

METRIC
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CULVERT REPLACEMENT
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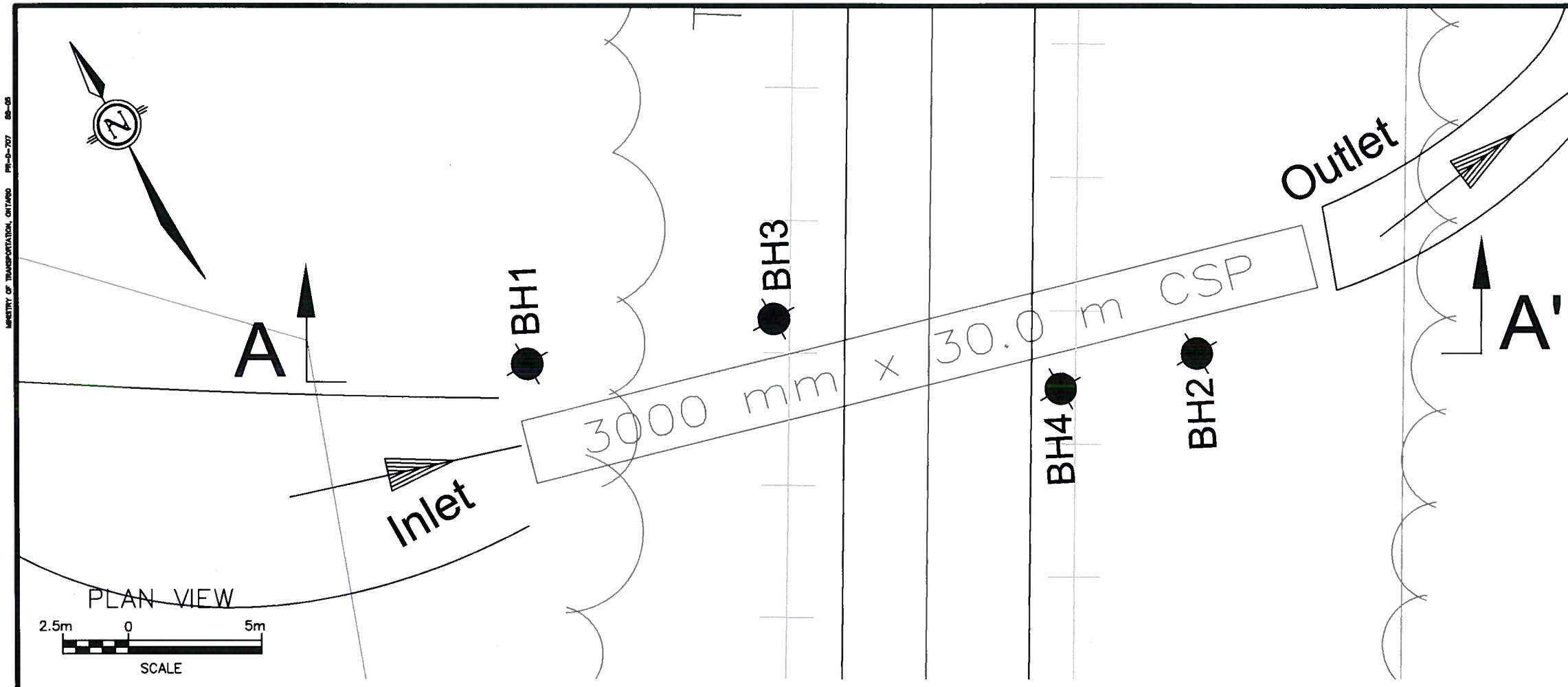
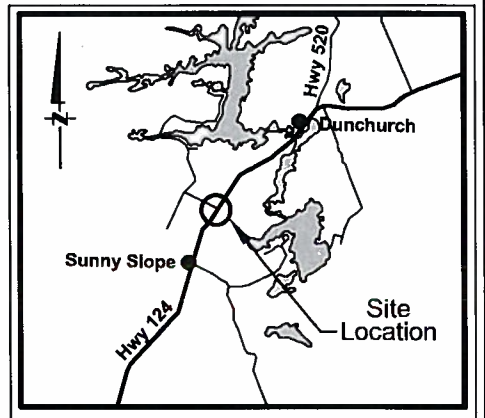
Borehole Location & Soil Stratigraphy

SHEET 20





LEGEND

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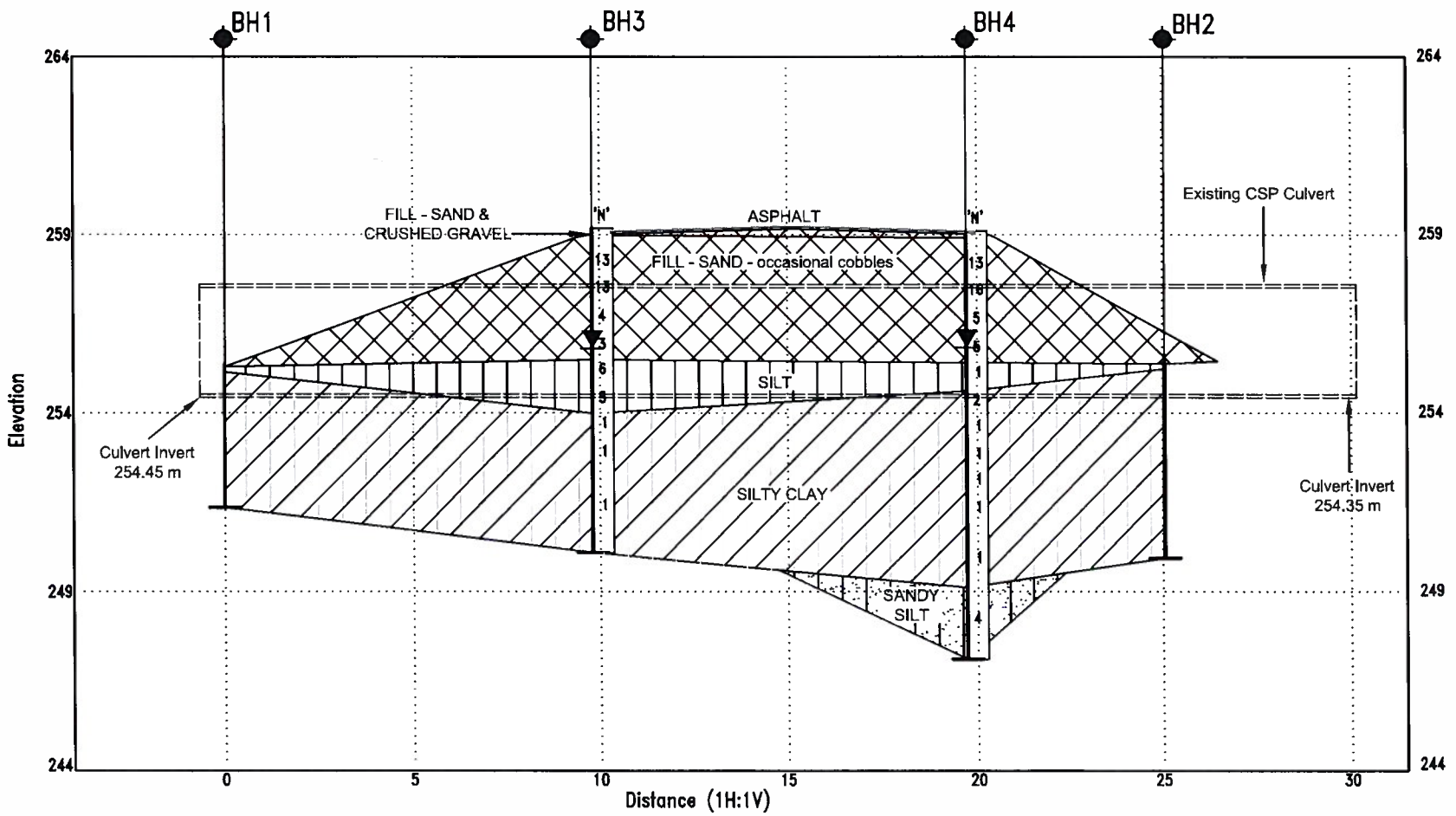

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LICENSED PROFESSIONAL ENGINEER
28/03/11
M. W. BO
100129334
PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER
20110327
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PROVINCE OF ONTARIO

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DST consulting engineers
DST Consulting Engineers Inc.
605 Hewitson Street
Thunder Bay, ON P7B 5V5
Ph: (807) 623-2929
Fx: (807) 623-1792
Email: thunderbay@dstgroup.com

DRAWING 2

MINISTRY OF TRANSPORTATION, ONTARIO FR-0-707 89-05

METRIC
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CULVERT REPLACEMENT
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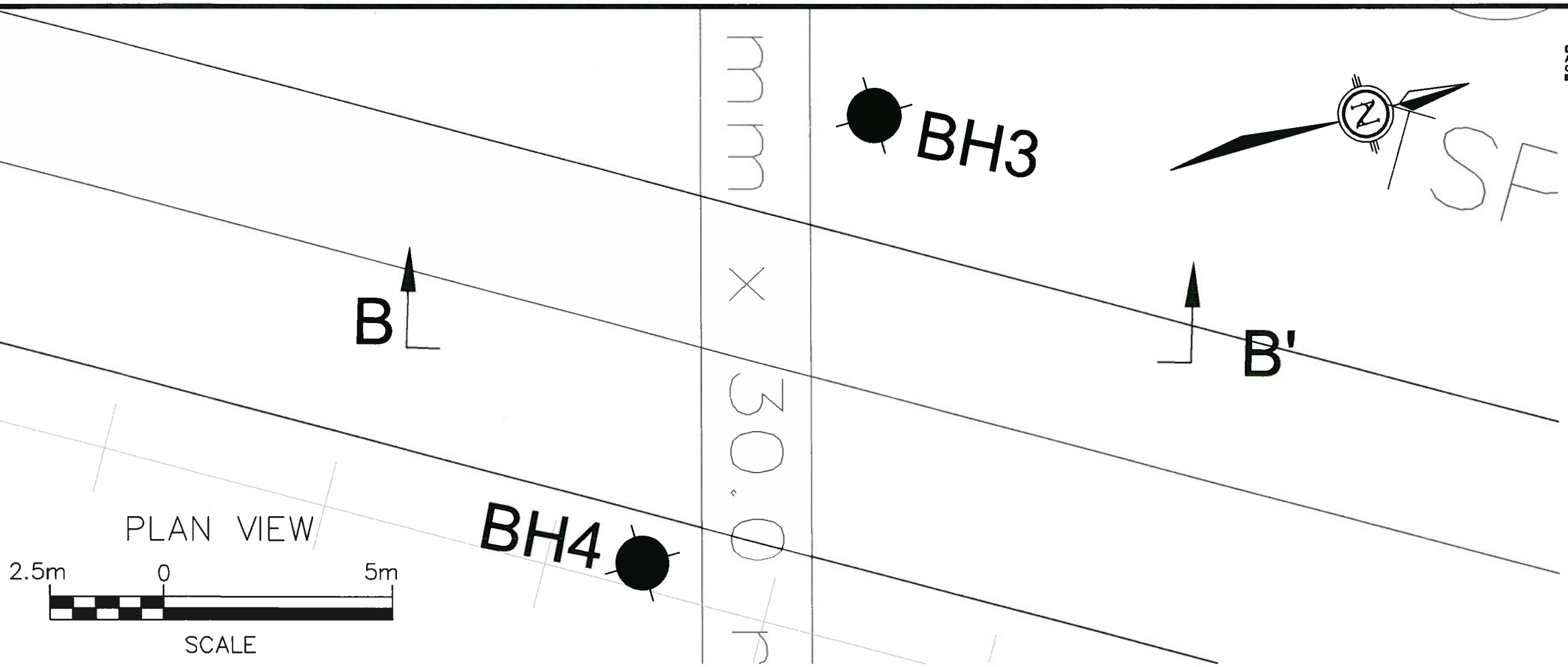
Borehole Location & Soil Stratigraphy

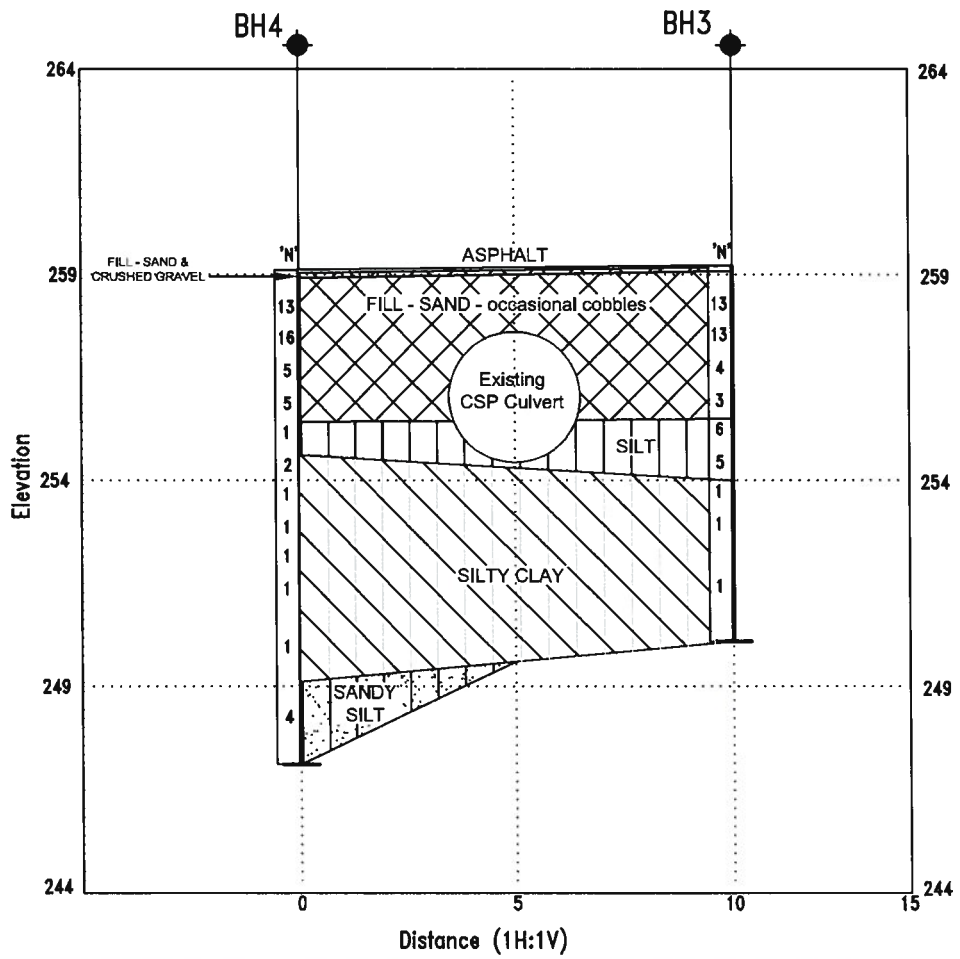
SHEET 21

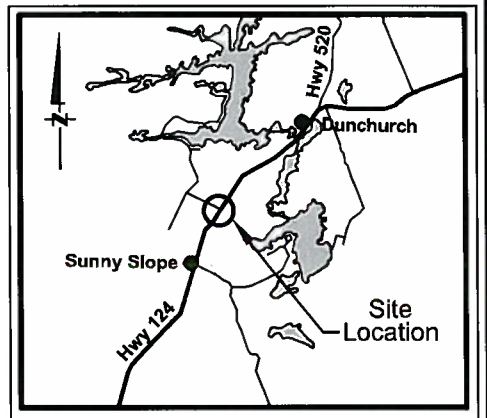


PLAN VIEW

2.5m 0 5m

SCALE





KEY PLAN
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SCALE IN KILOMETRES

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- Borehole
- Borehole with DCPT
- Dynamic Cone Penetration Test (DCPT)
- Rock Probe
- 'N' Blows/0.3m (Std. Pen Test, 475 J/Blow)
- Water level at time of investigation.
- Benchmark

Fill, Organics, Topsoil, Till, Bedrock
Sand, Silt, Clay, Sand & Gravel, Boulders

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28/03/11
M. W. BO
100129834
PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER
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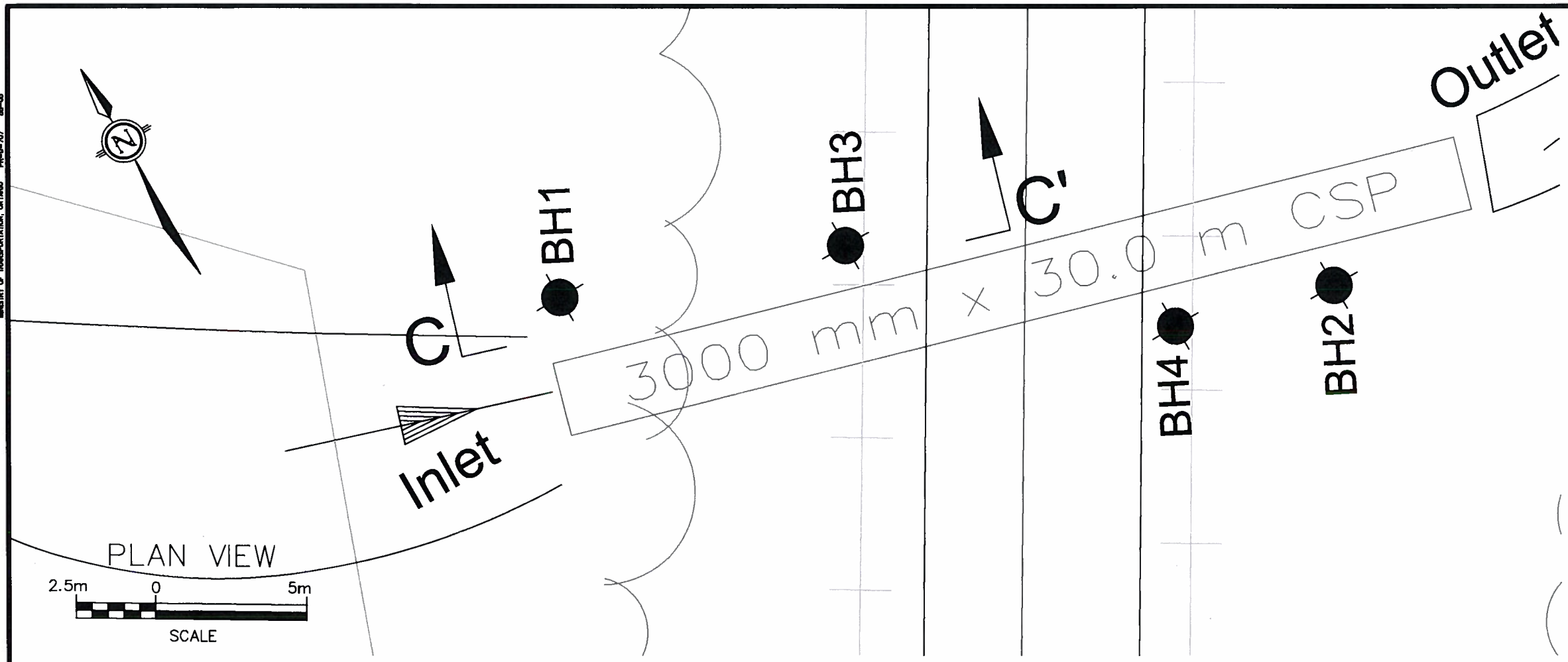
605 Hewitson Street
Thunder Bay, ON P7B 5V5
Ph: (807) 623-2929
Fx: (807) 623-1792
Email: thunderbay@dstgroup.com

DRAWING 3

MINISTRY OF TRANSPORTATION, ONTARIO FR-0-707 09-05



PLAN VIEW

2.5m 0 5m

SCALE

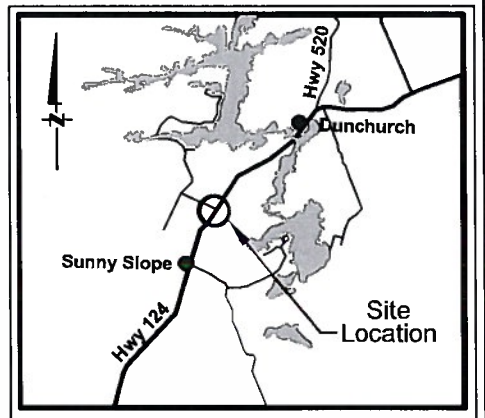
METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETERS + METERS

CONT	No	5010-E-0007
GWP	No	5424-06-00
WP	No	5424-06-01
Site	No	44-288

CULVERT REPLACEMENT
AT FARLEY CREEK
Highway 124 – Hagerman Twp.
Borehole Location & Soil Stratigraphy

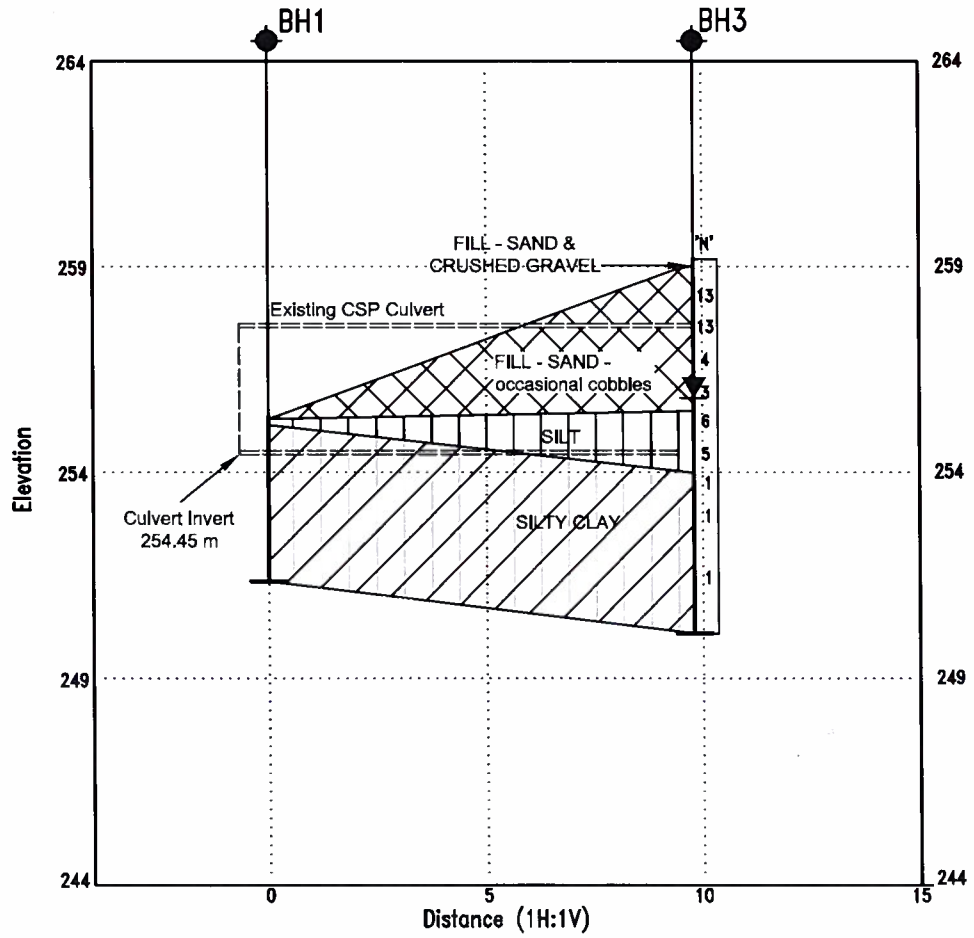
SHEET 22



KEY PLAN

0 8

SCALE IN KILOMETRES



LEGEND

- Borehole
- Borehole with DCPT
- Dynamic Cone Penetration Test (DCPT)
- Rock Probe
- 'N' Blows/0.3m (Std. Pen Test, 475 J/Blow)
- Water level at time of investigation.
- Benchmark
- Fill
- Organics
- Topsoil
- Till
- Bedrock
- Sand
- Silt
- Clay
- Sand & Gravel
- Boulders

No.	Elevation	Northing	Easting	Station	Offset
BH1	255.308	5054582	275306	21+029	15.0 LT
BH2	255.388	5054570	275328	21+030	10.0 RT
BH3	259.143	5054578	275315	21+030	5.5 LT
BH4	259.068	5054572	275323	21+029	4.8 RT

NOTE: Coordinates based on MTM Zone 10

LICENSED PROFESSIONAL ENGINEER
25/03/11
M. W. BO
100125834
PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER
2011 03 28
M. FABIUS
PROVINCE OF ONTARIO

NOTE:
The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed by interpolation and may not represent actual conditions.

DST consulting engineers
DST Consulting Engineers Inc.
605 Hewitson Street
Thunder Bay, ON P7B 5V5
Ph: (807) 623-2929
Fx: (807) 623-1792
Email: thunderbay@dstgroup.com

DRAWING 4

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLES OTHERWISE SHOWN. STATIONS IN KILOMETERS + METERS

CONT	No	5010-E-0007
GWP	No	5424-06-00
WP	No	5424-06-01
Site	No	44-288

CULVERT REPLACEMENT
AT FARLEY CREEK
Highway 124 – Hagerman Twp.
STAGE 1

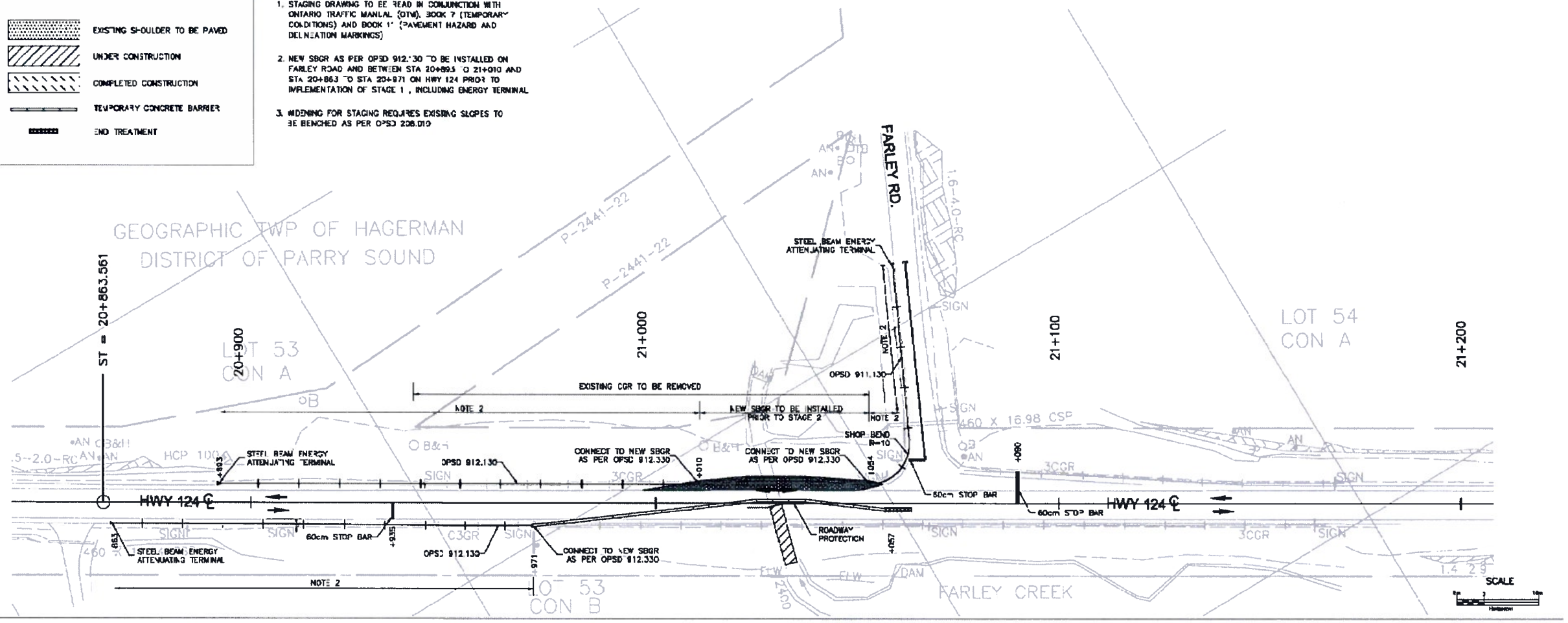
SHEET

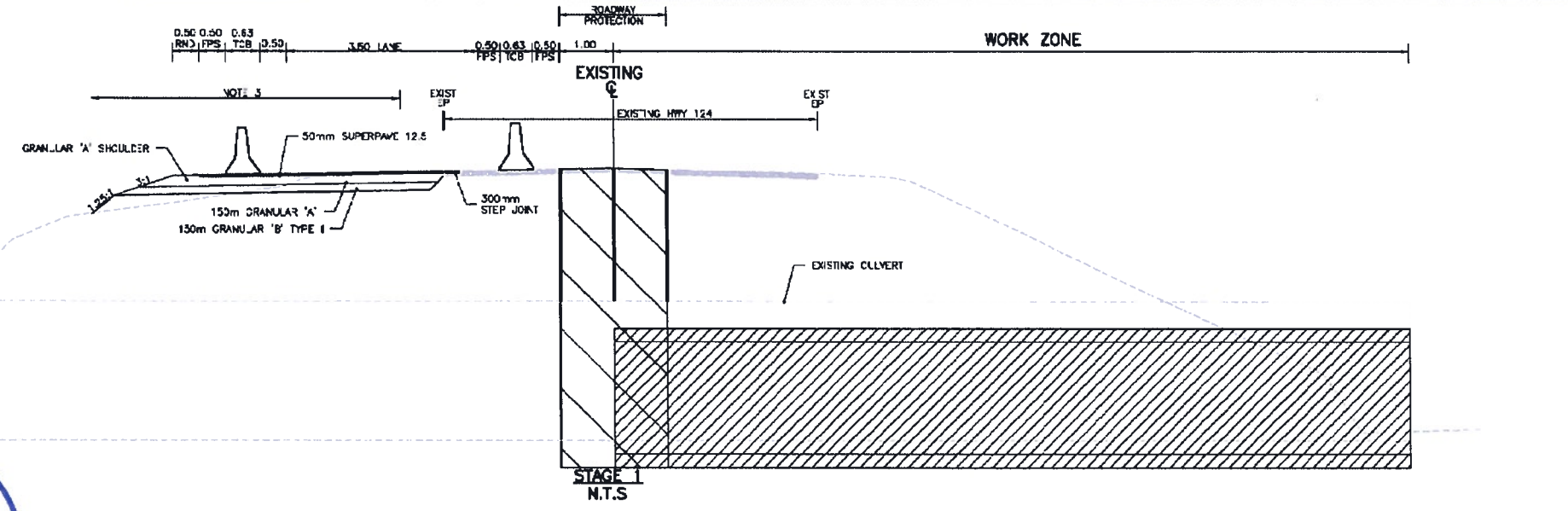
LEGEND

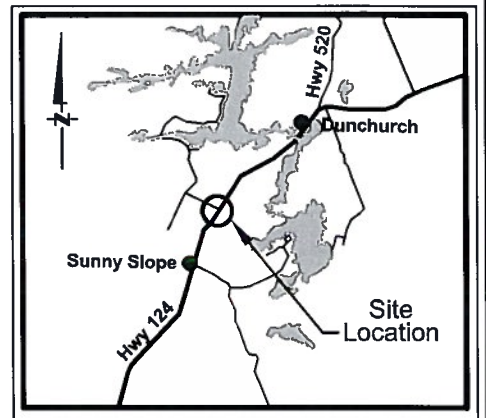
- EXISTING SHOULDER TO BE PAVED
- UNDER CONSTRUCTION
- COMPLETED CONSTRUCTION
- TEMPORARY CONCRETE BARRIER
- END TREATMENT

NOTES:

1. STAGING DRAWING TO BE READ IN CONJUNCTION WITH ONTARIO TRAFFIC MANUAL (OTM), BOOK 7 (TEMPORARY CONDITIONS) AND BOOK 11 (PAVEMENT HAZARD AND DELINEATION MARKINGS)
2. NEW SBGR AS PER OPSD 912.130 TO BE INSTALLED ON FARLEY ROAD AND BETWEEN STA 20+895 TO 21+010 AND STA 20+863 TO STA 20+971 ON HWY 124 PRIOR TO IMPLEMENTATION OF STAGE 1 , INCLUDING ENERGY TERMINAL
3. WIDENING FOR STAGING REQUIRES EXISTING SLOPES TO BE BENCHED AS PER OPSD 208.010







KEY PLAN
0 8
SCALE IN KILOMETRES

LEGEND

- Borehole
- Borehole with DCPT
- Dynamic Cone Penetration Test (DCPT)
- Rock Probe
- 'N' Blows/0.3m (Std. Pen Test, 475 J/Blow)
- Water level at time of investigation.
- Benchmark
- Fill
- Organics
- Topsoil
- Till
- Bedrock
- Sand
- Silt
- Clay
- Sand & Gravel
- Boulders

No.	Elevation	Northing	Easting	Station	Offset
BH1	255.308	5054582	275306	21+029	15.0 LT
BH2	255.388	5054570	275328	21+030	10.0 RT
BH3	259.143	5054578	275315	21+030	5.5 LT
BH4	259.068	5054572	275323	21+029	4.8 RT

NOTE: Coordinates based on MTM Zone 10

LICENSED PROFESSIONAL ENGINEER
28th 03 11
M. W. BO
100129834
PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER
2011 03 28
M. FABIUS
PROVINCE OF ONTARIO

NOTE: Drawing provided by Genivar

NOTE:
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Thunder Bay, ON P7B 5V5
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DRAWING 5

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLES OTHERWISE SHOWN. STATIONS IN KILOMETERS + METERS

CONT	No	5010-E-0007
GWP	No	5424-06-00
WP	No	5424-06-01
Site	No	44-288

CULVERT REPLACEMENT
AT FARLEY CREEK
Highway 124 – Hagerman Twp.
STAGE 2

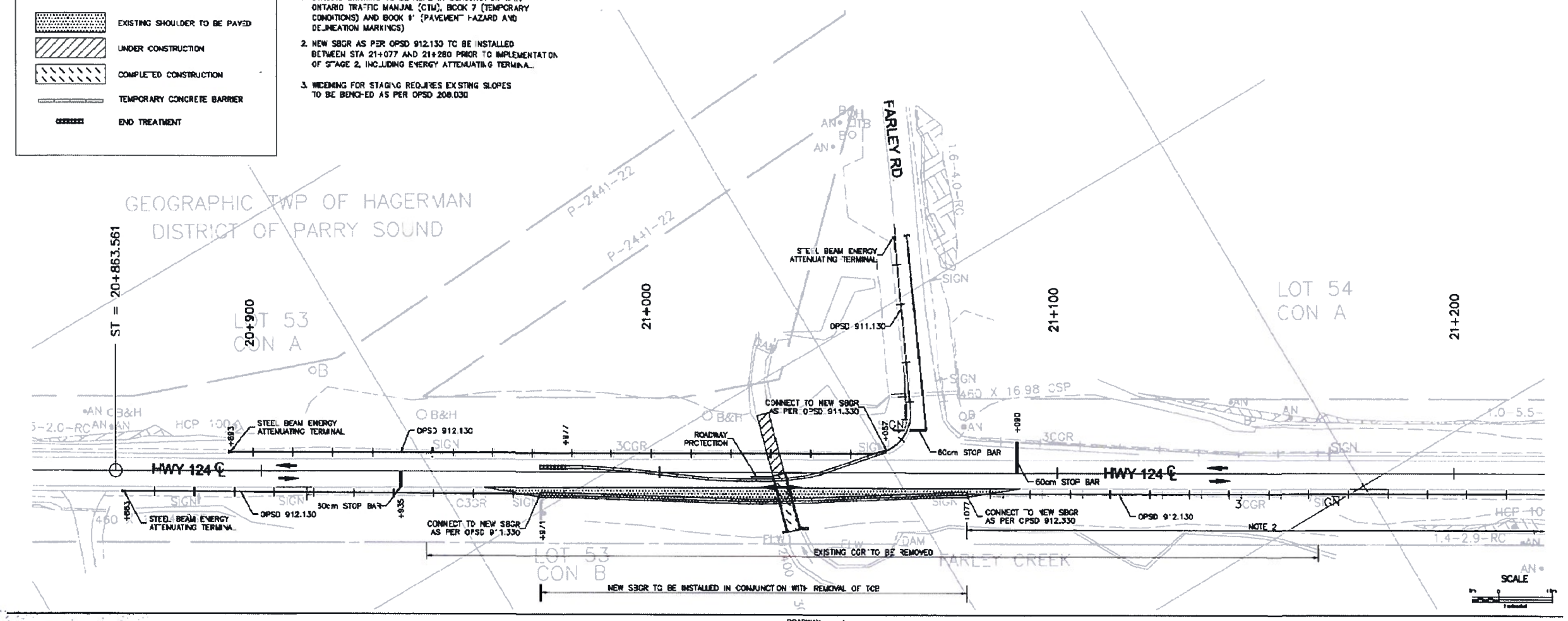
SHEET

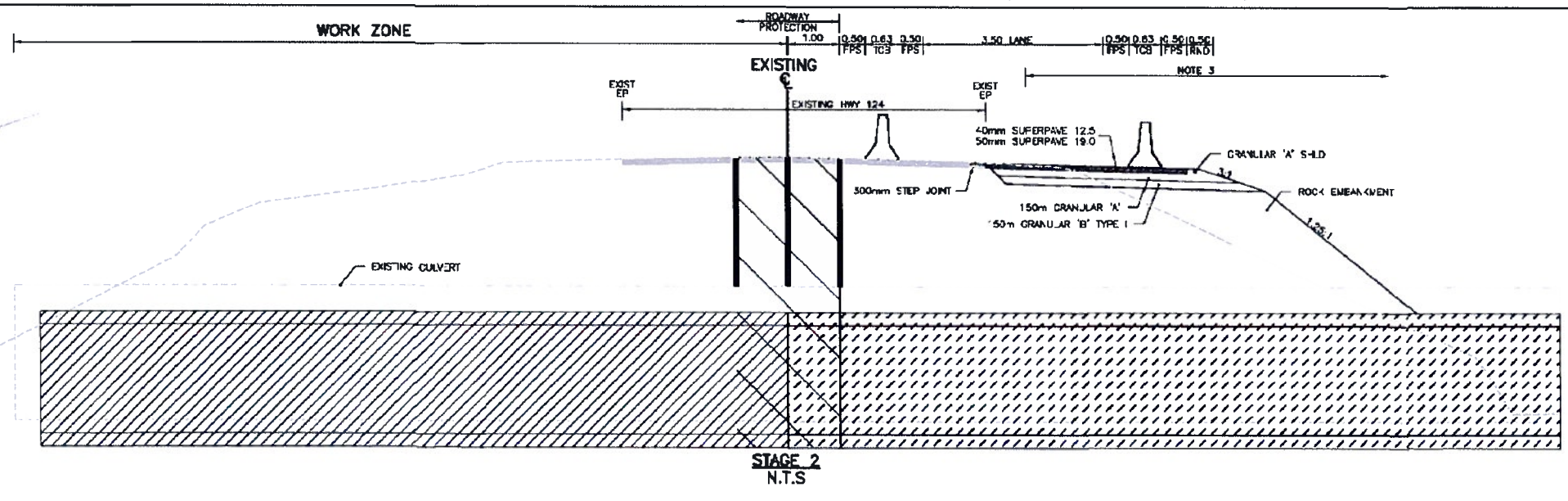
LEGEND

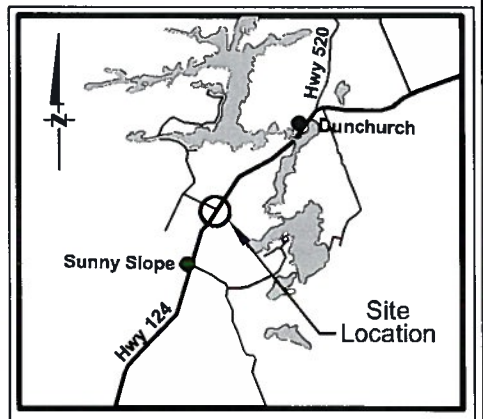
- EXISTING SHOULDER TO BE PAVED
- UNDER CONSTRUCTION
- COMPLETED CONSTRUCTION
- TEMPORARY CONCRETE BARRIER
- END TREATMENT

NOTES:

1. STAGING DRAWING TO BE READ IN CONJUNCTION WITH ONTARIO TRAFFIC MANUAL (OTM), BOOK 7 (TEMPORARY CONDITIONS) AND BOOK 8 (PAVEMENT HAZARD AND DELINEATION MARKINGS)
2. NEW SBGR AS PER OPSD 912.130 TO BE INSTALLED BETWEEN STA 21+077 AND 21+280 PRIOR TO IMPLEMENTATION OF STAGE 2, INCLUDING ENERGY ATTENUATING TERMINA...
3. WIDENING FOR STAGING REQUIRES EXISTING SLOPES TO BE BENCH-ED AS PER OPSD 208.030







KEY PLAN
0 8
SCALE IN KILOMETRES

LEGEND

- Borehole
- Borehole with DCPT
- Dynamic Cone Penetration Test (DCPT)
- Rock Probe
- 'N' Blows/0.3m (Std. Pen Test, 475 J/Blow)
- Water level at time of Investigation.
- Benchmark
- Fill
- Organics
- Topsoil
- Till
- Bedrock
- Sand
- Silt
- Clay
- Sand & Gravel
- Boulders

No.	Elevation	Northing	Easting	Station	Offset
BH1	255.308	5054582	275306	21+029	15.0 LT
BH2	255.388	5054570	275328	21+030	10.0 RT
BH3	259.143	5054578	275315	21+030	5.5 LT
BH4	259.068	5054572	275323	21+029	4.8 RT

NOTE: *Coordinates based on MTM Zone 10*

REGISTERED PROFESSIONAL ENGINEER
2011 03 28
M. FABIUS
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
28/03/11
M. W. BO
100129834
PROVINCE OF ONTARIO

NOTE: *The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed by interpolation and may not represent actual conditions.*

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NOTE: *Drawing provided by Genivar*

DRAWING 6

ENCLOSURES

RECORD OF BOREHOLE No BH1

1 OF 1

METRIC

W.P. #5010-E-0007 - Farley Creek | LOCATION STA. 21+029, 15.0 LT (17T 5053645 m N, 587497 m E) | ORIGINATED BY PR/KS

DIST | HWY 124 | BOREHOLE TYPE Hollow Stem Auger (80 mm ID) | COMPILED BY ML

DATUM Local | DATE 2010 10 06 | CHECKED BY LP/MWB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, □ QUICK TRIAXIAL, × FIELD VANE, ★ LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
255.3	GROUND SURFACE										
255.2 / 0.1	TOPSOIL - 60 mm										
255.1 / 0.2	SAND - Silty, trace organics, brown										Wet at surface.
	CLAY - Silty, grey/brown, stiff to very stiff		AS1	AS			255	× 130	●		0 2 (98)
			AS2	AS			254	× 4			
253.3											
2.0	CLAY - Silty, trace gravel, grey/red, firm to stiff		AS3	AS			253	× 2	●		
							252	× 4, × 2, × 2			
251.3											
4.0	End of Borehole at 4.0 m										

× 3, ★ 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ON_MOT GS-TB-012143 - GENIVAR - #5010-E-0007 - FARLEY CREEK CULVERT.GPJ DST_MIN.GDT 9/2/11

ENCLOSURE 1

RECORD OF BOREHOLE No BH2

1 OF 1

METRIC

W.P. #5010-E-0007 - Farley Creek | LOCATION STA. 21+030, 10.0 RT (17T 5053596 m N, 587465 m E) | ORIGINATED BY PR/KS

DIST | HWY 124 | BOREHOLE TYPE Hollow Stem Auger (80 mm ID) | COMPILED BY ML

DATUM Local | DATE 2010 10 06 | CHECKED BY LP/MWB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, □ QUICK TRIAXIAL, × FIELD VANE, ★ LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
255.4	GROUND SURFACE										
255.3 / 0.1	TOPSOIL - 60 mm										Wet at surface.
255.2 / 0.2	SAND - Silty, trace gravel, brown/grey		AS1	AS			255				1 15 72 12
	CLAY - Silty, grey, firm to stiff		AS2	AS							
			AS3	AS			254				
			AS4	AS			253				
			AS5	AS			252				
							251				
249.9							250				0 10 73 17
5.5	End of Borehole at 5.5 m										

$\times^3$, $\star^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ON_MOT GS-TB-012143 - GENIVAR - #5010-E-0007 - FARLEY CREEK CULVERT.GPJ DST_MIN.GDT 9/2/11

ENCLOSURE 2

RECORD OF BOREHOLE No BH3

1 OF 1

METRIC

W.P. #5010-E-0007 - Farley Creek | LOCATION STA. 21+030, 5.5 LT (17T 5053595 m N, 587417 m E) | ORIGINATED BY PR/KS

DIST | HWY 124 | BOREHOLE TYPE Hollow Stem Auger (80 mm ID) | COMPILED BY ML

DATUM Local | DATE 2010 10 06 | CHECKED BY LP/MWB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ✕ FIELD VANE □ QUICK TRIAXIAL ★ LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
259.1	GROUND SURFACE										
259.0 / 0.1	FILL - SAND & CRUSHED GRAVEL		AS1	AS			259				
	FILL - SAND - Gravelly to some gravel, trace silt, occasional cobbles, brown, very loose to compact										32 63 (5) Water level at 3.2 m on completion. Cave at 3.2 m.
			SS2	SS	13		258				
			SS3	SS	13						14 75 (11)
			SS4	SS	4		257				
			SS5	SS	3	▽	256				21 71 (8)
255.4 / 3.7	SILT - some clay, trace sand and organics, grey, firm		SS6	SS	6		255				
			SS7	SS	5						0 3 81 16
253.9 / 5.2	CLAY - Silty, grey/red, soft to stiff		SS8	SS	1		254	✕5			
			SS9	SS	1		253	✕3			0 12 64 24
			SS10	SS	1		252				
250.0 / 9.1	End of Borehole at 9.1 m Auger Refusal						251	✕3			

✕³, ★³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ON_MOT GS-TB-012143 - GENIVAR - #5010-E-0007 - FARLEY CREEK CULVERT.GPJ DST_MIN.GDT 9/2/11

ENCLOSURE 3

RECORD OF BOREHOLE No BH4

1 OF 1

METRIC

W.P. #5010-E-0007 - Farley Creek | LOCATION STA. 21+029, 4.8 RT (17T 5053597 m N, 587456 m E) | ORIGINATED BY PR/KS

DIST | HWY 124 | BOREHOLE TYPE Hollow Stem Auger (80 mm ID) | COMPILED BY ML

DATUM Local | DATE 2010 10 06 | CHECKED BY LP/MWB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
259.1	GROUND SURFACE							
259.0 / 0.1	ASPHALT - 70 mm		AS1	AS			259	
258.9 / 0.2	FILL - SAND & CRUSHED GRAVEL							
	FILL - SAND - some silt and gravel, occasional cobbles, brown, loose to compact		SS2	SS	13		258	12 74 (14)
			SS3	SS	16		257	
	- - - - - trace gravel		SS4	SS	5			7 81 (12)
			SS5	SS	5	▽	256	
255.4								
3.7	SILT - some clay, trace sand, grey/brown, very soft		SS6	SS	1		255	0 8 79 13
254.6								
4.5	CLAY - Silty, trace sand, layered, grey, soft to stiff		SS7	SS	2		254	
			SS8	SS	1			
			SS9	SS	1		253	
			SS10	SS	1		252	
			SS11	SS	1			0 5 69 26
							251	
			SS12	SS	1		250	
249.1								
10.0	SILT - Sandy, trace clay, layered, grey, very loose		SS13	SS	4		249	0 20 75 5
							248	
247.1								
12.0	End of Borehole at 12.0 m Auger Refusal							

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED ✕ FIELD VANE □ QUICK TRIAXIAL ★ LAB VANE; 20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%): 20 40 60

UNIT WEIGHT γ kN/m³

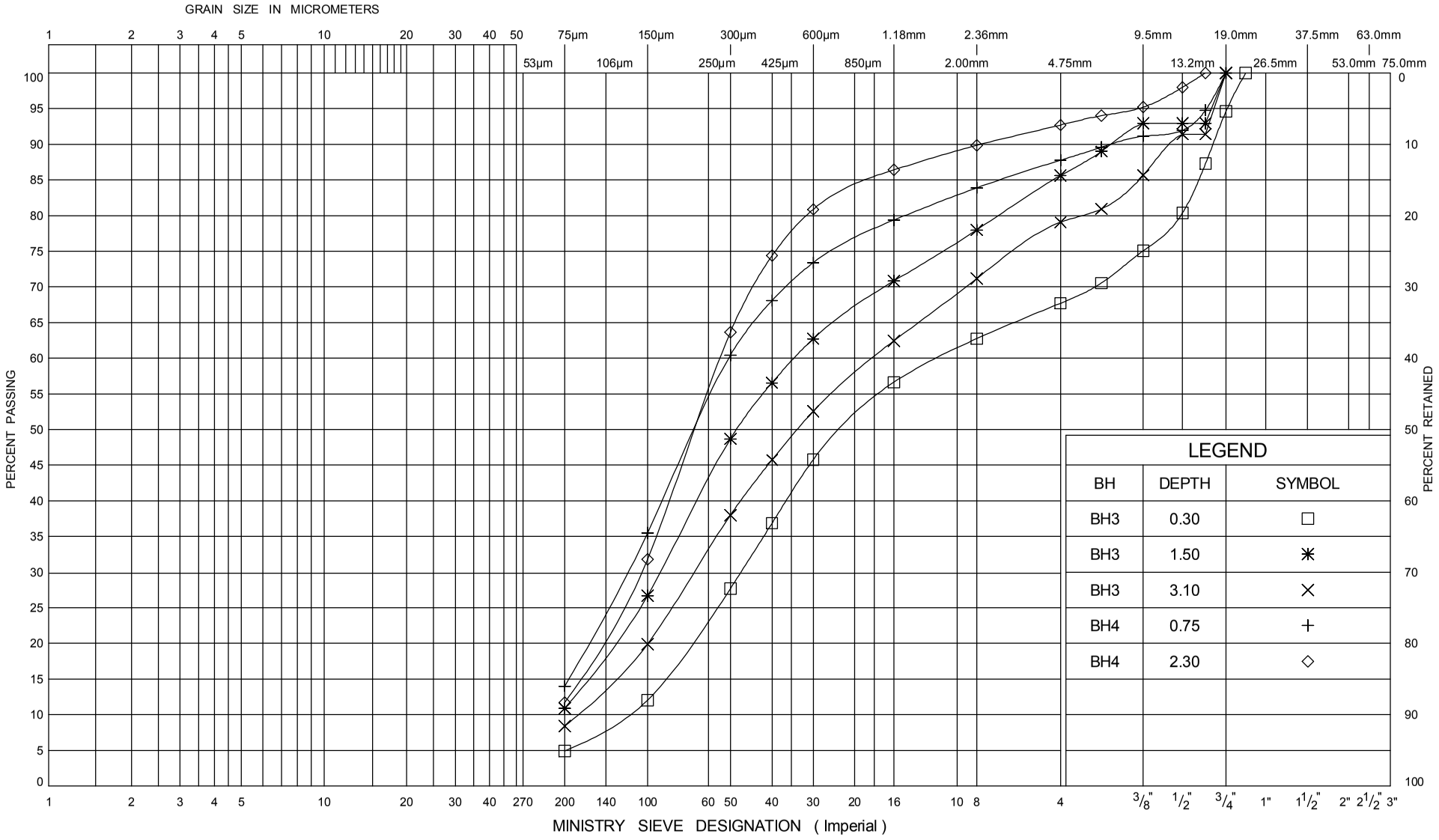
✕[3], ★[3]: Numbers refer to Sensitivity ○[3%] STRAIN AT FAILURE

Water level at 3.1 m on completion. Cave at 7.9 m.

ON_MOT GS-TB-012143 - GENIVAR - #5010-E-0007 - FARLEY CREEK CULVERT.GPJ DST_MIN.GDT 9/2/11

ENCLOSURE 4

UNIFIED SOIL CLASSIFICATION SYSTEM



ONTARIO MOT GRAIN SIZE GS-TB-012143 - GENIVAR - #5010-E-0007 - FARLEY CREEK CULVERT.GPJ DST_MIN.GDT 18/10/10

Ontario

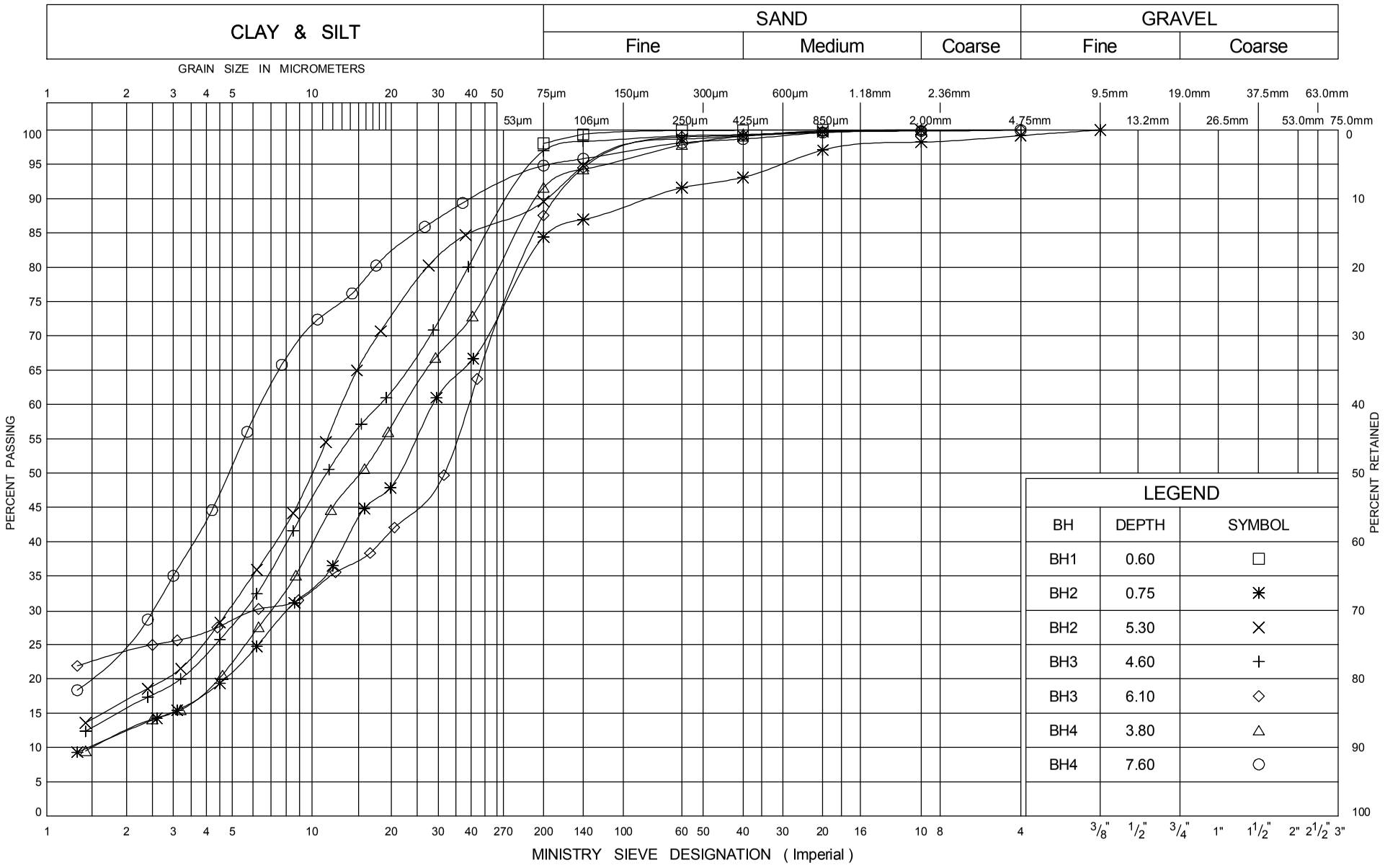
GRAIN SIZE DISTRIBUTION
SAND

ENCLOSURE 5

#5010-E-0007 - Farley Creek

HIGHWAY 124

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND		
BH	DEPTH	SYMBOL
BH1	0.60	□
BH2	0.75	✳
BH2	5.30	×
BH3	4.60	+
BH3	6.10	◇
BH4	3.80	△
BH4	7.60	○

Ontario

GRAIN SIZE DISTRIBUTION
SILTY CLAY

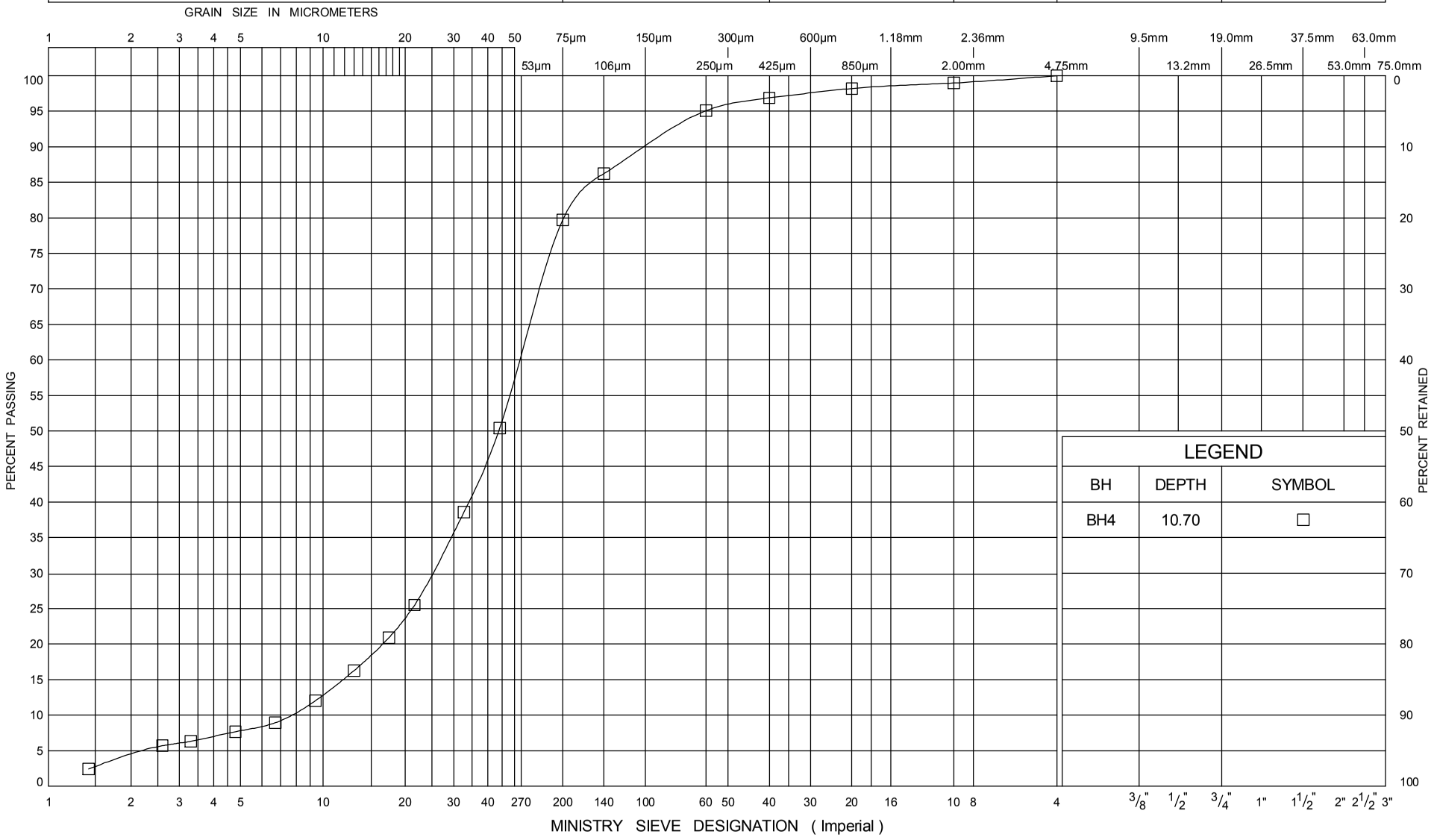
ENCLOSURE 6

#5010-E-0007 - Farley Creek

HIGHWAY 124

ONTARIO MOT GRAIN SIZE GS-TB-012143 - GENIVAR - #5010-E-0007 - FARLEY CREEK CULVERT.GPJ DST_MIN.GDT 19/10/10

UNIFIED SOIL CLASSIFICATION SYSTEM



ONTARIO MOT GRAIN SIZE GS-TB-012143 - GENIVAR - #5010-E-0007 - FARLEY CREEK CULVERT.GPJ DST_MIN.GDT 19/10/10

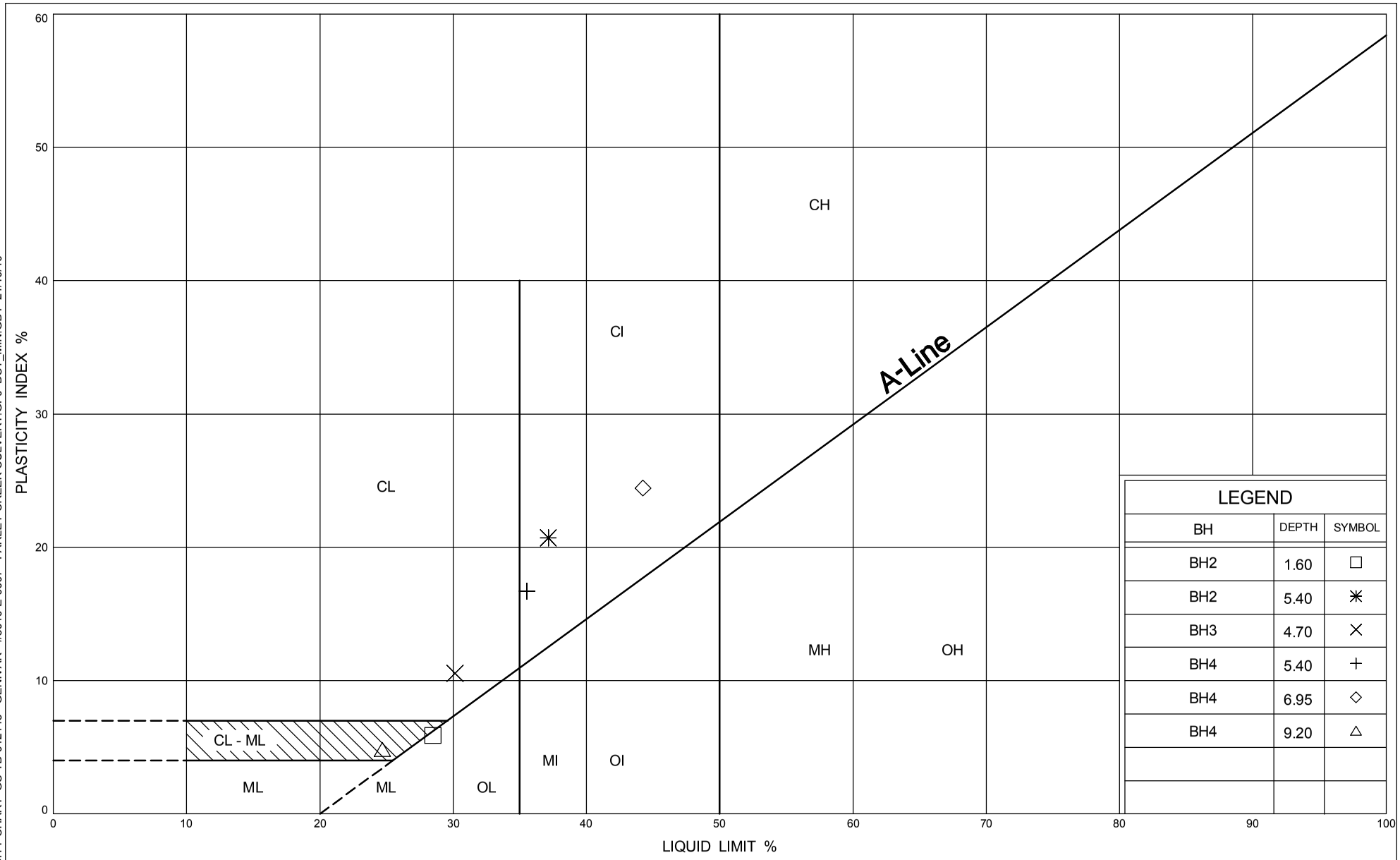
Ontario

GRAIN SIZE DISTRIBUTION
SANDY SILT

ENCLOSURE 7

#5010-E-0007 - Farley Creek

HIGHWAY 124



ONTARIO MOT PLASTICITY CHART GS-TB-012143 - GENIVAR - #5010-E-0007 - FARLEY CREEK CULVERT.GPJ DST_MIN.GDT 21/10/10

Ontario

PLASTICITY CHART

ENCLOSURE 8

#5010-E-0007 - Farley Creek

HIGHWAY 124