DEXTER CONSTRUCTION COMPANY LIMITED
WELSHTOWN QUARRY EXPANSION PROJECT, WELSHTOWN, SHELBURNE COUNTY NOVA SCOTIA

Addendum to Environmental Assessment Registration Document

January 2022

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Introduction

Dexter Construction Company Limited (Dexter) operates the Welshtown Quarry (the Quarry), located off Upper Clyde Road, Welshtown, Shelburne County, Nova Scotia. The Quarry is an existing less than 4-hectare aggregate quarry, operated under Nova Scotia Environment and Climate Change (NSECC) Industrial Approval No. 2016-095706. The Quarry is seasonally operated on an as needed basis and serves as an important source of construction aggregate for local projects as well as Nova Scotia Department of Public Works (NSPW) projects in the area.

Dexter is proposing to expand the quarry operating footprint to increase available aggregate reserves and ensure that a long-term aggregate supply is available to support local projects and infrastructure needs in the future. The proposed Quarry expansion would see the existing less than 4-hectare quarry expanded to a maximum 35.3-hectare footprint over the life of the quarry. Other than an increase in the total footprint of the site, site activities are not planned to increase in scope or frequency from past use.

The Environmental Assessment Regulations under the Nova Scotia *Environment Act* require that the operator of a pit or quarry that is larger than 4-ha in area, register the project for Environmental Assessment. Dexter registered the Welshtown Quarry Expansion Project (the Project) for Environmental Assessment on November 3, 2020 (https://www.novascotia.ca/nse/ea/Welshtown-Quarry-Expansion-Project/). On December 21, 2020, the Minister of Environment requested additional information in support of the proposed Project (Appendix A).

In Spring 2021, a virtual meeting was held with regulatory stakeholders to review the Ministers decision and discuss the scope of the request for additional information. It was agreed that an EARD Addendum addressing the requested items would be sufficient to address the Ministers request. The following report outlines the additional information requested by the Minister and is aligned with the discussions and feedback from regulatory stakeholders.

1.0 Minister's Request for Additional Information

1.1 Water Resources Assessment

"*In consultation with the Nova Scotia Environment, Sustainability and Applied Science Division, and DFO, provide additional details for the water resources assessment with accompanying discussion and analysis of potential effects to surface water resource quality and quantity, wetlands, and groundwater quality and quantity, that includes the following:"*

a) "A detailed description of development plans for the site. The plan should discuss how the work will proceed, site management, and reclamation plans for each phase, and relevant timelines."

A detailed Development Plan was prepared for the Welshtown Quarry. The Development Plan includes details on typical operations, site management, and progressive reclamation. Development phases include Existing Quarry Development, Quarry Mid-Life Development, Quarry Full Development, and Quarry Final Reclamation. These development phases are used in the Water Balance Assessment.

The Development Plan is included in Appendix B.

b) "A quantitative water balance analysis based on appropriate inputs and site grading. It is recommended that the analysis include the delineation of pre and post-development watershed boundaries, and discussion on the extent of disruption to surrounding water resources, including

wetlands. Water balances developed should include appropriate considerations (and justified assumptions) for components such as potential quarry floor infiltration, groundwater-surface water interactions, and groundwater inflows into the existing quarry. The water balance developed should also represent all the planned phases of the project if there are any."

A Water Balance Assessment was completed by Consulting Hydrogeologist Mr. Jim Fraser, P.Geo, M.A.Sc for the Welshtown Quarry Expansion Project. The Water Balance Assessment estimates changes in surface water flows to assess potential impacts of the proposed quarry expansion on the local hydrological regime. Watershed catchment areas were determined for each of the site development phases, and each development phase was evaluated under two infiltration scenarios to provide a range of potential outcomes resulting from the proposed quarry expansion.

Overall, the Water Balance Assessment concludes that the proposed quarry expansion is expected to have a negligible impact on the local hydrological regime.

The Water Balance Assessment report is included in Appendix C.

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c) *"Additional details regarding the site water management plan for all the planned phases (if there are any) of the project (including reclamation), with the intent of clearly outlining what is proposed and the effectiveness of proposed actions in mitigating impacts and alterations to nearby water resources. Details are to include, but not be limited to: considerations for the potential impacts associated with planned operations (e.g., precipitation season, extreme weather conditions, and times of site shut-down and restart, pumping requirements on site, aggregate washing, and dust suppression), plans/figures that provide sufficient details to illustrate what is being proposed (e.g. sediment control ponds, drainage ditches) and provide confidence in their feasibility and effectiveness, and details that consider the results of the assessments (e.g., potential need to manage groundwater inflows)."*

d) *"A detailed methodology and discussion on proposed water quality monitoring, including representativeness of water quality testing completed, baseline general chemistry and metals analysis to identify potential contaminants of concern, and identification of monitoring locations, sampling frequency and parameters."*

e) *"Identification of sources of water proposed to be used for dust suppression, including anticipated volume and frequency of use."*

A Water Management Plan has been prepared for the Project. The Water Management Plan includes details regarding site water management, proposed surface water and groundwater monitoring programs, and discussion on anticipated water usage at the site. Based on conversations with the various regulatory stakeholders, this plan was developed as a "concept plan". Specific design details will be determined as part of the subsequent Industrial Approval process.

The Water Management Plan has been included in Appendix D.

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f) *"Baseline fish and fish habitat studies for wetland 12 and associated watercourse, and update to assessment as appropriate, based on the results of the assessment."*

A Fish Habitat and Stream Survey was completed for Wetland 12 and the associated unnamed watercourse by Envirosphere Consultants Ltd. Overall, the assessment concluded that fish were present, and that water quality, forest cover, and stream habitat were acceptable in the unnamed watercourse

(referenced as Tributary 1). Several possible barriers to fish habitat were noted including a hung culvert on Upper Clyde Road that connects the unnamed watercourse to the Roseway River, a powerline utility corridor, and subterranean flow in areas. No fish habitat is present in Wetland 12, and contributions of flow from Wetland 12 to the unnamed watercourse are small. None of the proposed quarry expansion activities will physically disturb potential fish habitat in the unnamed watercourse.

The Fish and Fish Habitat Stream Survey has been included in Appendix E.

The Water Balance Assessment completed for the proposed quarry expansion notes that the estimated changes in runoff and infiltration are expected to be minimal and generally within the anticipated range of seasonal variance. Quarry drainage is directed to an established drainage corridor which eventually connects to the unnamed watercourse associated with Wetland 12 almost immediately before the unnamed watercourse discharges to the Roseway River. The Roseway River is significantly larger than the minimal input from the unnamed watercourse, so any impacts on the Roseway River are expected to be negligible.

Minimal runoff from the proposed Quarry expansion area is directed to the upper reaches of the unnamed watercourse. Consequently, any change in runoff / infiltration resulting from the proposed quarry expansion is expected to have a negligible impact on the flow within the unnamed watercourse.

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g) A detailed discussion of proposed mitigation measures and follow-up monitoring programs based on the results of any of the assessments.

Proposed mitigation measures and follow-up monitoring programs are described in the various plans, reports, and assessments included with this EARD Addendum.

Mitigation measures include:

- Application of Erosion and Sediment Control Strategies (detailed in the Water Management Plan)
- Application of Water Control Strategies (detailed in the Water Management Plan)

Monitoring Programs include:

- Surface Water Monitoring Plan (detailed in the Water Management Plan)
- Groundwater Monitoring Plan (detailed in the Water Management Plan)
- Occasional monitoring of fish in unnamed watercourse (detailed in the Fish and Fish Habitat Assessment)

Mitigation measures and monitoring plans will be implemented as part of the Industrial Approval amendment process.

Conclusion

This Welshtown Quarry Expansion Project EARD Addendum is provided in response to the Minister's request for additional information and is aligned with discussions and feedback from regulatory stakeholders. The various plans and monitoring programs will be revisited following comments and feedback from regulatory stakeholders. If an EA Approval is issued the plans and monitoring programs will be incorporated into a subsequent Industrial Approval Amendment Application.

DEXTER CONSTRUCTION COMPANY LIMITED

APPENDIX A

Minister's Request for Additional Information

927 Rocky Lake Drive | P.O Box 48100 | Bedford, NS B4A 3Z2
TEL: (902) 835-3381 | FAX: (902) 835-7300 | **www.municipalgroup.ca**

NOVA SCOTIA
Environment
Office of the Minister

PO Box 442, Halifax, Nova Scotia, Canada B3J 2P8 • www.novascotia.ca/nse

Our File number:
10700-40-56943
40100-30-310

December 21, 2020

Gary Rudolph, P. Eng
Dexter Construction Company Limited
927 Rocky Lake Drive
PO BOX 48100
Bedford, NS B4A 3Z2

Dear Gary Rudolph:

Re: **Environmental Assessment – Dexter Construction Co. Ltd.**
Welshtown Quarry Expansion Project, Shelburne County, Nova Scotia

The environmental assessment of the proposed Welshtown Quarry Expansion in Shelburne County, Nova Scotia has been completed.

This letter is to advise that, pursuant to Section 13 (l)(a) of the Environmental Assessment Regulations, I have determined that the Registration Document provided is insufficient to allow me to make a decision, and that I require additional information. Specifically, the review determined that the following additional information is required to evaluate potential environmental effects that may be caused by the undertaking:

1. In consultation with Nova Scotia Environment, Sustainability and Applied Science Division, and DFO, provide additional details for the water resources assessment with accompanying discussion and analysis of potential effects to surface water resource quality and quantity, wetlands and groundwater quality and quantity, that includes the following:

    a. A detailed description of development plans for the site. The plan should discuss how the work will proceed, site management and reclamation plan for each phase, and relevant timelines.
    b. A quantitative water balance analysis based on appropriate inputs and site grading. It is recommended the analysis include the delineation of pre and post-development watershed boundaries, and discussion on the extent of disruption to surrounding water resources, including wetlands. Water balances developed should include appropriate considerations (and justified assumptions) for components such as potential quarry floor infiltration, groundwater-surface water interactions, and groundwater inflows into the existing quarry. The water balance developed should also represent all the planned phases of the project if there are any.

…/2

c. Additional details regarding the site water management plan for all the planned phases (if there are any) of the project (including reclamation), with the intent of clearly outlining what is proposed and the effectiveness of the proposed actions in mitigating impacts and alterations to nearby water resources. Details are to include, but not be limited to: considerations for the potential impacts associated with planned operations (e.g., precipitation season, extreme weather conditions, and times of site shut-down and restart, pumping requirements on site, aggregate washing, dust suppression), plans/figures that provide sufficient detail to illustrate what is being proposed (e.g., sediment control ponds, drainage ditches) and provide confidence in their feasibility and effectiveness, and details that consider the results of the assessments (e.g., potential need to manage groundwater inflows).
d. A detailed methodology and discussion on proposed water quality monitoring, including representativeness of water quality testing completed, baseline general chemistry and metals analysis to identify potential contaminants of concern, and identification of monitoring locations, sampling frequency and parameters.
e. Identification of sources of water proposed to be used for dust suppression, including anticipated volume and frequency of use.
f. Baseline fish and fish habitat studies for wetland 12 and associated watercourse, and update to assessment as appropriate, based on the results of the assessment.
g. A detailed discussion of proposed mitigation measures and follow-up monitoring programs based on the results of any of the assessments.

This information must be submitted by Dexter Construction Company Limited within one year, as an addendum to the original Registration Document. Upon submission of the information, I will have 50 days to make my decision.

The Proponent shall publish a notice in the same manner as the original notice under Section 10 of the Environmental Assessment Regulations announcing the release of the additional information to the public and stating that written comments may be submitted about the additional information to the Department.

If you have any questions regarding the approval of this project, please contact Helen MacPhail, Supervisor, Environmental Assessment Branch, at (902) 483-2696 or via email at Helen.MacPhail@novascotia.ca.

Sincerely,

Gordon Wilson, MLA
Minister of Environment

c: Helen MacPhail

DEXTER CONSTRUCTION COMPANY LIMITED

APPENDIX B

Welshtown Quarry Development Plan

927 Rocky Lake Drive | P.O Box 48100 | Bedford, NS B4A 3Z2
TEL: (902) 835-3381 | FAX: (902) 835-7300 | **www.municipalgroup.ca**

DEVELOPMENT PLAN

WELSHTOWN QUARRY

Upper Clyde Road, Welshtown, Shelburne County, Nova Scotia

Date: November 10, 2021

INDRODUCTION

The Welshtown Quarry serves as an important source of construction aggregate for local projects as well as Nova Scotia Department of Public Works (NSPW) projects in the area. The quarry is operated periodically during the construction season to meet demand within the local construction industry. The quantity of aggregate produced at the site each year is dependent on demand and activity within the construction industry, the amount of provincial highway work to be completed each year, and Dexter successfully bidding work in the area. It is anticipated that future quarry operations will continue on an as needed basis to support local projects. For years in which the quarry is operational it is estimated that approximately 25,000 - 50,000 tonnes of aggregate will be produced per year. The rate of quarry development will progress slowly, gradually increasing at a rate consistent with aggregate demand in the area.

SITE OPERATIONS

Site Management and Development

As the quarry is developed, a recurring operational cycle will take place, typically consisting of; clearing of vegetation, grubbing of overburden, drilling and blasting of bedrock, production of aggregate via a portable crushing spread, stockpiling of various aggregate products, and loading, weighing, and hauling of aggregate products from the site. Advancement of the quarry highwall will be slow and progressive throughout the life of the quarry. The rate of quarry development will be consistent with the demand for aggregate within the local area.

Clearing of vegetation and grubbing of overburden will take place in advance of scheduled work at the site and may include harvesting trees and grubbing of overburden from areas anticipated for short-term (<5 years) progression of the site. When possible, overburden is strategically stockpiled onsite to reduce double handling of material, and may be used to construct berms adjacent to the quarry for safety purposes, or be stockpiled onsite for future use in rehabilitation efforts.

Blasting is conducted on an as-required basis, but is anticipated to occur once per year for years in which the quarry is operational. Blasting events are always undertaken by a fully certified and licensed blasting company with expertise in the field. A rock drill is used to drill boreholes into the exposed bedrock according to a specific blast design pattern. Boreholes are then loaded with explosives, and blasted to generate manageable sized rock that can be further crushed and screened into specific aggregate products. For the establishment of a relatively level quarry floor it is common practice for blasting to occur 3 to 5 feet below the intended extraction elevation. This allows for a relatively flat, graveled working area with a fractured quarry sub-floor approximately 3 to 5 feet in depth.

A portable crushing spread is used for aggregate production. A typical crushing spread consists of a series of chassis mounted crushers and screeners, mobile conveyors, and stackers, along with loaders for feeding and stockpiling materials. Blasted material is fed into the portable crusher by a front-end loader. The blasted rock is initially broken down by a primary crusher, and then conveyed to a secondary crusher and screening deck to be crushed and sized into finished aggregate products. Trailer enclosed generators supply power for the portable

crushing spread. A portable lab trailer is used to maintain quality control. A portable scalehouse and truck scale is set up along the site access road during periods of site activity.

Aggregate products are stockpiled in designated areas within the quarry by a front-end loader or portable conveyor stacker. A front-end loader will collect aggregate products from stockpiles and load them into dump trucks or transport them to a potable asphalt plant. Prior to leaving the quarry, trucks report to a scalehouse to be weighed. Trucks are routed to required project locations using the local and provincial road network.

Site management and operational processes are not expected to change significantly from one development phase to the next.

Progressive Reclamation

Reclamation of the Quarry will be completed in line with the Nova Scotia Environment Pit and Quarry Guidelines, the Terms and Conditions of the site Industrial Approval, and rehabilitation strategies that are consistent with industry standards and best practices. A Progressive Reclamation Approach will be used throughout the development and operation phases of the Quarry, and a Final Reclamation Plan will be developed and implemented at the conclusion of extraction and site related activities when aggregate reserves have been fully exhausted within the NSE approved quarry permit area.

As per the existing Industrial Approval for the Quarry, the site Reclamation Plan is updated every three years and submitted to NSE for review. Additionally, a Reclamation Bond is maintained to ensure funds are available to rehabilitate the Quarry. The value of the Reclamation Bond is reviewed and updated in line with the updated Reclamation Plans to ensure sufficient security is maintained throughout the life of the Quarry.

The Progressive Reclamation Approach will focus on rehabilitation strategies within the quarry footprint throughout the development and operations phases of the site. The following rehabilitation strategies will be progressively implemented to help facilitate final reclamation of the site in the future:

- As the site is developed and aggregate reserves are depleted, disturbed areas no longer required for aggregate production or site related activities will be progressively rehabilitated.
- Overburden will be strategically stockpiled to reduce handling and facilitate reuse and will be temporarily stockpiled on site for future use in site grading, slope construction, and re-vegetation efforts. Some overburden may also be used on an ongoing basis to construct more permanent berms adjacent to the quarry for safety and/or environmental considerations.
- Where a quarry highwall advances to the furthest extent possible within the approved quarry permit area, and future expansion of the highwall is not practical, efforts to rehabilitate / slope the highwall may be initiated with nearby overburden and excess rock that is unusable on site (i.e. oversize).
- Stabilized areas will be maintained as gravel staging areas for site related activities or for other potential site activities conducive to the area (i.e. set up for portable asphalt plant, forestry activities, etc.).
- Occasional site visits will be conducted to identify progressive reclamation opportunities and assess progressive reclamation outcomes.

QUARRY DEVELOPMENT PHASES

Attached is a sketch depicting the various quarry development phases considered, including; Existing Quarry Development, Quarry Mid-Development, Quarry Full Development, and Quarry Final Reclamation.

Phase 1: Existing Quarry Development

(Current disturbed footprint = approximately 5.0 hectares | 1-5 years)

The rate of quarry development will progress slowly with an existing disturbed area of approximately 5.0-hectares, and gradually increasing in footprint at a rate consistent with aggregate demand in the area. The existing disturbed area includes a working quarry highwall, areas cleared of vegetation and grubbed of overburden, stockpiled overburden, and a gravel set-up / stockpile area.

Surface water runoff from nearly all of the disturbed area is to the east via established site drainage corridors, ultimately flowing into the Roseway River, approximately 1 km from the quarry. Small amounts of runoff originating on perimeter slopes may flow offsite to vegetated areas. Appropriate erosion and sediment controls will be maintained onsite and within the site drainage corridors. Surface water discharge from the site will be monitored as per the Industrial Approval.

Phase 2: Quarry Mid-Development
(Mid-Development disturbed footprint = approximately 12.5 hectares | 6 – 20 years)

The rate of quarry development will continue to progress slowly with an estimated disturbed area of approximately 12.5-hectares at Quarry Mid-Development, and gradually increasing in footprint at a rate consistent with aggregate demand in the area. The anticipated disturbed area includes a quarry highwall that has progressed to the extent of the anticipated Quarry Mid-Development area, a gravel quarry floor with 3 to 5 foot fractured subgrade, and a gravel set-up / stockpile area.

Surface water runoff from nearly all of the Quarry Mid-Development disturbed area is anticipated to flow to the east via established site drainage corridors, ultimately discharging into the Roseway River approximately 1 km from the quarry. Small amounts of runoff originating on perimeter slopes may flow offsite to vegetated areas. Appropriate erosion and sediment controls will be maintained onsite and within the site drainage corridors. Surface water discharge from the site will be monitored as per the Industrial Approval.

Phase 3: Quarry Full Development

(Full Development disturbed footprint = 35.4 hectares | 21-40 years)

The rate of quarry development will continue to progress slowly with an estimated disturbed area of approximately 35.4-hectares at Quarry Full Development. The anticipated disturbed area would include a quarry highwall that has progressed to the extent of the anticipated Quarry Mid-Development area, a gravel quarry floor with 3 to 5 foot fractured subgrade, and an expanded gravel set-up / stockpile area.

Surface water runoff from nearly all of the Quarry Full-Development disturbed area is anticipated to flow to the east via established site drainage corridors, ultimately discharging into the Roseway River approximately 1 km from the quarry. Small amounts of runoff originating on perimeter slopes may flow offsite to vegetated areas. Appropriate erosion and sediment controls will be maintained onsite and within the site drainage corridors. Surface water discharge from the site will be monitored as per the Industrial Approval.

Phase 4: Quarry Final Reclamation

(Full Development area reclaimed – following Phase 3)

Final quarry reclamation will focus on rehabilitation of the site footprint at the conclusion of extraction and related activities when aggregate reserves have been fully exhausted within the NSE approved quarry permit area. Prior to fully rehabilitating the site, and when actual conditions representing final extraction limits and site features are known, Dexter will confirm a Final Reclamation Plan for the site. The following rehabilitation strategies will be considered to facilitate final reclamation of the site:

- *Removal of Facility Infrastructure*
- *Surface Contouring and Drainage Patterns*
- *Site Stabilization & Revegetation (including considerations to manage invasive plant species)*
- *Objectives for Final Land Use*
- *Other Reclamation Activities*

For the purposes of this Development Plan it is anticipated that the entire quarry will be rehabilitated, with slopes minimized, disturbed areas re-vegetated, and surface water runoff from the entire reclaimed quarry anticipated to flow to the east via established site drainage corridors, ultimately discharging into the Roseway River approximately 1 km from the quarry. Small amounts of runoff originating on perimeter slopes may flow offsite to vegetated areas. Appropriate erosion and sediment controls will be maintained onsite and within the site drainage corridors. Surface water discharge from the site will be monitored as per the Industrial Approval.

CONCLUSION

The Welshtown Quarry serves as an important source of construction aggregate for local projects as well as NSPW projects in the area. The quarry is operated periodically during the construction season to meet demand within the local construction industry. It is anticipated that future quarry operations will continue on an as needed basis to support local projects. The rate of quarry development will progress slowly, gradually increasing at a rate consistent with aggregate demand in the area. The various quarry development phases considered by this Development Plan include; Existing Quarry Development, Quarry Mid-Development, Quarry Full Development, and Quarry Final Reclamation. These development phases are used in the site Water Balance Assessment.

Welshtown Quarry
Site Development Plan

November 29, 2021

Water Features

- Watercourses (1:10,000)
- Wetlands (1:10,000)
- Wetlands (surveyed)
- Quarry Drainage (surveyed)

Development Plan

- Existing Development (5 ha)
- Mid-Development (12.5 ha)
- Full-Development (35.4 ha)

0 100 200 m

DEXTER

DEXTER CONSTRUCTION COMPANY LIMITED

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APPENDIX C

Welshtown Quarry Water Balance Assessment

927 Rocky Lake Drive | P.O Box 48100 | Bedford, NS B4A 3Z2
TEL: (902) 835-3381 | FAX: (902) 835-7300 | **www.municipalgroup.ca**

PROPOSED WELSHTOWN QUARRY EXPANSION

QUANTITATIVE WATER BALANCE ANALYSIS

Prepared by Mr. Jim Fraser, Consulting Hydrogeologist, P.Geo, M.A.Sc

Date: November 9, 2021

Table of Contents

1.0 INTRODUCTION

This document outlines the Water Balance Assessment undertaken for the Proposed Welshtown Quarry Expansion Project, located in Welshtown, Shelburne County, Nova Scotia. At the present time, Dexter Construction Company Limited (Dexter) is operating a Nova Scotia Environment approved quarry of less than 4 hectares (ha), which is proposed to be expanded to a maximum 35.4 ha over the full course of future operation. The proposed quarry expansion is intended to provide additional aggregate reserves and support the long-term sustainability of the site. It is anticipated that the rate of quarry development will progress gradually, at a rate consistent with aggregate demand in the area and growth of the local market.

The water balance presented herein is an assessment of the estimated quantitative effects on surrounding surface water features and groundwater resources resulting from proposed quarry expansion. The methodology used for this Water Balance Assessment is consistent with the approach used recently to assess similar quarry expansion projects undergoing Environmental Assessment.

For this Water Balance Assessment four (4) site conditions were analyzed; existing (baseline) conditions, quarry mid-development conditions, quarry full development conditions, and quarry final reclamation conditions. Each of these site conditions have been described in the Welshtown Quarry Development Plan.

Existing conditions include a gravelled quarry area of approximately 5-hectares, which includes the quarry highwall, set-up and stockpile areas, and portions of the site access road. Quarry mid-development conditions are considered at 12.5 ha (approximately 35% of the 35.4 ha permit area). Quarry full development conditions consider the quarry at full development of 35.4 ha. Reclamation conditions are representative of the site upon removal of all construction equipment and buildings, after re-contouring, and following the re-introduction of vegetative cover over the Quarry areas.

Progressive reclamation will occur throughout the development and operation phases of the quarry. As the site is developed and aggregate reserves are depleted, disturbed areas no longer required for aggregate production or site related activities will be progressively rehabilitated. This includes using grubbing material originating onsite for site grading, slope construction, and re-vegetation efforts. Re-using overburden is anticipated to simulate pre-development conditions. When compared to active quarry areas, areas that have been progressively rehabilitated would be expected to have reduced surface water runoff, and increased infiltration, reflective of natural conditions in the area. This Water Balance Assessment does not account for progressive reclamation, so the development scenarios presented represent the worst-case for each scenario with respect to runoff quantity.

Due to the range of infiltration rates possible, the water balance was completed for two (2) infiltration scenarios. The two infiltration scenarios represent the range of possible outcomes from existing / natural infiltration (most likely) to 100% impervious (worst case, no infiltration).

1.1 Data Collection

1.1.1 Topographic Data

The existing quarry and proposed quarry expansion area is located at the south edge of a bedrock plateau, with resulting steep slopes around it descending southeast, south and west. To the east from

the existing quarry, the land slopes gradually to the Roseway River. To the south the land slopes steeply to a table-like plateau with irregular drainage that supports peatlands, with a moderate slope to the west. Uplands at the site are characteristically regenerated mixed forest stands with some characteristic older and taller iconic species such as White Pine, and swales and basins occupied by forested swamps.

A 5-meter (m) contour interval obtained from provincial 1:10,000 topographic map for the area, was used to delineate the watershed catchment areas for the Project Site. The contours were assessed both digitally and manually to estimate catchment areas for the various quarry development scenarios.

1.1.2 Climate Data

Precipitation and temperature data were collected from the Liverpool Big Falls Climate Station (1981-2010) which is located approximately 50 kilometers from the Welshtown Quarry. While the Liverpool Big Falls Climate Station is located further away from the site than other Climate Stations, it was used for the Water Balance Analysis since it included the most recent, continuous record. Climate data from the Roseway (1950 – 1995) and Shelburne Sandy Point Climate Stations (2018-2020), which are located one (1) and nine (9) kilometers from the site, was also reviewed. Data from these stations was consistent with the Liverpool Big Falls data that was used. Total monthly precipitation values for the periods of record were averaged to determine the average precipitation values for the Project Area. Monthly lake evaporation normals were obtained from the Environment Canada Truro Station (1981-2010). The Truro station is the closest climate station to the Project Site that collects lake evaporation data and is located approximately 240 km away from the Welshtown quarry. Monthly potential evapotranspiration normals were calculated using the Hamon equation (1961) (Lu, et al., 2005). The Hamon equation requires monthly average hours of daylight and monthly average temperature as input. Monthly average hours of daylight were calculated for the site using the Sunrise and Sunset Calculator (https://www.timeanddate.com/sun/, last accessed on February 23, 2021).

Table 1 -Climate Normal Data

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	TOTAL
Temperature[1] (°C)	-4.60	-3.60	0.20	5.60	11.00	16.10	19.40	19.20	15.20	9.40	4.70	-0.90	
Precipitation[1] (mm)	147.5	123.1	152.6	123.5	102.6	97.4	97.6	90.8	108	127.7	166.3	149.3	1,486
Lake Evaporation[2] (mm)	0.0	0.0	0.0	0.0	89.9	102.0	117.8	96.1	69.0	40.3	0.0	0.0	515
PET[3] (mm)	0.0	0.0	0.0	39.3	60.9	87.0	103.5	94.6	66.7	40.9	26.6	0.0	520

[1] Values obtained from the Liverpool Big Falls Climate Station

[2] Values obtained from the Truro Climate Station

[3] Potential Evapotranspiration was calculated using the Hamon equation (1961), Lu, et al., 2005)

2.0 METHODOLOGY

The water balance assessment for the Welshtown Quarry was prepared to assess predicted changes in local flow characteristics during an average year for the four site conditions (existing / quarry mid-development / quarry full development / reclaimed quarry) and two infiltration scenarios (pervious / impervious). The methodology used for this water balance assessment is consistent with the approach used recently to assess similar quarry expansion projects undergoing Environmental Assessment.

2.1 Watershed Delineation

The area potentially affected by the proposed Welshtown Quarry expansion involves two (2) separate watersheds, defined as Catchment Area A and Catchment Area B. Catchment Area A encompasses a total of 230.3 ha, and for the purposes of this exercise has been separated into Sub-Catchment Area A-1 (107.8 ha) and Sub-Catchment Area A-2 (122.4 ha).

Existing quarry development conditions and quarry mid-development conditions are situated in the extreme northern portion of Catchment Area A and Sub-Catchment Area A-1. Surface water in Sub-Catchment A-1 flows from west to east. Surface water in Sub-Catchment A-2 flows from south to north. Surface water runoff from Catchment Area A (and the sub-catchments) ultimately discharges to the Roseway River located approximately 1000 m from the active quarry area.

Catchment Area B encompasses 346.6 ha and is currently undeveloped. This area will be affected at quarry full development conditions and quarry final reclamation conditions. Surface water in this watershed flows from southeast to northwest in the southern portion of the watershed and from east to west in the northern portion (the area of future quarry development), with the point of ultimate discharge to Birchtown Brook located approximately 1700 m from the western proposed future and final quarry boundary.

Watershed delineations are presented based on the four development phases of the existing and proposed quarry: **Figure 1** – Existing Conditions Catchment Areas, includes the existing quarry development conditions and quarry mid-development conditions; **Figure 2** – Full Development Catchment Areas includes the quarry full development conditions and quarry final reclamation conditions. These Figures are included at the conclusion of this document. It is noted that during all Phases of quarry development, surface water will be directed to Catchment Area A, specifically Sub-Catchment Area A-1. It is also noted that that the drainage from quarry full development conditions and quarry final reclamation conditions are expected to remain constant. As such watershed areas from quarry full development conditions and quarry final reclamation conditions do not change.

Additionally, Figure 3 – Unnamed Watercourse Catchment Area has been determined. The unnamed watercourse is located south of the existing quarry, and a baseline fish and fish habitat study has been completed for it. The unnamed watercourse catchment area suggests limited quarry development within the catchment area.

2.2 Evaporation and Evapotranspiration Potential

Evaporation (E) describes the process of the return of moisture to the atmosphere from open water and land surfaces. Evaporation from plant surfaces is referred to as evapotranspiration (ET). The magnitude of E or ET over time is a function of the climate, soil and vegetation is the area. E rates tend to peak in the summer months when the temperatures are the highest, daylight hours are the longest, sun intensity is greatest, and the growing season is at its peak.

Lake evaporation (LE) is the amount of evaporation from an open body of water. In Atlantic Canada, the LE rate is greater than the standard evaporation rate because of the constant availability of water. For this water balance, LE rates from the weather station in Truro, NS were utilized as this appears to be the only climate station in Nova Scotia that collects this data. The total annual LE rate is 515.1 millimeters (mm). July represents the month with the highest LE rate on average, at 117.8 mm. LE rates are only

reported for the months May to October, as the temperature during the six (6) months of November through April are typically around 0°C during which time evaporation is minimal or non-existent.

Table 1 presents a summary of the LE rates used as a water loss parameter in the water balance assessment, presented herein.

ET rates were calculated using the Hamon equation (1961), previously described which is based on average monthly temperatures and daylight hours. Potential ET rates for the 5 months of December to March were set to zero due to the low temperatures resulting in minimal potential for ET. The total PET used for this water balance is 520 mm/year. July Represents the month with the highest PET at 103.5 mm/month. **Table 1** also includes a summary of the PET rates used as a water loss parameter in the water balance assessment.

LE rates were applied to areas with year-round standing water, while PET rates were applied to all other areas. Year-round standing water was determined using aerial photos and mapping.

2.3 Infiltration Factor

The water storage/infiltration has been estimated using the infiltration factors taken from Table 3.1 of the Ontario Ministry of Environment, Conservation and Parks (OMECP) Stormwater Management Planning and Design Manual (2003). Calculations using OMECP Table 3.1 account for slope, soil types and vegetation cover when estimating the water holding capacity for an area. Each watershed or sub-watershed (where applicable) was analyzed in this manner and if multiple slope or land use segments existed within a watershed an area-ratio method was used to determine an average infiltration factor for the catchment area. Using this procedure, the catchment areas in the project area were determined to be hilly land (0.10 - 0.16 infiltration factor), with partial woodland (0.11 - 0.15) and poorly drained stony, sandy and shallow glacial till (0.11 - 0.15) derived from local bedrock sources (Stea et al., 1992).

Two scenarios were assessed for the infiltration conditions during existing quarry development conditions, quarry mid-development conditions, quarry full development conditions, and quarry final reclamation conditions; (1) an impervious quarry floor where no infiltration occurred through the floor of the quarry; and (2) a pervious quarry floor consisting of similar infiltration capabilities as existing surficial soils (poorly drained stony, sandy glacial till). Due to the nature of the surficial soils and the presence of bedrock near the ground surface, it is unlikely the soil will have greater infiltration at the floor of the quarry than the existing surface. In this regard therefore, these two scenarios represent the maximum and minimum values for expected infiltration in the quarry. These two scenarios provide a range of potential outcomes resulting from quarry development. New infiltration parameters for these scenarios were calculated based on an area-ratio method.

Reclamation conditions were expected to be similar to pre-development conditions, with the exception of Flat Land (0.30) and Cultivated Land (0.10) in the area where the quarry was located. An area-ratio method was applied to determine the appropriate infiltration factor for the slope and land use in watersheds with multiple slope and land use segments.

Runoff volumes for this water balance were assumed to equal the total precipitation less the potential evapotranspiration, lake evaporation, and infiltration. Infiltration includes groundwater recharge and groundwater that contributes to surface water resources as baseflow. This Water Balance Assessment does not distinguish between the two, and as such groundwater recharge was not included in this water

balance assessment. The proposed quarry expansion will not enter the deep bedrock groundwater table, and overall is not anticipated to significantly impact or alter groundwater.

3.0 WATER BALANCE ANALYSIS

3.1 Sub-Catchment Area A-1

The existing conditions at the proposed expanded quarry location involve a 5-ha quarry located in the Sub-Catchment Area A-1, which encompasses 107.9 ha. Surface water from this area drains eastward to the Roseway River. No other watersheds are affected by the existing quarry.

Table 2 provides the details of the Water Balance for Sub-Catchment A-1 for the 4 quarry development phases for both an impervious quarry floor and a pervious quarry floor.

TABLE 2 – WATER BALANCE – SUB-CATCHMENT AREA A-1

Sub-Catchment A-1	Area *(ha)*	Available Water *(m^3)*	Lake Evaporation *(m^3)*	PET *(m^3)*	Infiltration *(m^3)*	Runoff *(m^3)*	Change in Infiltration from Existing Conditions	Change in Runoff from Existing Conditions
Existing Conditions: Impervious Quarry Floor	107.9	1,603,826	4013	556,521	411,757	631,535	-	-
Quarry Mid-Development: Impervious Quarry Floor	107.9	1,603,826	4013	556,521	404,505	638,787	-1.8%	1.1%
Quarry Full Development: Impervious Quarry Floor	122.8	1,825,299	4013	633,930	439,989	747,367	6.9%	18.3%
Existing Conditions: Pervious Quarry Floor	107.9	1,603,826	4013	556,521	419,009	624,283	-	-
Quarry Mid-Development: Pervious Quarry Floor	107.9	1,603,826	4013	556,521	422,635	620,657	0.9%	-0.6%
Quarry Full Development: Pervious Quarry Floor	122.8	1,825,299	4013	633,930	491,331	696,025	17.3%	11.5%
Quarry Reclamation: Pervious Quarry Floor	122.8	1,825,299	4013	633,930	491,331	696,025	17.3%	11.5%

Based on the data from this table it is apparent that the change in Infiltration from Existing Conditions varies between –1.8% (Mid-Development, Impervious Quarry Floor) to 17.3% (Full Development, Pervious Quarry Floor). The change in Runoff from Existing Conditions varies from –0.6% (Mid-Development, Pervious Quarry Floor) to 18.3% (Quarry Full Development, Impervious Quarry Floor).

It is noted that runoff from the Quarry is largely through an established drainage corridor that enters an unnamed watercourse in Sub-Catchment A-1 almost immediately before the watercourse discharges to the Roseway River. Minimal runoff from the Quarry would directly contribute to flow in the unnamed watercourse, and consequently any changes in runoff / infiltration resulting from the proposed Quarry expansion is expected to have minimal impact on the flow within the unnamed watercourse.

3.1.1 Unnamed Watercourse Catchment Area

The catchment area for the unnamed watercourse is fully within Sub-Catchment Area A-1. The anticipated Quarry Development Plan phasing, and the boundary of the unnamed watercourse catchment area suggests limited future quarry development within the catchment area (2.4 ha compared to the 50.7 ha catchment). It is anticipated that a small amount of runoff from the perimeters slopes of the site would still contribute flow to the unnamed watercourse catchment area. Considering

the relatively small portion of the unnamed watercourse catchment area that may be impacted over the life of the quarry, any potential increase or decrease in flow to the unnamed watercourse is expected to be negligible.

3.2 Catchment Area A

Catchment Area A includes both Sub-Catchment Area A-1 (containing the quarry) and Sub-Catchment Area A-2 (unaffected by the quarry), to the south, which together encompass 230.3 ha. Both Catchment Areas combine to discharge surface water to the Roseway River to the east of the quarry.

Table 3 provides the details of the Water Balance for Catchment A for the 4 quarry development phases for both an impervious quarry floor and a pervious quarry floor.

TABLE 3 – WATER BALANCE – CATCHMENT AREA A

Sub-Catchment A-1	Area *(ha)*	Available Water *(m^3)*	Lake Evaporation *(m^3)*	PET *(m^3)*	Infiltration *(m^3)*	Runoff *(m^3)*	Change in Infiltration from Existing Conditions	Change in Runoff from Existing Conditions
Existing Conditions: Impervious Quarry Floor	230.3	3,423,179	7,088	1,189,319	879,754	1,347,019	-	-
Quarry Mid-Development: Impervious Quarry Floor	230.3	3,423,179	7,088	1,189,319	872,502	1,354,270	-0.8%	0.5%
Quarry Full Development: Impervious Quarry Floor	245.3	3,646,139	7,088	1,267,248	908,373	1,463,431	3.3%	8.6%
Existing Conditions: Pervious Quarry Floor	230.3	3,423,179	7,088	1,189,319	887,006	1,339,767	-	-
Quarry Mid-Development: Pervious Quarry Floor	230.3	3,423,179	7,088	1,189,319	890,632	1,336,141	0.4%	-0.3%
Quarry Full Development: Pervious Quarry Floor	245.3	3,646,139	7,088	1,267,248	959,715	1,412,089	8.2%	5.4%
Quarry Reclamation: Pervious Quarry Floor	245.3	3,646,139	7,088	1,267,248	959,715	1,412,089	8.2%	5.4%

Based on the data from this table it is apparent that the change in Infiltration from Existing Conditions varies between -0.8% (Mid-Development, Impervious Quarry Floor) to 8.2% (Full Development, Pervious Quarry Floor). The change in Runoff from Existing Conditions varies from –0.3% (Mid-Development, Pervious Quarry Floor) to 8.6% (Full Development, Impervious Quarry Floor).

This information, although not directly relevant to the quarry, provides information as to the change in conditions at the final Catchment Area A discharge point, prior to discharge to the Roseway River.

3.3 Catchment Area B

Catchment Area B includes the Birchtown Brook watershed located to the west of the existing quarry, encompassing 346.6 ha. As noted previously Catchment Area B is not affected by the existing quarry development conditions or the proposed quarry at its mid-quarry development conditions. It is, however affected by the full quarry development and quarry final reclamation scenarios in that water falling on Catchment Area B in the fully developed quarry will be directed to Catchment Area A-1.

Table 4 provides the details of the Water Balance for Catchment B for the 4 quarry development phases for both an impervious quarry floor and a pervious quarry floor.

TABLE 4 – WATER BALANCE – CATCHMENT AREA B

Sub-Catchment A-1	Area *(ha)*	Available Water *(m^3)*	Lake Evaporation *(m^3)*	PET *(m^3)*	Infiltration *(m^3)*	Runoff *(m^3)*	Change in Infiltration from Existing Conditions	Change in Runoff from Existing Conditions
Existing Conditions: Impervious Quarry Floor	346.6	5,151,862	38,491	1,761,854	1,335,588	2,015,929	-	-
Quarry Mid-Development: Impervious Quarry Floor	346.6	5,151,862	38,491	1,761,854	1,335,588	2,015,929	0.0%	0.0%
Quarry Full Development: Impervious Quarry Floor	331.5	4,927,416	38,491	1,683,406	1,277,189	1,928,330	-4.4%	-4.3%
Existing Conditions: Pervious Quarry Floor	346.6	5,151,862	38,491	1,761,854	1,335,588	2,015,929	-	-
Quarry Mid-Development: Pervious Quarry Floor	346.6	5,151,862	38,491	1,761,854	1,335,588	2,015,929	0.0%	0.0%
Quarry Full Development: Pervious Quarry Floor	331.5	4,927,416	38,491	1,683,406	1,277,189	1,928,330	-4.4%	-4.3%
Quarry Reclamation: Pervious Quarry Floor	331.5	4,927,416	38,491	1,683,406	1,277,189	1,928,330	-4.4%	-4.3%

Based on the data from this table it is apparent that the change in Infiltration from Existing Conditions varies between 0.0% (Mid-Development, Impervious & Pervious Quarry Floor) to -4.4% (Full Development, Impervious & Pervious Quarry Floor). The change in Runoff from Existing Conditions varies from 0.0% (Mid-Development, Impervious & Pervious Quarry Floor) to -4.3% (Full Development, Impervious & Pervious Quarry Floor).

This information provides the quantitative effect of the re-direction of surface water from Catchment Area B to Sub-Catchment A-1 and Catchment Area A. The effect on Catchment Area A has already been taken into consideration in Table 2.

4.0 SUMMARY

The Welshtown Quarry water balance assessment was prepared to estimate changes in surface water flow and assess the potential impact of the proposed quarry expansion on the local hydrological regime. The methodology used for this water balance assessment is consistent with the approach used recently to assess similar quarry expansion projects undergoing Environmental Assessment.

4.1 Sub-Catchment Area A-1

For Sub-Catchment Area A-1, the Water Balance Assessment estimates that the change in infiltration from Existing Conditions ranges between –1.8% (Mid-Development, Impervious Quarry Floor) to 17.3% (Quarry Full Development, Pervious Quarry Floor). It is estimated that the change in runoff from Existing Conditions ranges from –0.6% (Mid-Development, Pervious Quarry Floor) to 18.3% (Quarry Full Development, Impervious Quarry Floor).

It is noted that runoff from the Quarry is largely through an established drainage corridor that enters an unnamed watercourse in Sub-Catchment A-1 almost immediately before the watercourse discharges to the Roseway River. While the Water Balance Assessment suggests some level of change in infiltration / runoff due to the quarry expansion, this will largely be managed within the established quarry drainage corridor.

Minimal runoff from the Quarry would directly contribute to flow in the unnamed watercourse, and consequently any changes in runoff / infiltration resulting from the proposed Quarry expansion is expected to have minimal impact on the flow within the unnamed watercourse.

4.1.1 Unnamed Watercourse Catchment Area

The unnamed watercourse catchment area shows limited quarry development within the catchment area and subsequently any potential increase or decrease in flows to the unnamed watercourse are expected to be negligible. The quarry expansion area within the unnamed watercourse catchment area can be graded to promote drainage towards Wetland-12 and the unnamed watercourse to offset any potential loss of water.

4.2 Catchment Area A

For Catchment Area A, the Water Balance Assessment estimates that the change in infiltration from Existing Conditions ranges between -0.8% (Mid-Development, Impervious Quarry Floor) to 8.2% (Quarry Full Development, pervious Quarry Floor). It is estimated that the change in runoff from Existing Conditions ranges from –0.3% (Mid-Development, Pervious Quarry Floor) to 8.6% (Quarry Full Development, Impervious Quarry Floor).

It is noted that the estimated changes in runoff / infiltration for the larger Catchment Area A correlate to discharge from the unnamed watercourse to the Roseway River. The Roseway River Watershed encompasses approximately 550 km^2. By comparison the Catchment Area A is approximately 230.3 ha (2.303 km^2). Any minor changes in flow contribution from the unnamed watercourse to the Roseway River would have a negligible effect on the Roseway system.

4.3 Catchment Area B

For Catchment Area B. the Water Balance Assessment estimates that the change in infiltration from Existing Conditions ranges between 0% (Quarry Mid-Development, Pervious & Impervious Quarry Floor) to -4.4% (Quarry Full Development, Pervious & Impervious Quarry Floor). It is estimated that the change in runoff from Existing Conditions ranges from 0% (Quarry Mid-Development, Pervious & Impervious Quarry Floor) to -4.3% (Quarry Full Development, Pervious & Impervious Quarry Floor).

It is noted that the Quarry will not enter Catchment Area B until it has reached its mid-development point. The estimated changes in runoff / infiltration within Catchment Area B are minimal and within expected seasonal fluctuations. Consequently any impact on Catchment Area B is expected to be negligible.

4.4 Water Management Considerations

The results of the Water Balance Analysis will be used to form the basis of further analysis and design of surface water management infrastructure at the Quarry in the future. It is anticipated that conditions of any Environmental Assessment approval issued for the proposed quarry expansion will require a detailed surface monitoring plan, groundwater monitoring plan, erosion and sediment control plan, and stormwater management plan. As part of the EARD addendum package, preliminary versions of these plans have been developed. Following feedback received during the EA process, these plans will be

revised where appropriate and re-submitted as part of the subsequent Industrial Approval amendment process.

5.0 CONCLUSION

The Welshtown Quarry water balance assessment was prepared to estimate changes in surface water flow and assess the potential impact of the proposed quarry expansion on the local hydrological regime. The methodology used for this water balance assessment is consistent with the approach used recently to assess similar quarry expansion projects undergoing Environmental Assessment.

The estimated changes in runoff and infiltration from Catchment Area A and Catchment Area B are minimal and within the anticipated range of seasonal variance. The estimated changes in runoff and infiltration from Catchment Area A-1 are somewhat more significant, however any increases in runoff are expected to be captured and managed by the existing quarry drainage corridor. The drainage corridor connects to an unnamed watercourse almost immediately before the unnamed watercourse discharges to the Roseway River. The Roseway River is significantly larger than the minimal input from the unnamed watercourse and so any changes are negligible.

Minimal runoff from the Quarry is directed to the upper reaches of the unnamed watercourse, and there will be limited quarry development within the catchment area for the unnamed watercourse. Considering the relatively small portion of the catchment area that may be impacted over the life of the quarry, any potential increase or decrease in flow to the unnamed watercourse is expected to be negligible.

Based on the results of the Water Balance Assessment it is anticipated that the proposed quarry expansion will have a negligible impact on the local hydrological regime. Water management and monitoring plans will be implemented as part of the Industrial Approval process to validate the findings of the water balance assessment.

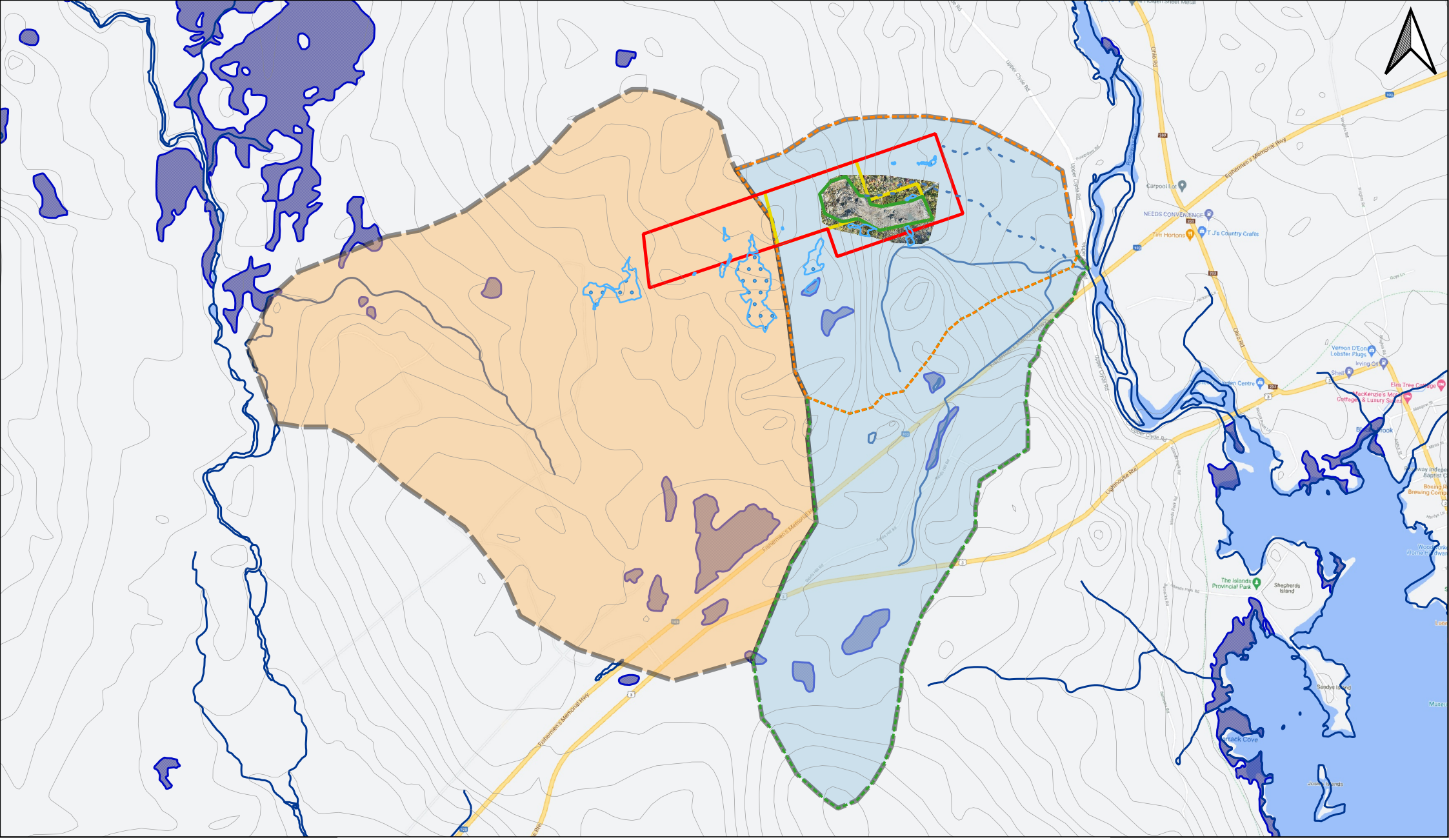
6.0 REFERENCES

GHD Consultants “Water Balance Analysis for the Proposed Dexter Quarry Located in Sheet Harbour, Nova Scotia”. (2019)

Lu et al. (2005). “A Comparison of Six Potential Evapotranspiration Methods for Regional Use in the Southeastern United States”. Journal of the American Water Resources Association, 41, 621-633.

Ontario Ministry of the Environment. (2003). Stormwater Management Planning and Design Manual.

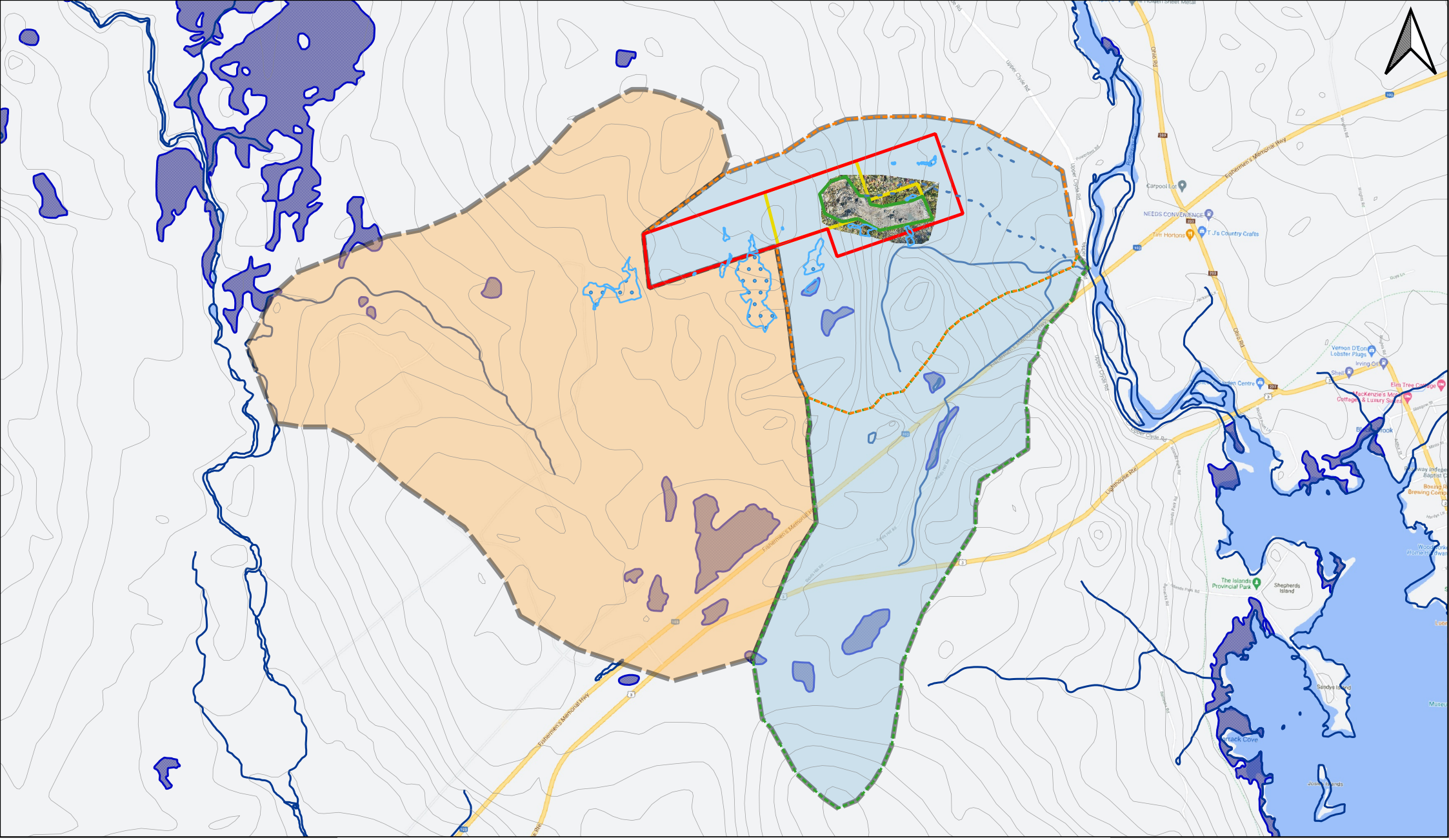
Climate Normal Data (Data taken from Roseway/Shelburne/Sandy Point and Truro Environment Canada Stations.



Welshtown Quarry
Figure 1
Existing Conditions Catchment Areas

November 8, 2021

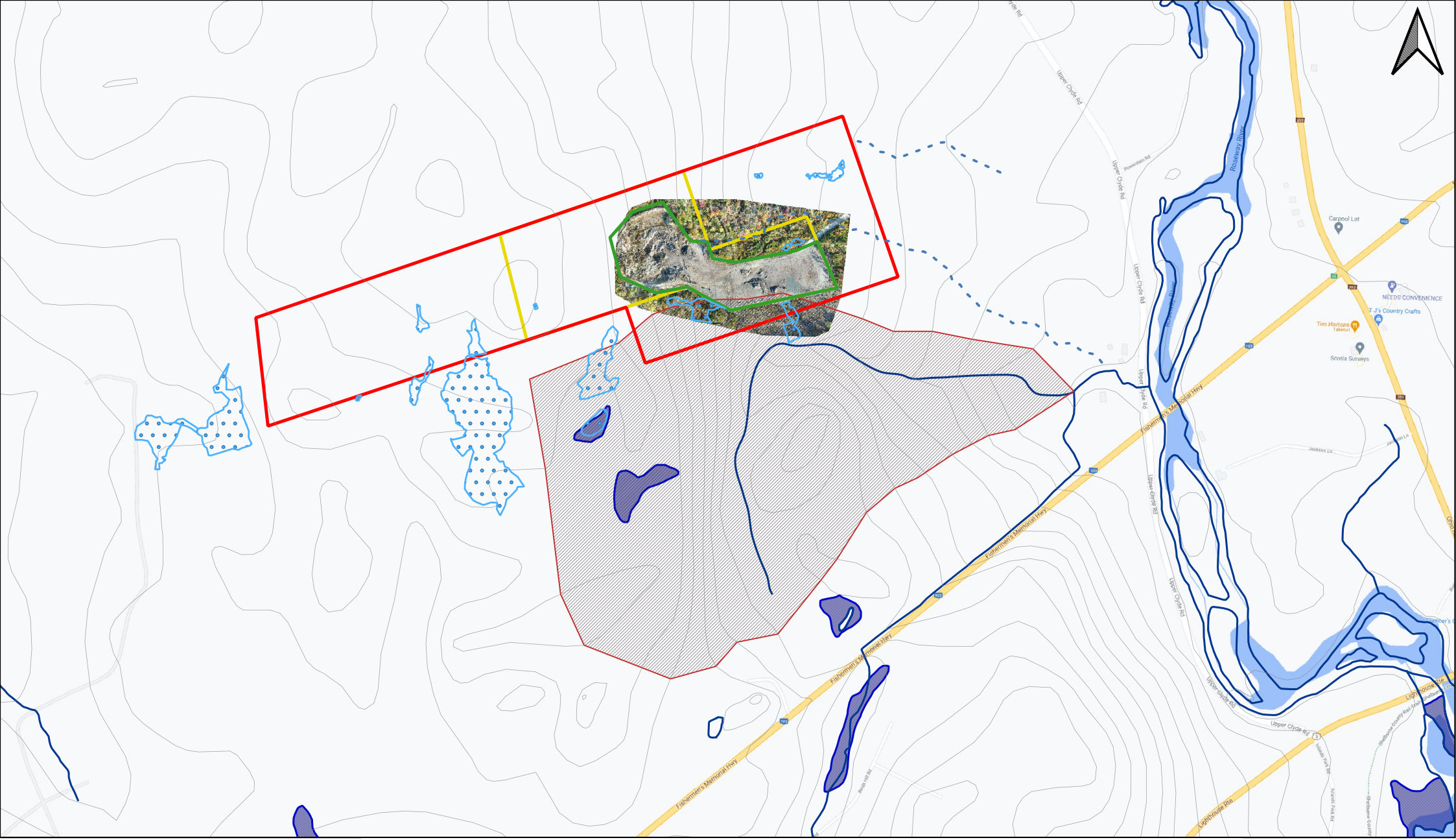
DEXTER CONSTRUCTION COMPANY LIMITED



Welshtown Quarry
Figure 2
Full Development Catchment Areas

November 8, 2021

DEXTER CONSTRUCTION COMPANY LIMITED



Welshtown Quarry
Figure 3
Unnamed Watercourse Catchment Areas

November 8, 2021

Water Features

- Watercourses (1:10,000)
- Wetlands (1:10,000)
- Wetlands (surveyed)
- Quarry Drainage (surveyed)

Development Plan

- Existing Development (5 ha)
- Mid-Development (12.5 ha)
- Full-Development (35.4 ha)

- Unnamed Watercourse Catchment (50.7 ha)
- Catchment Lost to Quarry Development (2.4 ha)

DEXTER

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0 100 200 m