WEST OXBOW LAKE ROAD
OXBOW LAKE, LAKE OF BAYS
SITE EVALUATION REPORT
STORM WATER MANAGEMENT AND CONSTRUCTION MITIGATION PLAN

Prepared by:

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January 2021
20-11530M – rev. 0

MUSKOKA | BARRIE

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APPENDICES

1.0 INTRODUCTION

1.1 General

Pinestone Engineering Inc. (PEL) was retained by Muskoka Lakeside Properties Inc. to complete a storm water management and construction mitigation plan for the proposed extensions of West Oxbow Lake Road.

The site is legally described as Concession 6, Lot 3, in the Geographic Township of Finlayson, Township of Lake of Bays. Surrounding land uses include West Oxbow Lake Road to the west, existing residential dwellings, vacant lands and Oxbow Lake. The site location is illustrated on Figure 1.

It is understood that the Township requires a storm water management plan, prepared by a professional engineer, which will prevent storm water impacts on neighbouring properties and Oxbow Lake.

1.2 Purpose and Scope

The purpose of this report is to provide a storm water management and construction mitigation plan for the property and addresses the following:

i. Storm water management;
ii. Promotion of water infiltration as opposed to direct runoff;
iii. Natural vegetative buffers and vegetation to be retained;
iv. Construction mitigation measures

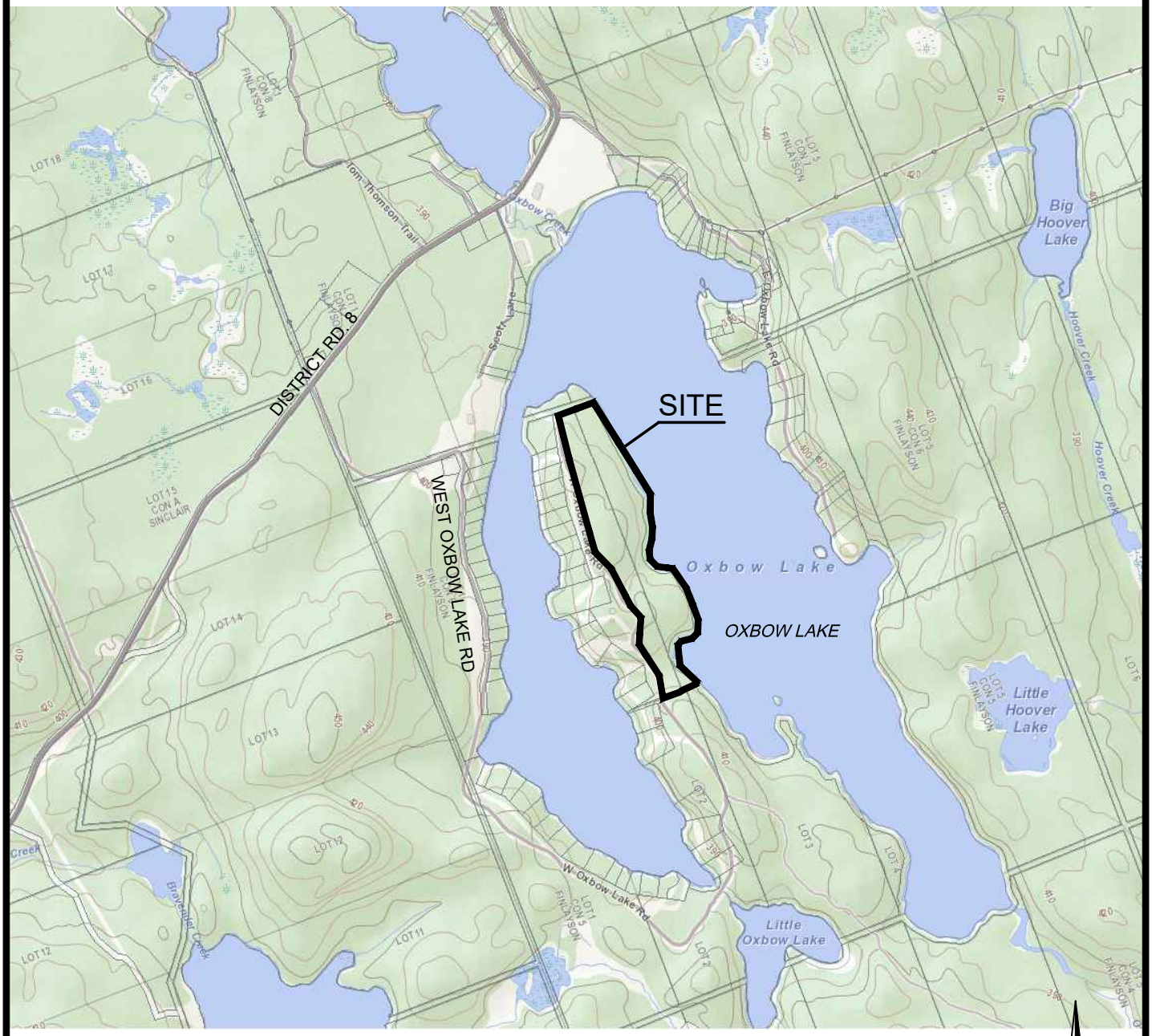
2.0 EXISTING SITE CONDITIONS

2.1 Property Description

The proposed development property located east of West Oxbow Lake Road, is currently vacant land. The proposed private driveways (2) will extend from West Oxbow Lake Road and run adjacent to the existing road.

2.2 Site Topography and Drainage Characteristics

Topography through the site is moderate with slopes of approximately 10-25%. Elevations through the site range from 405.00 metres ASL at the Peak of West Oxbow Lake Road to 385.00 metres ASL near the Lakefront. Drainage from the property is in the form of sheet flow and flows easterly towards Lake Oxbow. There are no defined drainage courses on the site.



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WEST OXBOW LAKE ROAD

LOCATION PLAN

DATE:	SCALE:	PROJECT No.	FIGURE No.
OCT. 2020	N.T.S.	20-11530-M	FIGURE 1

2.3 Fish Habitat

Oxbow Lake's shoreline provides critical habitat for fish and accordingly, the storm water management plan should be based on providing an "enhanced' level of protection (formerly level 1) as defined by the Ministry of the Environment (MOE).

3.0 STORM WATER MANAGEMENT

3.1 Reference Reports

The following reports and studies have been used for reference in the preparation of this Storm Water Management Plan:

i) *Ministry of the Environment and Energy's Storm Water Management Planning and Design Manual, March 2003.*
ii) *Inter Agency Storm Water Management Working Committee "Design Criteria for Storm Water Management in Muskoka" November 1991.*
iii) *Sediment Control Planning Central Region Group, prepared by the Ministry of Natural Resources.*

3.2 Design Criteria

The storm water management requirements for the development are as follows:

- Maintaining existing natural drainage paths.
- The installation of appropriate drainage features to safely convey drainage through the site to the lake without impacting neighbouring properties.
- Quality control of post development run-off to an "enhanced" level of protection using approved techniques in accordance with the MOE Storm Water Management Planning and Design manual.
- Maintaining existing vegetated buffers between the developed area and the water body.
- Protection against erosion as a result of site development.
- Installation of appropriate construction mitigation measures to protect against erosion during the construction period.

Peak flow attenuation of post development run-off will not be required as drainage from the proposed road will be routed around the future adjacent properties and conveyed to the receiving watercourse, removing any concerns regarding downstream flood impact.

3.3 Quality Control Plan

The MOE Storm Water Management Planning and Design Manual (MOE, 2003) provides guidance on various lot level and "end-of-pipe" controls that are appropriate for small scale developments (less than 5.0 ha).

For this site, a "treatment train" of approved quality control techniques is recommended as follows:

- The use of an enhanced grass/rip-rap ditch for conveyance of site generated run-off to promote cleansing, infiltration, attenuate flows and prevent erosion of receiving vegetation.

- The maintenance of existing landscaped areas up-gradient of the shoreline and vegetative buffers along the shoreline to filter the run-off prior to discharge to the lake.

- Discharging the ditch through rip-rap level spreader outfalls to encourage infiltration, reduce point source loading to the lake, and attenuate flow rates.

The recommended quality control plan elements are described in more detail below, and are illustrated on the Storm Water Management and Construction Mitigation Plan enclosed in the rear of this report.

3.4 Conveyance Features

The proposed Culverts have been sized to convey the storm water from the 10 year storm event.

The ditches provide adequate capacity for the 100 year storm event. Drainage will outlet to level spreaders designed in according with the MOE manual prior to discharging to Lake Oxbow.

The calculations are included in Appendix A.

3.5 Ditches and Level Spreaders

Drainage from the proposed road will be directed to enhanced grass/rip-rap lined ditches. The ditches will promote cleansing, infiltration, attenuate flows and protect receiving vegetation from erosion.

The ditch configuration has been based on providing enhanced water quality control and will consist of grass/rip-rap surface, 3:1 side slopes, 0.5m bottom width, and minimum 400mm depth.

The proposed ditching has been sized to convey the storm water from the 100 year storm event, as well as meet the velocity requirements for enhanced ditches as recommended by the MOE. Calculations are included in Appendix A.

The ditches will discharge to rip-rap level spreader outfalls. The level spreader ensures uniform flow over the existing landscape vegetation which promotes cleansing and infiltration of storm water. The spreader will be constructed with 50mm dia. rip-rap to ensure the spreader can withstand the velocity of runoff discharging from the steep swale. The design of the level spreader is consistent with the typical detail specified in the MOE manual.

Details of the level spreader design are illustrated on Drawing DET-1. Calculations are included in Appendix A.

3.6 Vegetative Buffers

A vegetative buffer is important to protect the natural shoreline from the impact of construction and lot disturbance. Shoreline buffers also filter runoff, absorb nutrients and protect from erosion.

The Contractor's operations shall not cause damage to the trunks or branches of trees not designated for removal or cause flooding or sediment deposits in tree preservation areas identified on the drawing.

Unless the contract requires work within the drip line of trees not designated for removal, equipment shall not be operated within that drip line area. When the contract requires work within the drip line of trees not designated for removal, operation of equipment within that drip line area shall be kept to the minimum necessary to perform the work required.

Equipment or vehicles shall not be parked, repaired or refuelled, construction material shall not be stored, and earth materials shall not be stockpiled within the drip line area of any tree not designated for removal.

Within 5 calendar days of damage, branches that are broken as a result of construction shall be cut back cleanly at the break, or to within ½" of their base if a substantial portion of the branch is damaged. Roots that are exposed by construction shall be cut back cleanly to the soil surface and damaged bark shall be neatly trimmed back to uninjured bark, without causing further injury.

4.0 CONSTRUCTION MITIGATION MEASURES

4.1 General

A heavy duty silt fence should be installed on the down gradient side of the proposed development. The fencing should be installed 3 to 5 metres away from the construction / filling limit. Where the base of the siltation fencing cannot be keyed into the underlying soils, sand soils shall be imported and placed on the flap of the fence to a depth of 0.2 metres.

Stripped or stockpiled earth material will be located a minimum of 15 metres away from natural drainage paths and always be placed up-gradient of the siltation controls. In addition, the stockpiles should be located a minimum of 15 metres away from the top of any existing embankment.

All reasonable methods to control erosion and sedimentation are to be taken during construction. The contractors will monitor runoff toward Oxbow Lake and the adjacent lots.

Details of the construction control facilities and their locations are shown on Drawings PP-1 and DET-1.

4.2 Monitoring and Maintenance

It is the responsibility of the contractor and owner to maintain the siltation control devices until suitable grass cover/vegetation has been established.

A regular review of the facilities by the contractor shall be carried out during the construction period to ensure that the facilities are being properly maintained, and if necessary replaced.

The contractor should inspect the siltation devices immediately after each rainfall. Damaged devices should be repaired immediately and additional devices installed if necessary.

Silt should be removed from the fencing and straw bale dams when deposits reach approximately 250mm above original ground.

In the event that the proposed works cannot be completed within one construction season or adequate vegetation has not been established prior to winter freeze up, the contractor should review the silt controls to assess potential problem areas which might exist during the spring thaw and install additional controls as necessary.

4.3 Contingency Plan

Should the erosion control measures fail and sediment migrate beyond the limits of the control works, the following tasks should be carried out:

- The Township of Lake of Bays should be notified of the event. The area will be assessed and cleaned up to the satisfaction of the Township.

- Additional sedimentation facilities be installed in the area of the migration and down gradient to contain the sediment.

- The Department of Fisheries and Oceans should be contacted in the event that sediment reaches Oxbow Lake.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions are based on the information and analysis presented in this report:

1) The storm water management requirements for the site can be addressed by implementing approved quality control techniques for small drainage areas.

2) Suitable drainage conveyance measures can be installed to safely convey drainage to the lake, protect against surface erosion and prevent impact on neighbouring properties.

3) A suitable construction mitigation plan can be prepared for the site to protect Oxbow Lake and adjacent lands from sediment erosion.

It is recommended that:

1) The general guidelines provided in this report be utilized during design and construction of the enhanced swale and level spreader.

2) This report and drawing be submitted to the Township of Lake of Bays in support of the site plan application.

3) A “treatment train” of approved quality control measures be implemented as outlined in this report. The recommended techniques include enhanced grass / rip-rap ditches for conveyance, maintenance of existing landscape vegetation and vegetative buffers to ensure the integrity of the existing slope and shoreline vegetation and the construction of rip-rap level spreaders at the ditch outfalls to promote uniform flow over vegetation, attenuate flow rates and reduce erosion potential.

4) The construction mitigation measures outlined are utilized as a guideline for construction mitigation management on this site.

All of which is respectfully submitted,

PINESTONE ENGINEERING LTD.

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APPENDIX A

Design Calculations

PINESTONE ENGINEERING LTD.

Level Spreader Length Calculation

The level spreader and vegetated filter strip shall be designed such that the peak flow from a 4 hour Chicago 10mm storm results in a flow depth of 50-100 mm through the vegetation. The flow depth over the level spreader can be calculated using a standard broad crested weir equation:

Weir Equation:

$$Q = \alpha L H^{1.5}$$

Catchment 201:

$$0.164 \text{cu.m/s} = (0.60)(L)(0.10\text{m})^{1.5}$$

$$L = 8.64 \text{ m}$$

In order for the 2yr storm event to weir over the level spreader at a maximum flow depth of 100mm, the minimum length of the level spreader is 8.7m. The swale outlet level spreader for catchment 201 provides 9.0m length.

Catchment 202:

$$0.059 \text{cu.m/s} = (0.60)(L)(0.10\text{m})^{1.5}$$

$$L = 3.11 \text{ m}$$

In order for the 2yr storm event to weir over the level spreader at a maximum flow depth of 100mm, the minimum length of the level spreader is 3.1m. The swale outlet level spreaders for catchment 203 provides 4.0m length.

OXBOW LAKE ROAD - ENHANCED SWALE CATCHMENT 201

RATIONAL METHOD CALCULATIONS

Lake of Bays, Ontario

Project Number: 20-11530M
Date: September 28, 2020
Design By: LT
File: Z:\Project Documents\11530M Oxbow Lake\Trapezoidal Channel - 201.xls

Chicago Storm Parameters				
Design Storm	a	b	c	Intensity (mm/hr)
5 Year	950	6.75	0.82	95.214
10 Year	1221	7.38	0.843	111.168
25 Year	1452	7.3	0.848	130.851
50 Year	1466	6.55	0.832	143.513
100 Year	1499	5.81	0.825	155.476

* Based on District of Muskoka IDF Data

Rational Coefficient	
DOWNTOWN BUSINESS	0.70-0.95
SINGLE FAMILY RESIDNTL	0.30-0.50
ASPHALT/CONCRETE	0.70-0.95
SANDY SOIL LAWN	0.05-0.20
HEAVY SOIL LAWN	0.13-0.35
BRICK	0.70-0.85

Time of Concentration(Tc) Calculator			
WATERSHED AREA	=	3.22	ha
LENGTH OF OVERLAND FLOW	=	90	m
SLOPE	=	0.2	m/m
RATIONAL COEFFICIENT	=	0.25	see table

Time of Concetration Results			
BRANSBY WILLIAMS FORMULA	=	**2.5**	min.
(use for C>=0.4)			
AIROPORT FORMULA	=	**9.8**	min.
(use for C<0.4)			

Design Flows (Q=CiA/360) m^3/sec	
5 Year	**0.213**
10 Year	**0.249**
25 Year	**0.293**
50 Year	**0.321**
100 Year	**0.348**

OXBOW LAKE ROAD - ENHANCED SWALE CATCHMENT 201

TRAPEZOIDAL CHANNEL DESIGN

Lake of Bays, Ontario

Project Number: 20-11530M
Date: September 28, 2020
Design By: LT
File: Z:\Project Documents\11530M Oxbow Lake\Trapezoidal Channel - 201.xls

Calculation of discharge, Q, and average velocity, V (S.I. Units)

Using the Manning Equation for Uniform Open Channel Flow

Instructions: *Enter values in blue boxes. Spreadsheet calculates values in yellow boxes*

Inputs			**Calculations**		
Bottom width, **b** =	0.5	m	Cross-Sect. Area, **A** =	0.680	m^2
Depth of Channel, **y** =	0.4	m	Wetted Perimeter, **P** =	3.03	m
Side Slope, **z =** (H:V = **z**:1)	3		Hydraulic Radius, **R** =	0.22	m
Manning roughness, **n** =	0.03		Discharge, **Q** =	1.67	m^3/s
Channel bottom slope, **S** =	0.04	m/m	Ave. Velocity, **V** =	2.46	m/s
Required Flow, **Q** =	0.348	m^3/s			

Design Check: **Size of Channel is adequate and can carry required flow**

$A = by + zy^2$	(cross-sectional area)
$P = b + 2y(1 + z^2)^{1/2}$	(wetted perimeter)
$R = A/P$	(hydraulic radius)
$Q = (1.0/n)(A)(R^{2/3})(S^{1/2})$	(Manning Equation)
$V = Q/A$	(average velocity)

Manning Roughness Coefficient Values

Channel Surface	Manning Roughness Coefficient, n
Asbestos cement	0.011
Brass	0.011
Brick	0.015
Cast-iron, new	0.012
Concrete, steel forms	0.011
Concrete, wooden forms	0.015
Concrete, centrifugally spun	0.013
Copper	0.011
Corrugated metal	0.022
Galvanized Iron	0.016
Lead	0.011
Plastic	0.009
Steel - Coal-tar enamel	0.01
Steel - New unlined	0.011
Steel - Riveted	0.019
Wood stave	0.012

OXBOW LAKE ROAD - ENHANCED SWALE CATCHMENT 201

Erodibilty Review

Lake of Bays, Ontario

Project Number: 20-11530M
Date: September 28, 2020
Design By: LT
File: Z:\Project Documents\11530M Oxbow Lake\Trapezoidal Channel - 201.xls

Maximum Flow Rate in Channel = 0.348 (100 Year Design Storm)
Mamimum Permitted Velocity = 1.2 (see charts)

Flow Area A (Q/V) = 0.289718 m^2

Calculate Flow Depth in Channel		Quadratic Function		
Area = (bottom width)d+(slope)d^2		**a**	**b**	**c**
		3	**0.5**	**-0.28971756**
	Root 1 =	0.238407191		
	Root 2 =	-0.405073857		
Thefore, depth of flow in the channel =		**0.238 m**		**OK**

Calculate Maximum Slope at which Erosion Protection is Required		
Smax =	**$(Vmax \times N/R^{2/3})^2$**	
N =	0.03	(Rip-Rap)
Wetted Perimeter	2.008	m
Hydraulic Radius	0.144	m
Smax =	0.017	m/m
Smax =	1.712	%

Channel Design Summary	
Bottom Width	**0.5 m**
Side Slopes (H:1)	**3**
Depth of Channel	**0.4 m**
Depth of Flow	**0.238 m**
Erosion Protection when slope of Channel exceeds	**1.71 %**

OXBOW LAKE ROAD - ENHANCED SWALE CATCHMENT 202

RATIONAL METHOD CALCULATIONS

Lake of Bays, Ontario

Project Number: 20-11530M
Date: September 28, 2020
Design By: LT
File: Z:\Project Documents\11530M Oxbow Lake\Trapezoidal Channel - 202.xls

Chicago Storm Parameters				
Design Storm	a	b	c	Intensity (mm/hr)
5 Year	950	6.75	0.82	95.214
10 Year	1221	7.38	0.843	111.168
25 Year	1452	7.3	0.848	130.851
50 Year	1466	6.55	0.832	143.513
100 Year	1499	5.81	0.825	155.476

* Based on District of Muskoka IDF Data

Rational Coefficient	
DOWNTOWN BUSINESS	0.70-0.95
SINGLE FAMILY RESIDNTL	0.30-0.50
ASPHALT/CONCRETE	0.70-0.95
SANDY SOIL LAWN	0.05-0.20
HEAVY SOIL LAWN	0.13-0.35
BRICK	0.70-0.85

Time of Concentration(Tc) Calculator			
WATERSHED AREA	=	1.16	ha
LENGTH OF OVERLAND FLOW	=	90	m
SLOPE	=	0.2	m/m
RATIONAL COEFFICIENT	=	0.25	see table

Time of Concetration Results			
BRANSBY WILLIAMS FORMULA	=	**2.8**	min.
(use for C>=0.4)			
AIROPORT FORMULA	=	**9.8**	min.
(use for C<0.4)			

Design Flows (Q=CiA/360) m^3/sec	
5 Year	**0.077**
10 Year	**0.090**
25 Year	**0.105**
50 Year	**0.116**
100 Year	**0.125**

OXBOW LAKE ROAD - ENHANCED SWALE CATCHMENT 202

TRAPEZOIDAL CHANNEL DESIGN

Lake of Bays, Ontario

Project Number: 20-11530M
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Calculation of discharge, Q, and average velocity, V (S.I. Units)

Using the Manning Equation for Uniform Open Channel Flow

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Inputs			**Calculations**		
Bottom width, **b** =	0.5	m	Cross-Sect. Area, **A** =	0.680	m^2
Depth of Channel, **y** =	0.4	m	Wetted Perimeter, **P** =	3.03	m
Side Slope, **z =** (H:V = **z**:1)	3		Hydraulic Radius, **R** =	0.22	m
Manning roughness, **n** =	0.03		Discharge, **Q** =	0.65	m^3/s
Channel bottom slope, **S** =	0.006	m/m	Ave. Velocity, **V** =	0.95	m/s
Required Flow, **Q** =	0.125	m^3/s			

Design Check: **Size of Channel is adequate and can carry required flow**

$A = by + zy^2$	(cross-sectional area)
$P = b + 2y(1 + z^2)^{1/2}$	(wetted perimeter)
$R = A/P$	(hydraulic radius)
$Q = (1.0/n)(A)(R^{2/3})(S^{1/2})$	(Manning Equation)
$V = Q/A$	(average velocity)

Manning Roughness Coefficient Values

Channel Surface	Manning Roughness Coefficient, n
Asbestos cement	0.011
Brass	0.011
Brick	0.015
Cast-iron, new	0.012
Concrete, steel forms	0.011
Concrete, wooden forms	0.015
Concrete, centrifugally spun	0.013
Copper	0.011
Corrugated metal	0.022
Galvanized Iron	0.016
Lead	0.011
Plastic	0.009
Steel - Coal-tar enamel	0.01
Steel - New unlined	0.011
Steel - Riveted	0.019
Wood stave	0.012

OXBOW LAKE ROAD - ENHANCED SWALE CATCHMENT 202

Erodibilty Review

Lake of Bays, Ontario

Project Number: 20-11530M
Date: September 28, 2020
Design By: LT
File: Z:\Project Documents\11530M Oxbow Lake\Trapezoidal Channel - 202.xls

Maximum Flow Rate in Channel = 0.125 (100 Year Design Storm)
Mamimum Permitted Velocity = 1.2 (see charts)

Flow Area A (Q/V) = 0.10437 m^2

Calculate Flow Depth in Channel	Quadratic Function		
Area = (bottom width)d+(slope)d^2	**a**	**b**	**c**
	3	**0.5**	**-0.1043703**

Root 1 = 0.120957011
Root 2 = -0.28762368

Thefore, depth of flow in the channel = 0.121 m OK

Calculate Maximum Slope at which Erosion Protection is Required		
Smax =	**$(Vmax \times N/R^{2/3})^2$**	
N =	0.03	(Rip-Rap)
Wetted Perimeter	1.265	m
Hydraulic Radius	0.083	m
Smax =	0.036	m/m
Smax =	3.608	%

Channel Design Summary	
Bottom Width	**0.5 m**
Side Slopes (H:1)	**3**
Depth of Channel	**0.4 m**
Depth of Flow	**0.121 m**
Erosion Protection when slope of Channel exceeds	**3.61 %**

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 7.52202 cfs

Design Flow: 8.79335 cfs

Maximum Flow: 12.2895 cfs

Table 1 - Summary of Culvert Flows at Crossing: Crossing 201

Headwater Elevation (m)	Total Discharge (cms)	Culvert 201 Discharge (cms)	Roadway Discharge (cms)	Iterations
0.86	0.21	0.21	0.00	1
0.88	0.23	0.23	0.00	1
0.90	0.24	0.24	0.00	1
0.91	0.25	0.25	0.00	1
0.94	0.27	0.27	0.00	1
0.96	0.28	0.28	0.00	1
0.98	0.29	0.29	0.00	1
0.99	0.31	0.31	0.00	1
1.01	0.32	0.32	0.00	1
1.03	0.33	0.33	0.00	1
1.06	0.35	0.35	0.00	1
1.22	0.44	0.44	0.00	Overtopping

Rating Curve Plot for Crossing: Crossing 201

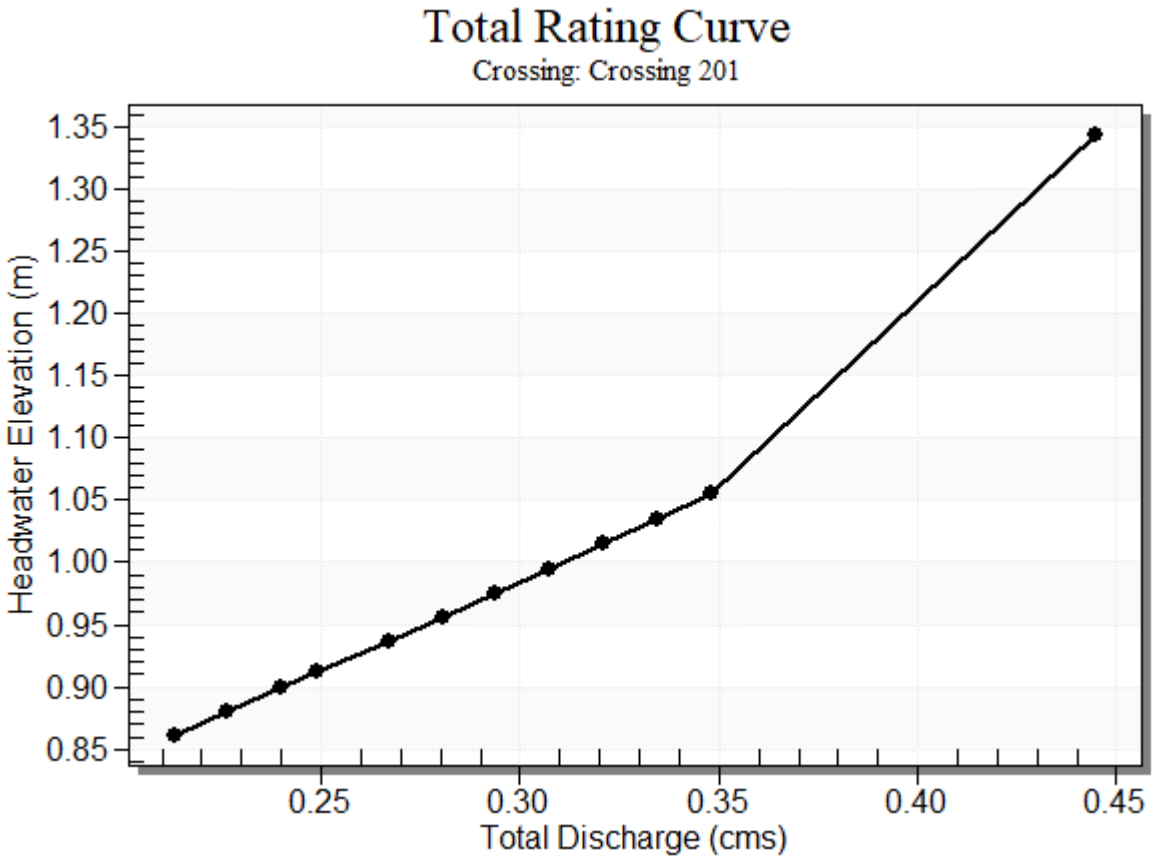


Table 2 - Culvert Summary Table: Culvert 201

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.21	0.21	0.86	0.462	0.0*	1-S2n	0.189	0.299	0.200	0.154	2.489	1.440
0.23	0.23	0.88	0.480	0.0*	1-S2n	0.195	0.308	0.207	0.159	2.533	1.465
0.24	0.24	0.90	0.499	0.013	1-S2n	0.201	0.317	0.214	0.163	2.566	1.487
0.25	0.25	0.91	0.512	0.026	1-S2n	0.205	0.323	0.219	0.166	2.583	1.502
0.27	0.27	0.94	0.537	0.053	1-S2n	0.213	0.335	0.227	0.172	2.629	1.530
0.28	0.28	0.96	0.556	0.075	1-S2n	0.219	0.344	0.233	0.176	2.662	1.551
0.29	0.29	0.98	0.575	0.096	1-S2n	0.224	0.352	0.240	0.180	2.693	1.570
0.31	0.31	0.99	0.595	0.118	1-S2n	0.230	0.361	0.246	0.184	2.719	1.589
0.32	0.32	1.01	0.615	0.140	5-S2n	0.235	0.369	0.253	0.188	2.745	1.607
0.33	0.33	1.03	0.635	0.162	5-S2n	0.241	0.376	0.259	0.192	2.771	1.625
0.35	0.35	1.06	0.656	0.186	5-S2n	0.246	0.385	0.265	0.195	2.793	1.642

* Full Flow Headwater elevation is below inlet invert.

****

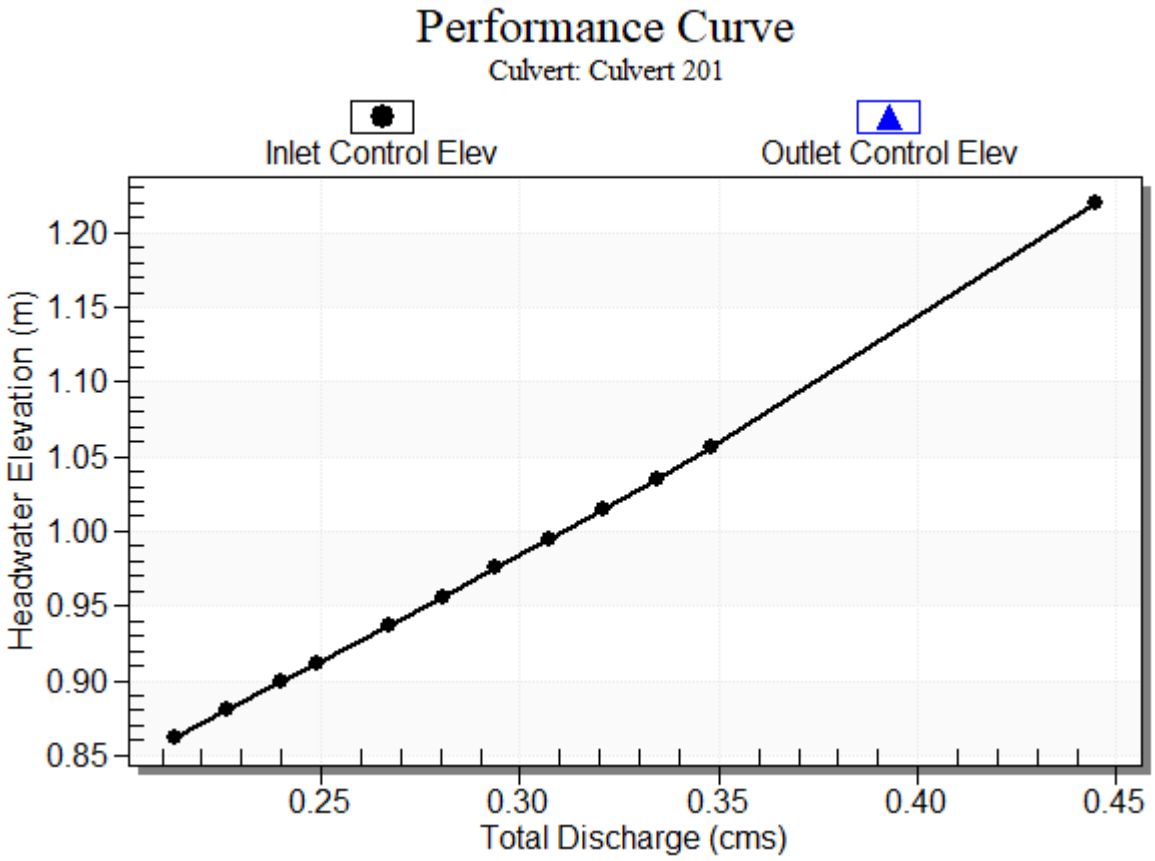
Straight Culvert

Inlet Elevation (invert): 0.40 m, Outlet Elevation (invert): 0.00 m

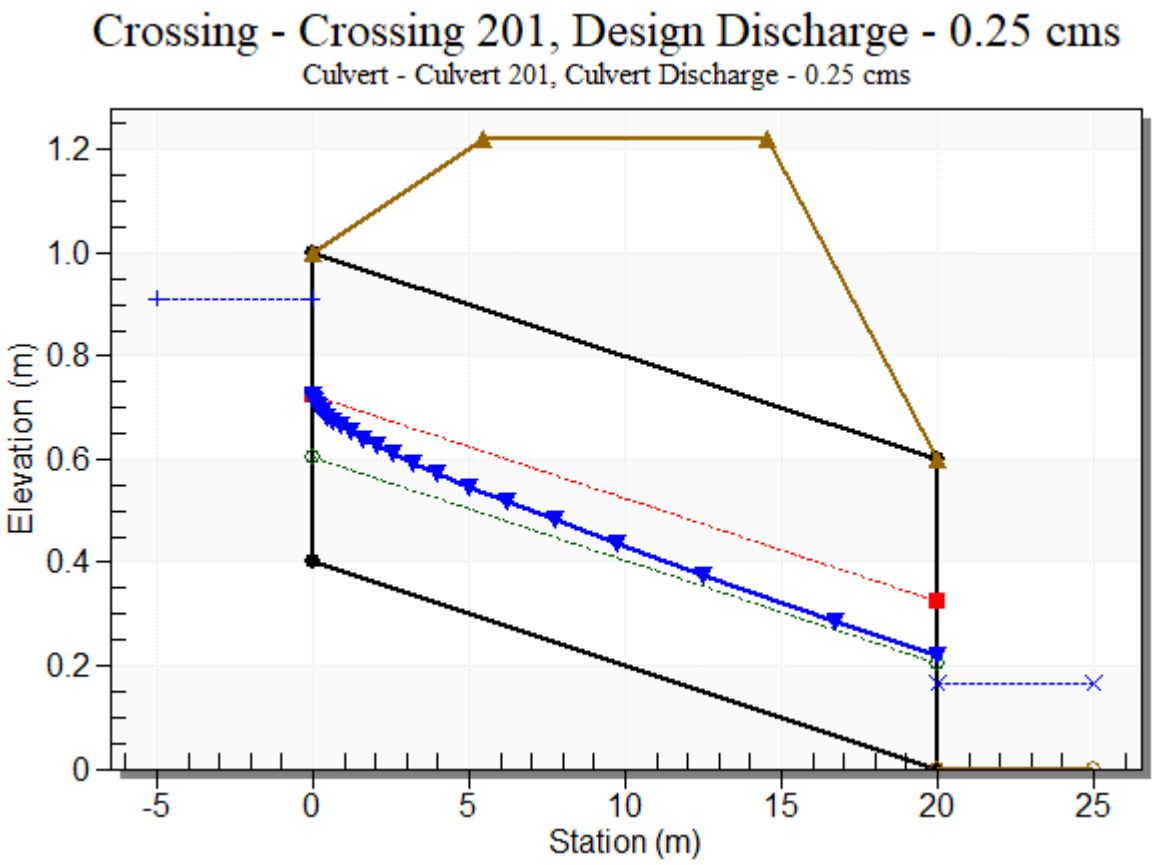
Culvert Length: 20.00 m, Culvert Slope: 0.0200

****

Culvert Performance Curve Plot: Culvert 201



Water Surface Profile Plot for Culvert: Culvert 201



Site Data - Culvert 201

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 0.40 m

Outlet Station: 20.00 m

Outlet Elevation: 0.00 m

Number of Barrels: 1

Culvert Data Summary - Culvert 201

Barrel Shape: Circular

Barrel Diameter: 600.00 mm

Barrel Material: Smooth HDPE

Embedment: 0.00 mm

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting

Inlet Depression: None

Table 3 - Downstream Channel Rating Curve (Crossing: Crossing 201)

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
0.21	0.15	0.15	1.44	60.31	1.43
0.23	0.16	0.16	1.46	62.16	1.43
0.24	0.16	0.16	1.49	63.96	1.44
0.25	0.17	0.17	1.50	65.11	1.44
0.27	0.17	0.17	1.53	67.37	1.45
0.28	0.18	0.18	1.55	69.00	1.45
0.29	0.18	0.18	1.57	70.60	1.46
0.31	0.18	0.18	1.59	72.14	1.46
0.32	0.19	0.19	1.61	73.65	1.46
0.33	0.19	0.19	1.62	75.12	1.47
0.35	0.20	0.20	1.64	76.55	1.47

Tailwater Channel Data - Crossing 201

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 0.50 m

Side Slope (H:V): 3.00 (_:1)

Channel Slope: 0.0400

Channel Manning's n: 0.0300

Channel Invert Elevation: 0.00 m

Roadway Data for Crossing: Crossing 201

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 10.00 m

Crest Elevation: 1.22 m

Roadway Surface: Paved

Roadway Top Width: 9.10 m

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 2.71923 cfs

Design Flow: 3.17832 cfs

Maximum Flow: 4.41433 cfs

Table 1 - Summary of Culvert Flows at Crossing: Crossing 202

Headwater Elevation (m)	Total Discharge (cms)	Culvert 202 Discharge (cms)	Roadway Discharge (cms)	Iterations
0.73	0.08	0.08	0.00	1
0.74	0.08	0.08	0.00	1
0.75	0.09	0.09	0.00	1
0.76	0.09	0.09	0.00	1
0.78	0.10	0.10	0.00	1
0.79	0.10	0.10	0.00	1
0.80	0.11	0.11	0.00	1
0.81	0.11	0.11	0.00	1
0.83	0.12	0.12	0.00	1
0.84	0.12	0.12	0.00	1
0.85	0.13	0.13	0.00	1
1.05	0.18	0.18	0.00	Overtopping

Rating Curve Plot for Crossing: Crossing 202

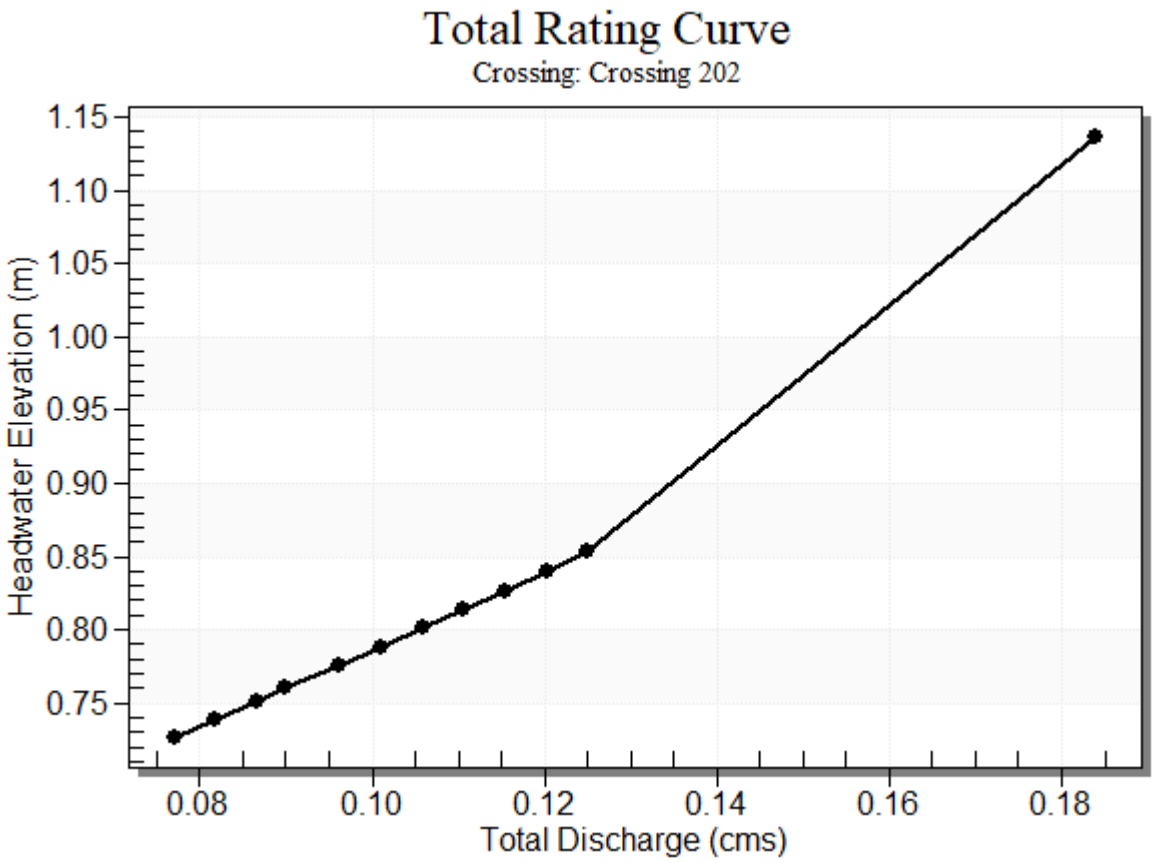


Table 2 - Culvert Summary Table: Culvert 202

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.08	0.08	0.73	0.307	0.0*	1-S2n	0.130	0.199	0.130	0.092	2.097	1.086
0.08	0.08	0.74	0.319	0.0*	1-S2n	0.134	0.205	0.134	0.094	2.135	1.105
0.09	0.09	0.75	0.331	0.0*	1-S2n	0.139	0.211	0.139	0.097	2.165	1.123
0.09	0.09	0.76	0.340	0.0*	1-S2n	0.141	0.215	0.141	0.099	2.189	1.135
0.10	0.10	0.78	0.356	0.0*	1-S2n	0.147	0.222	0.147	0.103	2.232	1.157
0.10	0.10	0.79	0.368	0.0*	1-S2n	0.150	0.228	0.157	0.105	2.141	1.173
0.11	0.11	0.80	0.381	0.0*	1-S2n	0.154	0.233	0.160	0.108	2.174	1.188
0.11	0.11	0.81	0.394	0.0*	1-S2n	0.158	0.239	0.158	0.111	2.317	1.203
0.12	0.12	0.83	0.407	0.0*	5-S2n	0.162	0.245	0.168	0.113	2.228	1.217
0.12	0.12	0.84	0.420	0.0*	5-S2n	0.166	0.250	0.172	0.115	2.247	1.231
0.13	0.13	0.85	0.433	0.0*	5-S2n	0.169	0.255	0.176	0.118	2.267	1.245

* Full Flow Headwater elevation is below inlet invert.

****

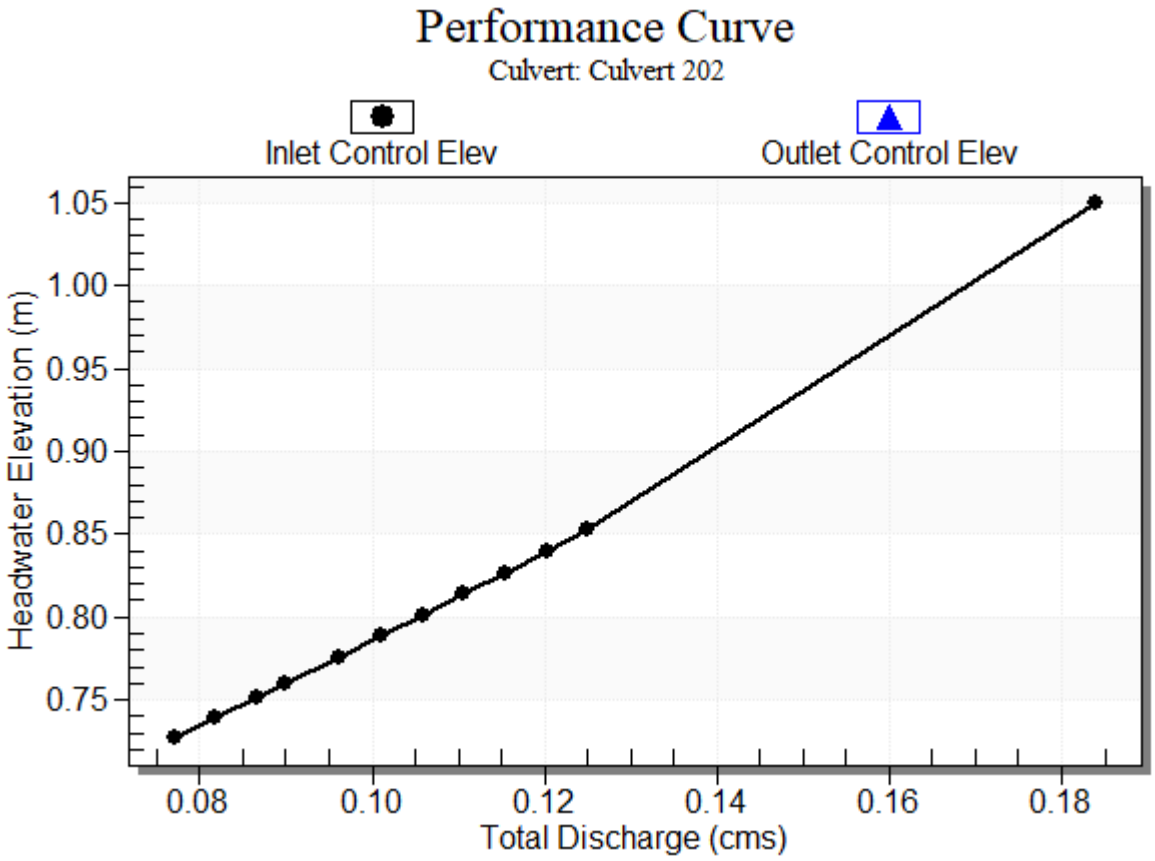
Straight Culvert

Inlet Elevation (invert): 0.42 m, Outlet Elevation (invert): 0.00 m

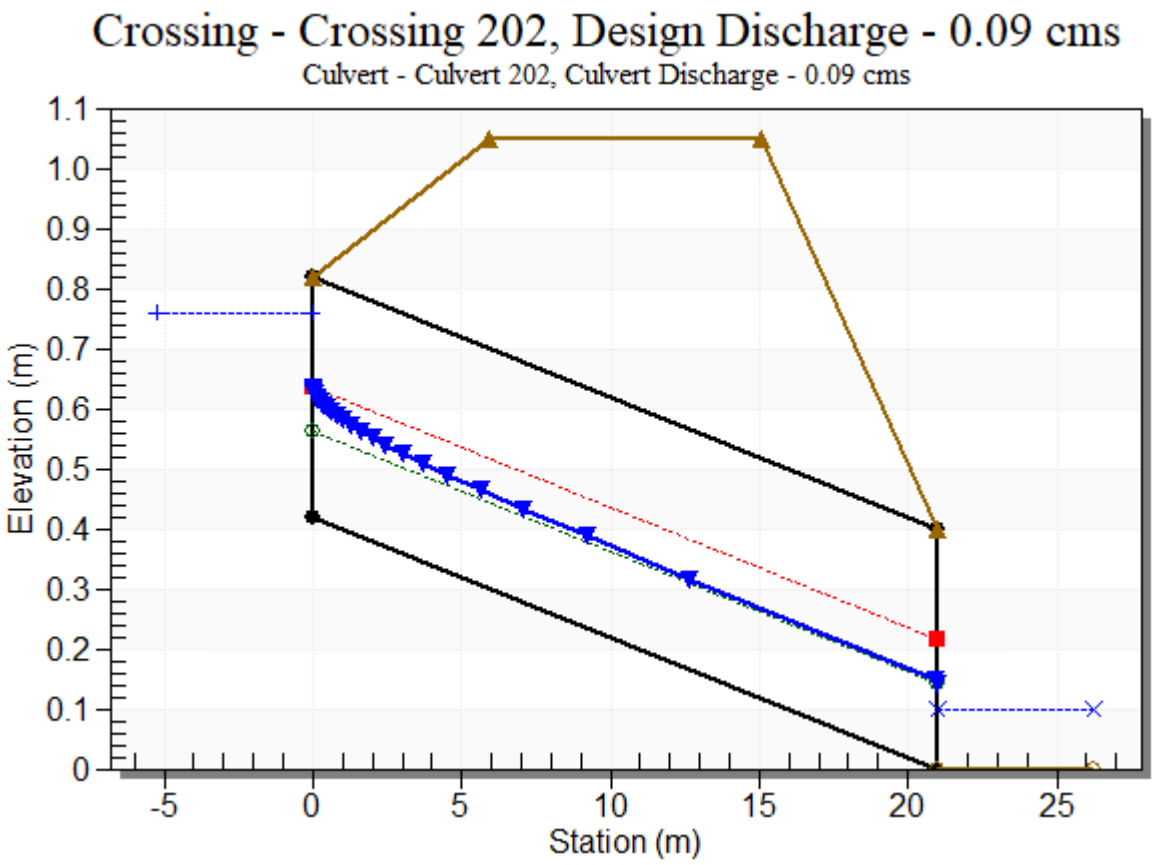
Culvert Length: 21.00 m, Culvert Slope: 0.0200

****

Culvert Performance Curve Plot: Culvert 202



Water Surface Profile Plot for Culvert: Culvert 202



Site Data - Culvert 202

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 0.42 m

Outlet Station: 21.00 m

Outlet Elevation: 0.00 m

Number of Barrels: 1

Culvert Data Summary - Culvert 202

Barrel Shape: Circular

Barrel Diameter: 400.00 mm

Barrel Material: Smooth HDPE

Embedment: 0.00 mm

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting

Inlet Depression: None

Table 3 - Downstream Channel Rating Curve (Crossing: Crossing 202)

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
0.08	0.09	0.09	1.09	35.89	1.33
0.08	0.09	0.09	1.10	37.05	1.34
0.09	0.10	0.10	1.12	38.17	1.34
0.09	0.10	0.10	1.13	38.96	1.35
0.10	0.10	0.10	1.16	40.33	1.35
0.10	0.11	0.11	1.17	41.36	1.36
0.11	0.11	0.11	1.19	42.36	1.36
0.11	0.11	0.11	1.20	43.34	1.37
0.12	0.11	0.11	1.22	44.30	1.37
0.12	0.12	0.12	1.23	45.24	1.37
0.13	0.12	0.12	1.24	46.15	1.38

Tailwater Channel Data - Crossing 202

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 0.50 m

Side Slope (H:V): 3.00 (_:1)

Channel Slope: 0.0400

Channel Manning's n: 0.0300

Channel Invert Elevation: 0.00 m

Roadway Data for Crossing: Crossing 202

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 10.00 m

Crest Elevation: 1.05 m

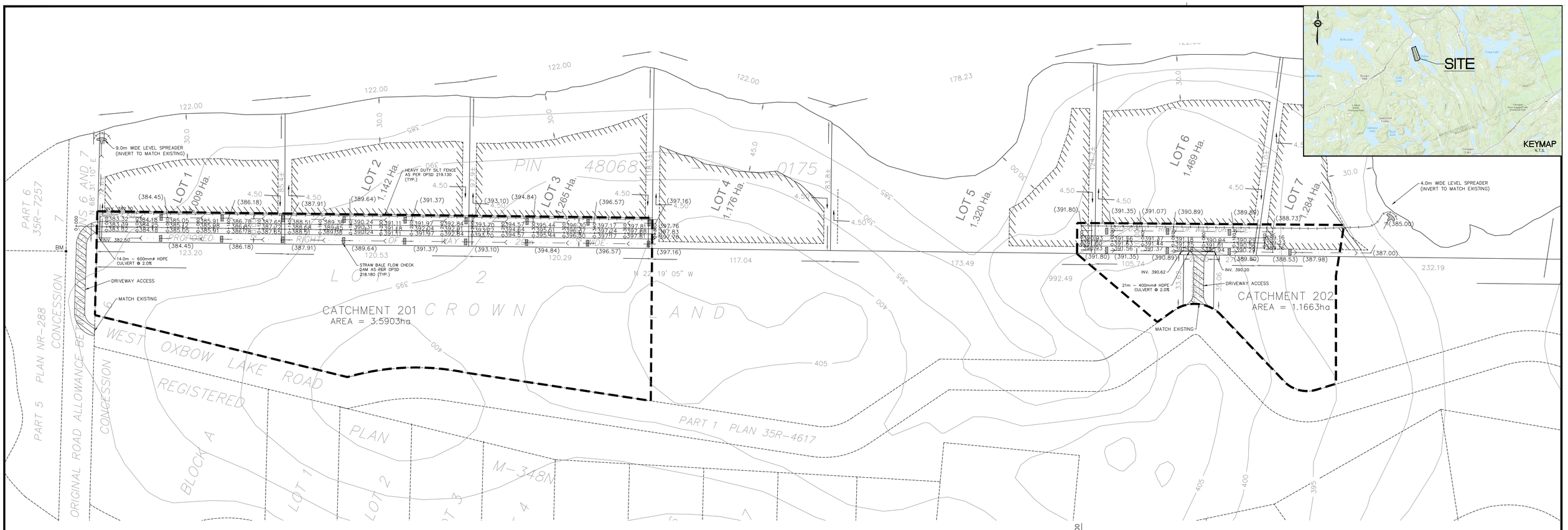
Roadway Surface: Paved

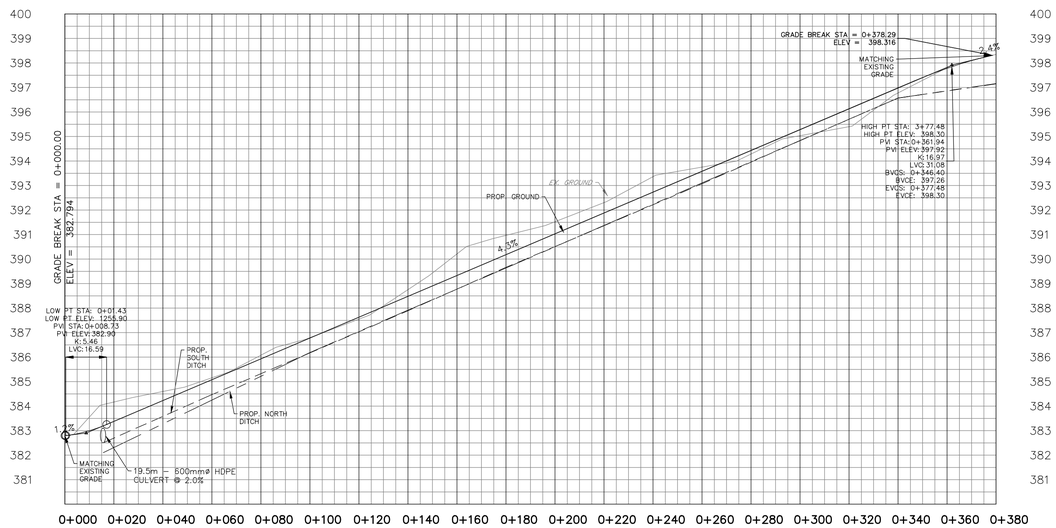
Roadway Top Width: 9.10 m

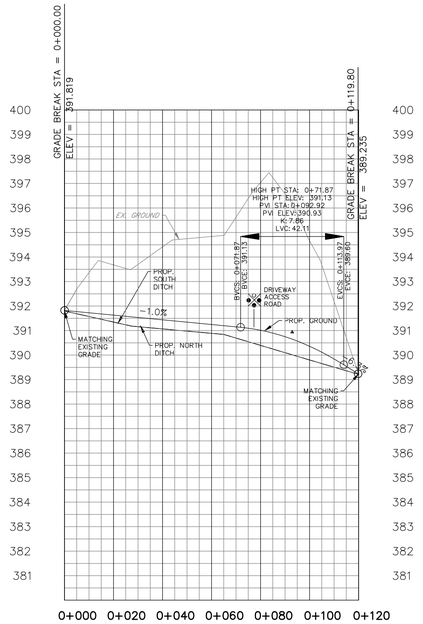
APPENDIX B

Drawings

PINESTONE ENGINEERING LTD.







NOTE:
CONTRACTOR TO VERIFY EXISTING ELEVATIONS

BM ▲ BENCHMARK: SIB NORTH OF PROPERTY ELEVATION 382.88m.

The position of existing above ground and underground utilities and facilities are not necessarily shown on the drawings, and where shown, the accuracy of the position of such utilities and facilities is not guaranteed. Before starting work, the contractor shall confirm the exact location of all existing utilities and facilities, and shall assume all liability for damage to them

Drawings shall not be used for construction unless sealed and signed. All work to be performed in accordance with the Occupational Health & Safety Act 1990.

Any errors and/or omissions shall be reported to Pinestone Engineering Ltd. without delay.

PINESTONE ENGINEERING LIMITED | www.pel.ca

SEAL

PROFESSIONAL ENGINEER — LICENSED — T.W. HARVEY — Jan 29 — PROVINCE OF ONTARIO

DRAWN BY:	CHECKED BY:
M.B.	T.H.
DESIGNED BY:	
L.T.	
SCALE:	DATE:
1:1250	AUGUST 2020

NO.	YY.MM.DD	REVISION	BY
1	21.01.14	DWY ALIGNMENT	M.B.

NORTH ARROW

PROJECT: WEST OXBOW LAKE ROAD

PROJECT No. : 20-11530-M

DRAWING: PLAN AND PROFILE

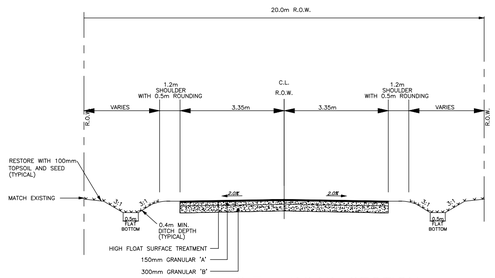
DRAWING No. PP-1

EROSION CONTROL NOTES:

1. All silt fencing to be installed prior to any grading or excavation.
2. Erosion control fencing to be installed around the base of all stockpiles.
3. Additional erosion control measures may be required as site development progresses. Contractor to provide all additional erosion control structures as directed by the engineer.
4. Pinestone Engineering Ltd. to monitor erosion control structures to ensure fencing is installed and maintenance is performed to municipal requirements.
5. Erosion control structures to be monitored regularly and any damage repaired immediately. Sediments to be removed when accumulations reach a maximum of 1/2 the height of the fence.
6. All erosion control structures to remain in place until all disturbed ground have been re-stabilized either by paving or restoration of vegetative ground cover.
7. No alternate methods of erosion protection shall be permitted unless approved Pinestone Engineering Ltd. and the Township of Lake of Bays Department of Public Works.
8. Contractor is responsible for municipal roadway to be cleared of all sediments from vehicular tracking etc. at the end of each day.

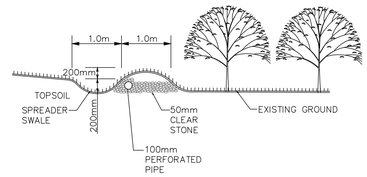
CULVERT NOTES

1. Culverts shall be 320KPa. HDPE pipe. Bedding shall be granular 'A' to OPSD 802.010 compacted to 95% SPD.
2. Place 150mm dia. rip rap at all culvert inlets and outlets per OPSD 810.01.
3. Frost tapers at culverts to be per OPSD.803.030
4. All culvert installations for entrances to municipal roads shall conform to OPSS.421 and OPSD.802.013 and 803.030.



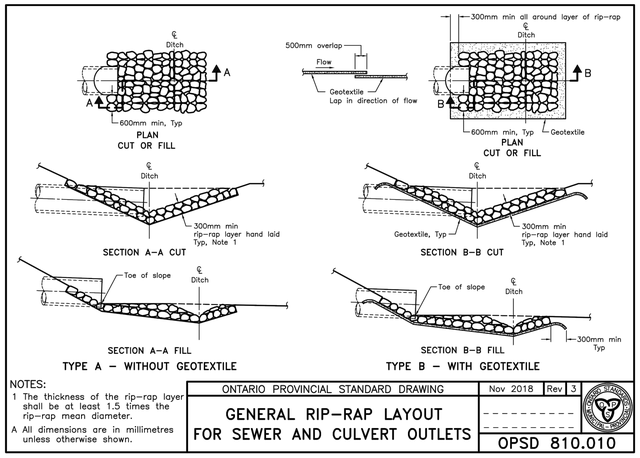
TYPICAL 6.7m ROAD SECTION

N.T.S.



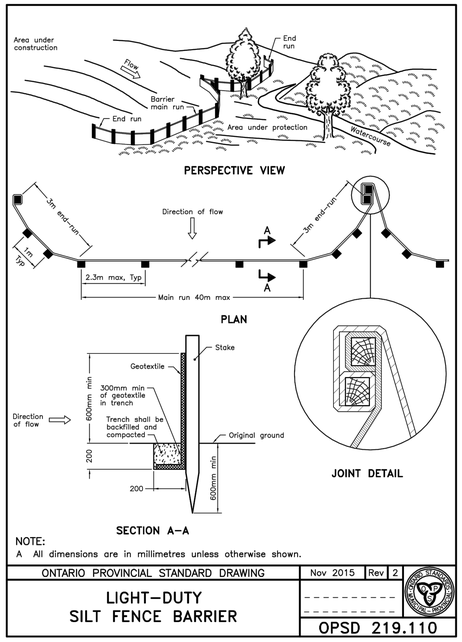
LEVEL SPREADER DETAIL

NTS



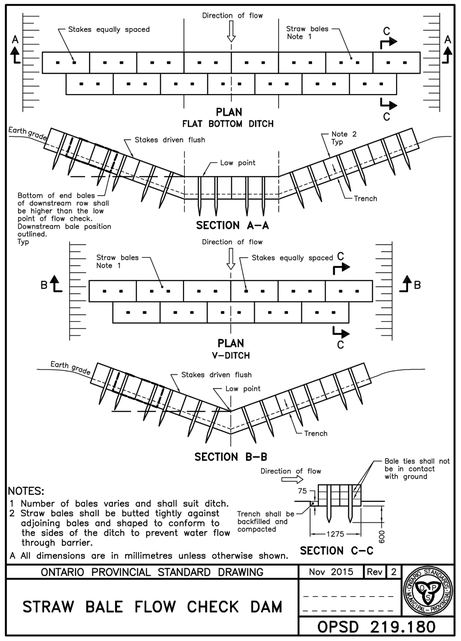
NOTES:
1 The thickness of the rip-rap layer shall be at least 1.5 times the rip-rap mean diameter.
A All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2018	Rev 3
GENERAL RIP-RAP LAYOUT FOR SEWER AND CULVERT OUTLETS		
	OPSD 810.010	



NOTE:
A All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2015	Rev 2
LIGHT-DUTY SILT FENCE BARRIER		
	OPSD 219.110	



NOTES:
1 Number of bales varies and shall suit ditch.
2 Straw bales shall be butted tightly against adjoining bales and shaped to conform to the sides of the ditch to prevent water flow through barrier.
A All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2015	Rev 2
STRAW BALE FLOW CHECK DAM		
	OPSD 219.180	

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SEAL

LICENSED PROFESSIONAL ENGINEER — THOMAS HARVEY — Jan 23, 21 — PROVINCE OF ONTARIO

DRAWN BY:	CHECKED BY:
M.B.	T.H.
DESIGNED BY:	
L.T.	
SCALE:	DATE:
	AUGUST 2020

NO.	YY.MM.DD	REVISION	BY
1	21.01.14	DWY ALIGNMENT	M.B.

NORTH ARROW

PROJECT: WEST OXBOW LAKE ROAD

PROJECT No. : 20-11530-M

DRAWING: GENERAL NOTES AND DETAILS

DRAWING No. DET-1