



2020-07-22

Public

Shannon Kohler, Director
Environmental Approvals Branch
Conservation and Climate
1007 Century Street
Winnipeg, MB R3H 0W4

Subject: Notice of Alteration - Notre Dame de Lourdes Wastewater Treatment Lagoon
Client ref.: File no. 2840.00

Dear Madam:

On behalf of the Municipality of Lorne, WSP Canada Inc. (WSP) is pleased to submit a Notice of Alteration regarding the intercell dyke repair for the Notre Dame de Lourdes Wastewater Treatment Lagoon.

Should you have any questions or require further information, please contact Dana Bredin at (204)-259-1486 or dana.bredin@wsp.com.

Kind regards,

Dana Bredin, P.Eng.
Project Manager

cc: Robert Boswick, P.Eng., Manitoba Conservation and Climate
Shannon Gauthier, CAO – Municipality of Lorne
Lilliane Sorin, Municipality of Lorne

Encl.
WSP ref.: 181-13386-00

1600 Buffalo Place
Winnipeg (Manitoba) R3T 6B8
Canada

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NOTICE OF ALTERATION

TO: Shannon Kohler, Director – Conservation and Climate, Environmental Approvals
FROM: Dana Bredin, P.Eng. – WSP Canada Inc.
SUBJECT: Notre Dame de Lourdes Lagoon Intercell Dyke Repair
DATE: July 22, 2020

INTRODUCTION

WSP Canada Inc. (WSP) is presently engaged with the Municipality of Lorne to provide professional engineering services regarding the repair to the intercell dyke of the Local Urban District (LUD) of Notre Dame de Lourdes wastewater treatment lagoon. As part of this process, we are pleased to submit a Notice of Alteration for review and approval by the Environmental Approvals Branch of Manitoba Conservation and Climate.

BACKGROUND

The existing two-cell facultative wastewater treatment lagoon is located within SE 02-07-09 WPM, approximately 1.2 km west of the LUD of Notre Dame de Lourdes, immediately north of Provincial Road (PR) 245. The primary cell is situated at the south end of the lagoon, and the secondary cell is situated at the north end. The lagoon currently operates under the Clean Environment Commission Order No. 1125.

The lagoon receives wastewater from the LUD's wastewater collection system, via a lift station and forcemain. It also receives truck-hauled septage from the surrounding rural residents. The lagoon storage period is set by the CEC Order, which allows discharging from May 15th to October 31st. The lagoon currently discharges into the low-lying marsh area north of the lagoon, which eventually flows back south around the perimeter of the lagoon to a drain south of PR 245.

The lagoon was originally constructed in 1987, with a soil liner expected to achieve a permeability of only 1×10^{-5} cm/s. During construction, permeability testing of the lagoon dykes was completed to determine the hydraulic conductivity of the embankment material. Results ranged from 2.8×10^{-7} cm/s to 4.5×10^{-9} cm/s. [1]

In 2005, accumulated biosolids (sludge) were removed from around the inlet pipe and truck dumping station in the primary cell, and pumped to a temporary dewatering bed at the southwest corner of the lagoon site. The dewatered biosolids were transferred to a waste disposal ground in 2006.



Of note, the discharge pipe invert was installed at 0.71 m above the floor of the secondary cell. [1] This positioning not only affects the Municipality's ability to adequately discharge the lagoon, but also contributes to high water levels in the lagoon almost every spring, thus exacerbating the dyke erosion issue. Unfortunately, the discharge pipe invert cannot be set any lower as existing ground elevations in the low-lying marsh area do not allow for gravity discharge of the secondary cell any lower than its current invert elevation.

GEOTECHNICAL SITE INVESTIGATION

On May 26, 2020, WSP completed a geotechnical assessment of the lagoon perimeter dykes to characterize and determine whether the embankment material and in-situ soils beneath would be suitable as an impervious liner system.

Eight (8) test holes were drilled by Maple Leaf Drilling using an Acker MP-5 track-mounted drill with a continuous flight solid stem auger (125 mm diameter). The test holes were drilled to depths ranging from 3.0 to 4.6 metres below grade (mbg).

Select samples were submitted for moisture content testing, particle size analysis and Atterberg limits. In addition, six (6) Shelby tube soil samples were obtained and of these two (2) were subsequently tested for hydraulic conductivity. Material testing was completed by Eng-Tech Consulting located in Winnipeg, MB.

The general soil profile reveals a topsoil layer of approximately 25 mm to 150 mm followed by a fill layer (embankment) consisting of a silt loam material, with the clay fraction ranging from 20 to 30%. Beneath the fill layer was a silt layer (>80% silt) which extended to the bottom of the test holes at 3.0 to 4.6 mbg.

Seepage and caving conditions were observed during our investigation within the in-situ silt layer in TH20-01. Water was measured at 2.0 mbg approximately 4 hours after drilling. No seepage or caving conditions were noted in the other seven test holes. Detailed descriptions of the test holes, TH20-01 to TH20-08 are enclosed.

Selected samples were submitted for laboratory analysis of moisture contents, particle size analysis, and Atterberg limits, with two samples also selected for hydraulic conductivity testing. The test results are also enclosed.

Of the six (6) Shelby tube samples, three (3) were taken within the embankment material (ST-1, ST-3 & ST-5), two (2) were taken at the interface between the embankment material and the in-situ material (ST-4 & ST-6) and one (1) was taken in the in-situ silt layer.

A particle size analysis and Atterberg limits were conducted on each Shelby tube sample. As previously discussed, the particle size analysis results indicate that the embankment material is a silty loam and the in-situ material is a silt. The Atterberg limits results indicate that both the embankment material and the in-situ material are classified as a medium-plastic clay material.

Two samples (ST-3 & ST-6) were submitted to determine the hydraulic conductivity of the embankment material, one in the upper portion (0.9 to 1.5 mbg) and one in the lower portion (2.15 to 2.45 mbg). Both samples are considered to be representative of the embankment material used to construct the lagoon dykes.

The hydraulic conductivity of ST-3 and ST-6 were 2.6×10^{-7} cm/s and 1.0×10^{-8} cm/s, respectively. These results are consistent with what was previously found during the post-construction testing in 1987.

Additionally, two (2) samples collected during a test dig of a potential borrow area north of the lagoon on September 19, 2019, were also submitted to Eng-Tech for particle size analysis and Atterberg limits. TP1, sampled at 0.3 mbg was found to be a silt material of medium plasticity, and TP2 sampled at 0.9 mbg was found to be a silt loam material of medium plasticity (31% clay fraction). This material may be considered for the repair of the eroded interior slopes, if required.

LAGOON DYKE REPAIR

The interior slopes of the lagoon dykes have experienced various levels of erosion. The area with the most significant erosion is located along the intercell dyke, which is currently at imminent risk of collapse (see [Figure 1](#)).



Figure 1 - Intercell dyke looking east

Large diameter (>300 mm) rip rap was previously placed on the north and east secondary cell dykes. This is the only location where rip rap has been installed at the lagoon, and consequently are the only two dykes where erosion is minimal.

WSP, on behalf of the Municipality, is proposing to repair the intercell dyke before it collapses and armour it with rip rap to prevent future erosion. The following methodology is proposed for the intercell dyke repair and rip rap armoring:

1. The Municipality will first isolate, test and discharge the secondary cell. The remaining liquid in the cell (below the discharge pipe) will then be pumped over the dyke into the adjacent discharge ditch, which will expose the floor of the cell.
2. Work will begin on the secondary cell side of the intercell dyke. Topsoil and vegetation will be stripped and stockpiled. The eroded dyke slope will be scarified and compacted prior to receiving any embankment material. The material used to complete the repair will be sourced from the previously eroded dyke material, which is currently mounded at the toe of the dyke. This material will be excavated, placed and compacted to form a proper 4H:1V slope.
3. A non-woven geotextile and a 300 mm thick layer of rip rap will then be placed on the repaired slope.
4. Once work has completed on the secondary cell, the valve between the primary and secondary cells will be opened. After the cells equalize, the valve will be closed and the remainder of the liquid in the primary cell will be pumped into the secondary cell, exposing the floor of the primary cell. The slope will be repaired in a similar manner as the secondary cell. Rip rap with geotextile will then be placed.
5. If borrow material is required for the embankment material, a borrow area has been identified north of the secondary cell. Topsoil and vegetation are to be stripped prior to accessing the borrow material.
6. Once the dyke repair is completed and rip rap placed, the topsoil and seed will be placed on the intercell dyke above the rip rap.

Detailed design drawings of the proposed works are enclosed.

CONCLUSION

The Municipality is anticipating completing the dyke repair works in 2020. We look forward to your timely response on this matter. If you have any questions or require further information, please contact the undersigned.

REFERENCES

- [1] O. Wohlgemut and J. Cousin, "Letter Report for the Notre Dame de Lourdes Wastewater Treatment Lagoon Assessment," JR Cousin Consultants Ltd., Winnipeg, 2016.



Dana Bredin, P.Eng.
Project Manager

Encl.

Cc: Robert Boswick, P.Eng., Manitoba Conservation and Climate
Shannon Gauthier, CAO – Municipality of Lorne
Lilliane Sorin, Municipality of Lorne

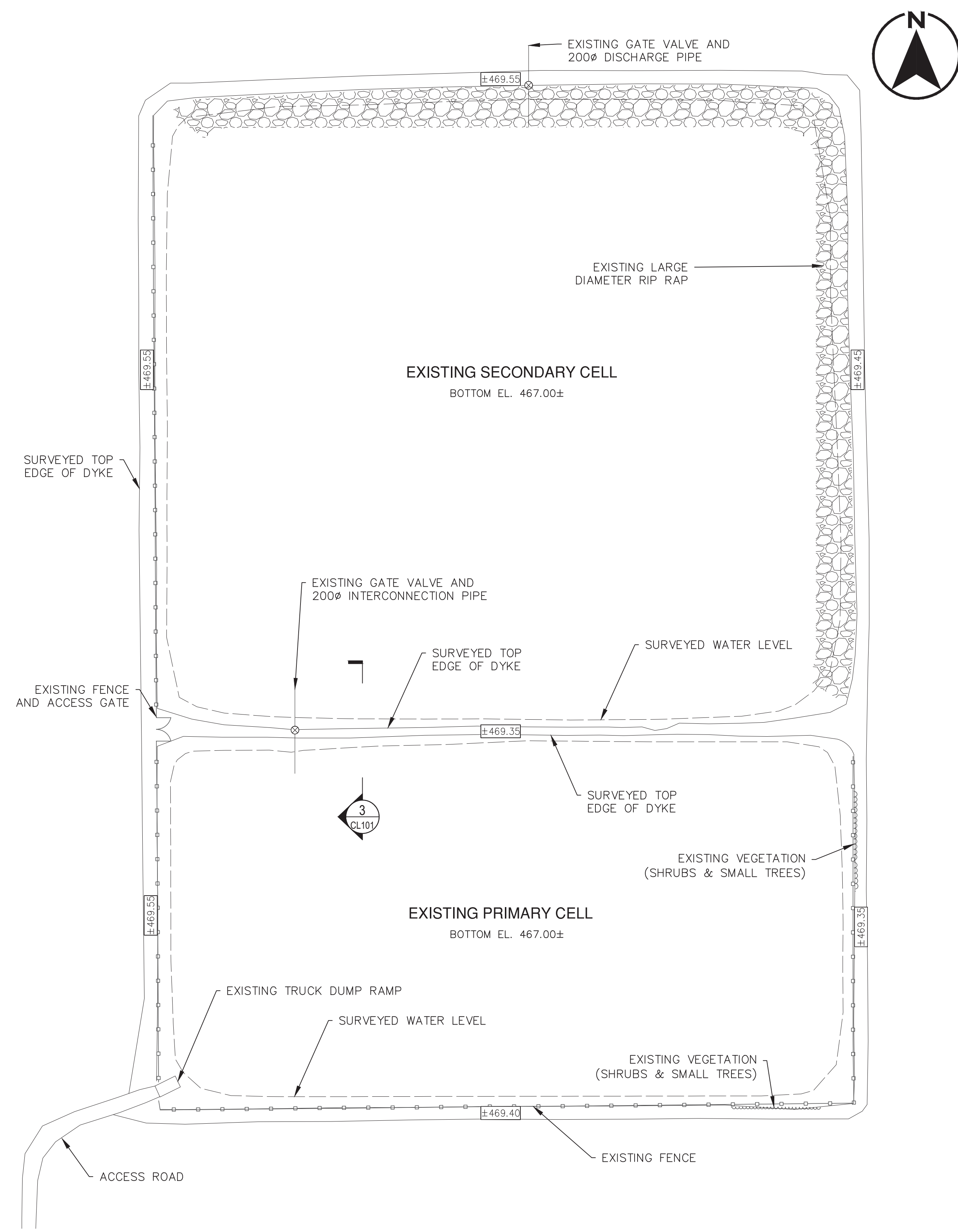
APPENDIX

A

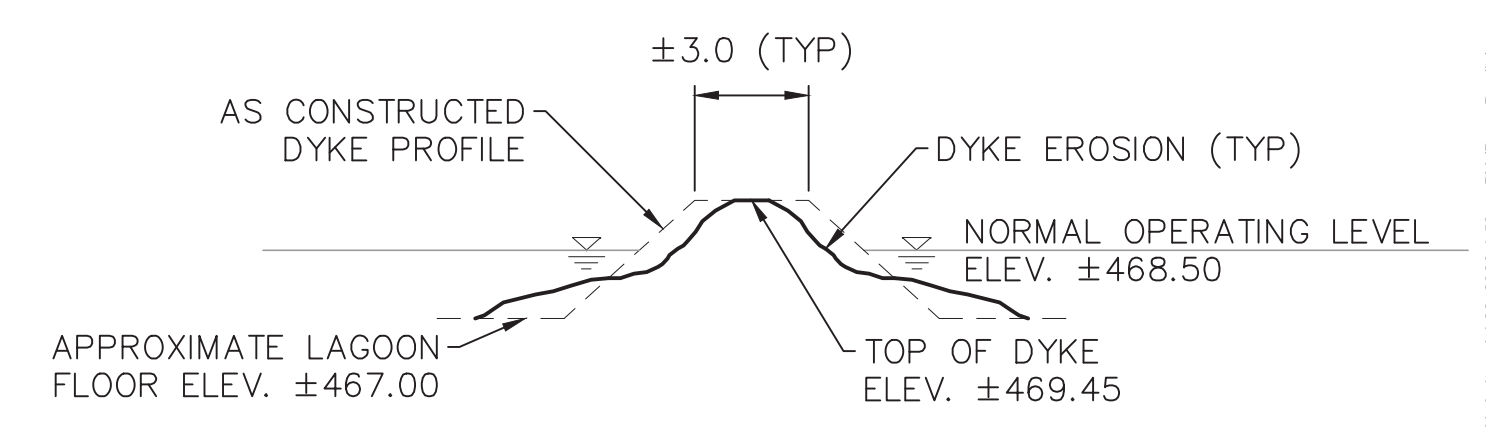
PRELIMINARY
DRAWINGS



1 NOTRE DAME DE LOURDES LAGOON OVERALL SITE PLAN
CL101 1:2000



2 EXISTING LAGOON SITE PLAN
CL101 1:750



3 EXISTING INTERCELL DYKE SECTION (TYP.)
CL101 N.T.S.

| EXISTING | LEGEND-PLAN | PROPOSED | EXISTING | LEGEND-PLAN | PROPOSED |
|----------|------------------------------|----------|----------|-----------------------|----------|
| 150 WM | WATER MAIN | 150 WM | 59.367 | GROUND ELEVATION | |
| 300 LDS | LAND DRAINAGE SEWER | 300 LDS | 00.00 | ROAD ELEVATION | 00.00 |
| 250 WWS | WASTE WATER SEWER | 250 WWS | 00.00 | DYKE ELEVATION | 00.00 |
| 250 FM | FORCEMAIN | 250 FM | 00.00 | DITCH ELEVATION | 00.00 |
| | GAS M.T.S. | | TH | SIGN / SURVEY BAR | |
| | OVERHEAD POWER | | HP | TEST HOLE/TEST PIT | |
| | UNDERGROUND POWER | | UHP | GLY WIRE / HYDRO POLE | |
| | EDGE OF ROAD / DYKE | | CS | CURB STOP / PLUG | |
| | DYKE TOE | | OH | VALVE / HYDRANT | |
| | PROPERTY LINE | | MC | MAN-HOLE / CLEANOUT | |
| | FENCE | | RR | RIP RAP | |
| | TREE OR SHRUB LINE | | R | ROADWAY | |
| | CULVERT | | C | CONCRETE | |
| | CATCH BASIN / FLOW DIRECTION | | E | EASEMENTS | |
| | DITCH | | CL | CLAY CORE | |

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THIS DRAWING IS NOT TO BE SCALED.

| IS | RE | DATE | DESCRIPTION |
|----|----|------------|-------------------------|
| 1 | 0 | 2020/07/22 | ENVIRONMENTAL APPROVALS |

SEAL:

CLIENT:

PRELIMINARY
NOT FOR CONSTRUCTION

PROJECT:

NOTRE-DAME-DE-LOURDES LAGOON DYKE REPAIR

CLIENT REF. #:

PROJECT NO. 181-13386-00

DATE: 2019/12/09

wsp

1800 BUFFALO PLACE
WINNEPEG, MANITOBA
CANADA R0T 6B0
PHONE: 204-477-8655 FAX: 204-477-2884
WWW.WSP.COM

ORIGINAL SCALE:
AS SHOWN

TITLE:

EXISTING SITE PLAN

SHEET NUMBER:

CL101
1 OF 2

DESIGNED BY:
D.G.T.B.

DRAWN BY:
M.J.S.

CHECKED BY:
D.G.T.B.

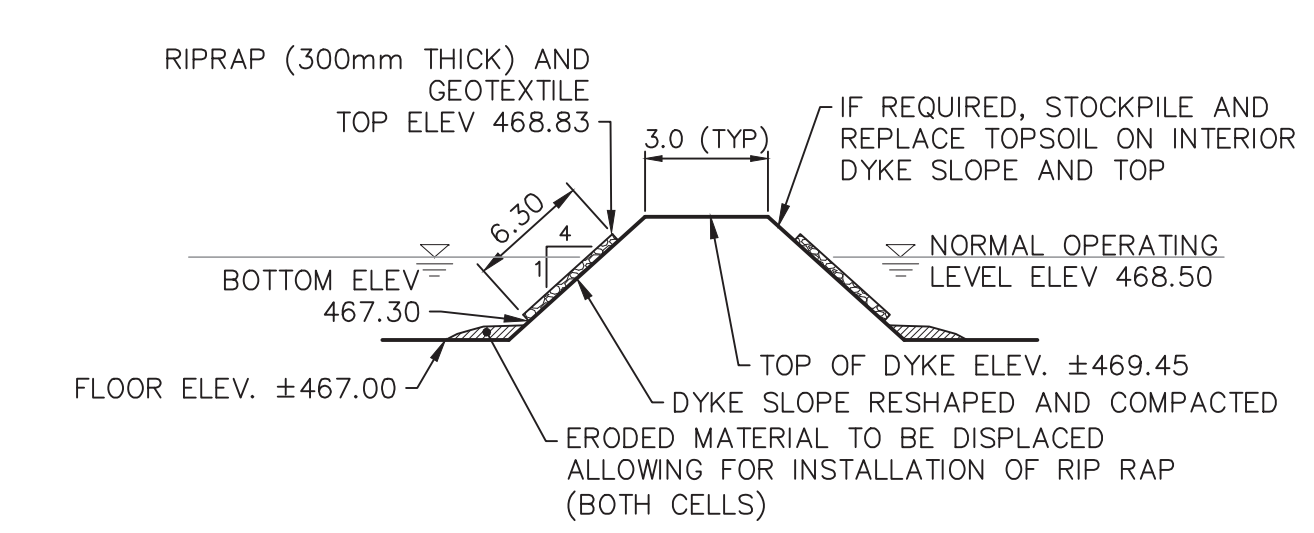
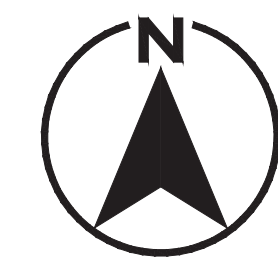
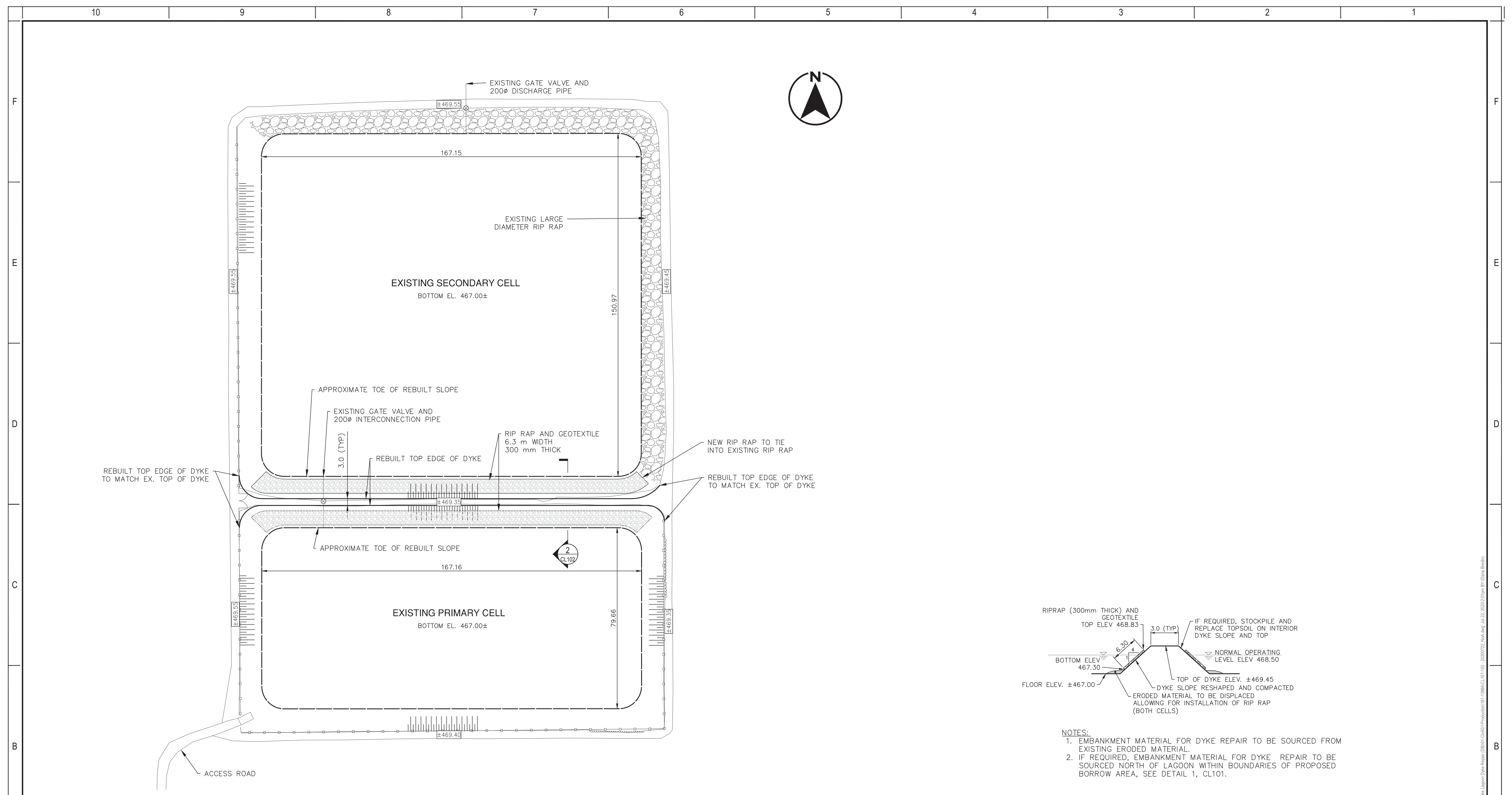
DISCIPLINE:
CIVIL

ISSUE:
ENVIRONMENTAL APPROVALS

DATE OF: 2020/07/22

REV #:
0

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- NOTES:**
1. EMBANKMENT MATERIAL FOR DYKE REPAIR TO BE SOURCED FROM EXISTING ERODED MATERIAL.
 2. IF REQUIRED, EMBANKMENT MATERIAL FOR DYKE REPAIR TO BE SOURCED NORTH OF LAGOON WITHIN BOUNDARIES OF PROPOSED BORROW AREA, SEE DETAIL 1, CL101.

1 PROPOSED LAGOON SITE PLAN
1:750

2 PROPOSED REPAIRED INTERCELL DYKE SECTION
NTS

| EXISTING | LEGEND-PLAN | PROPOSED | EXISTING | LEGEND-PLAN | PROPOSED |
|----------|------------------------------|----------|----------|-----------------------|----------|
| 59.367 | | | 59.367 | GROUND ELEVATION | |
| 150 WM | WATER MAIN | 150 WM | 00.00 | ROAD ELEVATION | 00.00 |
| 300 LDS | LAND DRAINAGE SEWER | 300 LDS | 00.00 | DYKE ELEVATION | 00.00 |
| 250 WWS | WASTE WATER SEWER | 250 WWS | 00.00 | DITCH ELEVATION | 00.00 |
| 250 FM | FORCEMAIN | 250 FM | | SIGN / SURVEY BAR | |
| | GAS M.T.S. | | TH | TEST HOLE/TEST PIT | |
| | OVERHEAD POWER | | HP | GYL WIRE / HYDRO POLE | |
| | UNDERGROUND POWER | | | CURB STOP / PLUG | |
| | EDGE OF ROAD / DYKE | | | VALVE / HYDRANT | |
| | DYKE TOE | | | MANHOLE / CLEANOUT | |
| | PROPERTY LINE | | | RIP RAP | |
| | FENCE | | | ROADWAY | |
| | TREE OR SHRUB LINE | | | CONCRETE | |
| | CULVERT | | | EASEMENTS | |
| | CATCH BASIN / FLOW DIRECTION | | | CLAY CORE | |
| | DITCH | | | | |

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THIS DRAWING IS NOT TO BE SCALED.

| | | | | | | |
|--|-----------------------|---|---|--|---|---|
| <p>PRELIMINARY NOT FOR CONSTRUCTION</p> | <p>CLIENT:</p> | <p>PROJECT: NOTRE-DAME-DE-LOURDES LAGOON DYKE REPAIR</p> | <p>1800 BUFFALO PLACE WINNIPEG, MANITOBA CANADA R0T 6B6 PHONE: 204-477-8655 FAX: 204-474-2884 WWW.WSP.COM</p> | <p>ORIGINAL SCALE: AS SHOWN</p> | <p>TITLE: PROPOSED SITE PLAN</p> | <p>DESIGNED BY: D.G.T.B.</p> |
| | | | | <p>CLIENT REF. #:</p> | <p>PROJECT NO.: 181-13386-00</p> | <p>DATE: 2019/12/09</p> |
| <p>ENVIRONMENTAL APPROVALS</p> | | <p>DATE OF: 2020/07/22</p> | | <p>REVISION: 0</p> | | |

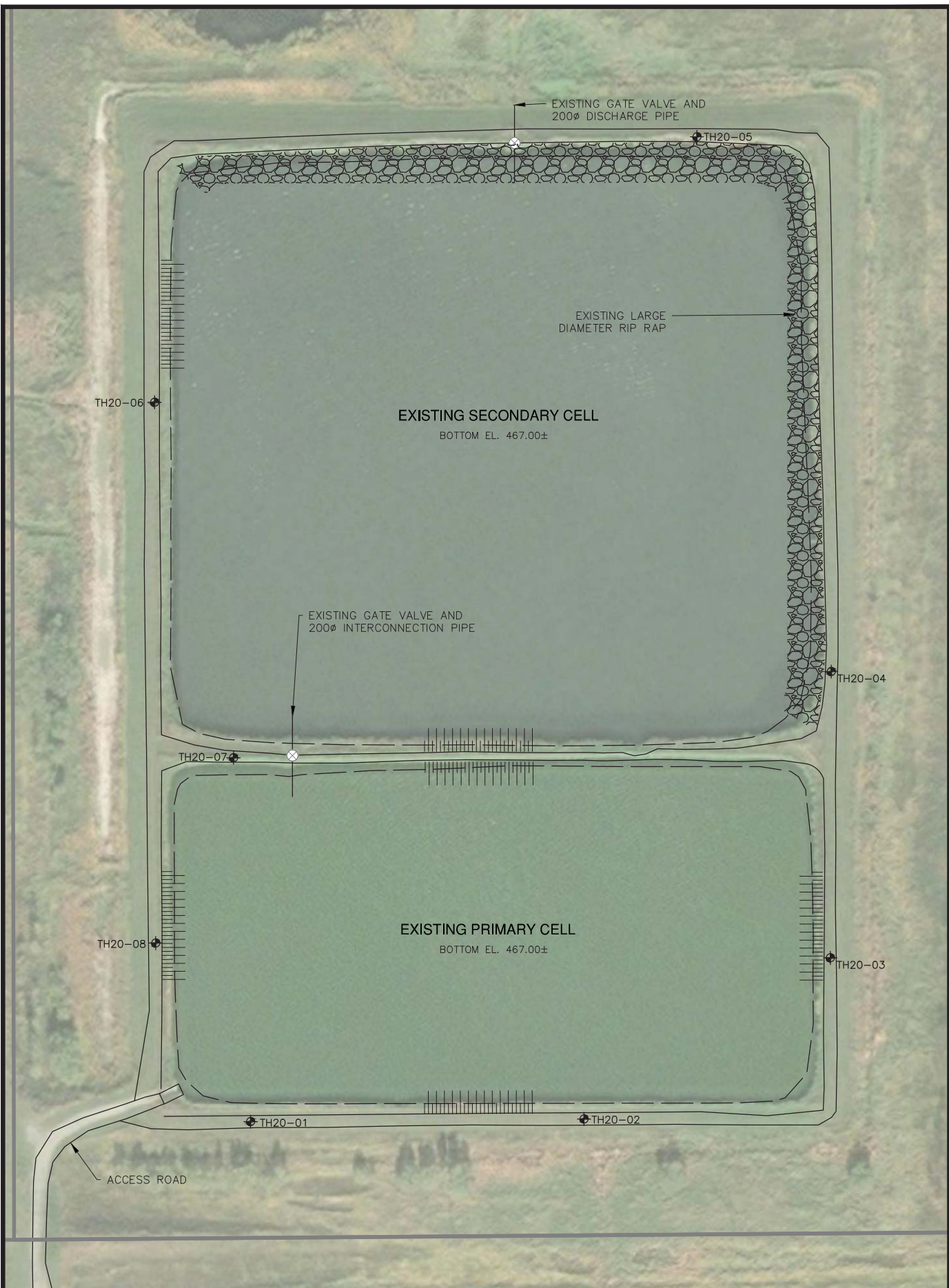
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APPENDIX

B

GEO TECHNICAL






1600 BUFFALO PLACE
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PHONE: 204-477-6650 FAX: 204-474-2864
WWW.WSPGROUP.COM

TITLE:
**NOTRE DAME DE LOURDES
WASTEWATER TREATMENT LAGOON
TESTHOLE LOCATIONS**

SCALE:
1:1500

DATE:
2020/07/22

PROJECT NO:
181-13386-00

REVISION:
0

DRAWING NO:
B-101



WSP
 1600 Buffalo Place
 Winnipeg, MB R3T 6B8
 Telephone: (204)-477-6650

TH20-01

PAGE 1 OF 1

CLIENT RM of Lorne

PROJECT NAME Notre Dame de Lourdes Lagoon Dyke Repair

PROJECT NUMBER 181-13386-00

PROJECT LOCATION Notre Dame de Lourdes, MB

DATE STARTED 5/26/20 COMPLETED 5/26/20

GROUND ELEVATION _____ HOLE SIZE 125 mm

DRILLING CONTRACTOR Maple Leaf Drilling

GROUND WATER LEVELS:

DRILLING METHOD Solid Stem Auger - MP-5 Track Rig

AT TIME OF DRILLING ---

LOGGED BY Dana Bredin CHECKED BY Wei Gao

AT END OF DRILLING 3.05 m

NOTES UTM Zone 14: 0530113 mE, 5486813 mN

4hrs AFTER DRILLING 2.00 m

| DEPTH (m) | GRAPHIC LOG | ELEV. (m) | WATER LEVEL | MATERIAL DESCRIPTION | SAMPLE TYPE NUMBER | BLOW COUNTS (N VALUE) | POCKET PEN. (kPa) | TORVANE (kPa) | MOISTURE CONTENT (%) | ▲ SPT N VALUE ▲ | |
|-----------|-------------|-----------|-------------|---|--------------------|-----------------------|-------------------|---------------|----------------------|-----------------|---------|
| | | | | | | | | | | PL | MC |
| | | | | | | | | | | qu (kPa) | Torvane |
| | | | | | | | | | | 100 200 300 400 | * |
| 1 | | | | TOPSOIL - Black, sandy, rootlets to 0.15 m FILL - Sandy silt with some clay, trace f. gravel, trace oxidation - Brown, moist to dry, stiff - Clayey, brown-black mixed, moist below 0.9 m - Silty, trace organics below 1.5 m - PSA at 1.5 m: 25.3% sand, 55.1% silt, 19.6% clay | | | | | | | |
| 2 | | | | | | | ST ST-1 | | | | 17 |
| 3 | | | | SILT - Brown to light grey, some clay, varved, firm, moist, trace oxidation - Soft, wet below 3.05 m - PSA at 3.05 m: 1.2% sand, 82.4% silt, 16.4% clay | | | | | | | |
| 4 | | | | | | | ST ST-2 | | | | 24 |

- Testhole open to 4.65 m upon completion
 - Water measured at 3.05 m upon completion
 - Backfilled with bentonite

GENERAL BH PLOTS - WSP_NDL_LAGOON_SOIL_LOGS.GPJ GINT STD CANADA.GDT 7/10/20

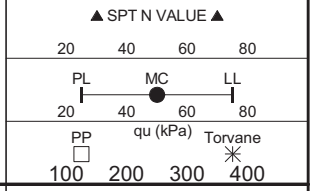


WSP
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 Telephone: (204)-477-6650

CLIENT RM of Lorne
 PROJECT NUMBER 181-13386-00
 DATE STARTED 5/26/20 COMPLETED 5/26/20
 DRILLING CONTRACTOR Maple Leaf Drilling
 DRILLING METHOD Solid Stem Auger - MP-5 Track Rig
 LOGGED BY Dana Bredin CHECKED BY Wei Gao
 NOTES UTM Zone 14: 0530207 mE, 5486813 mN

PROJECT NAME Notre Dame de Lourdes Lagoon Dyke Repair
 PROJECT LOCATION Notre Dame de Lourdes, MB
 GROUND ELEVATION _____ HOLE SIZE 125 mm
 GROUND WATER LEVELS:
 AT TIME OF DRILLING ---
 AT END OF DRILLING ---
 AFTER DRILLING ---

| DEPTH (m) | GRAPHIC LOG | ELEV. (m) | WATER LEVEL | MATERIAL DESCRIPTION | SAMPLE TYPE NUMBER | BLOW COUNTS (N VALUE) | POCKET PEN. (kPa) | TORVANE (kPa) | MOISTURE CONTENT (%) | ▲ SPT N VALUE ▲ | |
|-------------|-------------|-----------|-------------|---|--------------------|-----------------------|-------------------|---------------|----------------------|-----------------|----|
| | | | | | | | | | | 20 | 40 |
| 0.00 - 0.15 | | | | TOPSOIL - Black, rootlets to 0.15 m | | | | | | | |
| 0.15 - 2.45 | | | | FILL - Sandy silt with some clay, trace f. gravel - Brown-tan mixed, moist to dry, stiff - Brown-black mixed, trace organics below 0.75 m - Grey-black mixed below 1.2 m - Clayey, stiff below 2.45 m | | | | | | | |
| 2.45 - 4.35 | | | | SILT - Tan-brown, some clay, trace sand and gravel, firm, moist - Soft, moist, trace oxidation below 3.05 m - Light grey below 4.35 m | | | | | | | |



- Testhole open and dry to 3.35 m upon completion
 - Backfilled with bentonite

GENERAL BH PLOTS - WSP_NDL_LAGOON_SOIL_LOGS.GPJ_GINT_STD_CANADA.GDT_7/10/20



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TH20-03

PAGE 1 OF 1

CLIENT RM of Lorne

PROJECT NAME Notre Dame de Lourdes Lagoon Dyke Repair

PROJECT NUMBER 181-13386-00

PROJECT LOCATION Notre Dame de Lourdes, MB

DATE STARTED 5/26/20 COMPLETED 5/26/20

GROUND ELEVATION _____ HOLE SIZE 125 mm

DRILLING CONTRACTOR Maple Leaf Drilling

GROUND WATER LEVELS:

DRILLING METHOD Solid Stem Auger - MP-5 Track Rig

AT TIME OF DRILLING ---

LOGGED BY Dana Bredin CHECKED BY Wei Gao

AT END OF DRILLING ---

NOTES UTM Zone 14: 0530275 mE, 5486860 mN

AFTER DRILLING ---

| DEPTH (m) | GRAPHIC LOG | ELEV. (m) | WATER LEVEL | MATERIAL DESCRIPTION | SAMPLE TYPE NUMBER | BLOW COUNTS (N VALUE) | POCKET PEN. (kPa) | TORVANE (kPa) | MOISTURE CONTENT (%) | ▲ SPT N VALUE ▲ | | | | | | | | | |
|-----------|-------------|-----------|-------------|---|--------------------|-----------------------|-------------------|---------------|----------------------|-----------------|----|----|----|--|--|--|--|--|--|
| | | | | | | | | | | 20 | 40 | 60 | 80 | | | | | | |
| | | | | TOPSOIL - Black, rootlets to 0.15 m FILL - Sandy silt with some clay - Brown-grey mixed, moist to dry, stiff - Clayey, brown-black mixed, below 0.75 m - Grey-black mixed, trace organics below 1.5 m | | | | | | | | | | | | | | | |
| 1 | | | | | GB S1 | | | | 25 | | | | | | | | | | |
| 2 | | | | | GB S2 | | | | 23 | | | | | | | | | | |
| | | | | SILT - Brown, some clay, trace sand and f. gravel, firm, moist - Soft, moist to wet, trace oxidation below 2.6 m | GB S3 | | | | 19 | | | | | | | | | | |
| 3 | | | | | GB S4 | | | | 30 | | | | | | | | | | |

- Testhole open and dry to 2.75 m upon completion
 - Backfilled with bentonite

GENERAL BH PLOTS - WSP_NDL_LAGOON_SOIL_LOGS.GPJ GINT STD CANADA.GDT 7/10/20



WSP
 1600 Buffalo Place
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 Telephone: (204)-477-6650

CLIENT RM of Lorne
 PROJECT NUMBER 181-13386-00
 DATE STARTED 5/26/20 COMPLETED 5/26/20
 DRILLING CONTRACTOR Maple Leaf Drilling
 DRILLING METHOD Solid Stem Auger - MP-5 Track Rig
 LOGGED BY Dana Bredin CHECKED BY Wei Gao
 NOTES UTM Zone 14: 0530274 mE, 5486941 mN

PROJECT NAME Notre Dame de Lourdes Lagoon Dyke Repair
 PROJECT LOCATION Notre Dame de Lourdes, MB
 GROUND ELEVATION _____ HOLE SIZE 125 mm
 GROUND WATER LEVELS:
 AT TIME OF DRILLING ---
 AT END OF DRILLING ---
 AFTER DRILLING ---

| DEPTH (m) | GRAPHIC LOG | ELEV. (m) | WATER LEVEL | MATERIAL DESCRIPTION | SAMPLE TYPE NUMBER | BLOW COUNTS (N VALUE) | POCKET PEN. (kPa) | TORVANE (kPa) | MOISTURE CONTENT (%) | ▲ SPT N VALUE ▲ | | | |
|-------------|-------------|-----------|-------------|--|--------------------|-----------------------|-------------------|---------------|----------------------|-----------------|----------|---------|-----|
| | | | | | | | | | | PL | MC | LL | |
| | | | | | | | | | | 20 | 40 | 60 | 80 |
| | | | | | | | | | | 20 | 40 | 60 | 80 |
| | | | | | | | | | | PP | qu (kPa) | Torvane | * |
| | | | | | | | | | | 100 | 200 | 300 | 400 |
| 0.0 - 0.1 | | | | TOPSOIL - Black, rootlets to 0.1 m | | | | | | | | | |
| 0.1 - 2.0 | | | | FILL - Sandy silt with some clay, trace f. gravel - Brown-grey mixed, moist to dry, stiff - PSA at 0.9 m: 30.1% sand, 48.1% silt, 21.8% clay - Clayey, trace organics below 1.5 m | ST ST3 | | | | 21 | | | | |
| 2.0 - 2.45 | | | | CLAY - Organic clay, silty, black, moist, stiff | ST ST4 | | | | 18 | | | | |
| 2.45 - 2.75 | | | | SILT - Ligh grey, some clay and sand, firm to stiff, moist - PSA at 1.85 m: 34.6% sand, 36.2% silt, 27.2% clay - Soft, moist to wet, trace oxidation below 2.45 m | | | | | | | | | |

- Testhole open and dry to 2.75 m upon completion
 - Backfilled with bentonite



WSP
 1600 Buffalo Place
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 Telephone: (204)-477-6650

CLIENT RM of Lorne
 PROJECT NUMBER 181-13386-00
 DATE STARTED 5/26/20 COMPLETED 5/26/20
 DRILLING CONTRACTOR Maple Leaf Drilling
 DRILLING METHOD Solid Stem Auger - MP-5 Track Rig
 LOGGED BY Dana Bredin CHECKED BY Wei Gao
 NOTES UTM Zone 14: 0530239 mE, 5487092 mN

PROJECT NAME Notre Dame de Lourdes Lagoon Dyke Repair
 PROJECT LOCATION Notre Dame de Lourdes, MB
 GROUND ELEVATION _____ HOLE SIZE 125 mm
 GROUND WATER LEVELS:
 AT TIME OF DRILLING ---
 AT END OF DRILLING ---
 AFTER DRILLING ---

| DEPTH (m) | GRAPHIC LOG | ELEV. (m) | WATER LEVEL | MATERIAL DESCRIPTION | SAMPLE TYPE NUMBER | BLOW COUNTS (N VALUE) | POCKET PEN. (kPa) | TORVANE (kPa) | MOISTURE CONTENT (%) | ▲ SPT N VALUE ▲ | | | |
|-----------|-------------|-----------|-------------|---|--------------------|-----------------------|-------------------|---------------|----------------------|-----------------|----------|---------|-----|
| | | | | | | | | | | PL | MC | LL | |
| | | | | | | | | | | 20 | 40 | 60 | 80 |
| | | | | | | | | | | 20 | 40 | 60 | 80 |
| | | | | | | | | | | PP | qu (kPa) | Torvane | * |
| | | | | | | | | | | 100 | 200 | 300 | 400 |
| | | | | TOPSOIL - Black, rootlets to 0.25 m | | | | | | | | | |
| | | | | FILL - Sandy silt with some clay, trace f. gravel - Brown-black mixed, moist to dry, stiff - Silty, brown-tan mixed, below 0.75 m - Trace organics below 1.5 m | GB S5 | | | | 24 | | | | |
| 1 | | | | | GB S6 | | | | 23 | | | | |
| | | | | SILT - Grey, some clay, stiff to firm, moist - Sandy, brown, varved, trace oxidation below 2.0 m - Silty, soft, moist to wet, trace oxidation below 2.45 m | GB S7 | | | | 25 | | | | |
| 2 | | | | | GB S8 | | | | 32 | | | | |
| 3 | | | | | | | | | | | | | |

- Testhole open and dry to 2.75 m upon completion
 - Backfilled with bentonite

GENERAL BH PLOTS - WSP_NDL_LAGOON_SOIL_LOGS.GPJ_GINT STD CANADA.GDT 7/10/20



WSP
 1600 Buffalo Place
 Winnipeg, MB R3T 6B8
 Telephone: (204)-477-6650

CLIENT RM of Lorne
 PROJECT NUMBER 181-13386-00
 DATE STARTED 5/26/20 COMPLETED 5/26/20
 DRILLING CONTRACTOR Maple Leaf Drilling
 DRILLING METHOD Solid Stem Auger - MP-5 Track Rig
 LOGGED BY Dana Bredin CHECKED BY Wei Gao
 NOTES UTM Zone 14: 0530086 mE, 5487017 mN

PROJECT NAME Notre Dame de Lourdes Lagoon Dyke Repair
 PROJECT LOCATION Notre Dame de Lourdes, MB
 GROUND ELEVATION _____ HOLE SIZE 125 mm
 GROUND WATER LEVELS:
 AT TIME OF DRILLING ---
 AT END OF DRILLING ---
 AFTER DRILLING ---

| DEPTH (m) | GRAPHIC LOG | ELEV. (m) | WATER LEVEL | MATERIAL DESCRIPTION | SAMPLE TYPE NUMBER | BLOW COUNTS (N VALUE) | POCKET PEN. (kPa) | TORVANE (kPa) | MOISTURE CONTENT (%) | ▲ SPT N VALUE ▲ | |
|-----------|-------------|-----------|-------------|--|--------------------|-----------------------|-------------------|---------------|----------------------|-----------------|----|
| | | | | | | | | | | PL | MC |
| | | | | TOPSOIL - Black, rootlets to 0.15 m | | | | | | | |
| | | | | FILL - Sandy silt with some clay - Brown-black mixed, moist to dry, stiff - PSA at 0.75 m: 25.3% sand, 55.1% silt, 19.6% clay - Grey-black mixed, trace organics below 1.5 m - PSA at 2.15 m: 25.3% sand, 55.1% silt, 19.6% clay | ST ST-5 | | | | 23 | | |
| | | | | SILT - Brown, some clay, firm, moist, trace oxidation | ST ST-6 | | | | 22 | | |

- Testhole open and dry to bottom upon completion
 - Backfilled with bentonite

GENERAL BH PLOTS - WSP_NDL_LAGOON_SOIL_LOGS.GPJ GINT STD CANADA.GDT 7/10/20



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TH20-07

PAGE 1 OF 1

CLIENT RM of Lorne

PROJECT NAME Notre Dame de Lourdes Lagoon Dyke Repair

PROJECT NUMBER 181-13386-00

PROJECT LOCATION Notre Dame de Lourdes, MB

DATE STARTED 5/26/20 COMPLETED 5/26/20

GROUND ELEVATION _____ HOLE SIZE 125 mm

DRILLING CONTRACTOR Maple Leaf Drilling

GROUND WATER LEVELS:

DRILLING METHOD Solid Stem Auger - MP-5 Track Rig

AT TIME OF DRILLING ---

LOGGED BY Dana Bredin CHECKED BY Wei Gao

AT END OF DRILLING ---

NOTES UTM Zone 14: 0530108 mE, 5486916 mN

AFTER DRILLING ---

| DEPTH (m) | GRAPHIC LOG | ELEV. (m) | WATER LEVEL | MATERIAL DESCRIPTION | SAMPLE TYPE NUMBER | BLOW COUNTS (N VALUE) | POCKET PEN. (kPa) | TORVANE (kPa) | MOISTURE CONTENT (%) | ▲ SPT N VALUE ▲ | | | | | | | | | |
|-----------|-------------|-----------|-------------|---|--------------------|-----------------------|-------------------|---------------|----------------------|-----------------|----|----|----|--|--|--|--|--|--|
| | | | | | | | | | | 20 | 40 | 60 | 80 | | | | | | |
| | | | | TOPSOIL - Black, sandy, rootlets to 0.15 m | | | | | | | | | | | | | | | |
| | | | | FILL - Sandy silt with some clay - Brown-grey mixed, moist, firm - Clayey, below 0.75 m - Black-grey mixed, some sand, trace organics below 1.35 m | GB S9 | | | | 22 | | | | | | | | | | |
| | | | | | GB S10 | | | | 23 | | | | | | | | | | |
| | | | | | GB S11 | | | | 27 | | | | | | | | | | |
| | | | | SILT - Brown, some clay, varved, firm, moist, trace oxidation - Soft, moist to wet below 3.05 m - Grey below 3.95 m | GB S12 | | | | 27 | | | | | | | | | | |
| | | | | | GB S13 | | | | 36 | | | | | | | | | | |

- Testhole open and dry to 2.45 m upon completion
 - Backfilled with bentonite

GENERAL BH PLOTS - WSP_NDL_LAGOON_SOIL_LOGS.GPJ_GINT_STD_CANADA.GDT_7/10/20



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 Telephone: (204)-477-6650

TH20-08

PAGE 1 OF 1

CLIENT RM of Lorne
PROJECT NUMBER 181-13386-00
DATE STARTED 5/26/20 **COMPLETED** 5/26/20
DRILLING CONTRACTOR Maple Leaf Drilling
DRILLING METHOD Solid Stem Auger - MP-5 Track Rig
LOGGED BY Dana Bredin **CHECKED BY** Wei Gao
NOTES UTM Zone 14: 0530086 mE, 5486864 mN

PROJECT NAME Notre Dame de Lourdes Lagoon Dyke Repair
PROJECT LOCATION Notre Dame de Lourdes, MB
GROUND ELEVATION _____ **HOLE SIZE** 125 mm
GROUND WATER LEVELS:
AT TIME OF DRILLING ---
AT END OF DRILLING ---
AFTER DRILLING ---

| DEPTH (m) | GRAPHIC LOG | ELEV. (m) | WATER LEVEL | MATERIAL DESCRIPTION | SAMPLE TYPE NUMBER | BLOW COUNTS (N VALUE) | POCKET PEN. (kPa) | TORVANE (kPa) | MOISTURE CONTENT (%) | ▲ SPT N VALUE ▲ | | | |
|-------------|-------------|-----------|-------------|---|--------------------|-----------------------|-------------------|---------------|----------------------|-----------------|----------|---------|-----|
| | | | | | | | | | | PL | MC | LL | |
| | | | | | | | | | | 20 | 40 | 60 | 80 |
| | | | | | | | | | | 20 | 40 | 60 | 80 |
| | | | | | | | | | | PP | qu (kPa) | Torvane | * |
| | | | | | | | | | | 100 | 200 | 300 | 400 |
| 0.0 - 0.1 | | | | TOPSOIL - Black, rootlets to 0.1 m | | | | | | | | | |
| 0.1 - 1.05 | | | | FILL - Sandy silt with some clay, trace oxidation - Brown-grey mixed, moist to dry, stiff - Clayey, grey-black mixed, trace organics below 1.05 m | | | | | | | | | |
| 1.05 - 2.75 | | | | SILT - Brown to light grey, some clay, firm, moist - Soft, moist to wet below 2.75 m | | | | | | | | | |

- Testhole open and dry to 2.75 m upon completion
 - Backfilled with bentonite

GENERAL BH PLOTS - WSP - NDL LAGOON SOIL LOGS.GPJ GINT STD CANADA.GDT 7/10/20



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"Engineering and Testing Solutions That Work for You"

July 02, 2020

File No. 20-035-02

WSP Canada Group Ltd.
1600 Buffalo Place
Winnipeg, Manitoba
R3T 6B8

ATTENTION: Dana Bredin, P.Eng.

RE: Hydraulic Conductivity Test Results, Notre Dame de Lourdes Lagoon

ENG-TECH Consulting Limited (ENG-TECH) received six (6) Shelby tube samples from the above project on May 27, 2020 and completed the requested hydraulic conductivity analyses on the two samples selected by client. The Shelby tube samples were extracted on June 2 & 3, 2020 at ENG-TECH laboratory.

The samples identified as TH4-ST3 and TH6-ST6 were prepared for testing in accordance with ASTM D5084-16a, *Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials using a Flexible Wall Permeameter*. The final hydraulic conductivity values (k_{20}) of 2.6×10^{-7} cm/sec and 1.0×10^{-8} cm/sec were obtained from the samples identified as TH4-ST3 and TH6-ST6, respectively. The hydraulic conductivity test data is outlined in Table 1, while the graphical representations of the hydraulic conductivity versus elapsed time are presented in Charts 1 and 2. Photographs of the samples are attached.

Upon completion of testing the samples were broken open for observation. Silt and sand pockets were observed in sample TH4-ST3 and are likely the cause of the higher hydraulic conductivity value by creating preferential flow paths.

ENG-TECH trusts the above is all the information you require. If you have any questions, please contact the undersigned.

Sincerely,
ENG-TECH Consulting Limited

Paula Filizzola Pinheiro Chagas
EIT, CET, B.Sc. (C.E.), B.Sc. (Enviro. E.)
Engineering Department



Clark Hryhoruk, M.Sc., P.Eng.
President, Geotechnical Engineer

CDH/pfpc

Attachments: Table 1 – Hydraulic Conductivity Test Data (Notre Dame de Lourdes Lagoon)
Chart 1 – Hydraulic Conductivity Versus Elapsed Time (TH4-ST3)
Chart 2 – Hydraulic Conductivity Versus Elapsed Time (TH6-ST6)
Photographs (1 to 4)



**TABLE 1
HYDRAULIC CONDUCTIVITY TEST DATA
NOTRE DAME DE LOURDES LAGOON**

| SAMPLE IDENTIFICATION | TH4-ST3 | TH6-ST6 |
|---|-----------------------|----------------------|
| INITIAL VALUES | | |
| ENG-TECH Reference No. | 20-035-2-50 | 20-035-2-51 |
| Length (cm) | 7.43 | 7.44 |
| Diameter (cm) | 7.24 | 7.45 |
| Area (cm ²) | 41.1 | 43.6 |
| Volume (cm ³) | 305.7 | 324.2 |
| Water Content (%) | 19.6 | 23.6 |
| Bulk Dry Density (kg/m ³) | 1649 | 1583 |
| Specific Gravity (G _s) (assumed) | 2.70 | 2.70 |
| Void Ratio | 0.638 | 0.706 |
| Degree of Saturation (%) | 83.1 | 90.3 |
| FINAL VALUES | | |
| Length (cm) | 7.46 | 7.47 |
| Diameter (cm) | 7.26 | 7.31 |
| Area (cm ²) | 41.4 | 41.9 |
| Volume (cm ³) | 308.7 | 313.3 |
| Water Content (%) | 23.2 | 22.9 |
| Bulk Dry Density (kg/m ³) | 1621 | 1665 |
| Specific Gravity (G _s) (assumed) | 2.70 | 2.70 |
| Void Ratio | 0.665 | 0.621 |
| Degree of Saturation (%) | 94.0 | 99.3 |
| CONSOLIDATION PHASE | | |
| Confining Pressure (kPa) | 103.4 | 103.4 |
| Pore Water Pressure (kPa) | 82.7 | 82.7 |
| Effective Stress (kPa) | 20.7 | 20.7 |
| PERMEATION PHASE | | |
| Confining Pressure (kPa) | 103.4 | 103.4 |
| Pore Water Pressure (kPa) | 82.7 | 82.7 |
| Effective Stress (kPa) | 20.7 | 20.7 |
| Hydraulic Gradient | 15.1 | 15.1 |
| Permeant Fluid | Potable Tap Water | Potable Tap Water |
| HYDRAULIC CONDUCTIVITY AT TEST TEMPERATURE OF 24 °C (cm/sec) | 2.85×10^{-7} | 1.1×10^{-8} |
| HYDRAULIC CONDUCTIVITY AT TEMPERATURE OF 20 °C (K₂₀) (cm/sec) | 2.6×10^{-7} | 1.0×10^{-8} |

Chart 1: Hydraulic Conductivity Versus Elapsed Time
Notre Dame de Lourdes Lagoon: Sample TH4-ST3

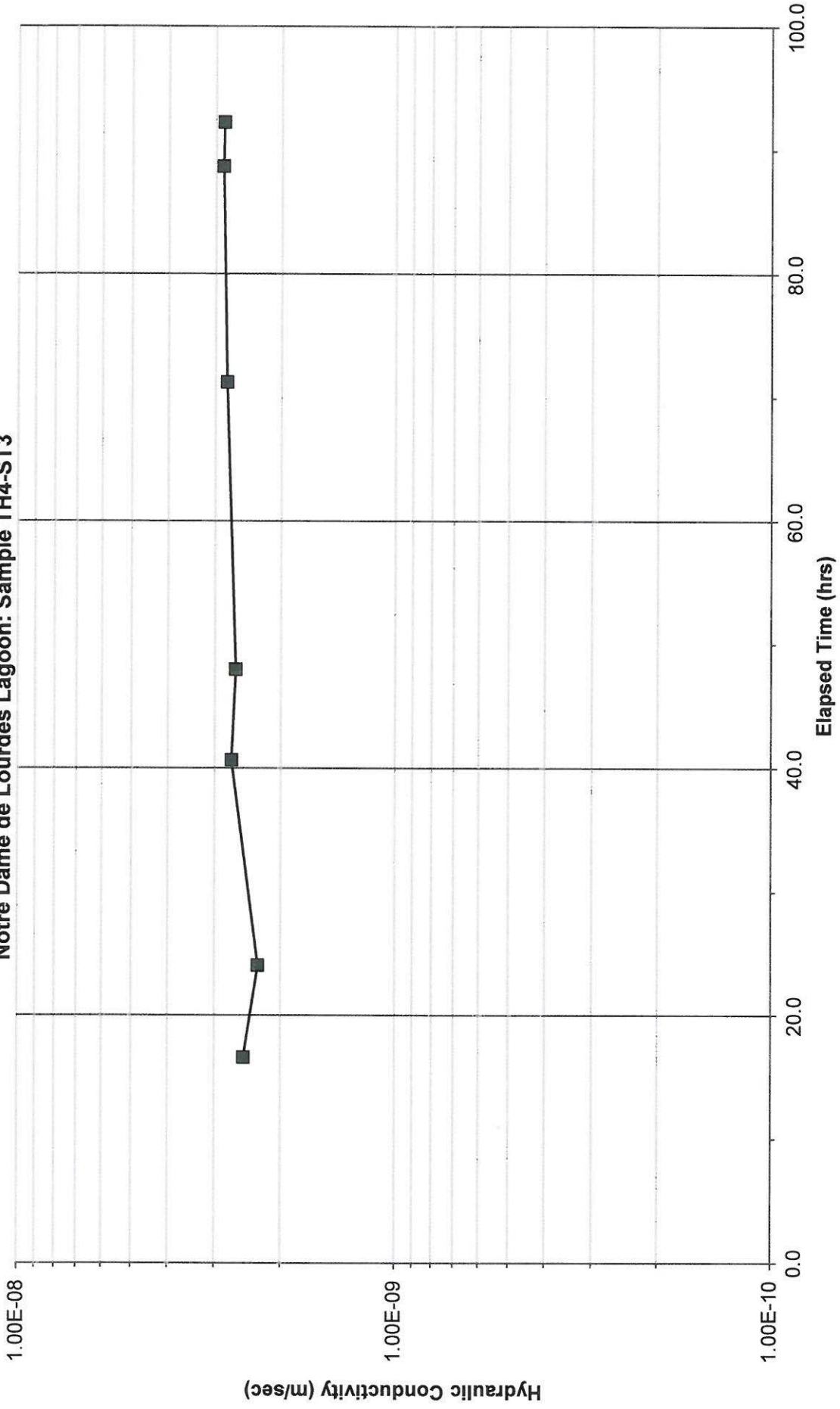
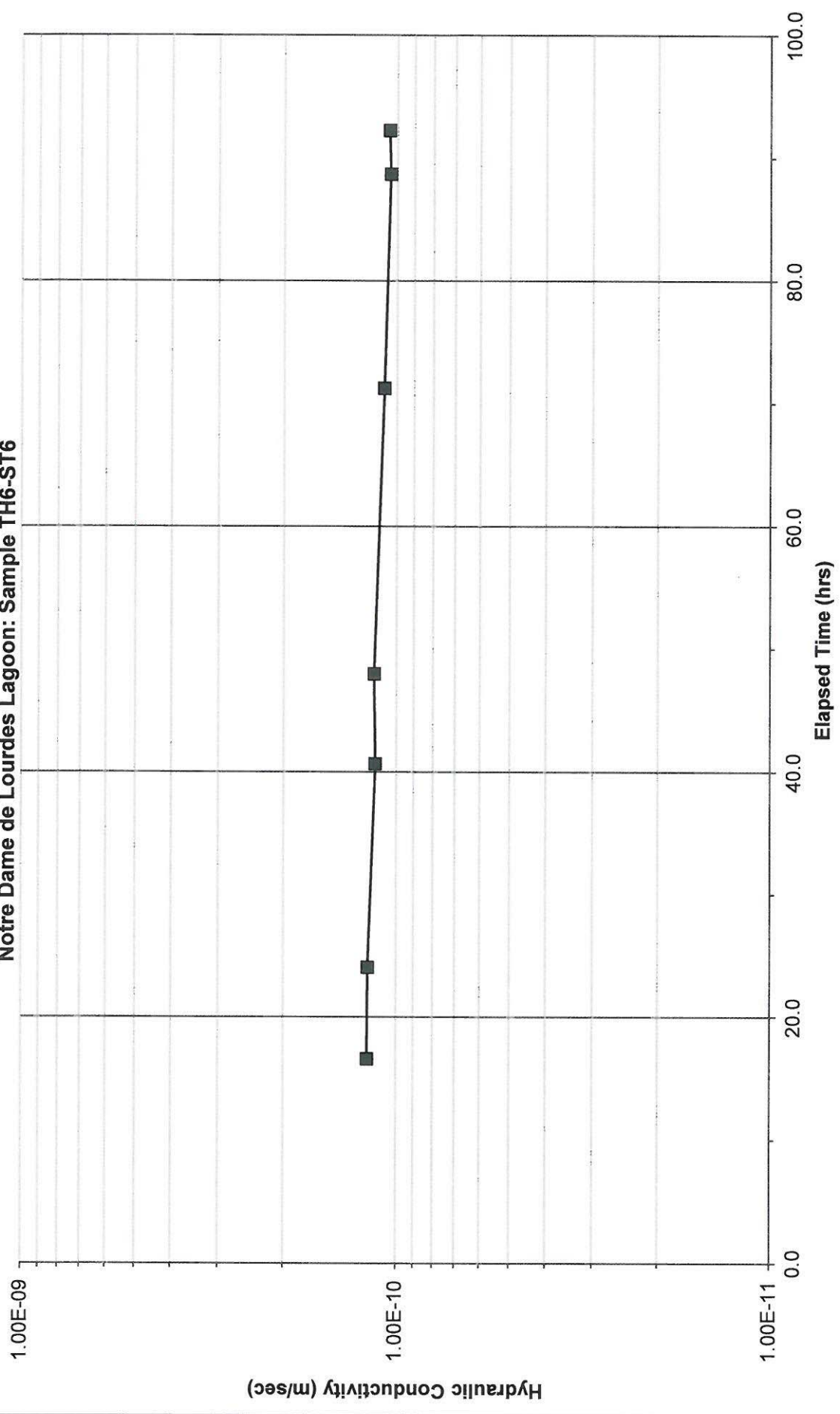
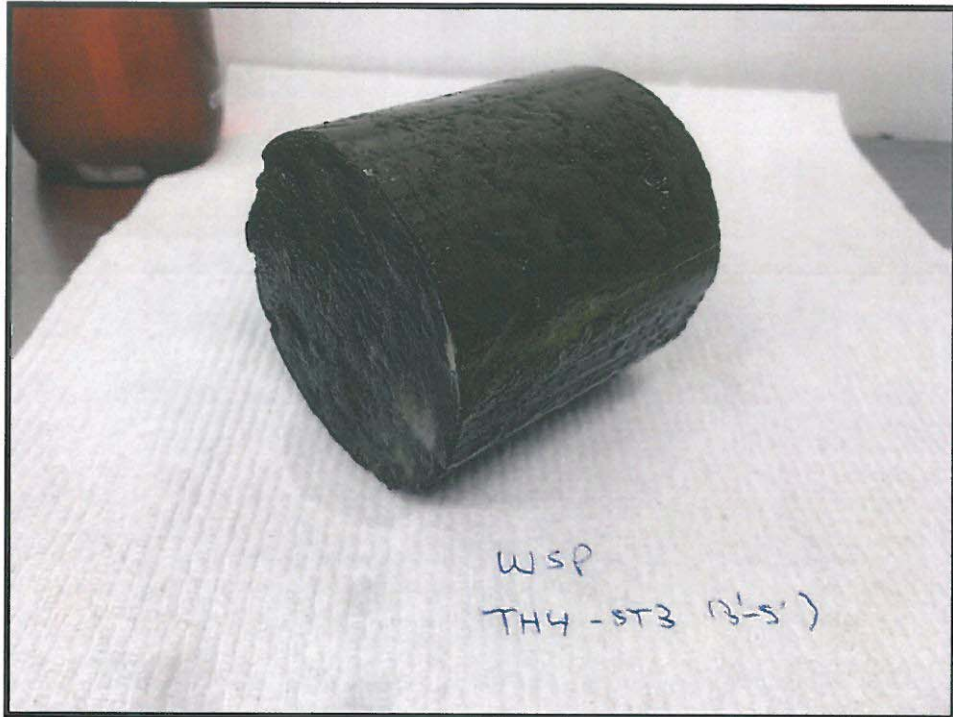


Chart 2: Hydraulic Conductivity Versus Elapsed Time
Notre Dame de Lourdes Lagoon: Sample TH6-ST6





PHOTOGRAPH #1: Sample (TH4-ST3) upon completion of test.



PHOTOGRAPH #2: Sample (TH4-ST3) after breaking apart.



PHOTOGRAPH #3: Sample (TH6-ST6) upon completion of test.



PHOTOGRAPH #4: Sample (TH6-ST6) after breaking apart.



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"Engineering and Testing Solutions That Work for You"

June 29, 2020

File No.: 20-035-02

WSP Canada Group Ltd.
1600 Buffalo Place
Winnipeg, Manitoba
R3T 6B8

ATTENTION: Dana Bredin, P. Eng.

RE: GEOTECHNICAL INVESTIGATION - NOTRE DAME DE LOURDES LAGOON

ENG-TECH Consulting Limited (ENG-TECH) has completed the requested analyses of soil samples from the above project. The laboratory soil analyses consisted of the following:

- Particle Size Analysis (8)
- Atterberg Limits (8)
- Moisture Content (21)

The above tests were conducted in accordance with the current ASTM Standard Test Methods D2216, D4318 and D7928 / D6913.

The results of the insitu moisture contents are shown on the enclosed Table 1 and the Atterberg Limits shown on the Liquid Limit, Plastic Limit and Plasticity Index of Soils Report(s) (Ref. No.'s 20-35-2-42, 43, 44, 45, 46, 47, 48 and 49) (enclosed). Also attached are the grain size distribution results shown on the Particle Size Analysis Report(s) (Ref. No.'s 20-35-2-34, 35, 36, 37, 38, 39, 40 and 41).

ENG-TECH trusts this is all the information you require. If you have any questions, please contact the undersigned.

Sincerely,
ENG-TECH Consulting Limited

A handwritten signature in blue ink, appearing to read "Darci", is written over a blue horizontal line.

Darci Babisky, C.E.T.
Operations Manager - Laboratory

DB/mvw

Enclosure: Table 1 Soil Sample Analysis (1 Page)
Liquid Limit, Plastic Limit and Plasticity Index of Soils Reports (Ref. No.'s 20-35-2-42, 43, 44, 45, 46, 47, 48 and 49)
Particle Size Analysis Reports (Ref. No.'s. 20-35-2-34, 35, 36, 37, 38, 39, 40 and 41)



TABLE 1
SOIL SAMPLE ANALYSIS
GEOTECHNICAL INVESTIGATION - NOTRE DAME DE LOURDES LAGOON

| Test Hole | Sample No. | Depth (ft) | Moisture Content (%) | Test Hole | Sample No. | Depth (ft) | Moisture Content (%) |
|-----------|------------|-------------|----------------------|-----------|------------|------------|----------------------|
| TP1 | 14 | 1.0 | 16.6 | TH5 | 5 | 2.5 | 23.8 |
| TP2 | 15 | 3.0 | 24.0 | TH5 | 6 | 5.0 | 22.6 |
| TH1 | ST1 | 5.0 - 7.0 | 21.4 | TH5 | 7 | 7.5 | 24.5 |
| TH1 | ST2 | 10.0 - 12.0 | 38.0 | TH5 | 8 | 10.0 | 32.3 |
| TH3 | 1 | 2.5 | 24.9 | TH6 | ST5 | 2.5 - 4.5 | 22.5 |
| TH3 | 2 | 5.0 | 23.0 | TH6 | ST6 | 7.0 - 9.0 | 22.4 |
| TH3 | 3 | 7.5 | 18.9 | TH7 | 9 | 2.5 | 21.8 |
| TH3 | 4 | 10.0 | 30.0 | TH7 | 10 | 5.0 | 23.1 |
| TH4 | ST3 | 3.0 - 5.0 | 20.8 | TH7 | 11 | 7.5 | 27.1 |
| TH4 | ST4 | 6.0 - 8.0 | 18.1 | TH7 | 12 | 10.0 | 26.5 |
| | | | | TH7 | 13 | 15.0 | 36.0 |



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PARTICLE SIZE ANALYSIS

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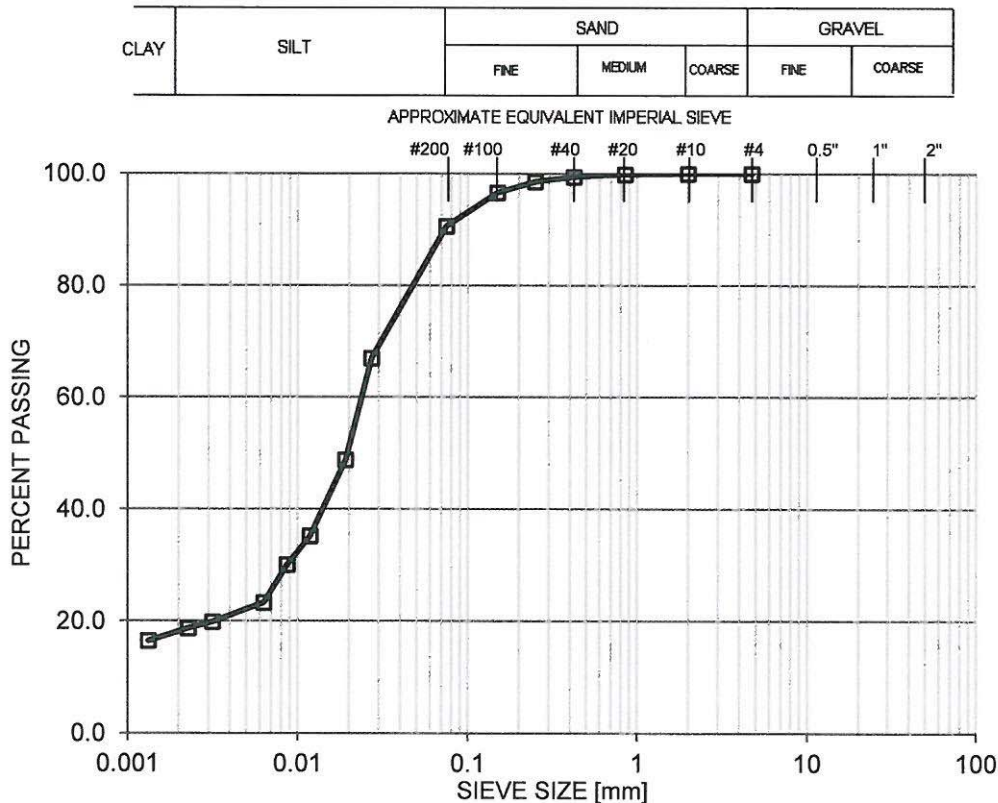
File No.: 20-035-02

Ref. No.: 20-35-2-34

Attention: Dana Bredin, P. Eng.

Project: GEOTECHNICAL INVESTIGATION - NOTRE DAME DE LOURDES LAGOON

| | | | | | |
|--------------------|---|------------------|---------------------------|--------------|--------------|
| Test Hole No.: | TP1 | Sample No.: | 14 | Depth: | 1.0 ft |
| Sampled By: | Client | Sampling Method: | Grab | Source: | Project site |
| Date Sampled: | May 26/20 | Date Received: | May 27/20 | Date Tested: | Jun 8/20 |
| Method: | ASTM D7928 & D6913 | | | | |
| Dispersion Device: | Apparatus A: Humboldt Mechanical Analysis Stirrer | | Dispersion Time (min.): 1 | | |



Percent of: GRAVEL (0.0 %), SAND (9.4 %), SILT (72.4 %), CLAY (18.2 %)

Sample Description:

Comments: As received moisture content: 16.6%.

Email: dana.bredin@wsp.com

ENG-TECH Consulting Limited

Per

Darci Babisky, C.E.T.
 Operations Manager - Laboratory
 Ph: (204) 233-1694 Fx: (204) 235-1579



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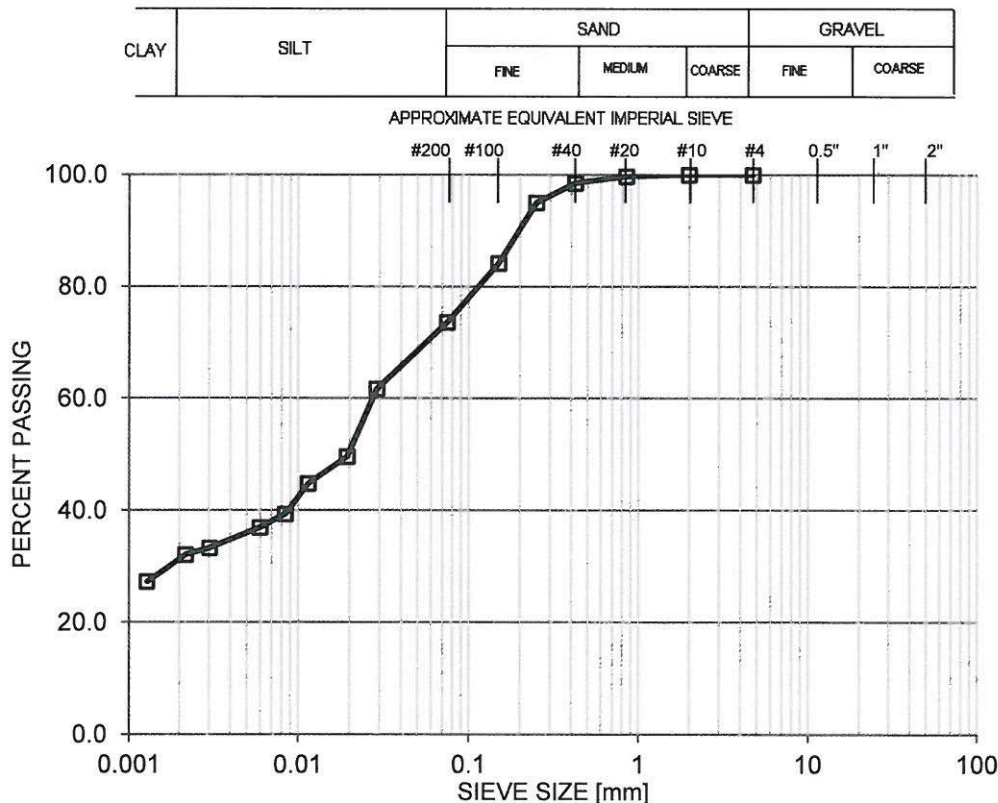
File No.: 20-035-02

Ref. No.: 20-35-2-35

Attention: Dana Bredin, P. Eng.

Project: GEOTECHNICAL INVESTIGATION - NOTRE DAME DE LOURDES LAGOON

| | | | | | |
|--------------------|---|------------------|-----------|-------------------------|--------------|
| Test Hole No.: | TP2 | Sample No.: | 15 | Depth: | 3.0 ft |
| Sampled By: | Client | Sampling Method: | Grab | Source: | Project site |
| Date Sampled: | May 26/20 | Date Received: | May 27/20 | Date Tested: | Jun 8/20 |
| Method: | ASTM D7928 & D6913 | | | | |
| Dispersion Device: | Apparatus A: Humboldt Mechanical Analysis Stirrer | | | Dispersion Time (min.): | 1 |



Percent of: GRAVEL (0.0 %), SAND (26.4 %), SILT (42.3 %), CLAY (31.3 %)

Sample Description:

Comments: As received moisture contents: 24.0%.

Email: dana.bredin@wsp.com

ENG-TECH Consulting Limited

Per

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 Operations Manager - Laboratory
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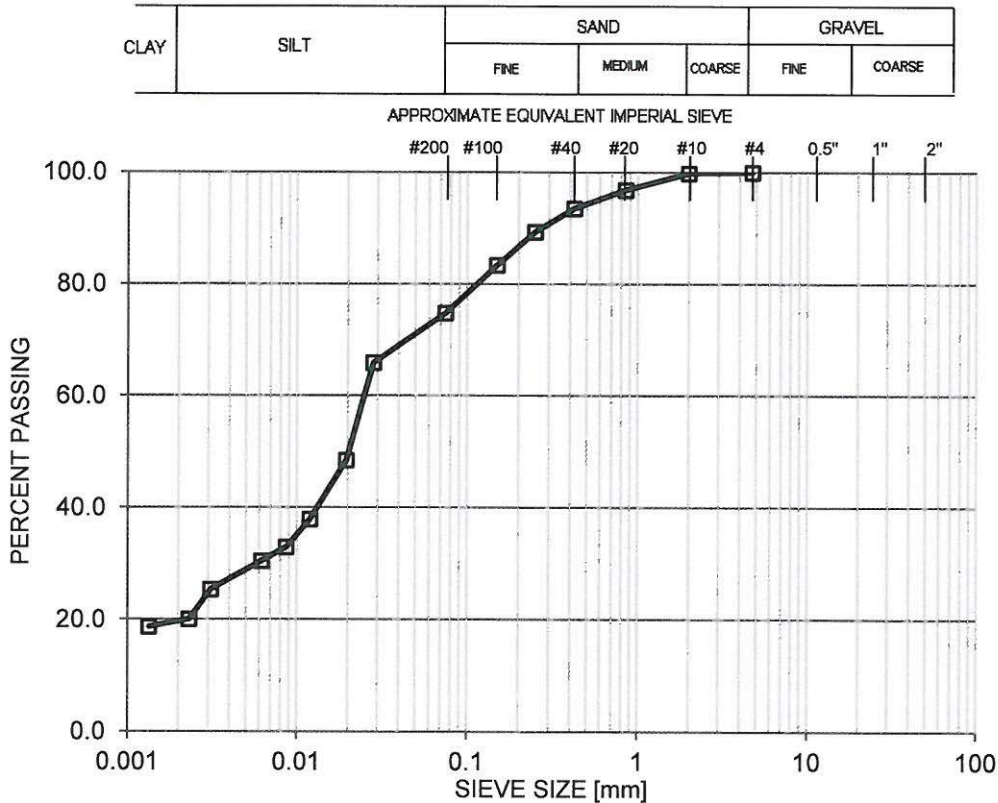
File No.: 20-035-02

Ref. No.: 20-35-2-36

Attention: Dana Bredin, P. Eng.

Project: GEOTECHNICAL INVESTIGATION - NOTRE DAME DE LOURDES LAGOON

| | | | | | |
|--------------------|---|------------------|-------------|-------------------------|--------------|
| Test Hole No.: | 1 | Sample No.: | ST1 | Depth: | 5.0 - 7.0 ft |
| Sampled By: | Client | Sampling Method: | Shelby tube | Source: | Project site |
| Date Sampled: | May 26/20 | Date Received: | May 27/20 | Date Tested: | Jun 17/20 |
| Method: | ASTM D7928 & D6913 | | | | |
| Dispersion Device: | Apparatus A: Humboldt Mechanical Analysis Stirrer | | | Dispersion Time (min.): | 1 |



Percent of: GRAVEL (0.0 %), SAND (25.3 %), SILT (55.1 %), CLAY (19.6 %)


Sample Description:

Comments: As received moisture content: 21.4%.

Email: dana.bredin@wsp.com

ENG-TECH Consulting Limited

Per


 Darci Babisky, C.E.T.
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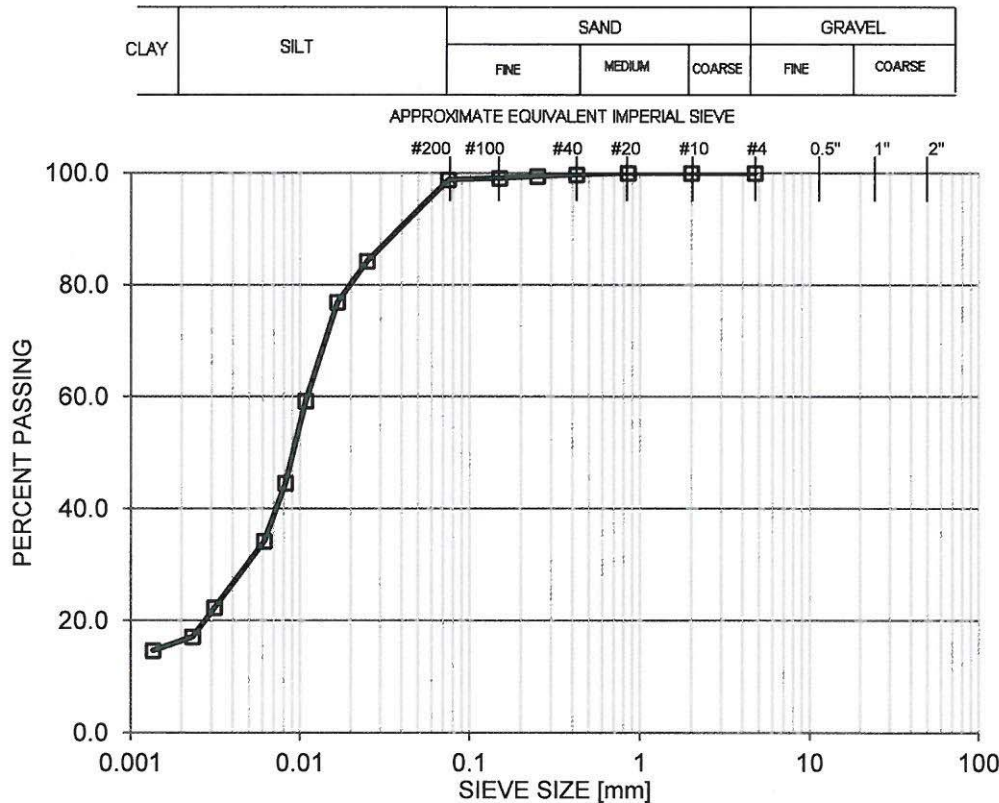
File No.: 20-035-02

Ref. No.: 20-35-2-37

Attention: Dana Bredin, P. Eng.

Project: GEOTECHNICAL INVESTIGATION - NOTRE DAME DE LOURDES LAGOON

| | | | | | |
|--------------------|---|------------------|-------------|-------------------------|----------------|
| Test Hole No.: | 1 | Sample No.: | ST2 | Depth: | 10.0 - 12.0 ft |
| Sampled By: | Client | Sampling Method: | Shelby tube | Source: | Project site |
| Date Sampled: | May 26/20 | Date Received: | May 27/20 | Date Tested: | Jun 17/20 |
| Method: | ASTM D7928 & D6913 | | | | |
| Dispersion Device: | Apparatus A: Humboldt Mechanical Analysis Stirrer | | | Dispersion Time (min.): | 1 |



Percent of: GRAVEL (0.0 %), SAND (1.2 %), SILT (82.4 %), CLAY (16.4 %)

Sample Description:

Comments: As received moisture content: 38.0%.

Email: dana.bredin@wsp.com

ENG-TECH Consulting Limited

Per

Darci Babisky, C.E.T.
 Operations Manager - Laboratory
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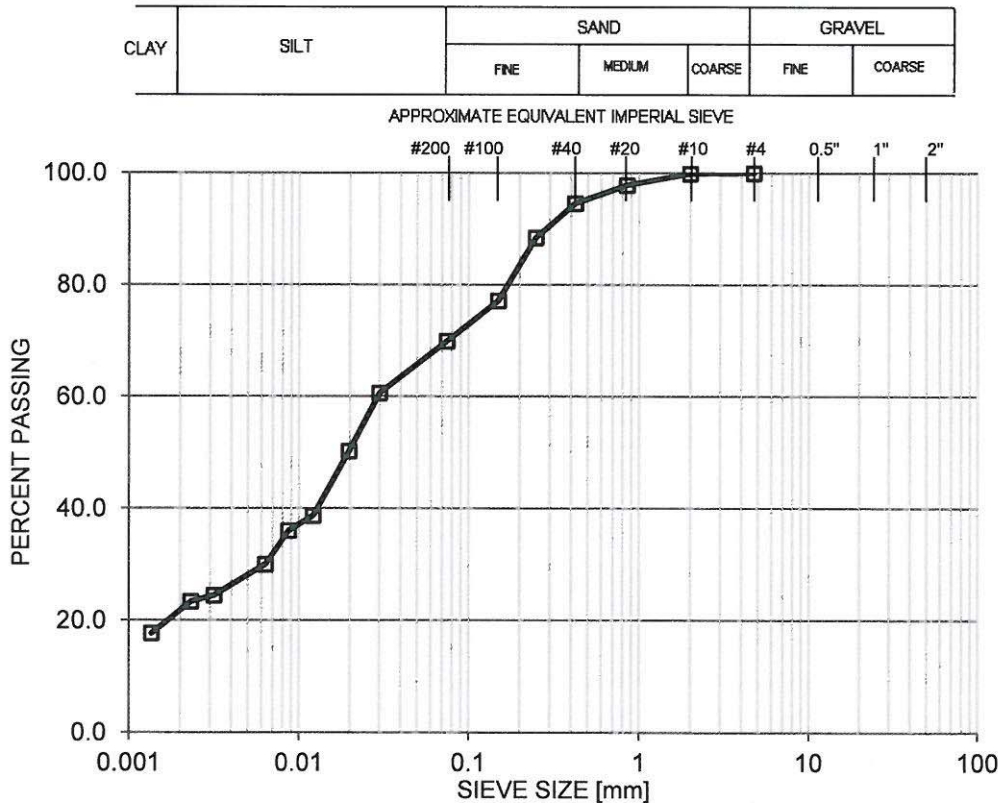
WSP Canada Group Ltd.
 1600 Buffalo Place
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 R3T 6B8

File No.: 20-035-02
 Ref. No.: 20-35-2-38

Attention: Dana Bredin, P. Eng.

Project: GEOTECHNICAL INVESTIGATION - NOTRE DAME DE LOURDES LAGOON

Test Hole No.: 4 Sample No.: ST3 Depth: 3.0 - 5.0 ft
 Sampled By: Client Sampling Method: Shelby tube Source: Project site
 Date Sampled: May 26/20 Date Received: May 27/20 Date Tested: Jun 17/20
 Method: ASTM D7928 & D6913
 Dispersion Device: Apparatus A: Humboldt Mechanical Analysis Stirrer Dispersion Time (min.): 1



Percent of: GRAVEL (0.0 %), SAND (30.1 %), SILT (48.1 %), CLAY (21.8 %)

Sample Description:

Comments: As received moisture content: 20.8%.

Email: dana.bredin@wsp.com

ENG-TECH Consulting Limited

Per

Darci Babisky, C.E.T.
 Operations Manager - Laboratory
 Ph: (204) 233-1694 Fx: (204) 235-1579



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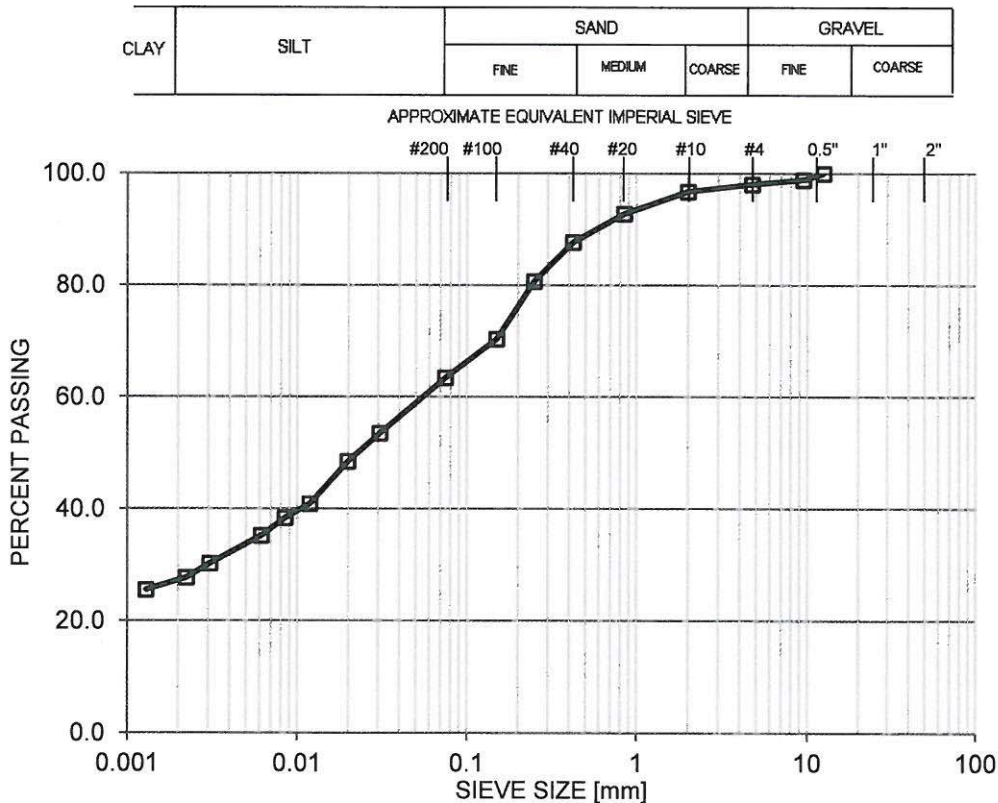
File No.: 20-035-02

Ref. No.: 20-35-2-39

Attention: Dana Bredin, P. Eng.

Project: GEOTECHNICAL INVESTIGATION - NOTRE DAME DE LOURDES LAGOON

| | | | | | |
|--------------------|---|------------------|-------------------------|--------------|--------------|
| Test Hole No.: | 4 | Sample No.: | ST4 | Depth: | 6.0 - 8.0 ft |
| Sampled By: | Client | Sampling Method: | Shelby tube | Source: | Project site |
| Date Sampled: | May 26/20 | Date Received: | May 27/20 | Date Tested: | Jun 17/20 |
| Method: | ASTM D7928 & D6913 | | | | |
| Dispersion Device: | Apparatus A: Humboldt Mechanical Analysis Stirrer | | Dispersion Time (min.): | 1 | |



Percent of: GRAVEL (2.0 %), SAND (34.6 %), SILT (36.2 %), CLAY (27.2 %)


Sample Description:

Comments: As received moisture content: 18.1%.

Email: dana.bredin@wsp.com

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Per


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PARTICLE SIZE ANALYSIS

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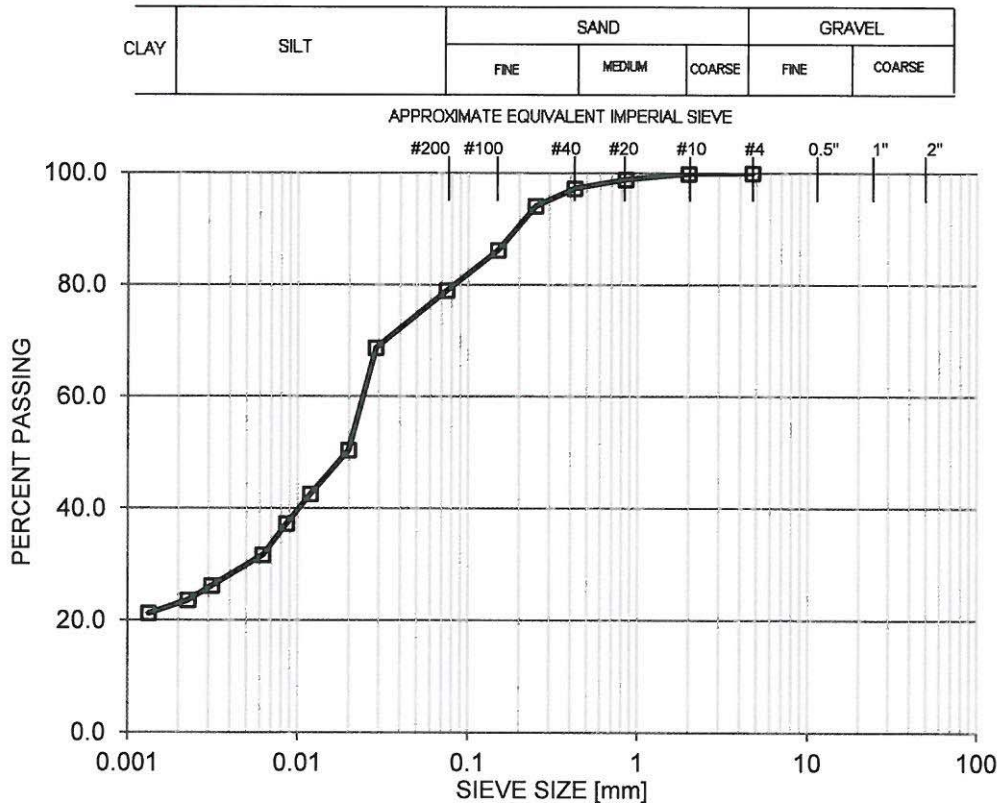
File No.: 20-035-02

Ref. No.: 20-35-2-40

Attention: Dana Bredin, P. Eng.

Project: GEOTECHNICAL INVESTIGATION - NOTRE DAME DE LOURDES LAGOON

| | | |
|---|-------------------------------------|----------------------------------|
| Test Hole No.: 6 | Sample No.: ST5 | Depth: 2.5 - 4.5 ft |
| Sampled By: Client | Sampling Method: Shelby tube | Source: Project site |
| Date Sampled: May 26/20 | Date Received: May 27/20 | Date Tested: Jun 17/20 |
| Method: ASTM D7928 & D6913 | | |
| Dispersion Device: Apparatus A: Humboldt Mechanical Analysis Stirrer | | Dispersion Time (min.): 1 |



Percent of: GRAVEL (0.0 %), SAND (21.1 %), SILT (55.9 %), CLAY (23.0 %)

Sample Description:

Comments: As received moisture content: 22.5%.

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LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS



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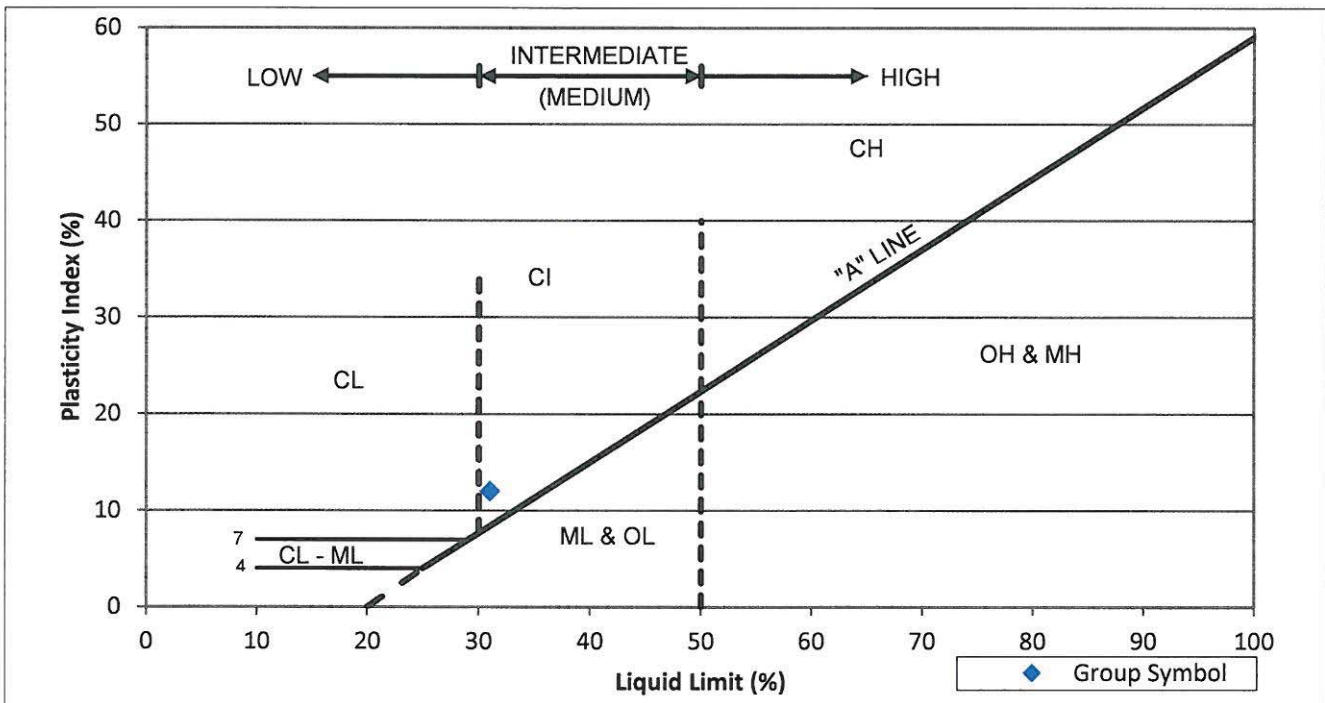
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File No.: 20-035-02
 Ref. No.: 20-35-2-42

Attention: Dana Bredin, P. Eng.

Project: GEOTECHNICAL INVESTIGATION - NOTRE DAME DE LOURDES LAGOON

Source: Project site
 Test Hole No.: TP1 Sample No.: 14 Depth: 1.0 ft
 Date Sampled: May 26/20 Sampling Method: Grab Sampled By: Client
 Date Received: May 27/20 Date Tested: Jun 17/20 Tested By: ENG-TECH (Owais Iqbal)
 Method: ASTM D4318 - A (Multipoint) Drying Method: Air



Liquid Limit (%): 31 Plastic Limit (%): 19 Plasticity Index (%): 12

Estimated Percentage of sand particles retained on 0.425mm sieve: 0.6

Classification:
 CI clay, medium plastic, brown

Comments:
 As received moisture content: 16.6%.

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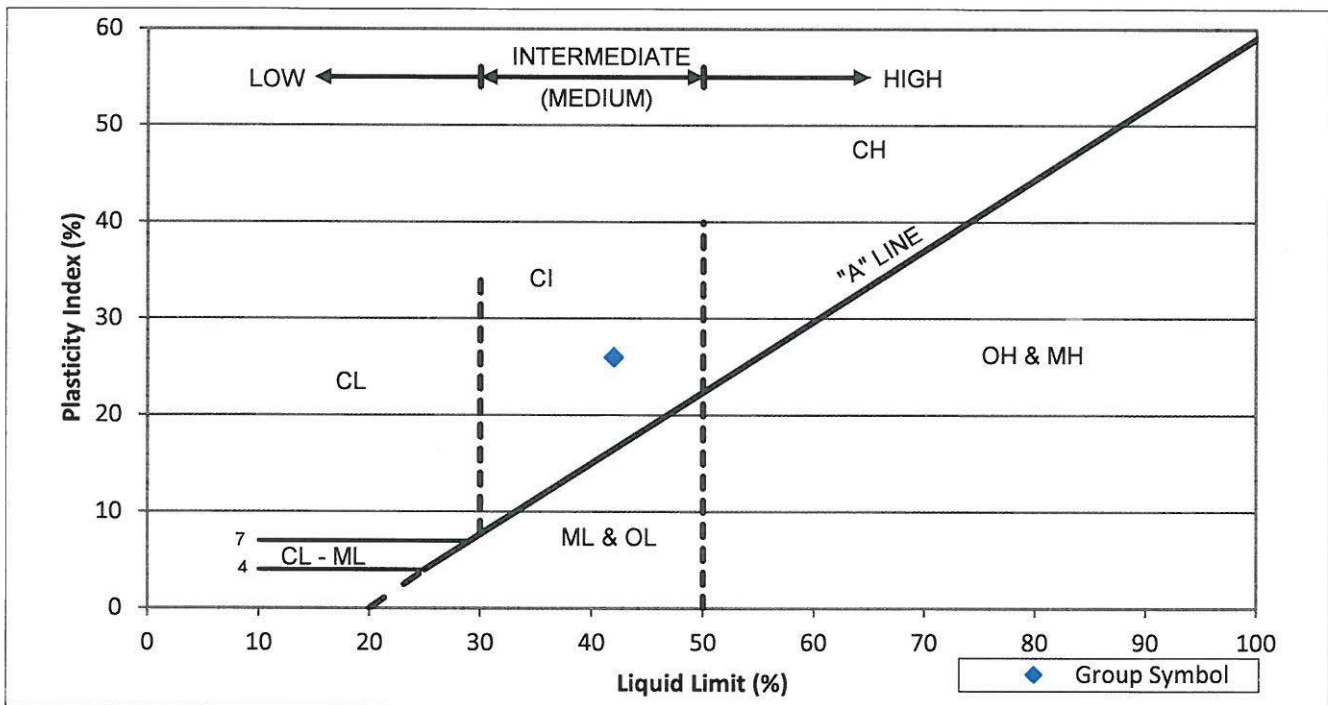
File No.: 20-035-02

Ref. No.: 20-35-2-43

Attention: Dana Bredin, P. Eng.

Project: GEOTECHNICAL INVESTIGATION - NOTRE DAME DE LOURDES LAGOON

| | | | |
|----------------|-----------------------------|------------------|------------------------|
| Source: | Project site | | |
| Test Hole No.: | TP2 | Sample No.: | 15 |
| Date Sampled: | May 26/20 | Sampling Method: | Grab |
| Date Received: | May 27/20 | Date Tested: | Jun 17/20 |
| Method: | ASTM D4318 - A (Multipoint) | Tested By: | ENG-TECH (Owais Iqbal) |
| | | Drying Method: | Air |



Liquid Limit (%): 42 Plastic Limit (%): 16 Plasticity Index (%): 26

Estimated Percentage of sand particles retained on 0.425mm sieve: 1.5

Classification:

CI clay, medium plastic, brown

Comments:

As received moisture content: 24.0%.

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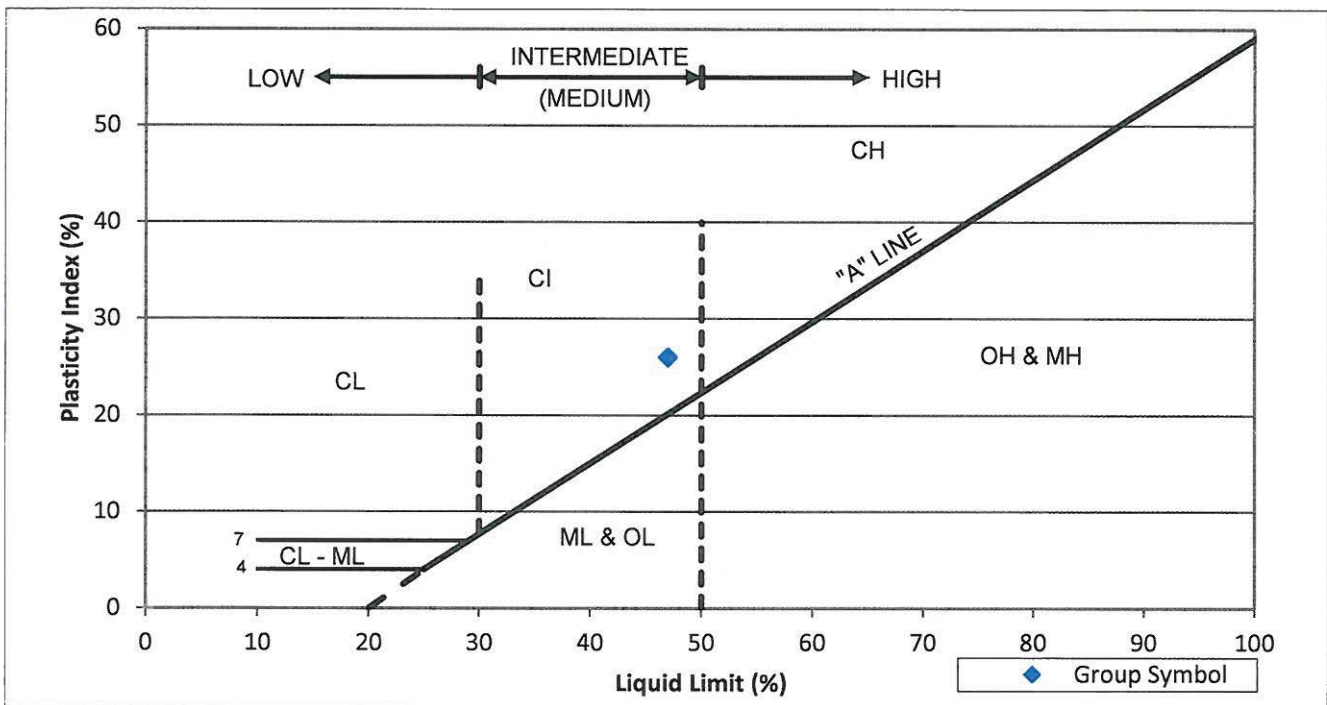
File No.: 20-035-02

Ref. No.: 20-35-2-44

Attention: Dana Bredin, P. Eng.

Project: GEOTECHNICAL INVESTIGATION - NOTRE DAME DE LOURDES LAGOON

| | | | |
|----------------|-----------------------------|------------------|------------------------|
| Source: | Project site | | |
| Test Hole No.: | 1 | Sample No.: | ST1 |
| Date Sampled: | May 26/20 | Sampling Method: | Shelby tube |
| Date Received: | May 27/20 | Date Tested: | Jun 17/20 |
| Method: | ASTM D4318 - A (Multipoint) | Drying Method: | Air |
| | | Depth: | 5.0 - 7.0 ft |
| | | Sampled By: | Client |
| | | Tested By: | ENG-TECH (Owais Iqbal) |



Liquid Limit (%): 47 Plastic Limit (%): 21 Plasticity Index (%): 26

Estimated Percentage of sand particles retained on 0.425mm sieve: 6.5

Classification:

CI clay, medium plastic, brown

Comments:

As received moisture content: 21.4%.

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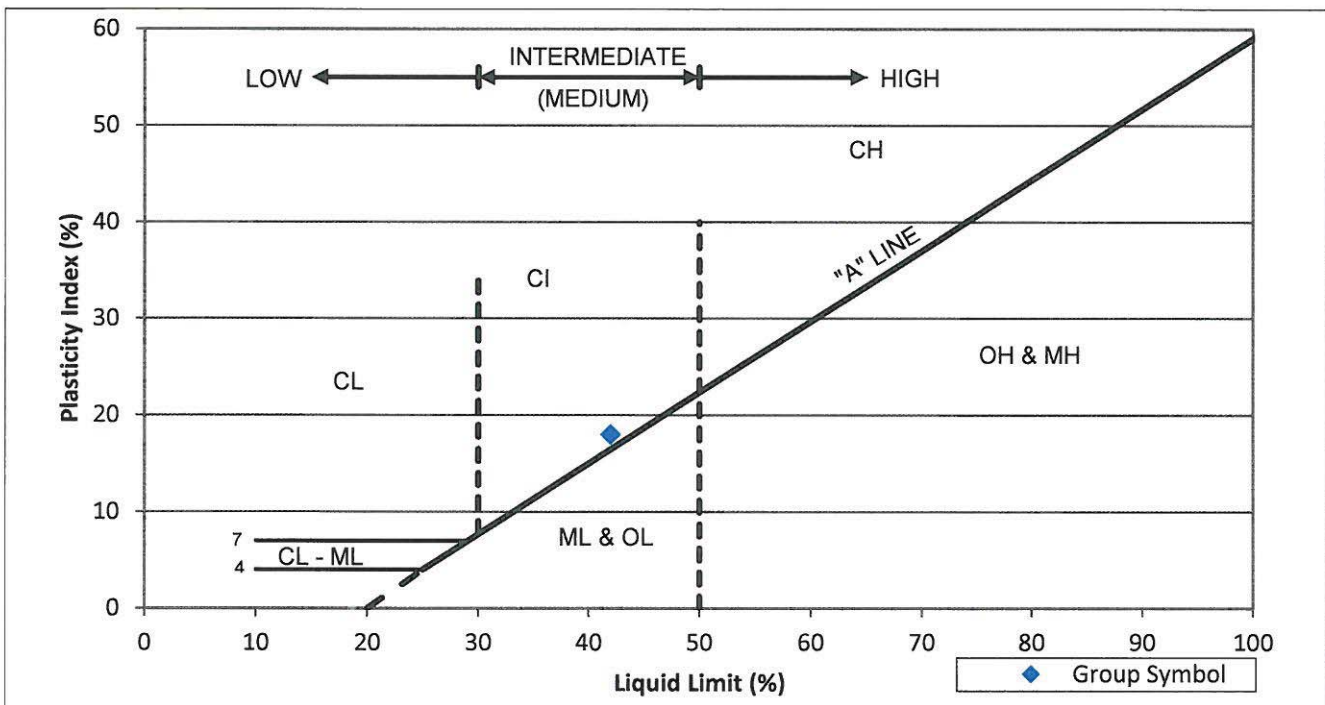
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Ref. No.: 20-35-2-45

Attention: Dana Bredin, P. Eng.

Project: GEOTECHNICAL INVESTIGATION - NOTRE DAME DE LOURDES LAGOON

| | | | | |
|----------------|-----------------------------|------------------|----------------|-----|
| Source: | Project site | | | |
| Test Hole No.: | 1 | Sample No.: | ST2 | |
| Depth: | 10.0 - 12.0 ft | | | |
| Date Sampled: | May 26/20 | Sampling Method: | Shelby tube | |
| Sampled By: | Client | | | |
| Date Received: | May 27/20 | Date Tested: | Jun 17/20 | |
| Tested By: | ENG-TECH (Owais Iqbal) | | | |
| Method: | ASTM D4318 - A (Multipoint) | | Drying Method: | Air |



Liquid Limit (%): 42 Plastic Limit (%): 24 Plasticity Index (%): 18

Estimated Percentage of sand particles retained on 0.425mm sieve: 0.3

Classification:

CI clay, medium plastic, brown

Comments:

As received moisture content: 38.0%.

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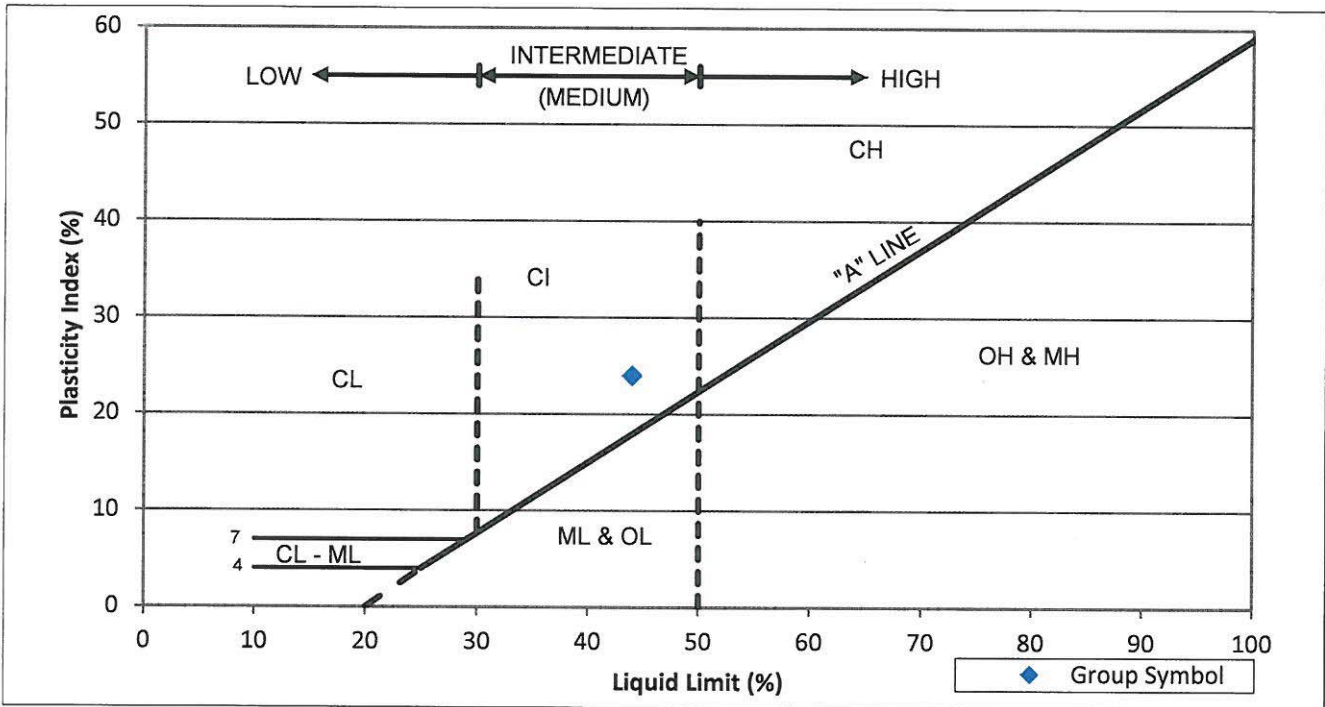
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Ref. No.: 20-35-2-46

Attention: Dana Bredin, P. Eng.

Project: GEOTECHNICAL INVESTIGATION - NOTRE DAME DE LOURDES LAGOON

| | | | |
|-----------------------|-----------------------------|-------------------------|------------------------|
| Source: | Project site | | |
| Test Hole No.: | 4 | Sample No.: | ST3 |
| Depth: | 3.0 - 5.0 ft | | |
| Date Sampled: | May 26/20 | Sampling Method: | Shelby tube |
| Date Received: | May 27/20 | Date Tested: | Jun 17/20 |
| Method: | ASTM D4318 - A (Multipoint) | Tested By: | ENG-TECH (Owais Iqbal) |
| | | Drying Method: | Air |



Liquid Limit (%): 44 Plastic Limit (%): 20 Plasticity Index (%): 24

Estimated Percentage of sand particles retained on 0.425mm sieve: 5.5

Classification:

Cl clay, medium plastic, brown

Comments:

As received moisture content: 20.8%.

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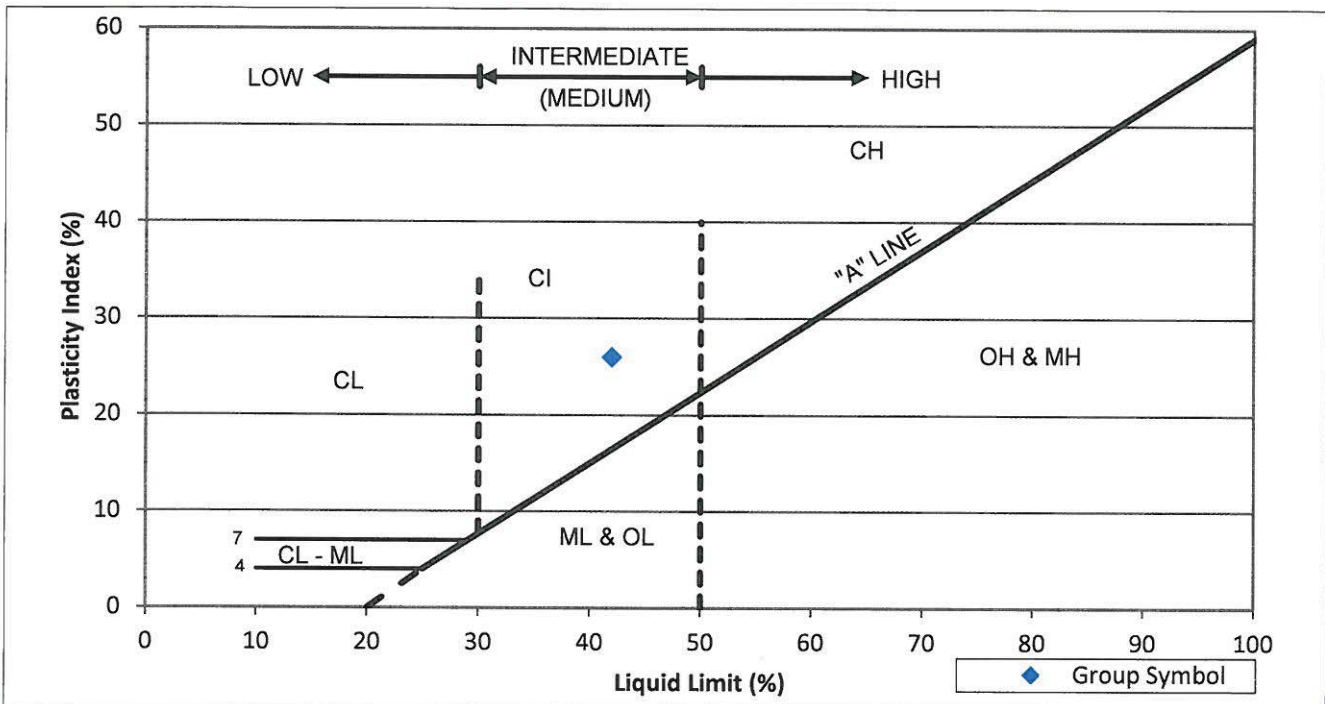
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Ref. No.: 20-35-2-47

Attention: Dana Bredin, P. Eng.

Project: GEOTECHNICAL INVESTIGATION - NOTRE DAME DE LOURDES LAGOON

| | | | |
|-----------------------|-----------------------------|-------------------------|------------------------|
| Source: | Project site | | |
| Test Hole No.: | 4 | Sample No.: | ST4 |
| Depth: | 6.0 - 8.0 ft | | |
| Date Sampled: | May 26/20 | Sampling Method: | Shelby tube |
| Date Received: | May 27/20 | Date Tested: | Jun 17/20 |
| Method: | ASTM D4318 - A (Multipoint) | Tested By: | ENG-TECH (Owais Iqbal) |
| | | Drying Method: | Air |



Liquid Limit (%): 42 Plastic Limit (%): 16 Plasticity Index (%): 26

Estimated Percentage of sand particles retained on 0.425mm sieve: 12.4

Classification:

CI clay, medium plastic, brown

Comments:

As received moisture content: 18.1%.

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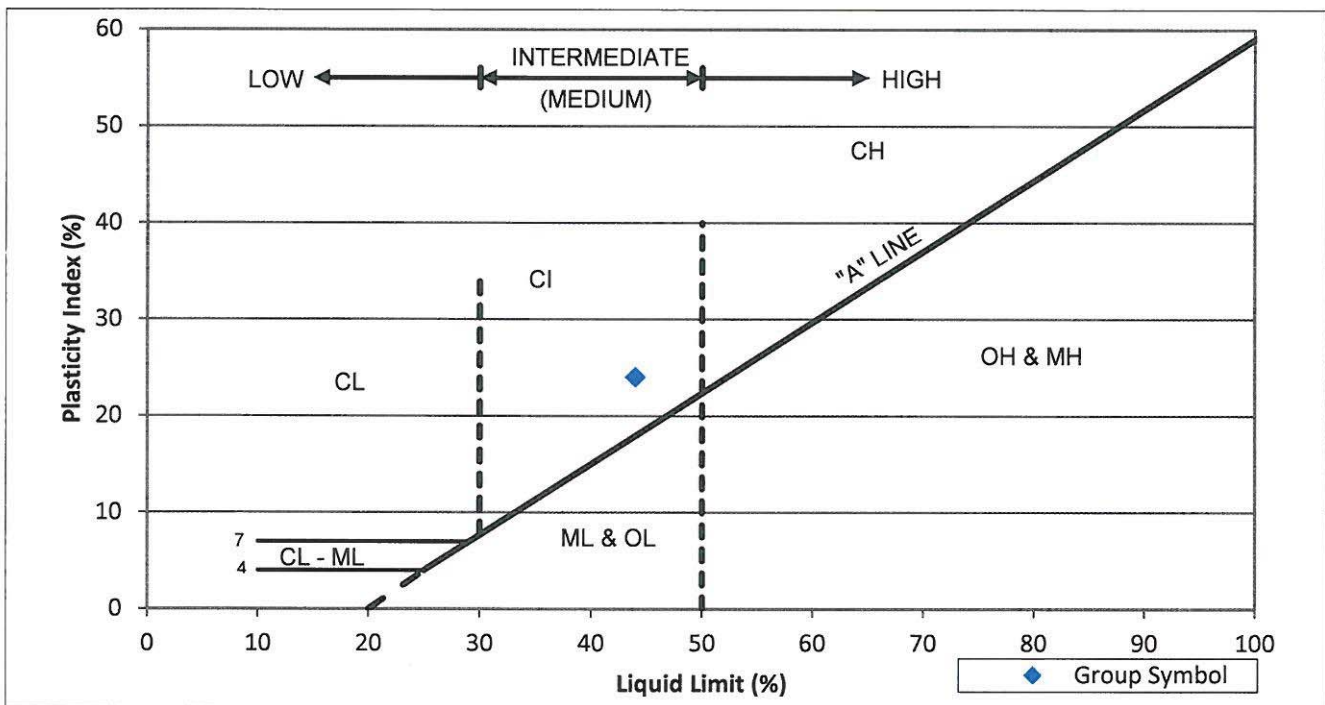
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Attention: Dana Bredin, P. Eng.

Project: GEOTECHNICAL INVESTIGATION - NOTRE DAME DE LOURDES LAGOON

| | | | |
|-----------------------|-----------------------------|-------------------------|------------------------|
| Source: | Project site | | |
| Test Hole No.: | 6 | Sample No.: | ST5 |
| Depth: | 2.5 - 4.5 ft | | |
| Date Sampled: | May 26/20 | Sampling Method: | Shelby tube |
| Date Received: | May 27/20 | Date Tested: | Jun 17/20 |
| Method: | ASTM D4318 - A (Multipoint) | Tested By: | ENG-TECH (Owais Iqbal) |
| | | Drying Method: | Air |



Liquid Limit (%): 44 Plastic Limit (%): 20 Plasticity Index (%): 24

Estimated Percentage of sand particles retained on 0.425mm sieve: 2.8

Classification:

CI clay, medium plastic, brown

Comments:

As received moisture content: 22.5%.

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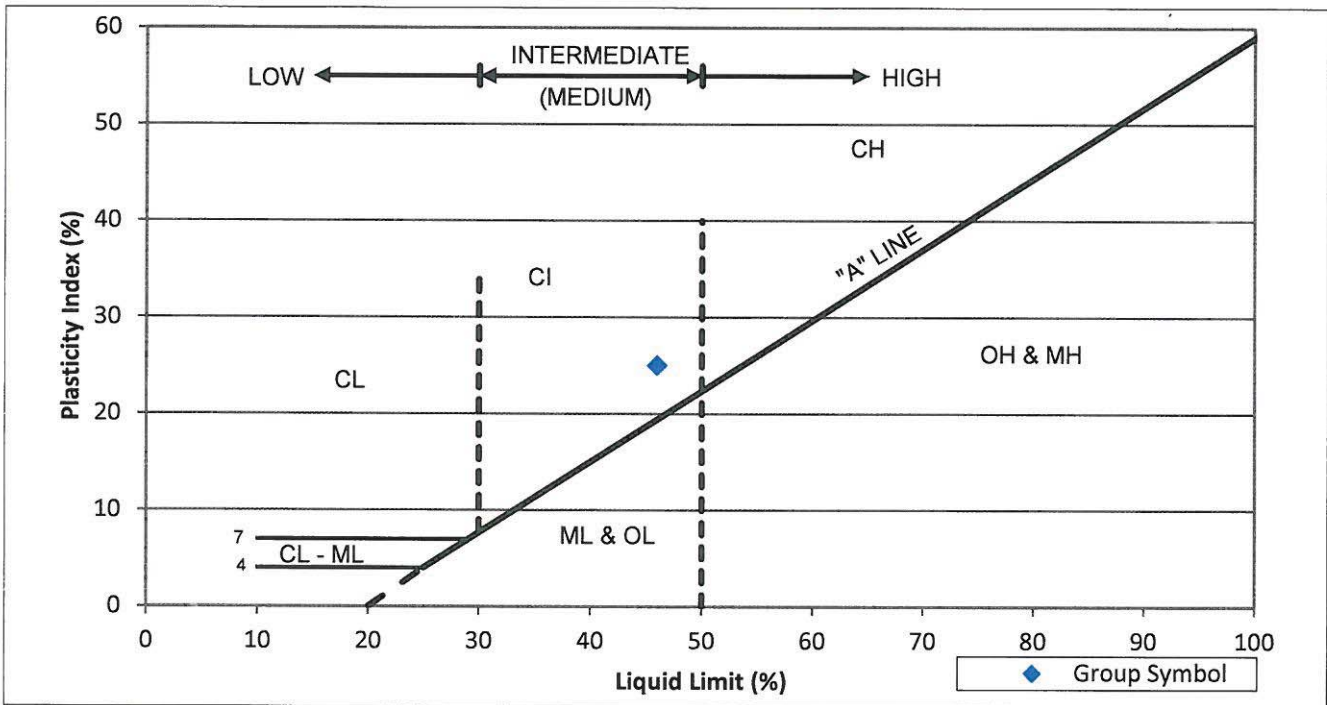
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Ref. No.: 20-35-2-49

Attention: Dana Bredin, P. Eng.

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| | | | |
|-----------------------|-----------------------------|-------------------------|------------------------|
| Source: | Project site | | |
| Test Hole No.: | 6 | Sample No.: | ST6 |
| Depth: | 7.0 - 9.0 ft | | |
| Date Sampled: | May 26/20 | Sampling Method: | Shelby tube |
| Date Received: | May 27/20 | Date Tested: | Jun 17/20 |
| Method: | ASTM D4318 - A (Multipoint) | Tested By: | ENG-TECH (Owais Iqbal) |
| | | Drying Method: | Air |



Liquid Limit (%): 46 Plastic Limit (%): 21 Plasticity Index (%): 25

Estimated Percentage of sand particles retained on 0.425mm sieve: 2.1

Classification:

CI clay, medium plastic, brown

Comments:

As received moisture content: 22.4%.

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