Tote Road Quarry Expansion Project

Environmental Assessment Additional Information Addendum

Scotian Materials Limited

09 November 2022

→ The Power of Commitment

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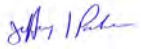
S4	01	Glen Merkley	Jeff Parks		Callie Andrews		Nov. 9, 2022

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1. Introduction

Scotian Materials Limited (Scotian) proposes to expand the existing Tote Road quarry from the approved less than 4 hectares (ha) to 22.6 ha (herein referred to as the Project). The Project is located on a 32.6 ha property on Tote Road, Head of St. Margarets Bay, Halifax County, Nova Scotia (NS) (herein referred to as the Site), approximately 2.3 kilometres (km) west of the community of Westwood Hills, Upper Tantallon, and 2.5 km northwest of the community of Head of St. Margarets Bay.

Project activities include blasting to extract rock and crushing and screening at mobile facilities within the Site to produce aggregate and associated rock products. Stockpiles, rock berms, overburden storage, and water management infrastructure will be established within the Site with all site run-off directed to a settling pond. The proposed quarry expansion area is shown in Figure 1.

1.1 Purpose of this report

The expansion of the Tote Road existing quarry beyond 4 ha in area requires a provincial environmental assessment (EA) registration as a Class I Undertaking under the *Environment Act*. On March 10, 2022, Scotian registered the Tote Road Quarry Expansion Project for environmental assessment. On April 29, 2022, the Minister of Environment and Climate Change determined that additional information was required related to water resources. The Minister requested “additional details for the water resources assessment with accompanying analysis of potential effects to surface water resource quality and quantity, wetlands and groundwater quantity, as well as related mitigation measures, and follow-up monitoring”.

A meeting was held on July 19, 2022 with Scotian, the GHD Limited (GHD) EA team and the Nova Scotia Department of Environment and Climate Change (NSECC) EA Branch and Sustainability and Applied Science Division to discuss the additional information request.

This report was prepared to address the additional information request. Information pertaining to groundwater is presented prior to the discussion of surface water as the outputs of the groundwater analysis were used in the surface water assessment.

2. Groundwater

Additional Information Request (4 c.):

Analysis of groundwater drawdown effects due to excavations depths below the water table, and the potential for these effects to extend off-site.

GHD Response:

To evaluate the potential groundwater drawdown effects due to the development of the expanded quarry to a depth of 116 m above sea level (masl), GHD reviewed the groundwater levels recorded from April 2021 to June 2022, conducted single well response tests, and utilized a numerical equation to determine the potential radius of influence (ROI) of the Project.

Groundwater Levels

In April 2021 four monitoring wells were installed at the Site. Manual water level measurements were collected in April 2021, August 2021, May 2022, and June 2022. All monitoring wells were equipped with pressure transducers to automatically record water levels every 15 minutes. A Baro-Diver was also installed to compensate the pressure data for the effects of atmospheric pressure. The elevation of groundwater ranged from 123.10 to 141.15 masl.

Groundwater levels for each well are shown on Figure 2 (hydrograph). It should be noted that the transducer installed in MW-02 was missing from the well during the August 2022 event and subsequently replaced.

Figures 3 through 5 provide a cross section location map and geologic cross sections through the existing and expanded quarry. The cross sections show the monitoring wells, groundwater elevations and expanded quarry floor. These cross sections indicate the proposed quarry floor will be beneath the water table.

Single Well Response Tests

In June 2022 GHD completed single well response tests (slug tests) in the monitoring wells. The tests were completed by inserting a solid slug into the well below the water level, causing an almost instantaneous rise in the water level in the well. The rate of the water level falling back to the static water level was recorded using a pressure transducer. The process was then repeated when the slug was removed, providing an instantaneous drop in the water level followed by a slower recovery period. The results of the single well response tests are provided in Table 1.

Table 1 Single Well Response Test Data

Well	Falling Head	Rising Head	Geometric Mean
	(m/sec)	(m/sec)	(m/sec)
MW-01	1.3×10^{-5}	1.0×10^{-5}	1.1×10^{-5}
MW-02	2.7×10^{-5}	4.9×10^{-5}	3.6×10^{-5}
MW-03	2.7×10^{-5}	1.5×10^{-5}	2.0×10^{-5}
MW-04	1.3×10^{-5}	1.3×10^{-5}	1.3×10^{-5}

GHD evaluated the impact of dewatering the expanded quarry on the surrounding groundwater table by using the hydraulic conductivity, the proposed drawdown and the Sichardt equation to estimate the zone of influence of the Project. The Sichardt equation is as follows:

$$R=3000\ s\ \sqrt{\{K\}}$$

Where:

– R = ROI (m)
– K = hydraulic conductivity (m/sec)
– s = drawdown (m)

The Sichardt equation was selected to evaluate the potential ROI because it provides an empirical estimate of the ROI based on site-derived aquifer properties such as hydraulic conductivity and drawdown.

The potential drawdown was estimated by subtracting the elevation of the proposed quarry floor from the measured November 2021 groundwater elevation. The routine groundwater elevation measurements from the Site are presented in Table 2.

Table 2 Groundwater Elevations

Monitoring Well ID	Date	Static Water Level (mbtr)	Reference Elevation[1] (masl)	Groundwater Elevation[2] (masl)
MW-01	08-Apr-21	5.24	128.49	123.25
	17-Aug-21	5.39		123.10
	15-Nov-21	5.25		123.24
	06-May-22	5.16		123.33
	29-Jun-22	5.08		123.41

Monitoring Well ID	Date	Static Water Level (mbtr)	Reference Elevation[1] (masl)	Groundwater Elevation[2] (masl)
MW-02	08-Apr-21	0.45	130.00	129.55
	17-Aug-21	0.58		129.42
	15-Nov-21	0.45		129.55
	06-May-22	0.46		129.54
	29-Jun-22	0.39		129.61
MW-03	08-Apr-21	0.84	128.44	127.60
	17-Aug-21	1.03		127.41
	15-Nov-21	0.86		127.58
	06-May-22	0.91		127.53
	29-Jun-22	0.77		127.67
MW-04	08-Apr-21	1.54	142.42	140.88
	17-Aug-21	1.96		140.46
	15-Nov-21	1.67		140.75
	06-May-22	1.44		140.98
	29-Jun-22	1.28		141.15

[1] Reference Elevation = Ground Surface + Riser

[2] Groundwater Elevation = Reference Elevation - Static Water Level

masl - metres above sea level

mbgs - metres below ground surface

mbtr - metres below top of riser

The November 2021 data were used as they are within the range of groundwater elevations measured at the Site. With lower groundwater elevations there will be a smaller ROI, and vice versa. Therefore, it is expected the ROI will vary with seasonal groundwater elevation changes.

Using the geometric means of the hydraulic conductivities measured at each monitoring well location results in the following ROI estimates:

Table 3 Radius of Influence Estimates

Well	**Hydraulic Conductivity Geometric Mean**	**Drawdown**	**ROI**
	(m/sec)	(m)	(m)
MW-01	1.1×10^{-5}	7.2	73
MW-02	3.6×10^{-5}	8.6	133
MW-03	3.0×10^{-5}	6.8	106
MW-04	1.3×10^{-5}	24	260

The hydraulic conductivity values derived from data collected at MW-01 and MW-02 were used to calculate the ROI because they are located adjacent to wetlands WL4 and WL1, respectively.

Additional Information Request (4 a.):

Detailed analysis related to the potential impacts due to groundwater dewatering, and proposed mitigation measures, considering that data provided in the EA registration document indicates that quarry expansion will interact with and extend below the water table.

GHD Response:

Based on the review of the potential groundwater/surface water interactions, the footprint of the expanded quarry was reduced to 22.6 ha in size including the existing quarry (see Figure 1). The Project will avoid the surface water catchment area of wetland 1 (WL1) and a 133 m buffer was also applied between the expanded quarry and WL1 based on the ROI calculation. Details of the surface water assessment are provided in Section 3.

A Groundwater Monitoring Plan will be developed to validate the predicted ROI and to monitor potential changes to groundwater levels based on Project activities. A surface water and wetland monitoring plan is discussed in Section 3.

Additional Information Request (4 b.):

Provide mapping views and cross-sectional details for the proposed final quarry depths/elevations/width, current location of the water table and relevant off-site wetland elevations.

GHD Response:

The mapping and cross-sectional details of the proposed final quarry depths, elevations and width along with the water table and the locations of the wetland features are shown in Figures 3, 4 and 5 (attached).

3. Water Balance Analysis

Additional Information Request (1.a.):

Details on the assumptions made in the water balance to support modelling results of each selected scenario, as in the EA registration document; or re-evaluate the appropriateness of the selected scenarios.

GHD Response:

This section discusses the assumptions made regarding Project scenarios, water management, infiltration, and catchment areas. Assumptions regarding groundwater-surface water interaction are discussed under the following additional information request.

Three scenarios were analyzed; existing (baseline); end-of-quarry (EOQ); and reclamation. Existing conditions consider the existing 4 ha quarry and serve to set criteria for the evaluation of impacts under the other two scenarios. EOQ conditions consider the quarry at full development of 22.6 ha and are expected to occur at approximately 30 years. Runoff in EOQ conditions will be discharged in the southwest portion of the Site. Some degree of progressive reclamation will occur as the Project is developed, however the EOQ scenario does not account for any re-vegetated soils in order to provide a “worst case” scenario. EOQ conditions were evaluated as they represent the largest land use changes during Project operations and allow for a conservative assessment of potential effects.

Reclamation conditions are representative of the Site upon removal of all equipment and after re-contouring and re-vegetation of exposed soils at the Site. The quarry floor will be allowed to flood under reclamation conditions, creating a pit lake. The pit lake will flow by gravity to a settling pond (discussed further in Section 4) and will discharge to the southwest.

The water storage/infiltration was estimated using the infiltration factors taken from the Ontario Ministry of Environment, Conservation and Parks Stormwater Management (SWM) Planning and Design Manual – Table 3.1 (OMECP, 2003). Calculations using these data account for slope, soil types, and vegetation cover when estimating water holding capacity for an area. Each watershed was individually analyzed to determine the slope, land use and soil type drainage factors. If multiple slope or land use segments existed within a watershed an area-ratio method was

used to determine the appropriate infiltration factor. During baseline conditions the watersheds in the project site were determined to be hilly land with a combination of cultivated land and woodland. A reduced infiltration factor for soils was used due to the shallow bedrock observed in the area. Considering these conditions, an infiltration factor of 0.5 was applied to forested and reclaimed areas, and an infiltration factor of 0.9 was applied to gravel areas outside of the quarry floor.

As described in the Water Balance Memo completed for the EA registration document (EARD) (GHD, 2021), significant infiltration into the quarry floor is expected due to the practice of laying crushed rock to create a flat surface for hauling aggregate. To further evaluate this assumption, a storage volume and surplus calculation was completed on this layer of crushed rock. The layer of crushed rock was assumed to be 1 m in depth with a void ratio of 30%. At the beginning of quarry operations, 90% of precipitation was assumed to infiltrate into the crushed rock layer. 10% of water within the crushed rock was also assumed to infiltrate to groundwater.

Under these conditions, the crushed rock layer was calculated to reach full saturation within 8 months. Water within the layer is assumed to infiltrate to groundwater at a ratio of 10% when the layer is fully saturated. However, due to losses from groundwater infiltration and evapotranspiration, storage within the crushed rock layer is calculated to drop below its maximum storage capacity between the months of June and October.

The proposed expanded quarry was revised to avoid intercepting the catchment area of WL1, which was previously identified as a wetland of special significance. Baseline watersheds for the adjacent watercourse and wetlands are shown in Figure 6, and EOQ and reclamation watersheds are shown in Figure 7.

Catchment areas corresponding to wetlands WL1 through WL4, watercourse WC1, and Island Lake were delineated using PCSWMM software and the 1 m digital elevation model (DEM) collected from the Nova Scotia Data Locator - Elevation Explorer (Nova Scotia, 2019). Catchment areas were verified by manual methods within a GIS environment using contours produced from the DEM. It should be noted the drainage from EOQ conditions to reclamation conditions is expected to remain constant. As such, watershed areas from EOQ conditions to reclamation conditions do not change. During EOQ and reclamation conditions, water which falls on the expanded quarry will be discharged to the drainage areas supplying WC1, WL4, and Island Lake.

Additional Information Request (1.b.)

Integration of surface water and groundwater.

GHD Response:

Integration of surface water and groundwater was completed by incorporating baseflow into the existing water balance analysis completed for the EARD. Streamflow volumes were calculated as the sum of the surface runoff and baseflow volumes. Surface runoff volumes were assumed to equal the total precipitation less the evapotranspiration and infiltration. Baseflow volumes were assumed to equal infiltration volumes when the pit is flooded and the water table is at equilibrium. The basis for this assumption is that the groundwater flow divide follows the catchment boundaries and the water infiltrated within the catchment area appears as baseflow at the corresponding assessment point. In EOQ conditions, groundwater will be drawn into the quarry, resulting in a reduction in baseflow in the adjacent watercourse and wetlands.

The estimated groundwater ROI is presented in Table 3. As a conservative measure, all infiltration within the groundwater ROI was assumed to be lost as groundwater inflow to the quarry. Baseflow volume reductions were estimated by reducing infiltration volumes by the percentage of the groundwater ROI that overlaps with the respective catchment.

All water collected in the expanded quarry, including surface runoff and groundwater inflows, will be directed to the settling pond and discharged southwest of the expanded quarry. Discharge will contribute runoff to the catchments supplying WC1 and WL4.

The updated annual water balance results are presented in Tables 4 through 8, below. The water balance was prepared using a monthly timestep; the results below are summarized using annual values.

Table 4 Water Balance - Existing conditions

Watershed	Area (ha)	Runoff + Baseflow (m^3)	Actual Evapotranspiration (AET) (m^3)	Infiltration (m^3)
WC1	77.86	744,249	360,210	298,805
WL1	6.42	61,789	27,243	21,975
WL2	2.00	17,262	10,438	8,421
WL3	3.09	53,621	29,759	24,005
WL4	41.13	422,373	177,925	166,090
Island Lake	1045.25	10,291,323	4,241,253	3,442,183

Table 5 Water Balance - EOQ conditions

Watershed	Area (ha)	Runoff + Baseflow (m^3)	AET (m^3)	Infiltration (m^3)
WC1	86.43	866,640	402,675	289,969
WL1	6.42	52,762	27,243	21,975
WL2	0.389	1,946	1,888	1,523
WL3	3.09	20,760	14,246	11,492
WL4	49.70	542,312	221,535	143,854
Island Lake	1052.04	10,215,238	4,275,317	3,413,803

Table 6 Water Balance – Reclamation Conditions

Watershed	Area (ha)	Runoff + Baseflow (m^3)	AET (m^3)	Infiltration (m^3)
WC1	86.43	794,012	305,907	246,757
WL1	6.42	61,789	27,243	21,975
WL2	0.39	3,469	1,888	1,523
WL3	3.09	28,595	14,246	11,492
WL4	49.70	465,391	124,767	100,642
Island Lake	1052.04	10,321,159	4,178,549	3,370,591

Table 7 EOQ Conditions comparison to Existing Conditions

Watershed	% Area Change	% Runoff + Baseflow Change
WC1	11.00%	16.44%
WL1	0.00%	-14.61%
WL2	-80.66%	-88.73%
WL3	0.00%	-61.28%
WL4	20.82%	28.40%
Island Lake	0.65%	-0.74%

Table 8 Reclamation Conditions comparison to Existing Conditions

Watershed	% Area Change	% Runoff + Baseflow Change
WC1	11.00%	6.69%
WL1	0.00%	0.00%
WL2	-80.66%	-79.91%
WL3	0.00%	-46.67%
WL4	20.82%	10.18%
Island Lake	0.65%	0.29%

Additional Information Request (1.c.)

Assessment of impacts to wetlands due to drainage area and surface water runoff. Methodology for the catchment area delineation shall be provided.

McCallum Environmental Limited (MEL) Response:

MEL provides an assessment of the potential indirect impacts WL1 and WL4, as presented in the EARD. The assessment was completed using updated groundwater and surface water impact assessments detailed in Section 2 and 3 (e.g., groundwater ROI and water balance). The description of the methodology for the catchment area delineation has been completed by GHD and is provided in Section 3.

Potential Indirect Impacts to Wetlands

As described in the EARD, WL2 and WL3 are expected to be impacted by significant changes to hydrology, therefore, these wetlands will be carried forward into the provincial wetland alteration application process (see EARD Section 6.5.2).

WL1 and WL4 are not proposed to be directly impacted. The updated expanded quarry footprint (22.6 ha) has been refined to avoid development within the catchment area for WL1 (potential wetland of special significance) and further limit the potential for indirect hydrological impacts to this wetland. In consideration of the expanded quarry footprint, WL1 catchment area, and conservative modelling methods, it was determined that WL1 is not expected to be functionally altered by indirect changes to local hydrology and will maintain wetland hydrology as defined by the US Army Corp of Engineers (2012). This determination is based on the following assessment:

– Project-related development is no longer planned within the WL1 catchment area, there is no predicted change to surface runoff to WL1 or its catchment.
– The impact extent of Project-related baseflow reduction is predicted by the groundwater ROI. The catchment's updated Water Balance Analysis (WBA) conservatively assumes that 100% of baseflow will be lost within the groundwater ROI, resulting in an average annual flow reduction in a portion of the WL1 catchment of 14.61% under EOQ conditions. The predicted ROI does not interact with WL1 (i.e., the ROI does not encroach within the WL1 boundary).
– WL1 is an isolated treed swamp with deep peat substrate (i.e., >40 cm) and a near-surface water table. Isolated swamps experience natural water table variability and have been reported to have seasonal water table fluctuation of ±20 cm (Keddy, 2010). The US Army Corp of Engineers (2012) stipulates that wetland hydrology is defined as saturation of soils 20 cm below the surface or groundwater levels within 30 cm of the surface for a period of two consecutive weeks in the growing season, typically June through September (period when no flow reduction is expected in the WL1 catchment).
– No change in flow (increase or decrease) is expected in the WL1 catchment under reclamation conditions.

As a result of the expanded quarry footprint and associated WBA, the WL4 catchment, which includes a portion of WC1, is expected to experience an annual average increase in flow of 28.40% at EOQ and 10.18% under reclamation conditions. WC1 is expected to experience an annual average increase in flow of 16.44% at EOQ and 6.69% under reclamation conditions. As described in the EARD, this increase is a result of all quarry area drainage, including

surrounding baseflow contributions, being directed to WL4 and WC1. As discussed above, it is conservatively estimated that 100% of baseflow will be lost within the groundwater ROI and ultimately redirected at surface to WL4 and WC1 via a settling pond. Additionally, calculated flow increases are 'worst case' estimates at EOQ and reclamation, which are not reflective of all development phases nor consider progressive reclamation throughout the life of the Project.

Under these scenarios, the increase in flow to the WL4 catchment may result in temporary hydrological shifts in WL4 during Project development. It is not expected that these temporary hydrological shifts will permanently alter the wetland's hydrological function. WL4 is a riparian treed swamp with deep peat substrate (i.e., high storativity), which currently displays characteristics indicating natural water level viability, such as standing/flowing water, stunted vegetation, and micro-topography (e.g., pools). As presented above, swamps typically undergo greater water table fluctuations than other wetland types (e.g., bogs, fens; Keddy, 2010, Warner & Rubec, 1997). Keddy (2010) further describes that wetlands associated with water features were found to have greater seasonal variability (>1 m).

WC1, WL4's outflow, is a first order, low gradient watercourse that has been identified to support fish. Currently, fish habitat within WC1 is extremely limited and seasonal due to dry low-flow conditions, multiple subterranean sections (up to 115 m in length), dechannelized surface flow, and low dissolved oxygen levels. As noted in the EARD, no fish were captured or observed through electrofishing surveys. Still, it was conservatively presumed that fish, specifically juvenile American eel who can navigate typical obstacles to fish and are considered "highly plastic in habitat use" (COSEWIC, 2006), could access the upper reaches of this watercourse but only during periods of high flow or after heavy rain events. The probability of negative impacts to fish and fish habitat in WC1 and WL4 as a result of the calculated increases in flow is low, especially considering the natural flow buffering functions of riparian wetlands. An increase in flow may in fact improve fish habitat conditions by enhancing passage of WC1 and access to habitat within WL4. Multiple areas of subterranean flow through moss-covered boulders have been documented as a potential limit to fish passage, and increased runoff to the watercourse may improve their navigability.

While WL4 is expected to withstand modelled hydrological changes to its catchment, given 'worst case' projections, and will not be hydrological altered, it is recommended WL4 be considered for monitoring to verify this assessment. Monitoring methods will be discussed in the Project's Industrial Approval (IA) amendment and wetland alteration application process and defined in consultation with NSECC. Should monitoring results indicate potential hydrological impacts, the monitoring results and scope will be reviewed and may be expanded (e.g., additional stations, monitoring wells and loggers), in consultation with NSECC.

Monitoring within WL1 is not proposed at this time, as no direct or indirect impacts are anticipated, nor are there any hydrologically contiguous features with potential Project-related direct or indirect impacts. Additionally, given the position of WL1 in relation to the quarry expansion phases (i.e., north of the proposed expansion area), the Project lifespan of ~30 years, and the planned progressive development, it is not anticipated that any potential indirect impacts would be observed in WL1 at the onset of the quarry expansion. A groundwater well (MW-02) has been installed adjacent to WL1, between the wetland and the expanded quarry, to capture baseline groundwater conditions at this location. Monitoring requirements within WL1 may be reassessed should groundwater levels be observed to significantly deviate from baseline conditions in MW-02. If required, a groundwater monitoring program will be further defined in accordance EA approval, the IA and as required by NSECC.

4. Water Management Design

Additional Information Request (3.):

Detailed information on the existing quarry site surface water drainage and management, and on the proposed surface water management through the various phases of the quarry expansion.

GHD Response:

The settling pond design and construction details are presented in Drawings C-01A, C-01B, and C-02 in Appendix A. The settling pond is required for the treatment of stormwater runoff from the Project. To ensure adequate sedimentation control for current conditions and future expansion of the quarry, a settling pond will be constructed in advance of the Project development. The design of the settling pond was developed based on the requirements of the Nova Scotia Department of Environment Erosion and Sediment Control Handbook for Construction Sites (1988).

The design of the settling pond is based on the following:

– The pond will be initially sized for a 10-ha quarry and expanded when necessary for the larger 22.6 ha quarry.
– The design basis is a 100-year storm event.
– The pond was designed to discharge at a flow rate equal to the pre-development peak flow rate during a 5-year storm event and a 100-year storm event.
– During operations water collected in the expanded quarry will be pumped to the settling pond.
– Under reclamation conditions, the pit lake will flow by gravity to the settling pond.
– Water will discharge via gravity to a level spreader located at the southwestern Project boundary.

There is adequate space in the southwestern portion of the Project to construct both the 10 ha and 22.6 ha sized pond. Grassed diversion ditches will be installed around the Site to divert off-Site 'clean' water away from the Project.

The existing quarry water management is permitted under the Industrial Approval (2014-090423-01).

5. Surface Water Quality

Additional Information Request (2.a.):

Measurement of Total Suspend Solids (TSS) with associated assessment for surrounding surface water resources.

GHD Response:

In-situ water quality was measured at five locations within WC1 on September 2, 2021, as described in the EARD. No discharge occurred from the Site on this date and these measurements are considered representative of baseline conditions. No subsequent water quality measurements or samples have been collected as there has been no discharge from the Site.

Additional Information Request (2.b.):

Water quality monitoring plan for the proposed new settling pond and associated discharge.

GHD Response:

All water collected in the expanded quarry will be directed to the settling pond and discharged to the southwest of the quarry. Site discharge is proposed to be sampled from the settling pond outlet pipe according to Table 9, below.

Table 9 Surface Water Monitoring Location

Sample Location ID	Rationale	Parameters	Frequency
SP-1	To monitor water quality within settling pond discharge	TSS, pH, field parameters, (DO, pH, temperature)	Quarterly when discharging

6. Closing

GHD has prepared this document to satisfy the Minister's request for additional information and based on discussions with NSECC.

All of Which is Respectfully Submitted,

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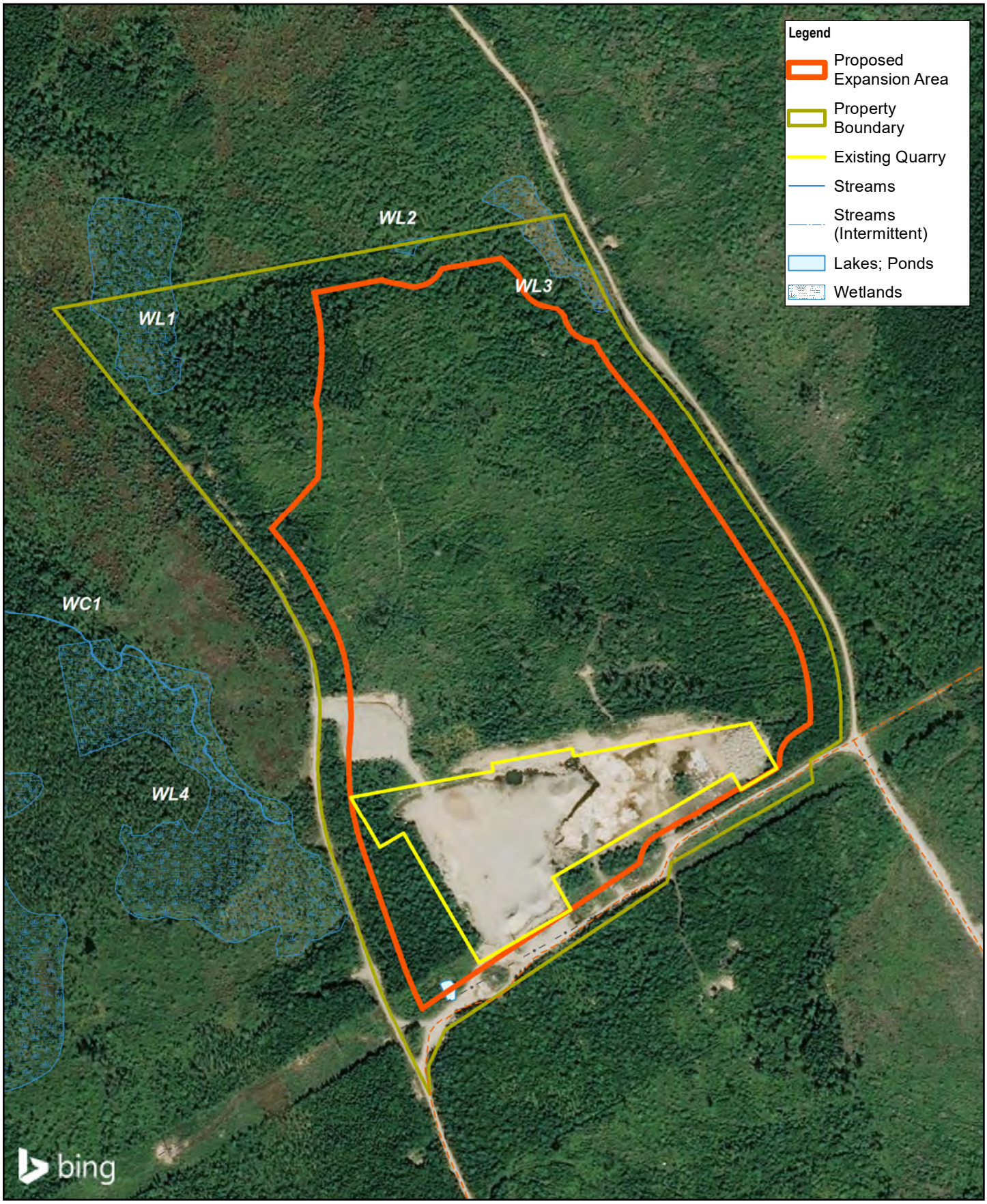

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983 CSRS
Grid: NAD 1983 CSRS UTM Zone 20N

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GHD

SCOTIAN MATERIALS LIMITED
HEAD OF ST MARGARETS BAY, NOVA SCOTIA
TOTE ROAD QUARRY EXPANSION PROJECT

PROPOSED REVISED EXPANSION AREA

Project No. **11216599**
Revision No. **-**
Date **12/10/2022**

FIGURE 1

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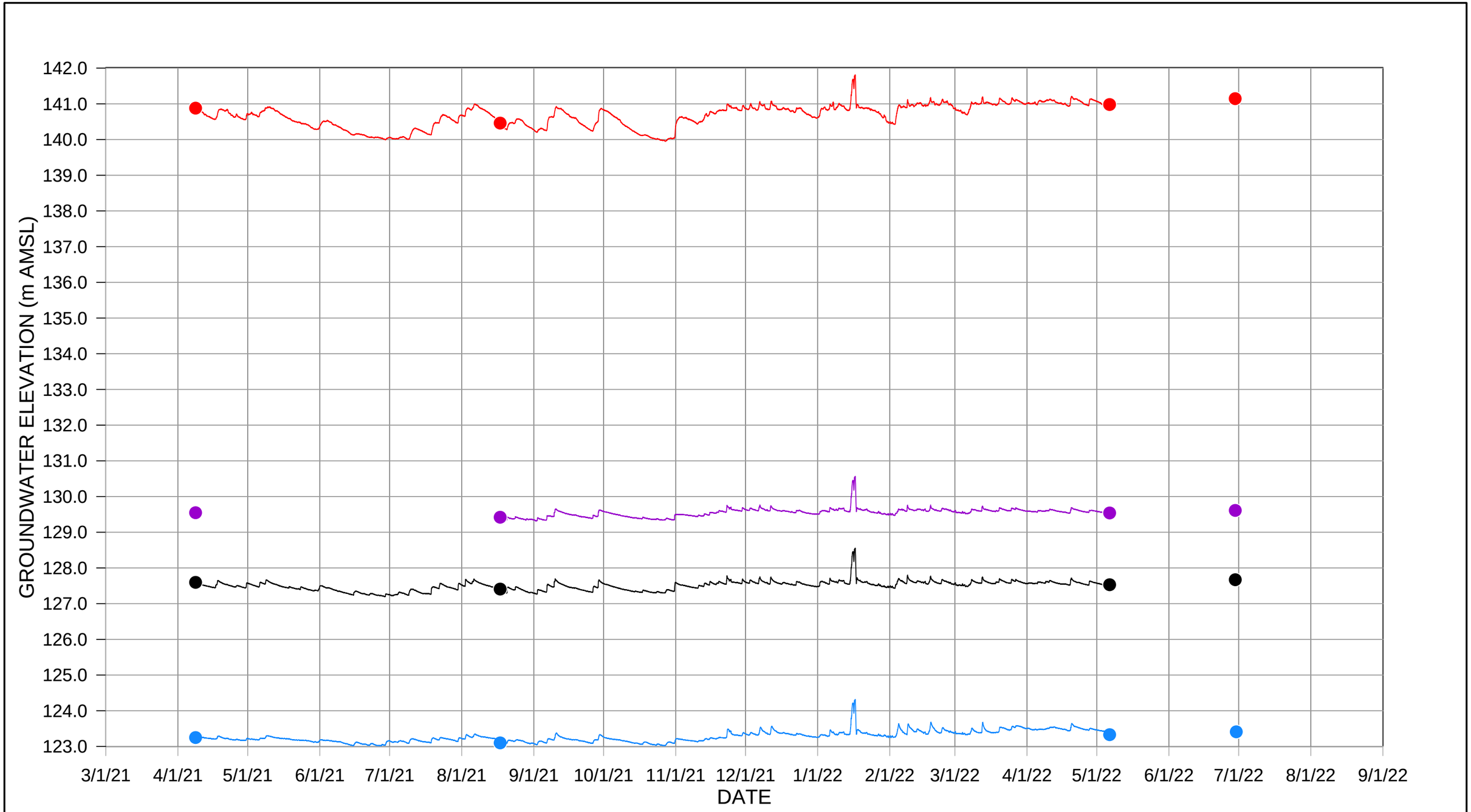


Legend

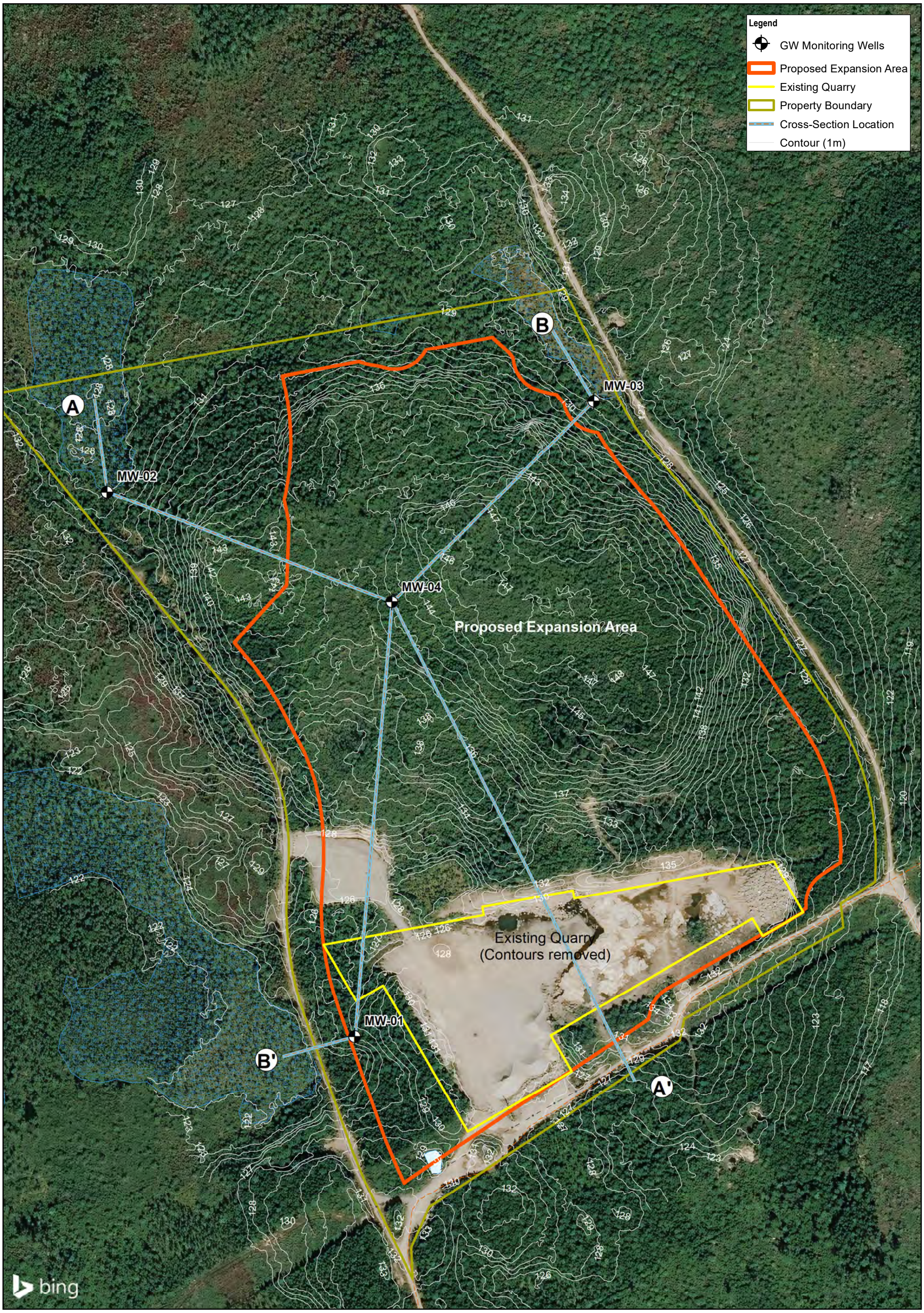
- MW-01 Manual Measurements
- MW-01 Transducer Data
- MW-02 Transducer Data
- MW-03 Transducer Data
- MW-04 Transducer Data
- MW-02 Manual Measurements
- MW-03 Manual Measurements
- MW-04 Manual Measurements

Scotia Materials Limited
Tote Road Quarry
Halifax County, Nova Scotia

GROUNDWATER ELEVATIONS

11216599
October 31, 2022

FIGURE 2



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Metres

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Horizontal Datum: North American 1983 CSRS
Grid: NAD 1983 CSRS UTM Zone 20N

GHD

SCOTIAN MATERIALS LTD
HEAD OF ST MARGARETS, NOVA SCOTIA
TOTE ROAD QUARRY EXPANSION PROJECT

MONITORING WELL PLACEMENT

Project No. **11216599**
Revision No. **-**
Date **11/03/2021**

FIGURE 3

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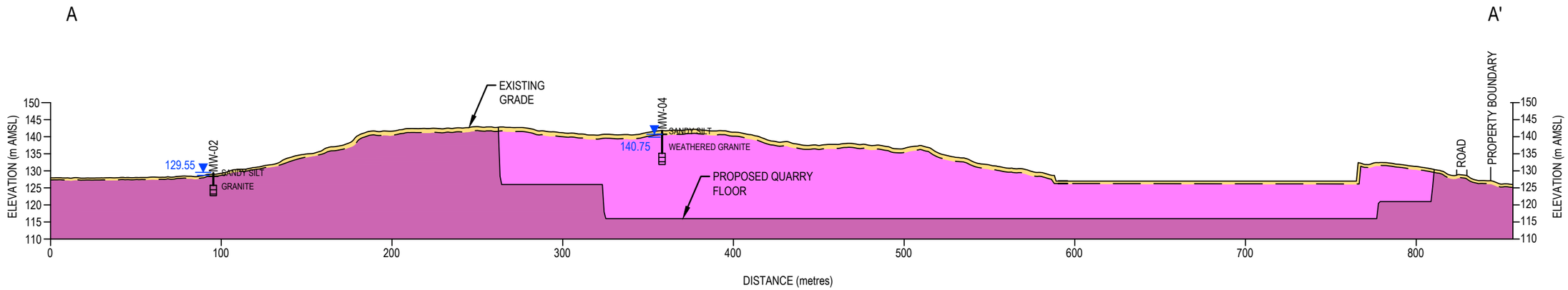

LEGEND

- OVERBURDEN
- BEDROCK (PROPOSED QUARRY)
- BEDROCK
- 125.40 GROUNDWATER ELEVATION, NOVEMBER 16, 2021

DRAFT

HORIZONTAL
1:2500
0 25 50 75

VERTICAL
1:1250
0 12.5 25 37.5

GHD

SCOTIAN MATERIALS LTD
HEAD OF ST MARGARETS, NOVA SCOTIA
TOTE ROAD QUARRY

CROSS-SECTION A-A'

Project No. **11216599**
Date **November 2022**

FIGURE 4

Filename: N:\CA\Halifax\Projects\66\11216599\Digital_Design\ACAD\Figures\PRE001\11216599-GHD-00-00-PRE-EN-D105_WA-001.dwg
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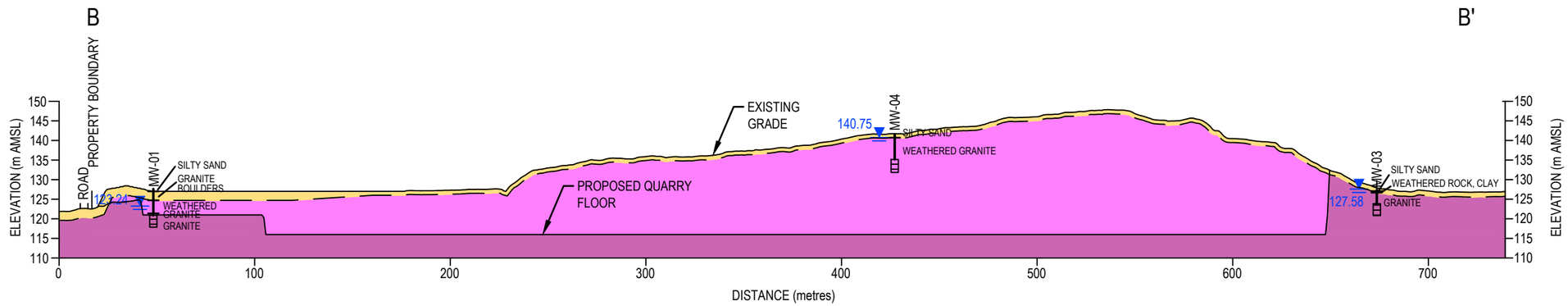

LEGEND

- OVERBURDEN
- BEDROCK (PROPOSED QUARRY)
- BEDROCK
- 125.40 GROUNDWATER ELEVATION, NOVEMBER 16, 2021

DRAFT

HORIZONTAL
1:2500
0 25 50 75
0 12.5 25 37.5
VERTICAL
1:1250

GHD

SCOTIAN MATERIALS LTD
HEAD PF ST MARGARETS, NOVA SCOTIA
TOTE ROAD QUARRY

CROSS-SECTION B-B'

Project No. **11216599**
Date **November 2022**

FIGURE 5

Filename: N:\CA\Halifax\Projects\66\11216599\Digital_Design\ACAD\Figures\PRE001\11216599-GHD-00-00-PRE-EN-D106_WA-001.dwg
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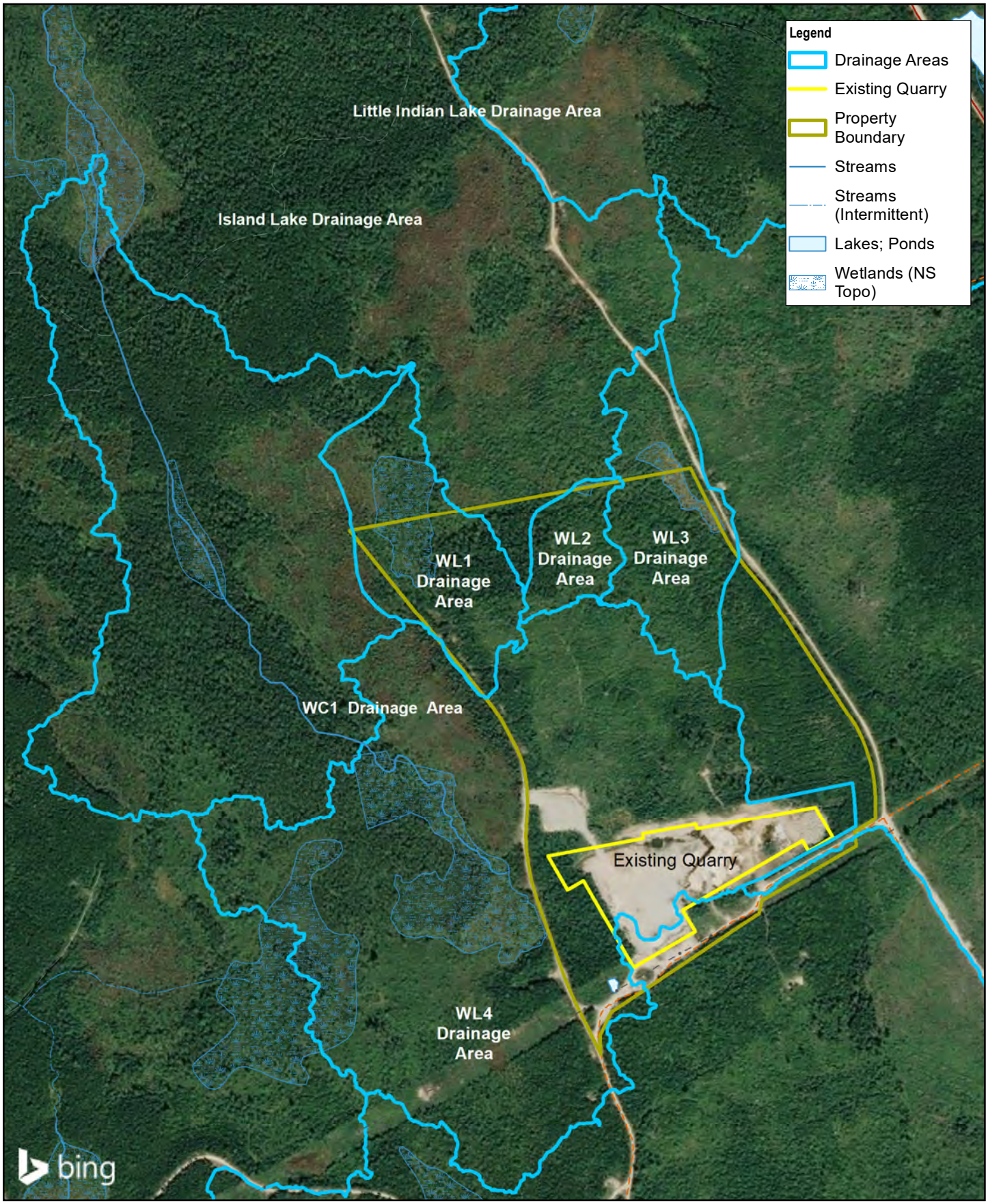

Paper Size ANSI A

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983 CSRS
Grid: NAD 1983 CSRS UTM Zone 20N

N

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SCOTIAN MATERIALS LIMITED
HEAD OF ST MARGARETS BAY, NOVA SCOTIA
TOTE ROAD QUARRY EXPANSION PROJECT

BASELINE WATERSHED DELINEATION

Project No. **11216599**
Revision No. **-**
Date **12/10/2022**

FIGURE 6

N:\CA\Halifax\Projects\661\11216599\GIS\Maps\Deliverables\11216599-RPT-04\11216599-RPT04-GIS-HX006.mxd
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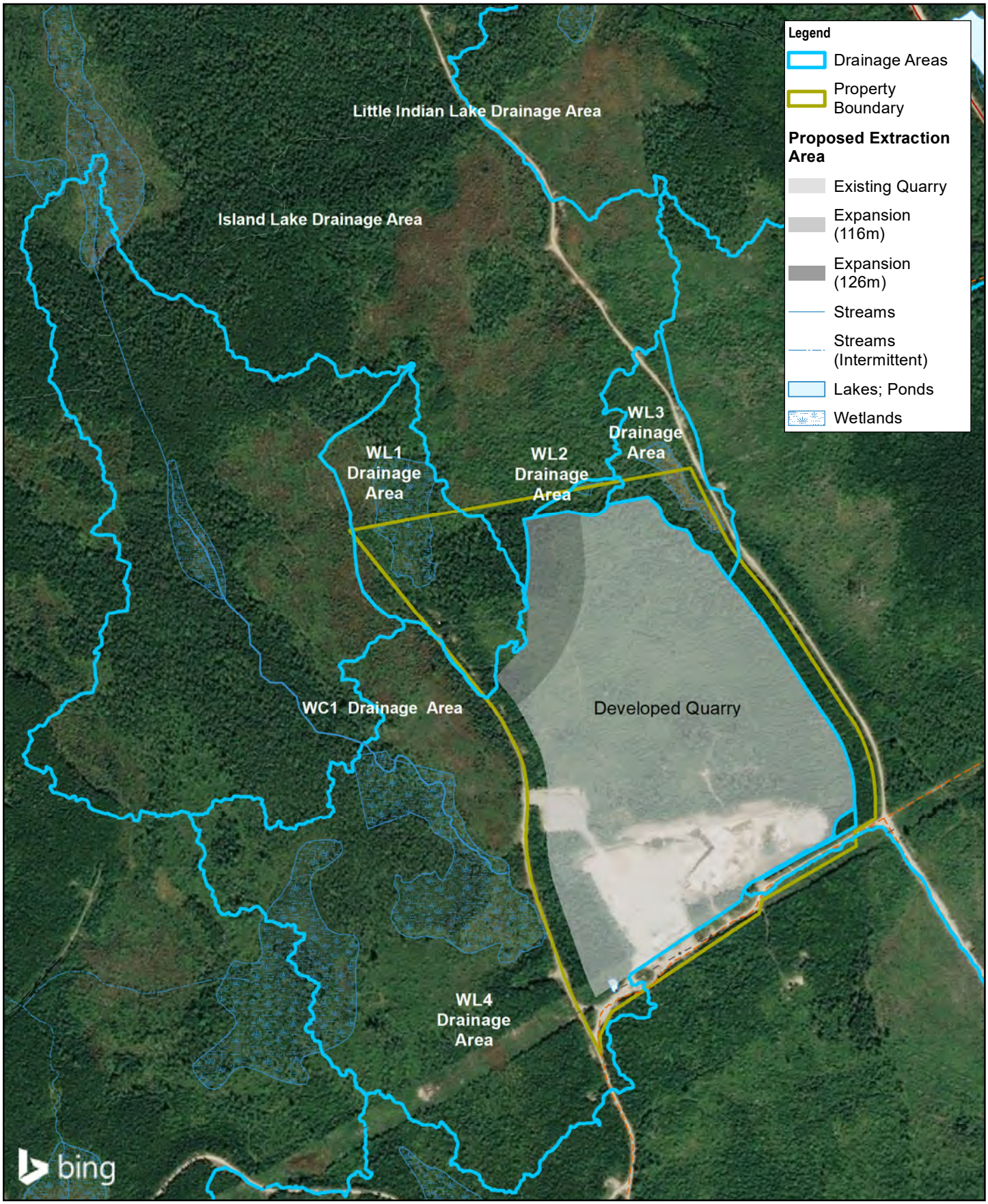

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Map Projection: Transverse Mercator
Horizontal Datum: North American 1983 CSRS
Grid: NAD 1983 CSRS UTM Zone 20N

N

GHD

SCOTIAN MATERIALS LIMITED
HEAD OF ST MARGARETS BAY, NOVA SCOTIA
TOTE ROAD QUARRY EXPANSION PROJECT

END OF QUARRY (EOQ) AND RECLAMATION WATERSHED DELINEATION

Project No. 11216599
Revision No. -
Date 12/10/2022

FIGURE 7

N:\CA\Halifax\Projects\661\11216599\GIS\Maps\Deliverables\11216599-RPT-04\11216599-RPT04-GIS-HX007.mxd
Print date: 07 Nov 2022 - 12:25

Appendices

Appendix A

Stormwater Management Drawings

LEGEND

- PROPERTY BOUNDARY
- QUARRY EXPANSION AREA
- CONTOUR (m)
- SHORELINE AND STREAMS
- WETLAND LIMITS
- EDGE OR ROAD/ EDGE OF GRAVEL

LOT ACXYZ
PID 41457821
SCOTIAN MATERIALS LIMITED
PROPOSED QUARRY EXPANSION AREA

LEASE PARCEL TRQ-1
EXISTING QUARRY AREA

PROPOSED STORMWATER POND
132.4m x 66.2m, 1.90m MIN. DEPTH.
MIN. POND VOLUME = 12,579m³
SIDE SLOPE 0.25 m/m
SEE DETAIL 1 AND DETAIL 2, SHEET C-02

PROPOSED LEVEL SPREADER
SEE DETAIL 5, SHEET C-02

PROPOSED OUTLET PIPE
SEE DETAIL 1 AND DETAIL 4, SHEET C-02

PROPOSED SILT FENCE
SEE DETAIL 6, SHEET C-02

PROPOSED SPILLWAY
SEE DETAIL 3, SHEET C-02

NOTE:
1. CONTRACTOR TO VERIFY EXISTING ELEVATIONS PRIOR TO CONSTRUCTION. ADVISE ENGINEER OF ANY DISCREPANCIES PRIOR TO STARTING WORK.
2. WATER FROM THE PROJECT SITE WILL BE PUMPED INTO SEDIMENTATION POND.

ISSUED FOR PERMIT APPROVAL

Scotian Materials, NS — **Run-Off Calculations**

Stormwater Management

Project No. 11216599
Sheet No. C-01
Date : 10/21/2022
Revised :
Prepared By : S.Tolouei

Table of Calculations

Land Cover Characteristics	SUPERFICIE (m2)		COEFFICIENT C (5 yr)	COEFFICIENT C (100 yr)
Pre-Condition				
Forest	226000		0.25	0.31
Post Condition (22.6 Ha Dev)				
Gravel	226000		0.75	0.94

Calculation of Allowable Peak Flow

	Time of Concentration (mins)	Rainfall Intensity (mm/hr) (5 year)	Rainfall Intensity (mm/hr) (100 year)	Peak Flow Rate (5 yr) (m3/s)	Peak Flow Rate (100 yr) (m3/s)
Pre-Condition	52	33.17	51.65	0.52	1.01
Post-Condition (10 Ha Develop)	36	40.58	63.16	1.20	2.34
Post-Condition (22.6 Ha Develop)	24	49.83	77.76	2.35	4.59

Calculation of Retention Volume (100 yr Design Storm)	10 Ha Developed	22.6Ha Developed
Required Retention Volume (m3) (Qpre - Qpost)	3507	8285
Design Retention Volume (m3)	3562	8285
Required Sediment Storage Volume (m3) (190 m3 per Ha)	1900	4294
Design Sediment Storage Volume (m3)	1955	4295

Stormwater Management Pond Calculations

Total Pond Volume (m3) = (Dessign sediment storage volume + Design retention volume)	5517	12580
Total Depth (m) =	1.90	1.90
Length (m) =	92	132.4
Width (m) =	46	66.2
Freeboard (m) =	0.15	0.15
Side Slopes (m/m) =	0.25	0.25
Maximum High Water Level (m)_100 Year	130.35	130.35

Flow Control Calculations

Design Storm	Flow Rate (m3/s)	Depth of Water Head (m)	Control Type	Diameter (m)/bottom width
5yr	0.52	0.73	Pipe	0.60
100yr	1.01	0.15	Overflow Spillway	1.00

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466 Hodgson Road
Fredericton New Brunswick E3C 2G5 Canada
T 506 458 1248 F 506 462 7646 W www.ghd.com

0 12.5 25 37.5m

Client
SCOTIAN MATERIALS LIMITED
HEAD OF MARGARETS BAY, NS

Project
TOTE ROAD QUARRY EXPANSION PROJECT

No.	Issue	Drawn	Approved	Date
1	ISSUED FOR PERMITTING	S.A.	A.C.	2022-10-20

Drawn	S. ARMSTRONG	Designer	S. TOLOUEI
Drafting Check	S. TOLOUEI	Design Check	A. CHOWN
Project Manager	C. ANDREWS	Date	Oct 25, 2022
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Original Size	ANSI D	Bar is 20mm on original size drawing	0 20mm

Project No. **11219548**

Title
STORMWATER MANAGEMENT PLAN (22.6 HECTARE DEVELOPMENT)

Sheet No.
C-01A

Sheet 1 of 1

Plot Date: 2 November 2022 - 7:56 PM Plotted By: Scott Armstrong CAD File: N:\CA\Halifax\Projects\661\11216599\Digital_Design\ACAD\Sheets\11216599-GHD-XX-XX-DRG-CI-D001a.dwg

LEGEND
- PROPERTY BOUNDARY
- QUARRY EXPANSION LIMITS
- CONTOUR (m)
- SHORELINE AND STREAMS
- WETLAND LIMITS
- EDGE OR ROAD/ EDGE OF GRAVEL

LOT ACXYZ
PID 41457821
SCOTIAN MATERIALS LIMITED
PROPOSED QUARRY EXPANSION AREA

LEASE PARCEL TRQ-1
EXISTING QUARRY AREA

PROPOSED STORMWATER POND
46m x 92m, 1.90m MIN. DEPTH.
MIN. POND VOLUME = 5,407m³
SIDE SLOPE 0.25 m/m
SEE DETAIL 1 AND DETAIL 2, SHEET C-02

PROPOSED LEVEL SPREADER
SEE DETAIL 5, SHEET C-02

PROPOSED OUTLET PIPE
SEE DETAIL 1 AND DETAIL 4, SHEET C-02

PROPOSED SILT FENCE
SEE DETAIL 6, SHEET C-02

PROPOSED SPILLWAY
SEE DETAIL 3, SHEET C-02

NOTE:
1. CONTRACTOR TO VERIFY EXISTING ELEVATIONS PRIOR TO CONSTRUCTION. ADVISE ENGINEER OF ANY DISCREPANCIES PRIOR TO STARTING WORK.
2. WATER FROM THE PROJECT SITE WILL BE PUMPED INTO SEDIMENTATION POND.

ISSUED FOR PERMIT APPROVAL

Scotian Materials, NS — **Run-Off Calculations**

Stormwater Management

Project No. 11216599
Sheet No. C-01
Date : 10/21/2022
Revised :
Prepared By : S.Tolouei

Table of Calculations

Land Cover Characteristics	SUPERFICIE (m2)		COEFFICIENT C (5 yr)	COEFFICIENT C (100 yr)
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Required Retention Volume (m3) (Qpre - Qpost)	3507	8285
Design Retention Volume (m3)	3562	8285
Required Sediment Storage Volume (m3) (190 m3 per Ha)	1900	4294
Design Sediment Storage Volume (m3)	1955	4295

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Total Depth (m) =	1.90	1.90
Length (m) =	92	132.4
Width (m) =	46	66.2
Freeboard (m) =	0.15	0.15
Side Slopes (m/m) =	0.25	0.25
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Flow Control Calculations

Design Storm	Flow Rate (m3/s)	Depth of Water Head (m)	Control Type	Diameter (m)/bottom width
5yr	0.52	0.73	Pipe	0.60
100yr	1.01	0.15	Overflow Spillway	1.00

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0 12.5 25 37.5m

Client
SCOTIAN MATERIALS LIMITED
HEAD OF MARGARETS BAY, NS

Project
TOTE ROAD QUARRY EXPANSION PROJECT

No.	Issue	Drawn	Approved	Date
1	ISSUED FOR PERMITTING	S.A.	A.C.	2022-10-20

Drawn	S. ARMSTRONG	Designer	S. TOLOUEI
Drafting Check	S. TOLOUEI	Design Check	A. CHOWN
Project Manager	C. ANDREWS	Date	Oct 25, 2022
This document shall not be used for construction unless signed and sealed for construction.		Scale	1:1250

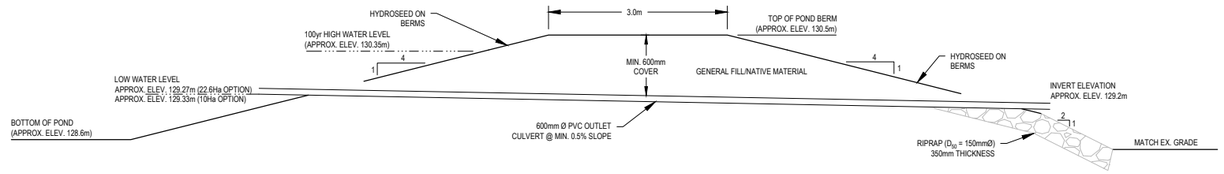
Original Size **ANSI D**
Bar is 20mm on original size drawing
0 20mm

Project No. **11219548**

Title
STORMWATER MANAGEMENT PLAN (10 HECTARE DEVELOPMENT)

Sheet No.
C-01B
Sheet 1 of 1

Plot Date: 2 November 2022 - 7:54 PM Plotted By: Scott Armstrong CAD File: N:\CA\Halifax\Projects\661\11216599\Digital_Design\ACAD\Sheets\11216599-GHD-XX-XX-DRG-CI-D001b.dwg



DETAIL 1 POND BERM THROUGH OUTLET PIPE
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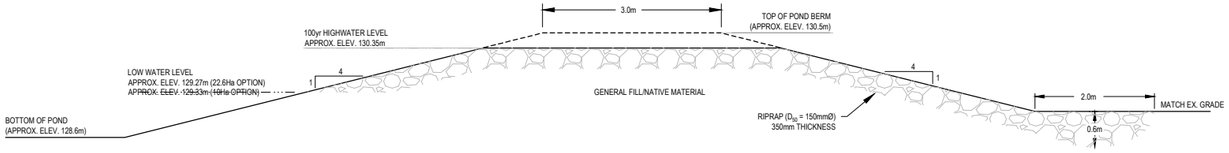

DETAIL 2 POND BERM THROUGH OVERFLOW WEIR
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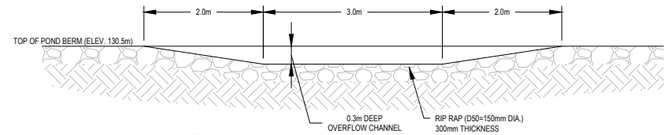

DETAIL 3 HIGHWATER OVERFLOW SPILLWAY
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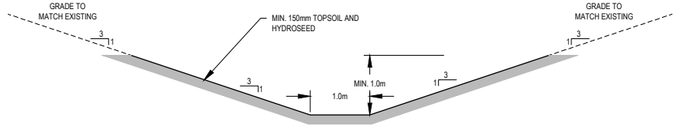

DETAIL 4 GRASSED DIVERSION DITCH
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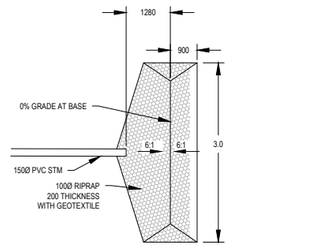
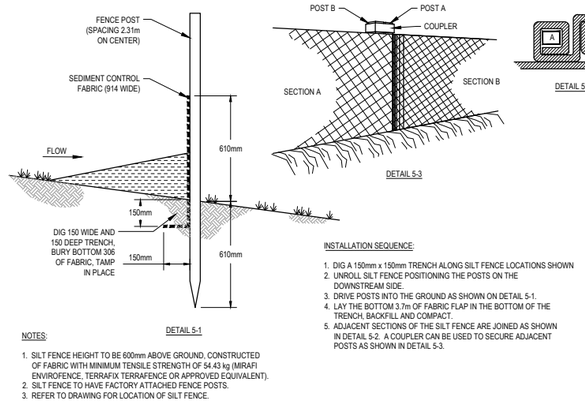
DETAIL TO BE CONFIRMED



DETAIL 5 LEVEL SPREADER
N.T.S. C-01



NOTES:

1. SILT FENCE HEIGHT TO BE 600mm ABOVE GROUND, CONSTRUCTED OF FABRIC WITH MINIMUM TENSILE STRENGTH OF 54.43 kg (MIRAFI ENVIROFENCE, TERRAFIX TERRAFENCE OR APPROVED EQUIVALENT).
2. SILT FENCE TO HAVE FACTORY ATTACHED FENCE POSTS.
3. REFER TO DRAWING FOR LOCATION OF SILT FENCE.

INSTALLATION SEQUENCE:

1. DIG A 150mm x 150mm TRENCH ALONG SILT FENCE LOCATIONS SHOWN
2. UNROLL SILT FENCE POSITIONING THE POSTS ON THE DOWNSTREAM SIDE.
3. DRIVE POSTS INTO THE GROUND AS SHOWN ON DETAIL 5-1.
4. LAY THE BOTTOM 3.7m OF FABRIC FLAP IN THE BOTTOM OF THE TRENCH, BACKFILL AND COMPACT.
5. ADJACENT SECTIONS OF THE SILT FENCE ARE JOINED AS SHOWN IN DETAIL 5-2. A COUPLER CAN BE USED TO SECURE ADJACENT POSTS AS SHOWN IN DETAIL 5-3.

DETAIL 6 SILT FENCE
N.T.S. C-01

EROSION AND SEDIMENT CONTROL NOTES:

1. CONTRACTOR SHALL CARRY OUT EROSION AND SEDIMENTATION CONTROL MEASURES IN ACCORDANCE WITH ALL FEDERAL AND PROVINCIAL PERMITS AND REQUIREMENTS, AND AS STATED IN CONTRACT DOCUMENTS.
2. THE CONTRACTOR SHALL MONITOR SEDIMENT POND DISCHARGE WATER QUALITY AS THE SITE IS DEVELOPED TO ENSURE SEDIMENT TREATMENT IS MAINTAINED.
3. THE CONTRACTOR SHALL DETERMINE NECESSARY TEMPORARY EROSION AND SEDIMENT CONTROL MEASURE (IE. SILT FENCE, CHECK DAMS) BASED ON SITE CONDITIONS AND OPERATIONS. THE CONTRACTOR SHALL MONITOR PERFORMANCE OF ESC MEASURES AND MODIFY AS CONDITIONS CHANGE.
4. MAINTAIN TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES FROM THE TIME OF INSTALLATION UNTIL AFTER ALL AREAS DRAINING TOWARDS THEM HAVE BEEN STABILIZED. CONTRACTOR SHALL REMOVE CONTROL ONLY AFTER ALL SURFACES HAVE BEEN ESTABLISHED.
5. INSPECT SEDIMENT AND EROSION CONTROL MEASURES ON A REGULAR BASIS AND AFTER HEAVY PRECIPITATION AND REPAIR AS NECESSARY DURING PERIODS OF OPERATION OF THE QUARRY.
6. INSTALL ADDITIONAL PROTECTION BERMS, CUT OFF DITCHES, OR OTHER PROTECTION METHODS AS REQUIRED BY THE SITE CONDITIONS TO PREVENT SEDIMENT FROM ENTERING WATERCOURSES AND DIRECT WATER TO SEDIMENT POND.
7. MAINTAIN A STOCKPILE OF APPROPRIATE EROSION CONTROL AND ENVIRONMENTAL PROTECTION MATERIALS ON SITE AT ALL TIMES.
8. CONTRACTOR SHALL PERFORM WORK TO MINIMIZE DISTURBANCE TO SURROUNDING PROPERTIES AND MINIMIZE EXPOSED OPEN GROUND.
9. THE CONTRACTOR SHALL INSTALL AND MAINTAIN DIVERSION DITCHES AROUND AND/OR THROUGH THE ACTIVE QUARRY SITE TO KEEP OFF-SITE 'CLEAN" WATER AWAY FROM THE WORKS.
10. STABILIZE ALL EXPOSED SLOPES AND OTHER AREAS NOT SUBJECT TO REWORKING AS SOON AS FINISHED GRADES ARE ESTABLISHED.
11. REMOVE SILT ACCUMULATIONS AT PROTECTION DEVICES AND SEDIMENT POND ON A REGULAR BASIS WHEN THE QUARRY IS IN OPERATION TO MAINTAIN CAPTURE CAPACITY.
12. WHEN DE-WATERING OF THE SITE IS REQUIRED, ONLY CLEAN WATER MAY BE DISCHARGED DIRECTLY TO A WATERCOURSE.
13. DO NOT PUMP, DRAIN OR PERMIT WATER CONTAINING SUSPENDED MATERIALS TO ENTER INTO WATERWAYS.
14. THE CONTRACTOR SHALL PROTECT ANY ADJACENT WATERCOURSE FROM ANY NEGATIVE IMPACT WHATSOEVER FROM THE CONSTRUCTION ACTIVITIES. THE CONTRACTOR SHALL PROTECT AREAS DOWNSTREAM FROM DAMAGE DUE TO SILTATION, RUN-OFF AND DE-WATERING PROCEDURES FROM THE CONSTRUCTION SITE.

EARTHWORK NOTES:

1. THE CONTRACTOR SHALL COMPLETE NECESSARY TEST PITS PRIOR TO CONSTRUCTION TO DETERMINE SUBSURFACE CONDITIONS FOR EXCAVATION, SHORING, AND DEWATERING PURPOSES INCLUDING DEPTH TO BEDROCK AND DEPTH TO GROUNDWATER PRIOR TO INSTALLATION OF SEDIMENT POND.
2. REMOVE ALL UNSUITABLE MATERIALS SUCH AS ORGANIC ROOT MAT, TOPSOIL, PEAT, ETC., FROM BENEATH NEW WORKS UNTIL ACCEPTABLE COMPACTION OF SUBGRADE CAN BE ACHIEVED IS ENCOUNTERED.
3. ALL DEMOLITION WASTE SHALL BE DISPOSED OF BY THE CONTRACTOR.
4. ALL COMPACTED BACKFILL MATERIALS SHALL BE PLACED IN MAXIMUM 200mm LIFTS AND COMPACTED TO 98% MAXIMUM DRY DENSITY UNLESS APPROVED OTHERWISE BY A GEOTECHNICAL ENGINEER.
5. IN AREAS REQUIRING FILL, ONLY APPROVED SITE EXCAVATED MATERIAL OR APPROVED IMPORTED MATERIALS WILL BE PERMITTED.
6. COMPACTION EQUIPMENT SHALL BE APPROVED BY THE ENGINEER
7. FINISH GRADES SHALL BE FIELD FIT BY THE CONTRACTOR BASED ON SITE CONDITIONS. ONCE CONSTRUCTION IS COMPLETE, ALL SURFACES WITHIN THE PROJECT LIMITS TO HAVE POSITIVE DRAINAGE TOWARDS THE SEDIMENT POND.
8. GRANULAR AND BACKFILL MATERIALS REFERRED TO ON THESE DRAWINGS SHALL BE AS PER NSTIR STANDARD SPECIFICATIONS, LATEST EDITION.

PRELIMINARY

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455 Phillip Street
Waterloo Ontario N2L 3X2 Canada
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Client
SCOTIAN MATERIALS LIMITED
HEAD OF MARGARETS BAY, NS

Project
TOTE ROAD QUARRY EXPANSION PROJECT

No.	Issue	Drawn	Approved	Date
1	ISSUED FOR PERMITTING	S.A.	A.C.	2022-10-20

Drawn	S. ARMSTRONG	Designer	S. TOLOUEI
Drafting Check	S. TOLOUEI	Design Check	A. CHOWN
Project Manager	A. CHOWN	Date	Aug 18, 2022
This document shall not be used for construction unless signed and sealed for construction.		Scale	1:50
Original Size	ANSI D	Bar is 20mm on original size drawing	0 20mm

Project No. **11216599**

Title
CONSTRUCTION DETAILS

Sheet No.
C-02

Sheet 2 of 2

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The Power of Commitment