TOWNHOMES OF LAKE THOMAS

3124, 3134 AND 3136 HIGHWAY 2, FALL RIVER, NOVA SCOTIA

PHOSPHORUS NET LOADING ASSESSMENT

February 28th, 2023

PREPARED BY:

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TABLE OF CONTENTS

TABLE OF FIGURES

LIST OF APPENDICES

1 Project Description

The Townhomes of Lake Thomas development, proposed by 3293309 Nova Scotia ULC, is located on the east side of Lake Thomas and Highway 2 in the southern part of Fall River, Nova Scotia. Development is to occur over two existing parcels of land which both have road access. A commercial building exists on civic 3124 (PID 40103202) and a residential home is located at civics 3134-3136 (PID 00504415). The commercial building is to be demolished to make room for development while the residential home is to remain. These parcels cover approximately 6.35 acres and are bound by Highway 2 to the west and private lands to the north, south and east. The south-eastern part of the site is currently tree-covered, and driveways and lawn areas exist along Highway 2 and to the North. The site primarily slopes from east to west toward Highway 2 and Lake Thomas.

The developer initially proposed eighteen 4-bedroom townhouse units in six townhouse blocks for the proposed site. The scale has since been reduced to 30 bedrooms in total under a smaller footprint. This reduction was recommended by ABLE due to both septic and stormwater limitations and in consideration of phosphorus load. Water services will be provided to the development from the 300mm ductile iron main that runs along the west side of Highway 2. Sewage effluent will be treated by a Waterloo Biofilter system with phosphorus removing electrostatic precipitators in septic tanks. Treated effluent disposal will occur in an infiltration field along the east side of the overall property, furthest from Lake Thomas, where natural trees, vegetation, and wetlands will remove excess phosphorus from entering the lake.

This report will outline how this development can proceed without increasing the trophic state of the receiving waters in accordance with the HRM River-lakes Secondary Planning Strategy. This is a very stringent requirement for developers that will require specialized infrastructure and specific measures to be implemented in the treatment of stormwater runoff and the treatment of onsite sewage. Best management practices will need to be in place post-construction to ensure that phosphorus export levels are kept low in the future.

2 Site Conditions

2.1 Land Use

The proposed site is located in the Shubenacadie Lakes Plan Area (Planning districts 14 and 17) and is zoned as Village Main Street (VMS). The commercial building at civic 3124 has historically been the location of massage therapy and construction businesses. A residential home is located on civic 3134/3136 with the majority south-eastern portion of this property being undeveloped.

The proposed use is to develop the lot for multi-unit residential development as shown on the proposed site concept plan, see drawing C100 in Appendix A and supplemental architectural drawings. This will involve the construction of four 3-unit townhouse buildings, primarily on the existing civic 3124 property.

2.2 Roads

Access to both parcels that encompass this site is provided via Highway 2 in Fall River. Civic 3134 is accessible by a paved driveway while a gravel driveway and parking lot serves the commercial building. It is anticipated that the proposed residential development will share access with the residential driveway to minimize hard surface. Oakes Road overlooks the property from the east.

2.3 Surficial Geology

Test pits and in-situ permeameter testing were completed on the site to determine soil suitability both for sewage effluent and stormwater infiltration. Test pits showed a pattern of 150-200mm organic material and 300-500mm of sandy silt overlaying silty clay. Test pit locations can be found on C100 of Appendix A and test pit and permeameter test results are in Appendix B. Nova Scotia's surficial geology map indicates silty till on the proposed site as can be seen in Figure 2.1 below extracted from NSDNRR's Surficial Geology Map.

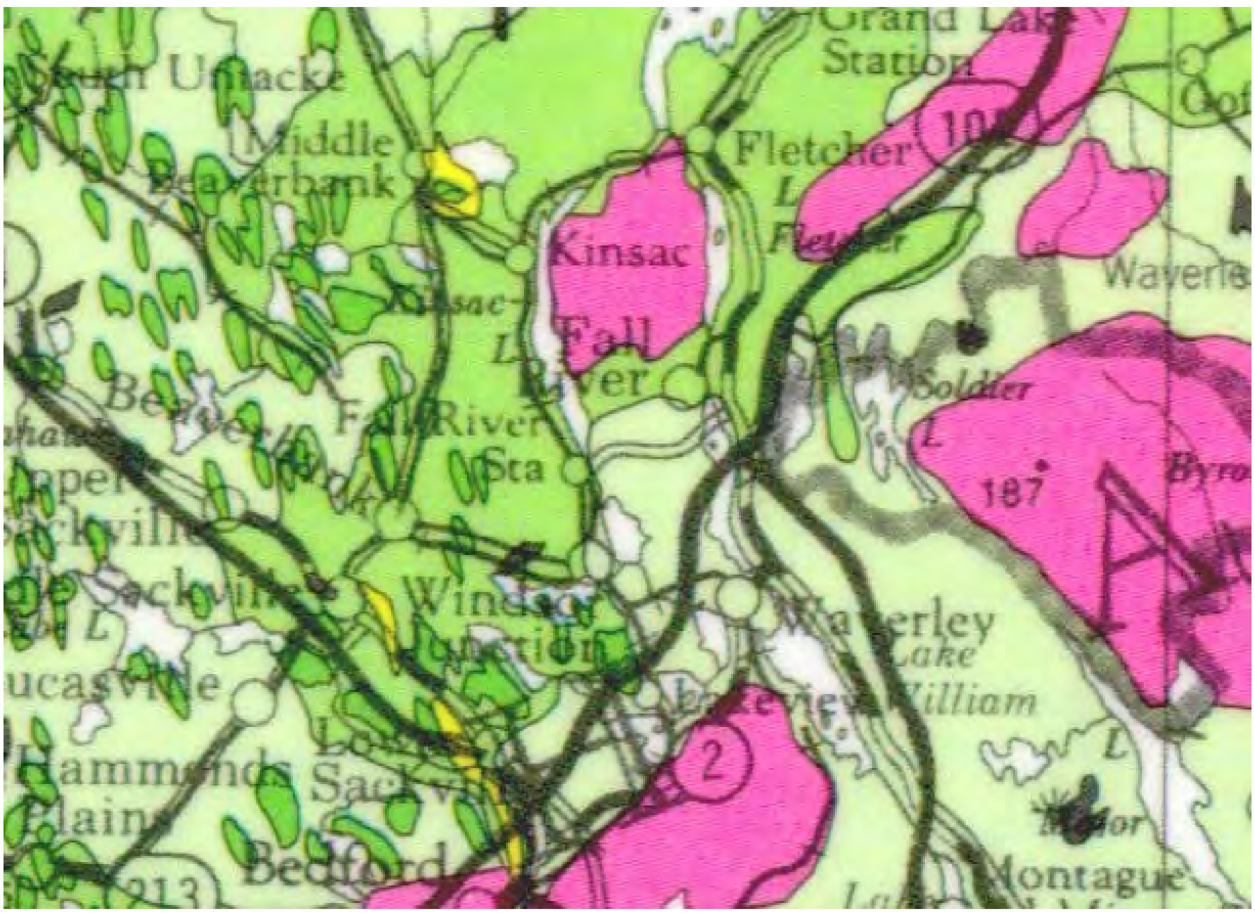

Figure 2.1 - Nova Scotia Surficial Geology Map of Development Area (NSDNRR)

In-situ permeameter testing at four locations provided varied results, see Table 2.1 below.

Location	Soil Type	Measured Permeability (k)
A – North of Commercial Bldg	Sandy Silt	$8.17x10^{-7}$
B – East of Residential Well	Clay Silt	$1.0x10^{-8}$
C – East Property Boundary	Sandy Silt	$4.11x10^{-6}$
D – South Property Boundary	Sandy Silt	$13.71x10^{-7}$
Average Permeability (k_{avg})		**$13.71x10^{-7}$**

Table 2.1 - In-Situ Permeameter Test Results

2.4 Bedrock Geology

The bedrock geology of the site consists of greenish grey metasandstone and minor interbedded, green, metasiltstone and dark grey-black slate from the Goldenville Group. Bedrock was not encountered in test pits at depths of 1.5m. See Figure 2.2 below from NSDNRR's Bedrock Geology Map of the Waverley area.

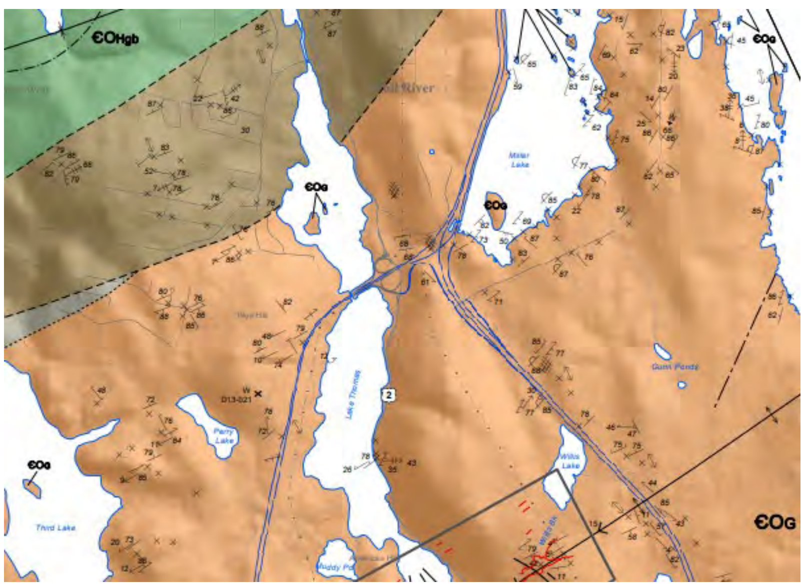

Figure 2.2 -Nova Scotia Bedrock Geology Map of Development Area (NSDNRR)

The site is in a low-risk area for radon in indoor air, so extra consideration for radon will likely not be required for these buildings.

Figure 2.3 - Nova Scotia Radon Potential for Development Area (NSDNRR)

2.5 Groundwater Resources

Groundwater will not be negatively impacted by new development as none will be withdrawn from the aquifer. Treated potable water is available on the site from the Pockwock water system. The existing residence has its own well. Residential water use will eventually find its way into the groundwater after undergoing tertiary treatment with the proposed sewage treatment system, filtering down through the overlying soils described above. Well logs in the area show varied results for water yield; between 4.5 and 40 litres per minute. A perched water table exists in areas of the site due to the nature of existing soils as was observed when test pits for permeability testing filled when left over-night.

The map in Figure 2.4 below from NSDNRR shows that the area of this development is more likely to have uranium and other radionuclides naturally occurring in the groundwater.

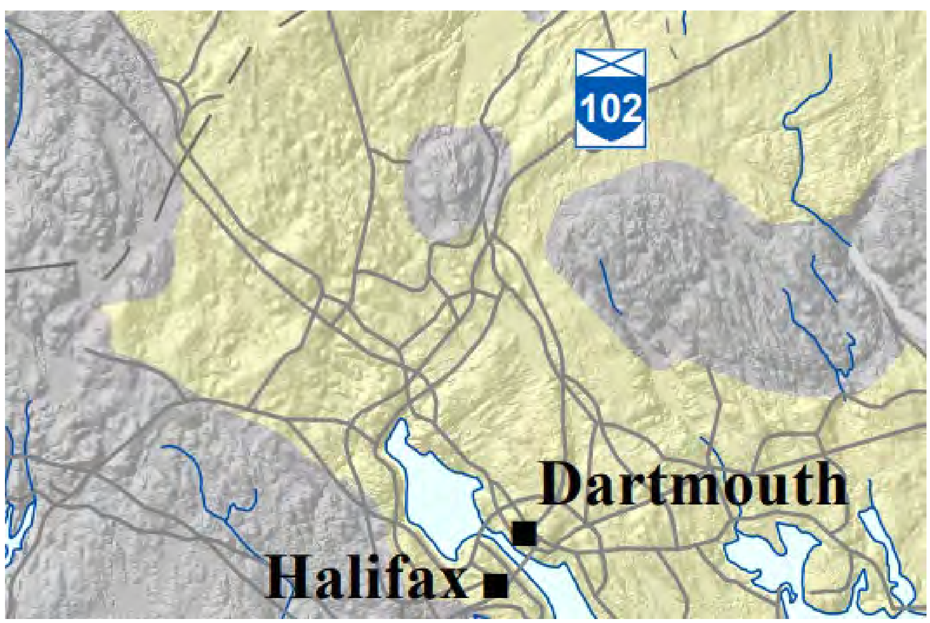

Figure 2.4 - Uranium and Radionuclide Potential for Development Area (NSDNRR)

Arsenic in groundwater is another naturally occurring problem in many parts of Nova Scotia. Fall River area is known to have some naturally occurring arsenic in the groundwater. A report from (Kennedy and Drage 2016) shows the percentage of samples that exceed the level of 10 ug/l of arsenic in the water which was the drinking water limit at the time. 27% of wells sampled in the Fall River area exceeded this level of arsenic as shown in Figure 2.5 below.

Figure 2.5 - Arsenic Risk in Groundwater for Fall River Area (Kennedy and Drage)

2.6 Precipitation

Rainfall information for the area was obtained from weather records kept by Environment Canada at the Halifax Citadel station. This station was chosen conservatively over the Halifax Stanfield International Airport which receives less rainfall but is closer. The total average rainfall per year is 1.47 meters or 1468 mm/year in this area as shown in Table 2.3 below. This information is required to calculate annual phosphorus load from surface water.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rainfall (mm)	96.7	75.1	101.3	111.3	118.4	111.8	110.3	96.4	108.9	124.1	143.6	115.9	1313.9
Snowfall (cm)	43.1	35	31.2	7	0.8	0	0	0	0	0.1	7.8	29.2	154.2
Precipitation (mm)	139.7	110.1	132.5	118.3	119.1	111.8	110.3	96.4	108.9	124.3	151.4	145.1	1468.1

Table 2.2 - Average Rainfall at Halifax Citadel (Environment Canada)

2.7 Stormwater Management

2.7.1 Methodology

The NSCS (USDA Natural Resources Conservation Service) TR-55 method is used to analyse pre and post condition stormwater runoff for the proposed development. This method is approved by Halifax Water and uses runoff curve numbers to predict direct runoff and infiltration from rainfall. See Drawings C102 and C103 in Appendix A for defined catchment areas and detailed runoff analysis. Autodesk's Storm and Sanitary Analysis software is used to aid in stormwater modelling for pre- and post-development conditions.

2.7.2 Design Storms

24-hour short duration rainfall intensity-duration-frequency data for Halifax Citadel for the required return periods are used in analysis and obtained from Environment Canada. Chicago storm distributions are used to closely match rainfall distributions in our area.

Figure 2.5 below shows the historical IDF curve for the Halifax Citadel station:

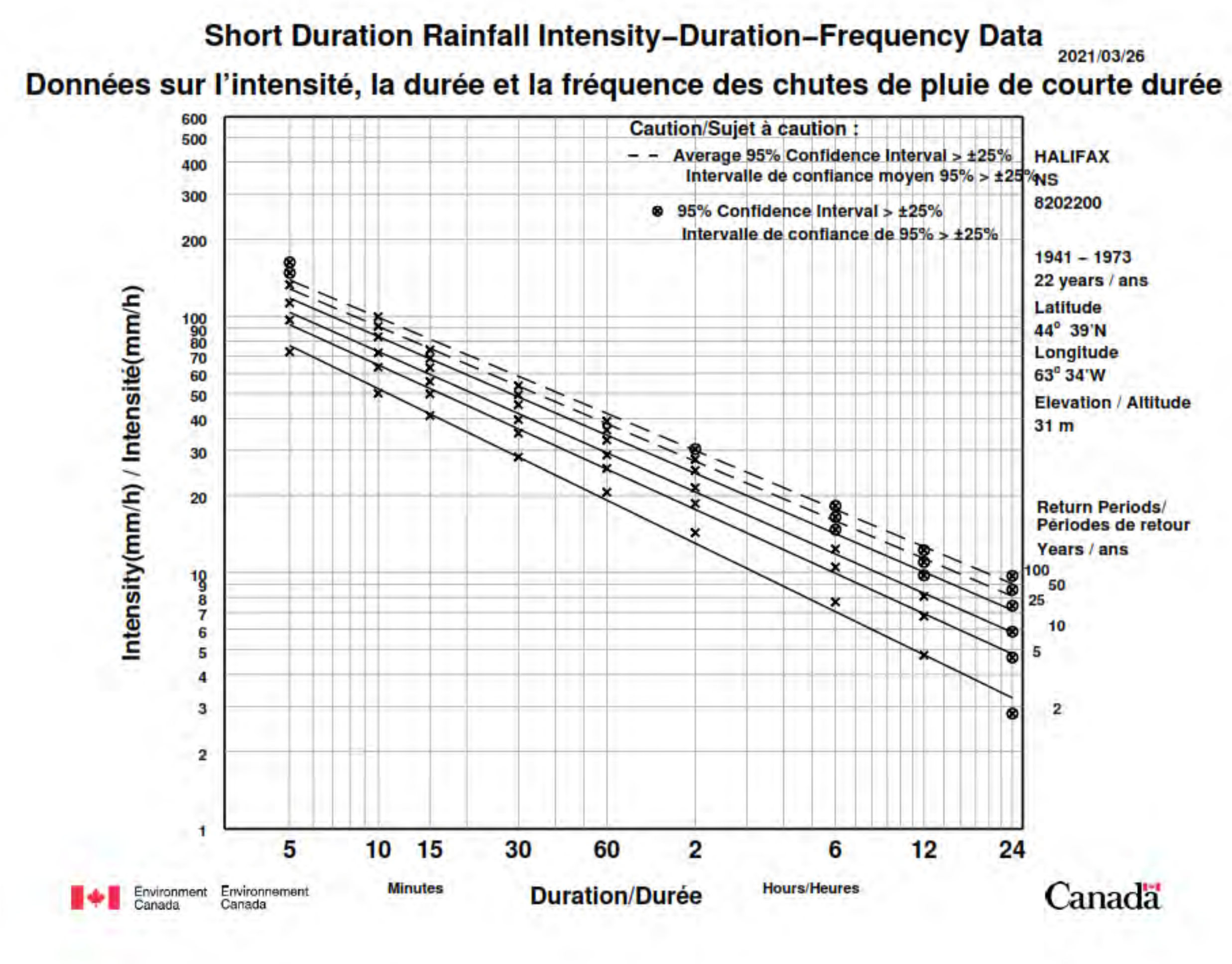

Figure 2.6 - Halifax Citadel IDF Curve (Environment Canada)

24-hour return period rainfall amounts used in calculations are as follows in Table 2.3:

Return Period (Years)	Rainfall (mm)
2	67.6
5	111.8
10	141.1
25	178.2
50	205.6
100	232.9

Table 2.3 - Halifax 24-Hour Return Period Rainfall Amounts (Environment Canada)

2.7.3 Existing Drainage Condition

Existing condition subbasin delineations are shown on Drawing C102 of Appendix C. Table 2.4 below summarizes these subbasin areas and the curve numbers used in TR-55 analysis. Our analysis considered three separate endpoints (outfalls) for surface water on the existing site: the wetland, the road at the low end of the development site, and the single-family residential homes to the south of the proposed site. Catchment runoff considered includes upstream areas as far as Oakes Road to the east. Water from these endpoints eventually ends up in Lake Thomas, whether through surface or groundwater flow.

ID	Description	Area (m^2)	Outfall	Weighted Curve Number
1	Ex Bldg	36	Road Outfall	98
2	Ex Bldg 2	154	Road Outfall	98
3	Ex DWY 1	523	Road Outfall	89
4	Ex DWY 2	447	Road Outfall	98
5	Ex Green Space 1	4032	Road Outfall	80
6	Ex Green Space 2	6870	Road Outfall	76
7	Ex Green Space 3	25807	Wetland	76
8	Ex Green Space 4	9861	Wetland	72
9	Ex Green Space 5	5299	Adjacent Lots	76
10	Ex Green Space 6	3123	Road Outfall	74
11	Ex Green Space 7	1841	Road Outfall	74
12	Ex House	365	Road Outfall	98

Table 2.4 - NSCS Subbasin Curve Numbers - Existing

2.7.4 Post-Development Drainage Condition

Post-condition drainage information can be found on drawing C103 of Appendix A. Although stormwater detention values required to match pre-condition flows are minimal (5.1M^3 for a 100-year storm), it is important that phosphorus-laden runoff be controlled and filtered. A stormwater detention pond will be installed at the low end of the site to collect and filter hard surface runoff. A filter berm will also be installed below the existing wetland to catch and treat runoff from above and reduce the intensity of stormwater runoff to lower properties. Post-condition subbasin areas and TR-55 curve numbers can be found in Table 2.5 below.

ID	Description	Area (m^2)	Outfall	Weighted Curve Number
1	Ex Green Space 1	3700	Road Outfall	80.00
2	Ex Green Space 2	6900	Road Outfall	76.00
3	Ex Green Space 3	25800	Wetland	76.00
4	Ex Green Space 4	9900	Wetland	72.00
5	Ex Green Space 5	5300	Adjacent Lots	76.00
6	Ex House	400	Road Outfall	98.00
7	Prop Bldg 3	200	Road Outfall	98.00
8	Prop Bldg 4	200	Road Outfall	98.00
9	Prop Bldg 5	200	Road Outfall	98.00
10	Prop Bldg 6	200	Road Outfall	98.00
11	Prop DWY 3	100	Road Outfall	96.00
12	Prop DWY 4	100	Road Outfall	96.00
13	Prop DWY 5	100	Road Outfall	96.00
14	Prop DWY 6	100	Road Outfall	96.00
15	Prop Green Space 2	1800	Road Outfall	74.00
16	Prop Green Space/Pond	2600	Road Outfall	74.00
17	Prop Road	700	Road Outfall	92.00

Table 2.5 - NSCS Subbasin Curve Numbers - Proposed

2.8 Vegetation

See drawing C100 Appendix A for proposed areas of disturbance. A significant portion of the site (59%) will remain undisturbed, and areas that are disturbed during construction must be revegetated with grass as soon as possible to reduce runoff and prevent soil erosion. The existing site imperviousness percentage is around 6% and the proposed development will increase this to approximately 11%.

2.9 Sensitive Natural Areas and Buffers

A wetland and watercourse delineation were completed on the proposed site by McCallum Environmental Limited in September of 2018. A 664m² non-contiguous wetland was identified and can be found in Appendix B. Intermittent drainage courses identified were not classified as watercourses. A berm will be installed along the lower side of the wetland as part of the development. The berm will collect and naturally filter phosphorus surface water from lands to the east; some of which runs off to residential properties in current state. This will help the site phosphorus balance. 20m wetland buffers will be respected throughout site development in accordance with the land use bylaw, further enhancing phosphorus retention and uptake by plants.

As shown on C100 in Appendix A, the total site disturbance will remain under the 50% limit defined in HRM RL-23 of the River-Lakes Planning Strategy.

2.10 Water Service

Water services to the proposed townhouses will be provided from the newly installed 300mm watermain which runs along the West side of Highway 2. Servicing will be provided by one single service main as there is no intention for future subdivision of individual units.

2.11 Sewer Service

Municipal sewer is not available in the area; therefore, an onsite septic system must be installed to treat wastewater from the new development. Wastewater can be a significant contributor to site phosphorus load and must be managed diligently to achieve net-zero phosphorus for the project.

2.11.1 Flow Estimates

Estimated average sewage flows for the proposed 12-unit, 30-bedroom development would be 11,400 litres per day according to the 380 litres per person, per day, of the 2022 revision of the Atlantic Wastewater Guidelines.

Applying a Harmon peaking factor of 4.35 gives peak flows of 0.58 litres per second.

$$Q_p = \quad MQ_A$$

$$M = 1 + \frac{14}{4 + P^{0.5}}$$

$$P = 30\,people = \frac{30}{1{,}000} = \; 0.03$$

$$Q_A = A * p = 380L/day\ (30) \ = 11{,}400\ L/day$$

$$M = 1 + \frac{14}{4 + (0.03)^{0.5}} = 4.35$$

$$\boldsymbol{Q_p = \ \ MQ_A = (4.35)(11,400)}$$

$$\boldsymbol{Q_p = 49,590 \frac{L}{day} = 0.58L/sec}$$

2.11.2 Primary Treatment

A schematic of the proposed sewage collection and treatment arrangement can be found on C100 of Appendix A. Primary sewage treatment will occur through a series of septic tanks and aeration tanks. 1,000gal precast septic tanks will be placed at the townhouse units where one tank will serve two units. Waterloo EC-P units will be installed in the holding tanks for phosphorus removal. Effluent will then flow by gravity to a secondary, 2,500gal septic tank where further treatment and collection of solids will occur. A third aeration tank will contain a submersible aerator and effluent filter, flowing to a 2,500gal recirculation tank which will house duplex pumps to dose the proposed Waterloo Biofilters during secondary treatment.

2.11.3 Secondary Treatment

A modular filtration system from Waterloo Biofilters, designed for 20,000 litres per day, will be implemented after the recirculation tank in the treatment chain. Wastewater is distributed over a foam-like filter media where contaminants are removed. Treated water then flows to a splitter tee, where 50% of the treated water is sent to the treatment field, and 50% is returned to the 2,500gal secondary tank to encourage further phosphorus removal.

2.11.4 Tertiary Treatment

Treatment effluent will be pumped uphill to a disposal at the top of the site for tertiary treatment. A modified “gravel trench drain field” disposal bed was proven by the University of Florida. The typical drain field configuration will be widened to include 5m of sand filtration, further compensating for semi-permeable soils. A significant undisturbed buffer will be maintained between the septic field and downstream residential properties as an added phosphorus buffer. Due to the low permeability of soils found in test pits, the loading rate will be kept under 100 litres per meter in accordance with NS on-site sewage standards.

2.12 Setbacks from On-Site Septic Systems

The onsite sewage disposal trenches for the treated effluent from the biofilters will be a minimum of 31 meters from any wetland or watercourse. A tree buffer will be maintained downslope of the disposal trenches wherever possible. Setbacks for level and uphill property lines will be at least 3 meters and downslope boundaries will be at a minimum distance of 10 meters. 15 meters will be maintained from the residential drilled well at civic 3134 and the assumed location of the well south of the wetland. It should be noted that ABLE was unable to locate this well during site investigation. The location of this well should be confirmed (if possible) during construction and sealed with bentonite clay to reduce the chance of future groundwater contamination as the casing deteriorates.

3 Phosphorus Loading Calculations

The amount of phosphorus is calculated using the Model from Minnesota which is used on small properties of less than 640 acres. The model is included in Appendix D of this report.

3.1 Pre-Development

3.1.1 Surface Water Contribution

The following formula calculates the annual phosphorus load from rainfall for the site prior to development:

$$L_{pre} = 0.20PR_vCA$$

Where:

L_{pre} = Average annual load of total phosphorus exported from site (lb/year)

P = Rainfall depth over the desired time period (inches) = 58in

R_v = Runoff coefficient which expresses the fraction of rainfall converted to runoff:

$$R_v = 0.05 + 0.009I_{pre}$$

I_{pre} = Pre-development site imperviousness (%) = 6.39

$$R_v = 0.05 + 0.009(6.39) = 0.11$$

C = Flow-weighted mean concentration of the pollutant (0.30mg/L) = 0.30mg/L

A = Area of the development site (acres) = 6.35acre

$$L_{pre}(Rainfall) = 0.20(58)(0.11)(0.30)(6.35) = \boldsymbol{2.43lb/year}$$

3.1.2 On-Site Sewage Contribution

Onsite sewage systems can also contribute a significant amount of phosphorus to the environment. With an onsite septic system, much of the phosphorus is removed in the septic tank (20-50%) however after this the remainder goes out into the environment where we distribute it in infiltration trenches. The solids in the septic tank are pumped out every 2-3 years, removing this portion of the phosphorus. Effluent from the septic tanks still contains approximately 8.6 mg/l of Total Phosphorus and 6.0 mg/l of Soluble phosphorus that needs to be removed. (Reference: **Domestic Wastewater Phosphorus Concentration Report** Phosphorus Concentration of Residential Clarified Effluent by the **State of Idaho Department of Environmental Quality, August 2012**). Other studies show higher levels of phosphorus of over 18-20+ mg/l from septic tanks where they were using their trademarked electrochemical technology to remove it. **Economical and effective phosphorus removal for septic systems** by **Craig Jowett, Yanqing Xu, Christopher James, Glenn Pembleton & Christopher Jowett.**

To calculate the phosphorus loading rates I have selected a value of 14.2 mg/L, in between these, which should provide a safety factor from the lower number found in the more widespread Idaho study and the higher number done in systems by Craig Jowett and others.

There are two on-site sewage systems on the pre-development site. It is conservatively assumed that wastewater from the residential dwelling corresponds with that of a five-bedroom home at 1,700 litres per day, and that flows from the commercial building are typical of a 20-employee commercial establishment at 1,000 litres per day. Assumed flows are consistent with the Atlantic Wastewater Guidelines. Standard on-site sewage disposal beds, likely to be sloping sand filters in this case, can remove 23-99% of phosphorus from wastewater. We will assume that 60% is removed from existing systems for the purpose of this report.

Therefore:

$$L_{pre}(Septic) = (0.4)(14.2x10^{-6}kg/L)(1{,}000L/day + 1{,}700L/day)(2.205lb/kg)(365day/year)$$
$$= \mathbf{12.34 lb/year}$$

3.2 Post-Development

3.2.1 Surface Water Contribution

Similar to pre-condition rainfall calculations, for post-development:

$$L_{post} = 0.20PR_vCA$$

Where:

L_{post} = Average annual load of total phosphorus exported from developed site (lb/year)

P = 54.97in

$$R_v = 0.05 + 0.009I_{post}$$

I_{post} = 11%

$$R_v = 0.05 + 0.009(11) = 0.15$$

C = 0.30mg/L

$A = 6.35$ acre

$$L_{post}(Rainfall) = 0.20(58)(0.15)(0.30)(6.35) = \mathbf{3.32lb/year}$$

3.2.2 Onsite Sewage Contributions

At 380 litres per person, per day, the 30 bedrooms proposed as new development will produce approximately 11,400 litres of wastewater daily. Adding a factor of safety for municipal water and multiple units, this wastewater flow will be analysed as 12,000 litres per day. Using the 14.2mg/L phosphorus loading rate above to calculate the untreated phosphorus load:

$$L_{post}(Septic) = (14.2x10^{-6}kg/L)(12{,}000L/day)(2.205lb/kg)(365day/year) = \mathbf{137.15lb/year}$$

Technology such as Waterloo Biofilters EC-P (Electrochemical Phosphorus removal technology) will remove 95% of the phosphorus from the wastewater. See brochure by Waterloo Biofilter on Phosphorus removal system in Appendix D.

This technology will be used to reduce the phosphorus load above to a more manageable level in the disposal bed. 0.05 x 137.15 = 6.86 lb/year.

Onsite sewage disposal beds remove from 23% - 99% of the phosphorus. The wide range of variability is due to different conditions and soil characteristics, pH, iron content of soils, CaCo3 content found in onsite system. Saturated flow conditions will result in removals towards the lower range; therefore, we have selected a trench design that will spread the effluent out over a greater distance to lower the loading rate per meter. The design of the trench has been modified from what is normally utilized under the Provincial On-site Sewage Disposal System Technical Guidelines based on a design that was tested by the University of Florida and found to remove greater than 97% of the phosphorus.

(Reference: **Septic Systems Contribution to Phosphorus in Shallow Groundwater: Field-Scale Studies Using Conventional Drainfield Designs Sara Mechtensimer, Gurpal S. Toor**).

This bed is constructed with only 6” of cover over the drainpipe which are underlain by 12” of clean stone and this is underlain by 12” of clean fast draining sand. See the cross-section of the selected trench below in Figure 3.1.

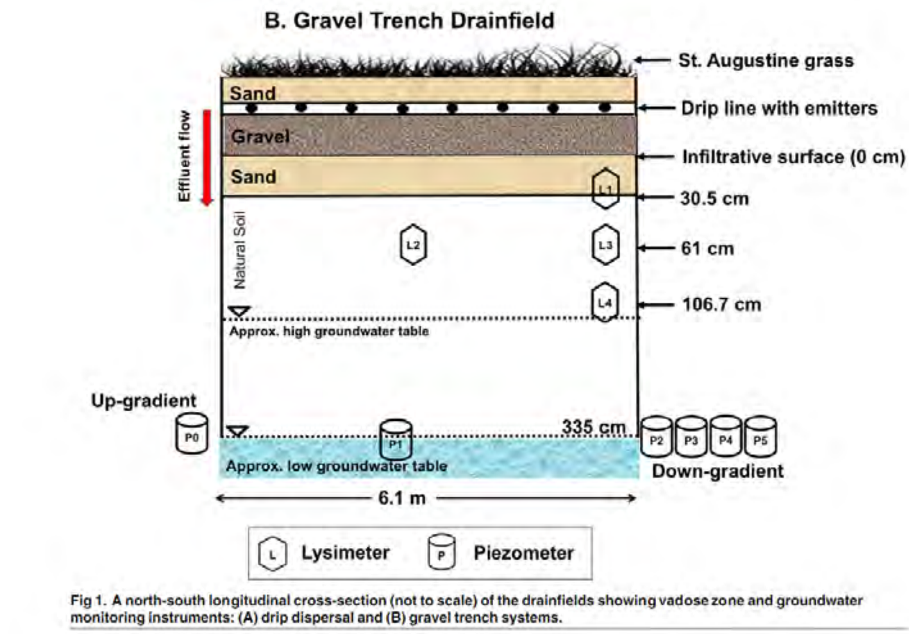

Figure 3.1 - Gravel Trench Drainfield (University of Florida)

Considering 97% phosphorus removal in the disposal bed, the final remaining phosphorus load is as follows: 0.03 x 6.86lb/year = 0.21lb/year. The existing residential on-site septic system is to remain, therefore:

$$L_{post}(Septic) = (0.4)(14.2x10^{-6}kg/L)(1{,}700L/day)(2.205lb/kg)(365day/year) + 0.21lb/year$$
$$= \mathbf{7.98lb/year}$$

3.3 Post-Development Removal Requirements

Table 3.1 below summarizes pre-construction and post-construction phosphorus loading calculations:

Pre-Condition		Post-Condition	
Rainfall	2.43 lb/year	Rainfall	3.32 lb/year
Wastewater	12.34 lb/year	Wastewater	7.98 lb/year
Total	**14.77 lb/year**	**Total**	**11.30 lb/year**

Table 3.1 - Pre-Condition and Post-Condition Phosphorus Loads

As seen above, by decommissioning the existing commercial on-site septic system, phosphorus loading is theoretically less than the pre-development state. This is not, however, adequate to achieve net-zero phosphorus from the site.

Proposed hard surface is primarily being added on the existing commercial lot, just upslope of Highway 2 where the storm system discharges directly to Lake Thomas. It is important that site runoff is proactively managed and filtered prior to this direct discharge. Disturbed area for septic disposal beds may also add to runoff flows to existing residential properties. It is important that controls still be put in place to manage any phosphorus from future activity on the property.

3.4 Planned Phosphorus Mitigation Measures

A proposed site plan outlining future control measures can be found on C100 in Appendix A. A bioswale and bioretention pond (with filter berm) will be designed to filter any phosphorus from hard surfaces added as part of the proposed development. The assumed removal efficiencies of the bioswale and bioretention pond are assumed to be 40 and 50%, respectively. The quantity of phosphorus being managed on this site is the equivalent of a small bag of fertilizer. A strict phosphorus control program for the development must be put in place and adhered to by future owners and operators of the development. Figure 3.2 below from the University of Minnesota outlines some best practices that should be followed. It is recommended that phosphorus mitigation policies be implemented in lease agreements and/or condo policies as applicable.

Residential pollution prevention methods effective for controlling or reducing phosphorus.
Link to this **table**

Practice	Relative effectiveness	Method	Image[1]
Fertilizer and pesticide management	High	Reduce or eliminate the need for fertilizer and pesticides by practicing natural lawn care, planting native vegetation, and limiting chemical use; follow Minnesota Statutes Chapter 18C and federal regulatory requirements on fertilizer and pesticide storage and application if used.	
Litter and animal waste control	High	Properly dispose of pet waste and litter in a timely manner and according to local ordinance requirements.	
Yard Waste Management	High	Prevent yard waste from entering storm sewer systems and water bodies by either composting or using curbside pickup services and avoiding accumulation of yard waste on impervious surfaces; keep grass clippings and leaves out of the street.	
Better Car and Equipment Washing	Moderate	Wash cars less often and on grassy areas using phosphorus free detergents and non-toxic cleaning products or use commercial car washes to prevent dirty wash water from flowing to storm sewer systems and water bodies.	
Septic tank maintenance	High		
Native Landscaping	High	Reduce turf areas by planting native species to reduce and filter pollutant-laden runoff and prevent the spread of invasive, non-native plant species into the storm sewer system.	
Better Sidewalk and Driveway Deicing	Moderate	Reduce or eliminate the need for deicing products by manually clearing sidewalks and driveways prior to deicer use; use environmentally-friendly deicing products when possible, apply sparingly and store properly if used.	
Exposed Soil Repair	High	Use native vegetation or grass to cover and stabilize exposed soil on lawns to prevent sediment wash off.	
Healthy Lawns	Moderate	Maintain thick grass planted in organic-rich soil to a height of at least 3 inches to prevent soil erosion, filter stormwater contaminants, and absorb airborne pollutants; limit or eliminate chemical use and water and repair lawn as needed	

Figure 3.2 - Phosphorus Pollution Prevention Methods (University of Minnesota)

4 Summary and Conclusions

The no net phosphorus contribution to nearby lakes and streams leading to the Shubenacadie River System will require some extensive planning and sitework around the proposed facilities and a specially designed onsite sewage disposal system to meet this stringent requirement as shown above. Plans have been prepared by ABLE Engineering Services Inc. for how this should be achieved. Once the site has been developed, long-term best management practices for residents and owners, such as those outlined above, must be diligently followed.

Providing that plans and recommendations in this report are followed by present developers, future tenants and future owners, no net phosphorus load will be added to the lake district by this development.

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Josh Porter, P.Eng.,

Civil Engineer

5 References

Mapping by Property Online Nova Scotia.

Surficial Geology, Bedrock Geology, and Soils Mapping from Nova Scotia Dept of Natural Resources

Soils Mapping from Agriculture Canada online at http://sis.agr.gc.ca/cansis/publications/ns/index.html

Mapping of wetlands(Wet Areas Mapping) by Nova Scotia Department of Natural Resources http://www.gov.ns.ca/natr/forestry/gis/wamdownload.asp

Nova Scotia Department of Natural Resources Radon Risk Mapping.

GeoNova Nova Scotia Data Mapping for Well Logs, Uranium in Groundwater, Arsenic in Groundwater https://geonova.novascotia.ca/base-mapping

Environment Canada Weather Records for Halifax Stanfield International Airport.

Septic Systems Contribution to Phosphorus in Shallow Groundwater: Field-Scale Studies Using Conventional Drainfield Designs Sara Mechtensimer, Gurpal S. Toor.

Waterloo Biofilter systems Phosphorus Removal technology available at https://waterloo-biofilter.com/wp-content/uploads/2017/05/PhosphorousRemovalBrochure.pdf

The simple model for estimating Phosphorus Export from Minnesota Storm Water Manual available at https://stormwater.pca.state.mn.us/index.php/The_Simple_Method_for_estimating_phosphorus_export

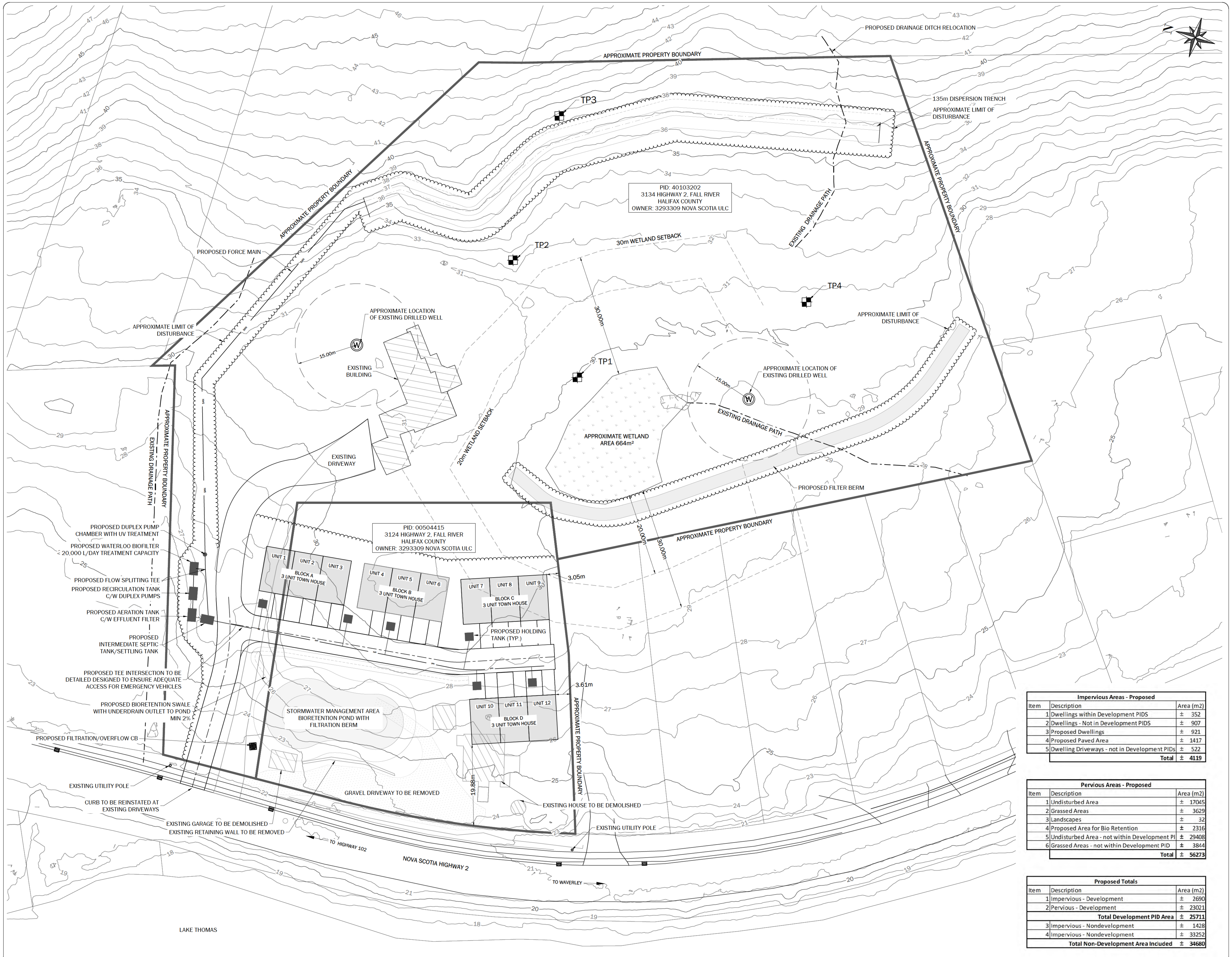
Domestic Wastewater Phosphorus Concentration Report Phosphorus Concentration of Residential Clarified Effluent by the State of Idaho Department of Environmental Quality, August 2012)

Economical and effective phosphorus removal for septic systems By Craig Jowett, Yanqing Xu, Christopher James, Glenn Pembleton & Christopher Jowett 2014

Onsite Sewage disposal System Technical Guidelines, Nova Scotia, April 2013

Septic Systems Contribution to Phosphorus in Shallow Groundwater: Field-Scale Studies Using Conventional Drainfield Designs Sara Mechtensimer, Gurpal S. Toor.

Appendix A

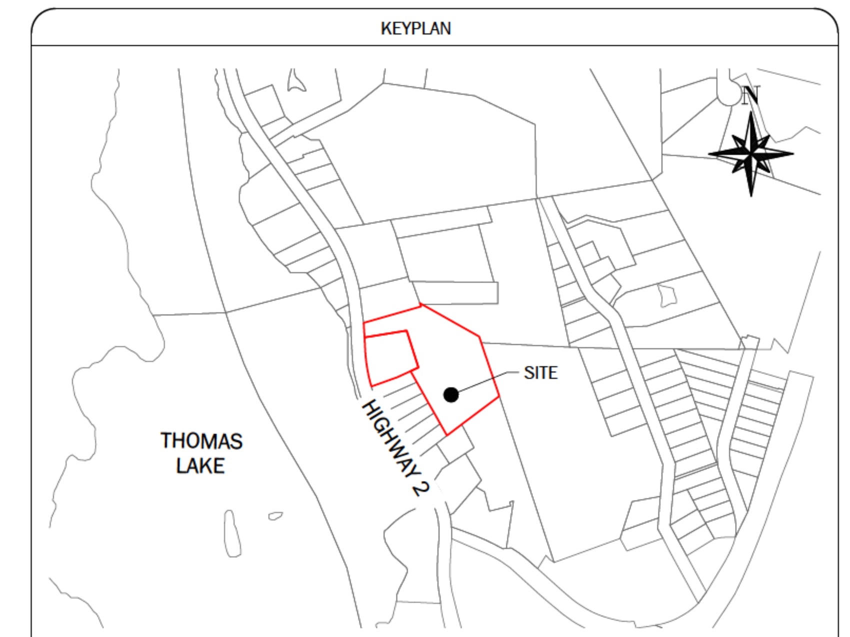


Impervious Areas - Proposed		
Item	Description	Area (m2)
1	Dwellings within Development PIDS	± 352
2	Dwellings - Not in Development PIDS	± 907
3	Proposed Dwellings	± 921
4	Proposed Paved Area	± 1417
5	Dwelling Driveways - not in Development PIDs	± 522
	Total	**± 4119**

Pervious Areas - Proposed		
Item	Description	Area (m2)
1	Undisturbed Area	± 17045
2	Grassed Areas	± 3629
3	Landscapes	± 32
4	Proposed Area for Bio Retention	± 2316
5	Undisturbed Area - not within Development PI	± 29408
6	Grassed Areas - not within Development PID	± 3844
	Total	**± 56273**

Proposed Totals		
Item	Description	Area (m2)
1	Impervious - Development	± 2690
2	Pervious - Development	± 23021
	Total Development PID Area	**± 25711**
3	Impervious - Nondevelopment	± 1428
4	Impervious - Nondevelopment	± 33252
	Total Non-Development Area Included	**± 34680**

KEYPLAN



GENERAL NOTES

1. THIS IS NOT A LEGAL BOUNDARY SURVEY. BOUNDARIES SHOWN HERE ARE APPROXIMATE, DERIVED FROM PROPERTY ONLINE MAPPING/PLAN OF SURVEY AND FIELD RECONNAISSANCE BY CIVIL ENGINEERING TECHNICIAN. BOUNDARIES ARE SUBJECT TO A LEGAL FIELD SURVEY BY A LICENSED NSLS, AND A LEGAL SURVEY MAY CAUSE OFFSETS AND BOUNDARIES TO DIFFER FROM WHAT IS SHOWN HEREIN.
2. ALL MEASUREMENTS SHOWN ARE IN METRIC UNITS OF METERS.
3. EXISTING CONTOURS ARE BASED ON 2019 LIDAR DATA WITH AN INTERVAL OF 1m & 5m.

DISTURBED AREA = 41% - 10558m²

UNDISTURBED AREA = 59% - 15139.54m²

TOTAL SITE AREA = 25697.54m²

LID BMP - PROPOSED			
ITEM	TYPE	AREA (m²)	VOLUME (m³)
BS-1	BIOSWALE	105	25
EDWP-1	EXTENDED DETENTION WET POND	440	220
SF-1	SAND FILTER BERM	765	765

PRELIMINARY
NOT FOR CONSTRUCTION

No.	MM/DD/YYYY	Revision Description	By
1	02/27/2023	ISSUED FOR REVIEW	AC

Seal

[redacted] 12012 [redacted]

ABLE Engineering Services Inc.
CHESTER KENTVILLE TANTALLON
NOVA SCOTIA, CANADA
1-833-756-8433 info@ableinc.ca

SCALE: 1:400
0m 10m 20m 30m 40m 50m

Horizontal	Vertical	Plot
1:400	N/A	ARCH D (24"x36")

Project

THE TOWNHOMES OF LAKE THOMAS

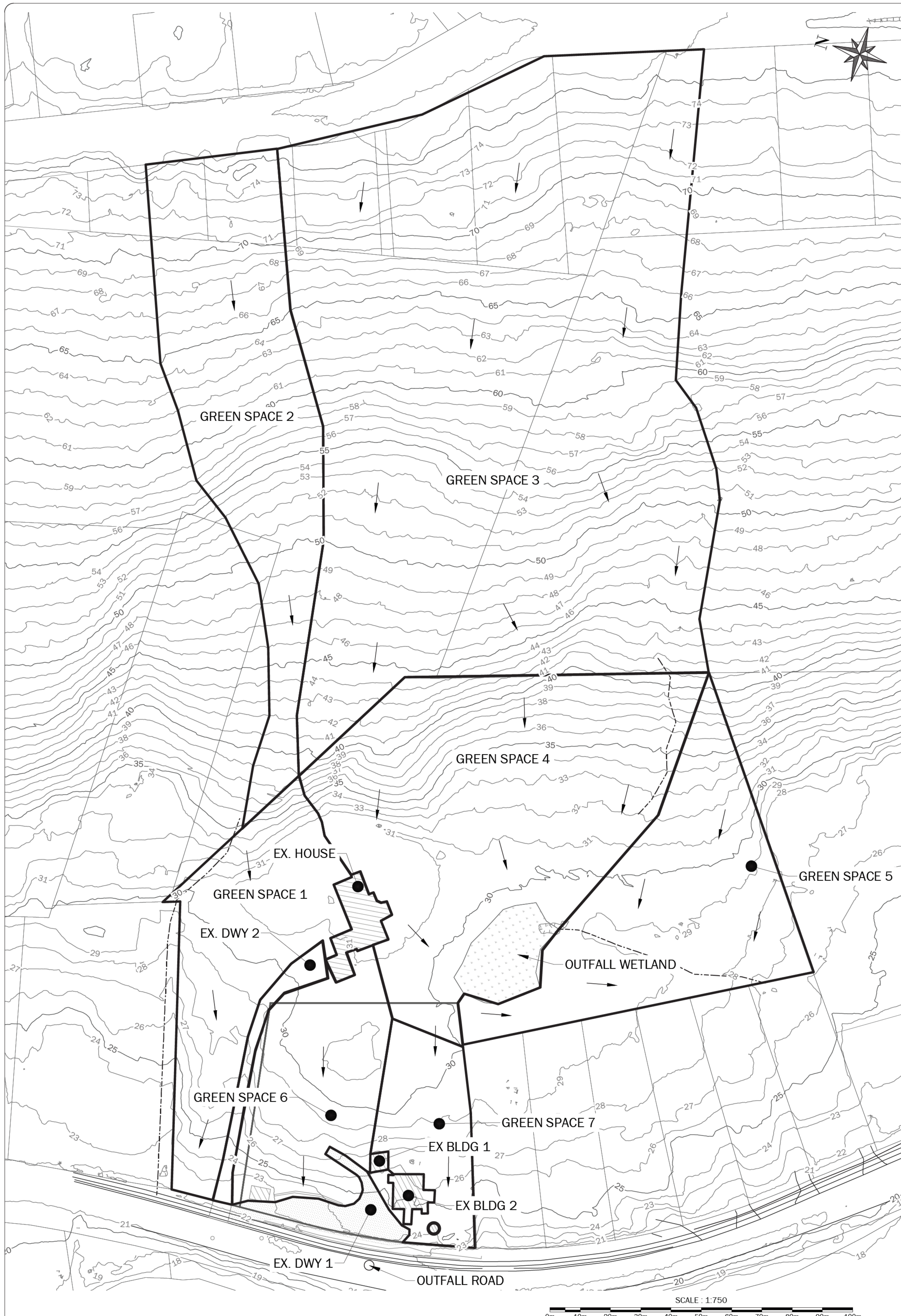
3124 AND 3134 HIGHWAY 2, FALL RIVER
NOVA SCOTIA

Title

CONCEPT PLAN

Project No. 210919-50	Drawn A. COLLICUTT	Sheet 1 of 4
Ref.	Engineer J. PORTER	Plan No. C100
Date JANUARY 10, 2022	Check M.VISENTIN	

SHEET PRODUCED 3/2/2023 10:39 AM LAST SAVED BY J.PORTER



Existing 5 Year Storm Event

SN	Element ID	Area (ha)	Drainage Node ID	Weighted Curve Number	Rain Gage ID	Peak Rate Factor	Total Precipitation (mm)	Total Runoff (mm)	Peak Runoff (lps)	Time of Concentration (days hh:mm:ss)
1	Ex Bldg	0.00	Road Outfall	98.00	5 Year	484	111.15	73.81	0.28	0 00:05:00
2	Ex Bldg 2	0.02	Road Outfall	98.00	5 Year	484	111.15	104.65	1.98	0 00:05:00
3	Ex DWY 1	0.05	Road Outfall	89.00	5 Year	484	111.15	80.62	5.66	0 00:05:00
4	Ex DWY 2	0.04	Road Outfall	98.00	5 Year	484	111.15	105.11	5.66	0 00:05:00
5	Ex Green Space 1	0.40	Road Outfall	80.00	5 Year	484	111.15	59.84	30.58	0 00:15:26
6	Ex Green Space 2	0.69	Road Outfall	76.00	5 Year	484	111.15	51.59	43.61	0 00:18:49
7	Ex Green Space 3	2.58	Wetland	76.00	5 Year	484	111.15	51.59	164.24	0 00:18:42
8	Ex Green Space 4	0.99	Wetland	72.00	5 Year	484	111.15	43.92	52.95	0 00:16:57
9	Ex Green Space 5	0.53	Adjacent Lots	76.00	5 Year	484	111.15	51.59	33.98	0 00:16:45
10	Ex Green Space 6	0.31	Road Outfall	74.00	5 Year	484	111.15	47.68	18.41	0 00:17:10
11	Ex Green Space 7	0.18	Road Outfall	74.00	5 Year	484	111.15	47.68	10.76	0 00:16:38
12	Ex House	0.04	Road Outfall	98.00	5 Year	484	111.15	105.08	4.81	0 00:05:00

Existing 10 Year Storm Event

SN	Element ID	Area (ha)	Drainage Node ID	Weighted Curve Number	Rain Gage ID	Peak Rate Factor	Total Precipitation (mm)	Total Runoff (mm)	Peak Runoff (lps)	Time of Concentration (days hh:mm:ss)
1	Ex Bldg	0.00	Road Outfall	98.00	10 Year	484	140.28	101.63	0.28	0 00:05:00
2	Ex Bldg 2	0.02	Road Outfall	98.00	10 Year	484	140.28	133.91	2.55	0 00:05:00
3	Ex DWY 1	0.05	Road Outfall	89.00	10 Year	484	140.28	108.46	7.36	0 00:05:00
4	Ex DWY 2	0.04	Road Outfall	98.00	10 Year	484	140.28	134.19	7.08	0 00:05:00
5	Ex Green Space 1	0.40	Road Outfall	80.00	10 Year	484	140.28	85.17	43.89	0 00:15:26
6	Ex Green Space 2	0.69	Road Outfall	76.00	10 Year	484	140.28	75.49	64.56	0 00:18:49
7	Ex Green Space 3	2.58	Wetland	76.00	10 Year	484	140.28	75.49	242.96	0 00:18:42
8	Ex Green Space 4	0.99	Wetland	72.00	10 Year	484	140.28	66.24	81.27	0 00:16:57
9	Ex Green Space 5	0.53	Adjacent Lots	76.00	10 Year	484	140.28	75.49	50.40	0 00:16:45
10	Ex Green Space 6	0.31	Road Outfall	74.00	10 Year	484	140.28	70.82	27.75	0 00:17:10
11	Ex Green Space 7	0.18	Road Outfall	74.00	10 Year	484	140.28	70.79	16.42	0 00:16:38
12	Ex House	0.04	Road Outfall	98.00	10 Year	484	140.28	134.19	5.95	0 00:05:00

Existing 25 Year Storm Event

SN	Element ID	Area (ha)	Drainage Node ID	Weighted Curve Number	Rain Gage ID	Peak Rate Factor	Total Precipitation (mm)	Total Runoff (mm)	Peak Runoff (lps)	Time of Concentration (days hh:mm:ss)
1	Ex Bldg	0.00	Road Outfall	98.00	25 Year	484	177.16	135.61	0.57	0 00:05:00
2	Ex Bldg 2	0.02	Road Outfall	98.00	25 Year	484	177.16	170.87	3.12	0 00:05:00
3	Ex DWY 1	0.05	Road Outfall	89.00	25 Year	484	177.16	144.30	9.91	0 00:05:00
4	Ex DWY 2	0.04	Road Outfall	98.00	25 Year	484	177.16	171.04	9.06	0 00:05:00
5	Ex Green Space 1	0.40	Road Outfall	80.00	25 Year	484	177.16	118.64	60.88	0 00:15:26
6	Ex Green Space 2	0.69	Road Outfall	76.00	25 Year	484	177.16	107.57	92.60	0 00:18:49
7	Ex Green Space 3	2.58	Wetland	76.00	25 Year	484	177.16	107.57	347.73	0 00:18:42
8	Ex Green Space 4	0.99	Wetland	72.00	25 Year	484	177.16	96.70	120.06	0 00:16:57
9	Ex Green Space 5	0.53	Adjacent Lots	76.00	25 Year	484	177.16	107.57	72.21	0 00:16:45
10	Ex Green Space 6	0.31	Road Outfall	74.00	25 Year	484	177.16	102.11	40.21	0 00:17:10
11	Ex Green Space 7	0.18	Road Outfall	74.00	25 Year	484	177.16	102.11	23.79	0 00:16:38
12	Ex House	0.04	Road Outfall	98.00	25 Year	484	177.16	171.04	7.65	0 00:05:00

Existing 50 Year Storm Event

SN	Element ID	Area (ha)	Drainage Node ID	Weighted Curve Number	Rain Gage ID	Peak Rate Factor	Total Precipitation (mm)	Total Runoff (mm)	Peak Runoff (lps)	Time of Concentration (days hh:mm:ss)
1	Ex Bldg	0.00	Road Outfall	98.00	50 Year	484	204.70	167.08	0.57	0 00:05:00
2	Ex Bldg 2	0.02	Road Outfall	98.00	50 Year	484	204.70	198.43	3.68	0 00:05:00
3	Ex DWY 1	0.05	Road Outfall	89.00	50 Year	484	204.70	171.27	11.61	0 00:05:00
4	Ex DWY 2	0.04	Road Outfall	98.00	50 Year	484	204.70	198.58	10.48	0 00:05:00
5	Ex Green Space 1	0.40	Road Outfall	80.00	50 Year	484	204.70	144.27	73.91	0 00:15:26
6	Ex Green Space 2	0.69	Road Outfall	76.00	50 Year	484	204.70	132.36	113.83	0 00:18:49
7	Ex Green Space 3	2.58	Wetland	76.00	50 Year	484	204.70	132.36	428.15	0 00:18:42
8	Ex Green Space 4	0.99	Wetland	72.00	50 Year	484	204.70	120.55	150.08	0 00:16:57
9	Ex Green Space 5	0.53	Adjacent Lots	76.00	50 Year	484	204.70	132.36	88.92	0 00:16:45
10	Ex Green Space 6	0.31	Road Outfall	74.00	50 Year	484	204.70	126.44	50.12	0 00:17:10
11	Ex Green Space 7	0.18	Road Outfall	74.00	50 Year	484	204.70	126.44	29.45	0 00:16:38
12	Ex House	0.04	Road Outfall	98.00	50 Year	484	204.70	198.58	8.78	0 00:05:00

Existing 100 Year Storm Event

SN	Element ID	Area (ha)	Drainage Node ID	Weighted Curve Number	Rain Gage ID	Peak Rate Factor	Total Precipitation (mm)	Total Runoff (mm)	Peak Runoff (lps)	Time of Concentration (days hh:mm:ss)
1	Ex Bldg	0.00	Road Outfall	98.00	100 Year	484	231.54	197.41	0.57	0 00:05:00
2	Ex Bldg 2	0.02	Road Outfall	98.00	100 Year	484	231.54	225.30	4.25	0 00:05:00
3	Ex DWY 1	0.05	Road Outfall	89.00	100 Year	484	231.54	197.66	13.31	0 00:05:00
4	Ex DWY 2	0.04	Road Outfall	98.00	100 Year	484	231.54	225.40	11.89	0 00:05:00
5	Ex Green Space 1	0.40	Road Outfall	80.00	100 Year	484	231.54	169.62	86.65	0 00:15:26
6	Ex Green Space 2	0.69	Road Outfall	76.00	100 Year	484	231.54	157.05	134.79	0 00:18:49
7	Ex Green Space 3	2.58	Wetland	76.00	100 Year	484	231.54	157.05	507.44	0 00:18:42
8	Ex Green Space 4	0.99	Wetland	72.00	100 Year	484	231.54	144.42	180.10	0 00:16:57
9	Ex Green Space 5	0.53	Adjacent Lots	76.00	100 Year	484	231.54	157.05	105.34	0 00:16:45
10	Ex Green Space 6	0.31	Road Outfall	74.00	100 Year	484	231.54	150.72	59.75	0 00:17:10
11	Ex Green Space 7	0.18	Road Outfall	74.00	100 Year	484	231.54	150.72	35.11	0 00:16:38
12	Ex House	0.04	Road Outfall	98.00	100 Year	484	231.54	225.40	9.91	0 00:05:00

Impervious Areas - Existing

Item	Description		Area
1	Dwellings within Development PIDS	±	528
2	Dwellings - Not in Development PIDS	±	907
3	Gravel Areas (Within Development)	±	629
4	Paved Areas (Within Development)	±	471
5	Dwelling Driveways - not in Development PIDs	±	522
	Total	±	**3057**

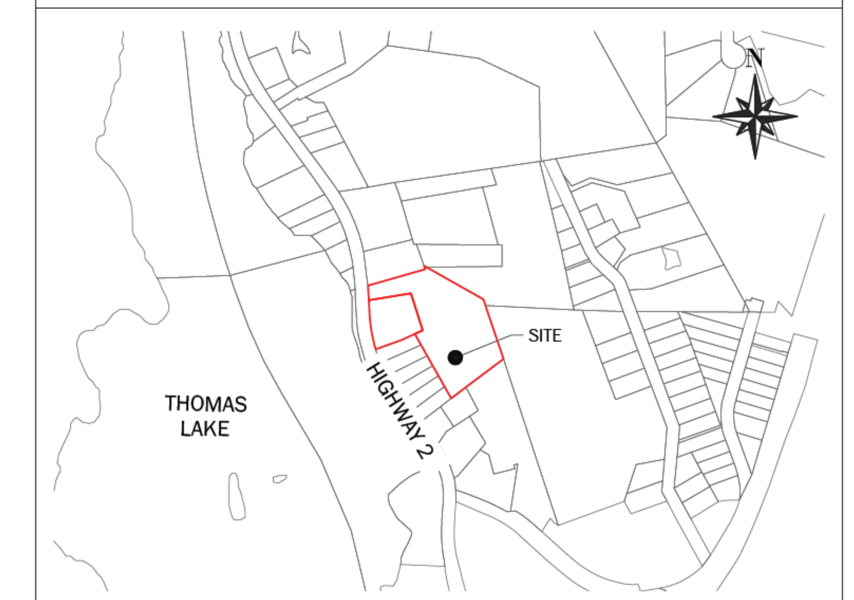
Pervious Areas - Existing

Item	Description		Area
1	Undisturbed Area	±	19563
2	Grassed Areas	±	4488
3	Landscapes	±	32
4	Undisturbed Area - not within Development PI	±	27351
5	Grassed Areas - not within Development PID	±	3865
	Total	±	**55298**

Existing Totals

Item	Description		Area
1	Impervious - Development	±	1629
2	Pervious - Development	±	24083
	Total Development PID Area	±	**25711**
3	Impervious - Nondevelopment	±	1428
4	Impervious - Nondevelopment	±	31216
	Total Non-Development Area Included	±	**32644**

KEYPLAN



GENERAL NOTES

1. THIS IS NOT A LEGAL BOUNDARY SURVEY. BOUNDARIES SHOWN HERE ARE APPROXIMATE, DERIVED FROM PROPERTY ONLINE MAPPING/PLAN OF SURVEY AND FIELD RECONNAISSANCE BY CIVIL ENGINEERING TECHNICIAN. BOUNDARIES ARE SUBJECT TO A LEGAL FIELD SURVEY BY A LICENSED NSLS, AND A LEGAL SURVEY MAY CAUSE OFFSETS AND BOUNDARIES TO DIFFER FROM WHAT IS SHOWN HEREIN.
2. ALL MEASUREMENTS SHOWN ARE IN METRIC UNITS OF METERS.
3. EXISTING CONTOURS ARE BASED ON 2019 LIDAR DATA WITH AN INTERVAL OF 1m & 5m.

PRELIMINARY
NOT FOR CONSTRUCTION

No.	MM/DD/YYYY	Revision Description	By
1	02/27/2023	ISSUED FOR REVIEW	AC

Seal

REGISTERED PROFESSIONAL ENGINEER
DATE 03/02/2023
[redacted]
12012
PROVINCE OF NOVA SCOTIA

ABLE Engineering Services Inc.
CHESTER KENTVILLE TANTALLON
NOVA SCOTIA, CANADA
1-833-756-8433 info@ableinc.ca

Horizontal	Vertical	Plot
1:750	N/A	ARCH D (24"x36")

Project

THE TOWNHOMES OF LAKE THOMAS

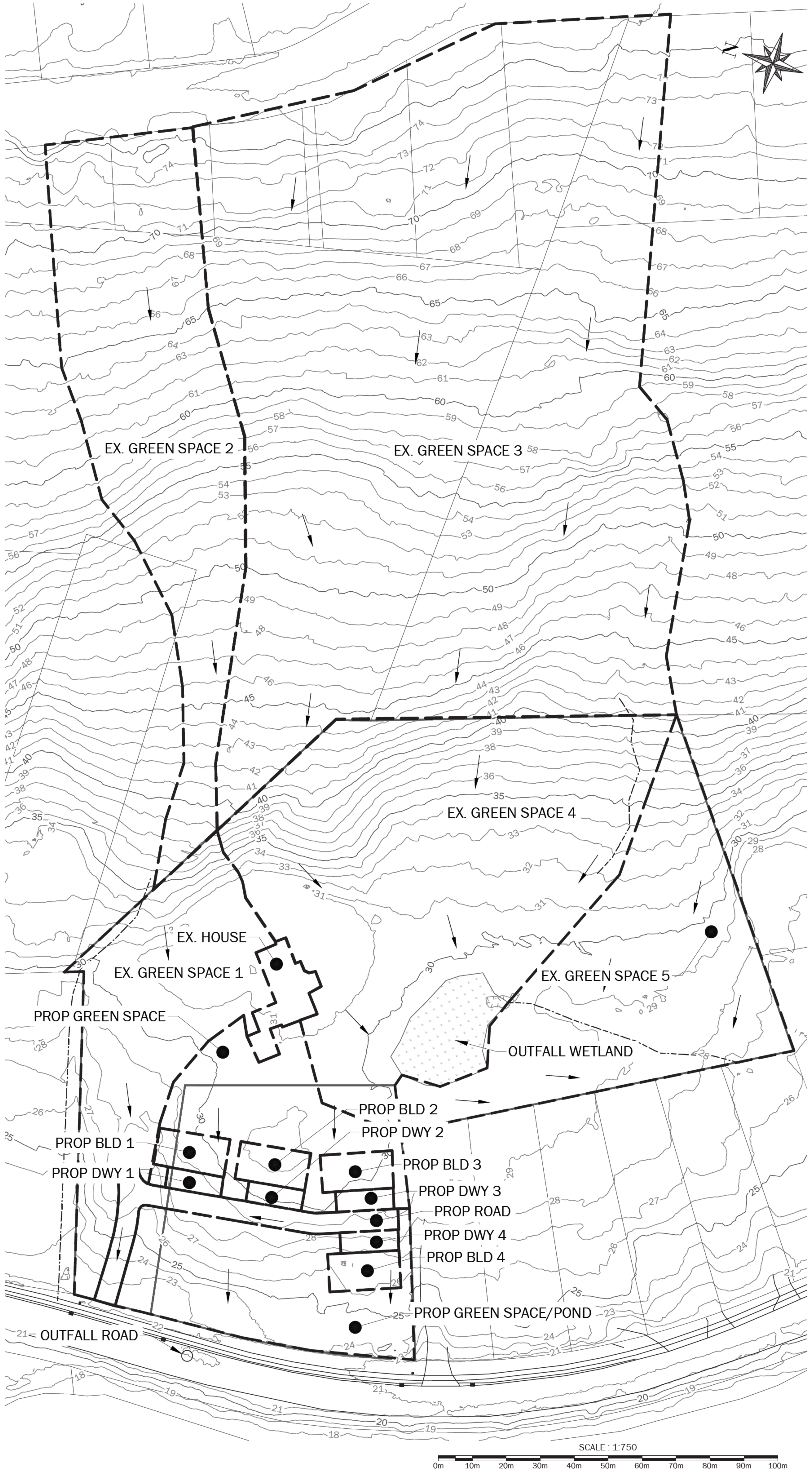
3124 AND 3134 HIGHWAY 2, FALL RIVER
NOVA SCOTIA

Title

STORMWATER ANALYSIS EXISTING CONDITION

Project No.	Drawn	Sheet
210919-50	A. COLLICUTT	2 of 4
Ref.	Engineer	Plan No.
	J. PORTER	C101
Date	Check	
OCTOBER 27 2022	M.VISENTIN	

SHEET PRODUCED 3/2/2023 10 39 AM LAST SAVED BY J.PORTER



Proposed 5 Year Storm Event

SN	Element ID	Area (ha)	Drainage Node ID	Weighted Curve Number	Rain Gage ID	Peak Rate Factor	Total Precipitation (mm)	Total Runoff (mm)	Peak Runoff (lps)	Time of Concentration (days hh:mm:ss)
1	Ex Green Space 1	0.37	Road Outfall	80.00	5Year	484	111.15	59.84	28.32	0 00:15:26
2	Ex Green Space 2	0.69	Road Outfall	76.00	5Year	484	111.15	51.59	43.89	0 00:18:49
3	Ex Green Space 3	2.58	Wetland	76.00	5Year	484	111.15	51.59	164.24	0 00:18:42
4	Ex Green Space 4	0.99	Wetland	72.00	5Year	484	111.15	43.92	52.95	0 00:16:57
5	Ex Green Space 5	0.53	Adjacent Lots	76.00	5Year	484	111.15	51.59	33.98	0 00:16:45
6	Ex House	0.04	Road Outfall	98.00	5Year	484	111.15	105.08	4.81	0 00:05:00
7	Prop Bldg 4	0.02	Road Outfall	98.00	5Year	484	111.15	104.95	3.12	0 00:05:00
8	Prop Bldg 3	0.02	Road Outfall	98.00	5Year	484	111.15	104.95	3.12	0 00:05:00
9	Prop Bldg 2	0.02	Road Outfall	98.00	5Year	484	111.15	104.95	3.12	0 00:05:00
10	Prop Bldg 1	0.02	Road Outfall	98.00	5Year	484	111.15	104.95	3.12	0 00:05:00
11	Prop DWY 4	0.01	Road Outfall	96.00	5Year	484	111.15	97.74	1.42	0 00:05:00
12	Prop DWY 3	0.01	Road Outfall	96.00	5Year	484	111.15	97.74	1.42	0 00:05:00
13	Prop DWY 2	0.01	Road Outfall	96.00	5Year	484	111.15	97.74	1.42	0 00:05:00
14	Prop DWY 1	0.01	Road Outfall	96.00	5Year	484	111.15	97.74	1.42	0 00:05:00
15	Prop Green Space	0.18	Road Outfall	74.00	5Year	484	111.15	47.68	10.48	0 00:16:25
16	Prop Green Space/Pond	0.26	Road Outfall	74.00	5Year	484	111.15	47.68	15.29	0 00:12:58
17	Prop Road	0.07	Road Outfall	92.00	5Year	484	111.15	88.37	8.50	0 00:05:00

Proposed 10 Year Storm Event

SN	Element ID	Area (ha)	Drainage Node ID	Weighted Curve Number	Rain Gage ID	Peak Rate Factor	Total Precipitation (mm)	Total Runoff (mm)	Peak Runoff (lps)	Time of Concentration (days hh:mm:ss)
1	Ex Green Space 1	0.37	Road Outfall	80.00	10year	484	140.28	85.17	40.78	0 00:15:26
2	Ex Green Space 2	0.69	Road Outfall	76.00	10year	484	140.28	75.49	65.13	0 00:18:49
3	Ex Green Space 3	2.58	Wetland	76.00	10year	484	140.28	75.49	242.68	0 00:18:42
4	Ex Green Space 4	0.99	Wetland	72.00	10year	484	140.28	66.24	81.27	0 00:16:57
5	Ex Green Space 5	0.53	Adjacent Lots	76.00	10year	484	140.28	75.49	50.40	0 00:16:45
6	Ex House	0.04	Road Outfall	98.00	10year	484	140.28	134.19	5.95	0 00:05:00
7	Prop Bldg 4	0.02	Road Outfall	98.00	10year	484	140.28	134.11	3.68	0 00:05:00
8	Prop Bldg 3	0.02	Road Outfall	98.00	10year	484	140.28	134.11	3.68	0 00:05:00
9	Prop Bldg 2	0.02	Road Outfall	98.00	10year	484	140.28	134.11	3.68	0 00:05:00
10	Prop Bldg 1	0.02	Road Outfall	98.00	10year	484	140.28	134.11	3.68	0 00:05:00
11	Prop DWY 4	0.01	Road Outfall	96.00	10year	484	140.28	126.92	1.70	0 00:05:00
12	Prop DWY 3	0.01	Road Outfall	96.00	10year	484	140.28	126.92	1.70	0 00:05:00
13	Prop DWY 2	0.01	Road Outfall	96.00	10year	484	140.28	126.92	1.70	0 00:05:00
14	Prop DWY 1	0.01	Road Outfall	96.00	10year	484	140.28	126.92	1.70	0 00:05:00
15	Prop Green Space	0.18	Road Outfall	74.00	10year	484	140.28	70.79	15.86	0 00:16:25
16	Prop Green Space/Pond	0.26	Road Outfall	74.00	10year	484	140.28	70.82	23.22	0 00:12:58
17	Prop Road	0.07	Road Outfall	92.00	10year	484	140.28	116.82	11.04	0 00:05:00

Proposed 25 Year Storm Event

SN	Element ID	Area (ha)	Drainage Node ID	Weighted Curve Number	Rain Gage ID	Peak Rate Factor	Total Precipitation (mm)	Total Runoff (mm)	Peak Runoff (lps)	Time of Concentration (days hh:mm:ss)
1	Ex Green Space 1	0.37	Road Outfall	80.00	25year	484	177.16	118.64	56.63	0 00:15:26
2	Ex Green Space 2	0.69	Road Outfall	76.00	25year	484	177.16	107.57	93.16	0 00:18:49
3	Ex Green Space 3	2.58	Wetland	76.00	25year	484	177.16	107.57	347.45	0 00:18:42
4	Ex Green Space 4	0.99	Wetland	72.00	25year	484	177.16	96.70	120.06	0 00:16:57
5	Ex Green Space 5	0.53	Adjacent Lots	76.00	25year	484	177.16	107.57	72.21	0 00:16:45
6	Ex House	0.04	Road Outfall	98.00	25year	484	177.16	171.04	7.65	0 00:05:00
7	Prop Bldg 4	0.02	Road Outfall	98.00	25year	484	177.16	170.99	4.81	0 00:05:00
8	Prop Bldg 3	0.02	Road Outfall	98.00	25year	484	177.16	170.99	4.81	0 00:05:00
9	Prop Bldg 2	0.02	Road Outfall	98.00	25year	484	177.16	170.99	4.81	0 00:05:00
10	Prop Bldg 1	0.02	Road Outfall	98.00	25year	484	177.16	170.99	4.81	0 00:05:00
11	Prop DWY 4	0.01	Road Outfall	96.00	25year	484	177.16	164.24	2.27	0 00:05:00
12	Prop DWY 3	0.01	Road Outfall	96.00	25year	484	177.16	164.24	2.27	0 00:05:00
13	Prop DWY 2	0.01	Road Outfall	96.00	25year	484	177.16	164.24	2.27	0 00:05:00
14	Prop DWY 1	0.01	Road Outfall	96.00	25year	484	177.16	164.24	2.27	0 00:05:00
15	Prop Green Space	0.18	Road Outfall	74.00	25year	484	177.16	102.11	22.94	0 00:16:25
16	Prop Green Space/Pond	0.26	Road Outfall	74.00	25year	484	177.16	102.11	33.70	0 00:12:58
17	Prop Road	0.07	Road Outfall	92.00	25year	484	177.16	153.14	14.44	0 00:05:00

Proposed 50 Year Storm Event

SN	Element ID	Area (ha)	Drainage Node ID	Weighted Curve Number	Rain Gage ID	Peak Rate Factor	Total Precipitation (mm)	Total Runoff (mm)	Peak Runoff (lps)	Time of Concentration (days hh:mm:ss)
1	Ex Green Space 1	0.37	Road Outfall	80.00	50year	484	204.70	144.27	68.81	0 00:15:26
2	Ex Green Space 2	0.69	Road Outfall	76.00	50year	484	204.70	132.36	114.68	0 00:18:49
3	Ex Green Space 3	2.58	Wetland	76.00	50year	484	204.70	132.36	427.59	0 00:18:42
4	Ex Green Space 4	0.99	Wetland	72.00	50year	484	204.70	120.55	150.08	0 00:16:57
5	Ex Green Space 5	0.53	Adjacent Lots	76.00	50year	484	204.70	132.36	88.92	0 00:16:45
6	Ex House	0.04	Road Outfall	98.00	50year	484	204.70	198.58	8.78	0 00:05:00
7	Prop Bldg 4	0.02	Road Outfall	98.00	50year	484	204.70	198.53	5.66	0 00:05:00
8	Prop Bldg 3	0.02	Road Outfall	98.00	50year	484	204.70	198.53	5.66	0 00:05:00
9	Prop Bldg 2	0.02	Road Outfall	98.00	50year	484	204.70	198.53	5.66	0 00:05:00
10	Prop Bldg 1	0.02	Road Outfall	98.00	50year	484	204.70	198.53	5.66	0 00:05:00
11	Prop DWY 4	0.01	Road Outfall	96.00	50year	484	204.70	191.90	2.55	0 00:05:00
12	Prop DWY 3	0.01	Road Outfall	96.00	50year	484	204.70	191.90	2.55	0 00:05:00
13	Prop DWY 2	0.01	Road Outfall	96.00	50year	484	204.70	191.90	2.55	0 00:05:00
14	Prop DWY 1	0.01	Road Outfall	96.00	50year	484	204.70	191.90	2.55	0 00:05:00
15	Prop Green Space	0.18	Road Outfall	74.00	50year	484	204.70	126.44	28.60	0 00:16:25
16	Prop Green Space/Pond	0.26	Road Outfall	74.00	50year	484	204.70	126.44	41.63	0 00:12:58
17	Prop Road	0.07	Road Outfall	92.00	50year	484	204.70	180.37	16.71	0 00:05:00

Proposed 100 Year Storm Event

SN	Element ID	Area (ha)	Drainage Node ID	Weighted Curve Number	Rain Gage ID	Peak Rate Factor	Total Precipitation (mm)	Total Runoff (mm)	Peak Runoff (lps)	Time of Concentration (days hh:mm:ss)
1	Ex Green Space 1	0.37	Road Outfall	80.00	100year	484	231.54	169.62	80.70	0 00:15:26
2	Ex Green Space 2	0.69	Road Outfall	76.00	100year	484	231.54	157.05	135.92	0 00:18:49
3	Ex Green Space 3	2.58	Wetland	76.00	100year	484	231.54	157.05	506.87	0 00:18:42
4	Ex Green Space 4	0.99	Wetland	72.00	100year	484	231.54	144.42	180.10	0 00:16:57
5	Ex Green Space 5	0.53	Adjacent Lots	76.00	100year	484	231.54	157.05	105.34	0 00:16:45
6	Ex House	0.04	Road Outfall	98.00	100year	484	231.54	225.40	9.91	0 00:05:00
7	Prop Bldg 4	0.02	Road Outfall	98.00	100year	484	231.54	225.37	6.23	0 00:05:00
8	Prop Bldg 3	0.02	Road Outfall	98.00	100year	484	231.54	225.37	6.23	0 00:05:00
9	Prop Bldg 2	0.02	Road Outfall	98.00	100year	484	231.54	225.37	6.23	0 00:05:00
10	Prop Bldg 1	0.02	Road Outfall	98.00	100year	484	231.54	225.37	6.23	0 00:05:00
11	Prop DWY 4	0.01	Road Outfall	96.00	100year	484	231.54	218.80	2.83	0 00:05:00
12	Prop DWY 3	0.01	Road Outfall	96.00	100year	484	231.54	218.80	2.83	0 00:05:00
13	Prop DWY 2	0.01	Road Outfall	96.00	100year	484	231.54	218.80	2.83	0 00:05:00
14	Prop DWY 1	0.01	Road Outfall	96.00	100year	484	231.54	218.80	2.83	0 00:05:00
15	Prop Green Space	0.18	Road Outfall	74.00	100year	484	231.54	150.72	34.26	0 00:16:25
16	Prop Green Space/Pond	0.26	Road Outfall	74.00	100year	484	231.54	150.72	49.84	0 00:12:58
17	Prop Road	0.07	Road Outfall	92.00	100year	484	231.54	206.99	18.97	0 00:05:00

5 Year Storm

Outfall	Existing Flow (L/sec)	Proposed Flow (L/sec)	Required Detention Storage (m^3)
Road	118.5	123.53	5.32
Wetland	217.11	216.96	0
Adjacent Lots	34.00	34.00	0

Notes: 1. The Soil Conservation Service (SCS) Method was used to estimate the peak flow for the storm event.
2. Storm simulation modeled using AutoDESK Storm and Sanitary Analysis 2021.

10 Year Storm

Outfall	Existing Flow (L/sec)	Proposed Flow (L/sec)	Required Detention Storage (m^3)
Road	172.06	177.17	4.93
Wetland	323.72	323.47	0
Adjacent Lots	50.42	50.42	0

Notes: 1. The Soil Conservation Service (SCS) Method was used to estimate the peak flow for the storm event.
2. Storm simulation modeled using AutoDESK Storm and Sanitary Analysis 2021.

25 Year Storm

Outfall	Existing Flow (L/sec)	Proposed Flow (L/sec)	Required Detention Storage (m^3)
Road	242.35	248.72	5.05
Wetland	467.85	467.5	0
Adjacent Lots	72.1	72.1	0

Notes: 1. The Soil Conservation Service (SCS) Method was used to estimate the peak flow for the storm event.
2. Storm simulation modeled using AutoDESK Storm and Sanitary Analysis 2021.

50 Year Storm

Outfall	Existing Flow (L/sec)	Proposed Flow (L/sec)	Required Detention Storage (m^3)
Road	296.13	303.29	5.07
Wetland	578.07	577.62	0
Adjacent Lots	88.57	88.57	0

Notes: 1. The Soil Conservation Service (SCS) Method was used to estimate the peak flow for the storm event.
2. Storm simulation modeled using AutoDESK Storm and Sanitary Analysis 2021.

100 Year Storm

Outfall	Existing Flow (L/sec)	Proposed Flow (L/sec)	Required Detention Storage (m^3)
Road	349.7	356.84	5.1
Wetland	686.59	686.08	0
Adjacent Lots	104.86	104.86	0

Notes: 1. The Soil Conservation Service (SCS) Method was used to estimate the peak flow for the storm event.
2. Storm simulation modeled using AutoDESK Storm and Sanitary Analysis 2021.

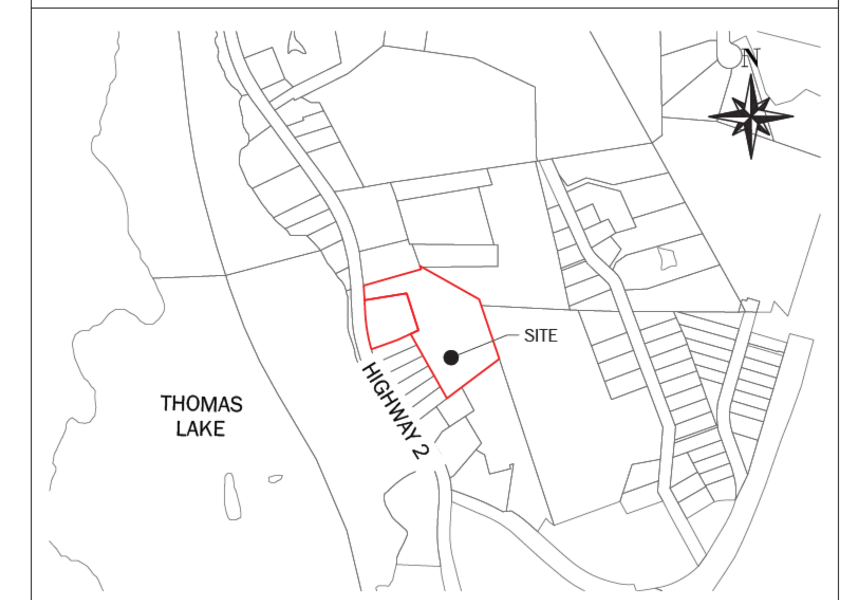
Proposed

SN	Element	Area (m2)
1	Ex Green Space 1	4038.167
2	Ex Green Space 2	6814.929
3	Ex Green Space 3	25816.856
4	Ex Green Space 4	9872.599
5	Ex Green Space 5	5298.357
6	Ex House	365.129
7	Prop Bldg 4	232.405
8	Prop Bldg 3	230.556
9	Prop Bldg 2	230.742
10	Prop Bldg 1	230.324
11	Prop DWY 4	105.214
12	Prop DWY 3	102.325
13	Prop DWY 2	99.539
14	Prop DWY 1	98.406
15	Prop Green Space	798.368
16	Prop Green Space/Pond	2551.796
17	Prop Road	723.116

100 Year Storm

Outfall	Existing Runoff (m^3)	Proposed Runoff (m^3)
Road	2822.14	2897.58
Wetland	5444.41	5440.34
Adjacent Lots	829.2	829.2

KEYPLAN



GENERAL NOTES

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SANITARY FLOWS :

SANITARY DEMAND FOR APARTMENT BUILDING SPACE = 0.000816 m^3/s (Q)
SANITARY CAPACITY FOR 150mm LATERAL AT 0.6% SLOPE= 0.0103 m^3/s (q)

$$Qr = \frac{[1.5 \times (a \times M)] + (B \times AREA)}{86.4} = 0.72812 L/s = 0.000728 m^3/s$$

$$M = 1 + \frac{14}{4+P^{0.5}}$$

a= 0.30 m^3/P/day
M= 2.573
B= 24 m^3/ha/day
AREA= 2.571 ha
p= 24

Manning Formula :

$V = (1.0/N)\, R^{(\frac{2}{3})}\, S^{(\frac{1}{2})}$
R= A/Pw
q=A x V

q= 0.0103 m^3/s S=0.006
V= 0.9307 m/s Pw=0.2658 m
N= 0.010 a= 0.0111
R= 0.0416m

PRELIMINARY
NOT FOR CONSTRUCTION

No.	MM/DD/YYYY	Revision Description	By
1	02/27/2023	ISSUED FOR REVIEW	AC

Seal
REGISTERED PROFESSIONAL ENGINEER * PROVINCE OF NOVA SCOTIA *
DATE 03/02/2023
[redacted]
12012

ABLE Engineering Services Inc.
CHESTER KENTVILLE TANTALLON
NOVA SCOTIA, CANADA
1-833-756-8433 info@ableinc.ca

Horizontal	Vertical	Plot
1:750	N/A	ARCH D (24"x36")

Project
THE TOWNHOMES OF LAKE THOMAS
3124 AND 3134 HIGHWAY 2, FALL RIVER
NOVA SCOTIA

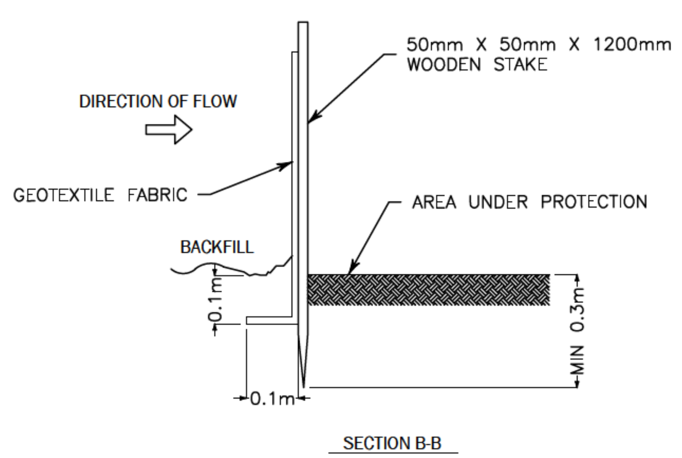
Title
STORMWATER ANALYSIS
PROPOSED CONDITION

Project No.	Drawn	Sheet
210919-50	A. COLLICUTT	4 of 3
Ref.	Engineer J. PORTER	Plan No.
Date OCTOBER 27 2022	Check M.VISENTIN	C102

SHEET PRODUCED 3/2/2023 10 39 AM LAST SAVED BY J.PORTER

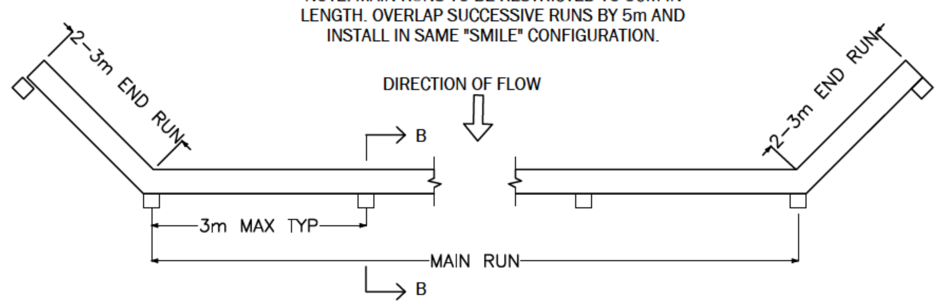
EROSION AND SEDIMENT CONTROL NOTES

1. THE CONTRACTOR SHALL CARRY OUT WORK ON THIS SITE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, PROVINCIAL, AND MUNICIPAL REGULATIONS, INCLUDING BUT NOT LIMITED TO THE OCCUPATIONAL HEALTH AND SAFETY ACT FOR THE PROVINCE OF NOVA SCOTIA.
2. THE CONTRACTOR SHALL OVERSEE THAT ALL WORK IS CONSTRUCTED IN ACCORDANCE WITH THE REQUIREMENTS OF NOVA SCOTIA DEPARTMENTS OF ENVIRONMENT (NSE).
3. THE ENVIRONMENTAL BMPS INCLUDED IN THIS ESC PLAN ARE PROVIDED AS THE SUGGESTED APPROACH TO EROSION AND SEDIMENT CONTROL DURING WORK ON THIS SITE. THE CONTRACTOR SHALL IMPLEMENT THESE MEASURES AS A MINIMUM.
4. TO CONTROL EROSION AND PREVENT SEDIMENT FROM LEAVING THE SITE IT MAY BE NECESSARY TO INSTALL ADDITIONAL ENVIRONMENTAL CONTROLS BEYOND THOSE INCLUDED IN THE ESC PLAN.
5. THE CONTRACTOR SHALL OVERSEE A COPY OF ALL PERTINENT APPROVALS AND PERMITS ARE KEPT ONSITE (INCLUDING THE ESC PLAN FOR THE SITE AND ANY SUBSEQUENT REVISIONS TO THE ESC PLAN). THE CONTRACTOR SHALL COMPLY WITH ALL PERMIT REQUIREMENTS AND CONDITIONS ISSUED BY THE REGULATORS.
6. THE CONTRACTOR SHALL MAINTAIN ALL ENVIRONMENTAL CONTROLS UNTIL THE SITE HAS BEEN STABILIZED AND APPROVED BY THE REGULATOR.
7. THE CONTRACTOR SHALL PREVENT THE RELEASE OF SEDIMENT TO ALL WATERCOURSES, WETLANDS AND/OR PROPERTIES ADJACENT TO THE CONSTRUCTION SITE.
8. THE CONTRACTOR OR SITE DESIGNATE SHALL NOTIFY NSE IF THERE ARE ANY OFFSITE IMPACTS AND ENSURE THAT DEFICIENCIES ARE CORRECTED WITHIN 12 HOURS OF ANY BREACH.
9. THE CONTRACTOR OR SITE DESIGNATE SHALL INSPECT ENVIRONMENTAL CONTROLS BEFORE AND AFTER PRECIPITATION EVENTS FORECASTED TO BE > 10 MM.
10. IN THIS ESC PLAN, ANY REFERENCE TO A PREDICTED FORECAST FOR PRECIPITATION EVENTS REFERS TO FORECASTS BY ENVIRONMENT CANADA ONLY.
11. NO WASHING, FUELING OR MAINTENANCE OF VEHICULAR EQUIPMENT WILL BE ALLOWED WITHIN 30 M OF ANY WATERCOURSE OR WETLAND WITHOUT SECONDARY CONTAINMENT.
12. NO STORAGE OF CHEMICALS, PETROLEUM, OILS OR LUBRICANTS WILL BE ALLOWED WITHIN 30 M OF A WATERCOURSE OR WETLAND.
13. ALL EQUIPMENT USED DURING CONSTRUCTION ACTIVITIES WILL BE FREE OF LEAKS AND COATINGS OF HYDROCARBON—BASED FLUIDS OR LUBRICANTS THAT ARE HARMFUL TO THE ENVIRONMENT. HOSES AND TRUCK FUEL TANKS WILL BE ROUTINELY CHECKED FOR FRACTURES OR BREAKS.
14. THE CONTRACTOR SHALL HAVE AN EMERGENCY SPILL PREVENTION AND RESPONSE PLAN PREPARED PRIOR TO THE COMMENCEMENT OF ANY WORK AT THE SITE. THE CONTRACTOR SHALL HAVE THE APPROPRIATE SPILL RESPONSE EQUIPMENT, SPECIFIC TO THE TYPE OF SPILLS THAT MOST LIKELY TO OCCUR DURING WORK ACTIVITIES ON THE SITE AT ALL TIMES.
15. THE CONTRACTOR MAY BE REQUIRED TO COVER EXPOSED SOIL BEFORE THE NEXT PRECIPITATION EVENT. TEMPORARY COVER WILL CONSIST OF DRY MULCHING AT A RATE OF 4,500 KG/HA (45 KG/100 M2) TO PREVENT EROSION.
16. CONSTRUCTION ON THE SITE SHALL NOT RESULT IN SEDIMENT AND DEBRIS BEING DEPOSITED ON PUBLIC ROADS. ADJACENT PUBLIC ROADS SHALL BE CLEANED AT THE END OF EACH DAY AGGREGATE PADS MAY HAVE TO BE PLACED AT THE EGRESS OF ALL ACCESS ROADS FROM THE SITE TO REMOVE MUD AND DEBRIS FROM TRUCK AND EQUIPMENT TIRES.
17. WORK SHOULD BE SEQUENCED TO LIMIT EXPOSED SOILS TO THOSE AREAS WHICH WORK CAN BE PERFORMED IN A TIMELY MANNER & SHOULD SUBSEQUENTLY BE PROTECTED TO MINIMIZE RENDERING SUITABLE SOILS FROM BECOMING UNSUITABLE. ALLOW TO RE—VEGETATE EXPOSED SOILS IN GREEN AREAS AS SOON AS POSSIBLE TO AVOID PHOSPHORUS—LADEN RUNOFF FROM ENTERING LAKE THOMAS.
18. PREPARED SURFACES SHOULD BE PROTECTED TO MINIMIZE THE AMOUNT OF DEGRADATION. IT IS RECOMMEND SEALING THE SURFACES WITH A ROLLER AT THE END OF EACH WORK DAY TO HELP MINIMIZE WATER PENETRATION. IT WOULD ALSO BE PRUDENT TO INCLUDE PROVISION FOR A STABILIZING LAYER OF ROCKFILL IN AREAS OF HIGH CONSTRUCTION TRAFFIC FLOW.
19. SEDIMENT FENCE AND GRUBBING BERM AREAS TO BE INSPECTED AFTER EVERY RAINFALL EVENT AND WEEKLY. RECORD TO BE KEPT BY CONTRACTOR.
20. KEEP CLEAN WATER CLEAN.
21. SEDIMENT CONTROL BMPS (I.E., PERIMETER CONTROLS) SHOULD BE PLACED TO CAPTURE ANY RESIDUAL SEDIMENT FROM ENTERING A WATERCOURSE OR WETLAND AND/OR LEAVING THE SITE.
22. SEDIMENT PONDS WILL BE USED ON THIS SITE. THE DISCHARGE LOCATION SHALL BE IN A DENSELY VEGETATED AREA LOCATION MORE THAN 100 M FROM ANY WATERCOURSE OR WETLAND. THE PERFORATED PIPE MUST BE LAID FLAT ON A CONTOUR SO THAT FLOW TAKES PLACE OVER THE ENTER LENGTH OF THE PIPE.
23. TEMPORARY SEDIMENTATION PONDS TO HOLD MINOR RAIN EVENTS. IN the OF HEAVY RAINFALL, CONTRACTOR TO INCREASE ESC MEASURES TO PROTECT SURROUNDING AREA

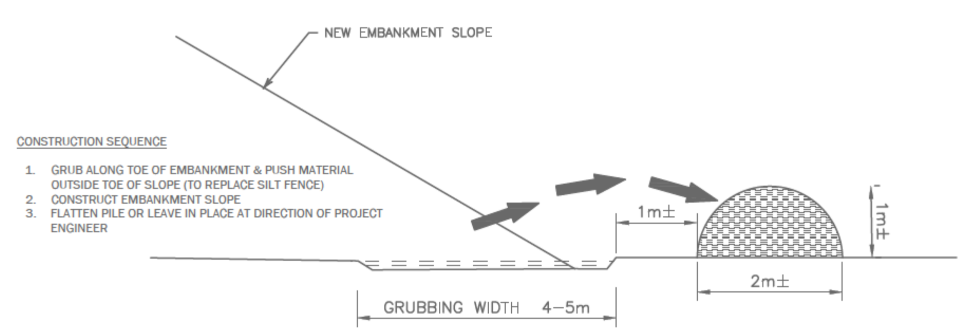


1 C104 INSTALLATION TYPE 1 SILT FENCE NTS.

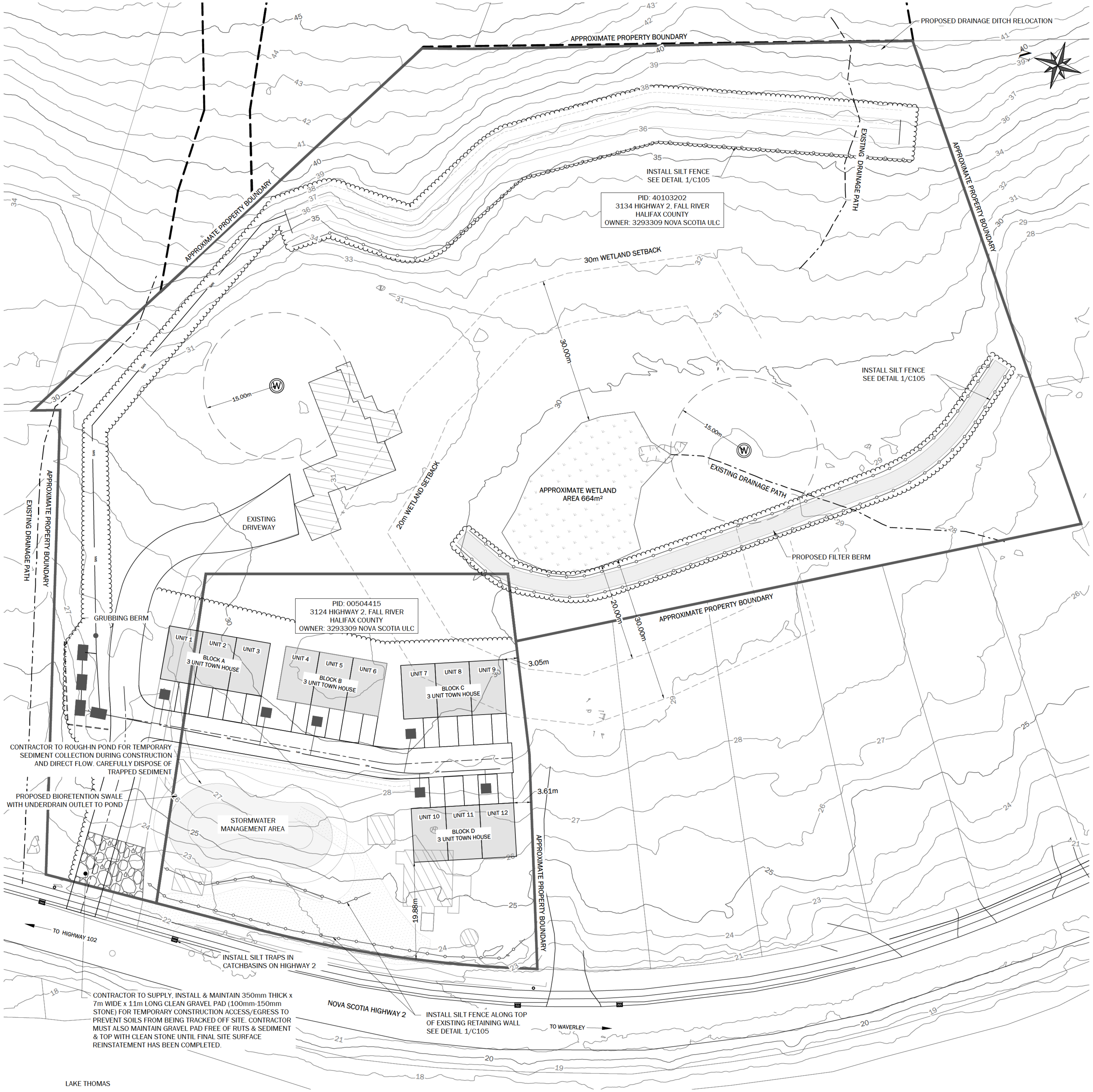
NOTE: MAIN RUNS TO BE RESTRICTED TO 50m IN LENGTH. OVERLAP SUCCESSIVE RUNS BY 5m AND INSTALL IN SAME "SMILE" CONFIGURATION.



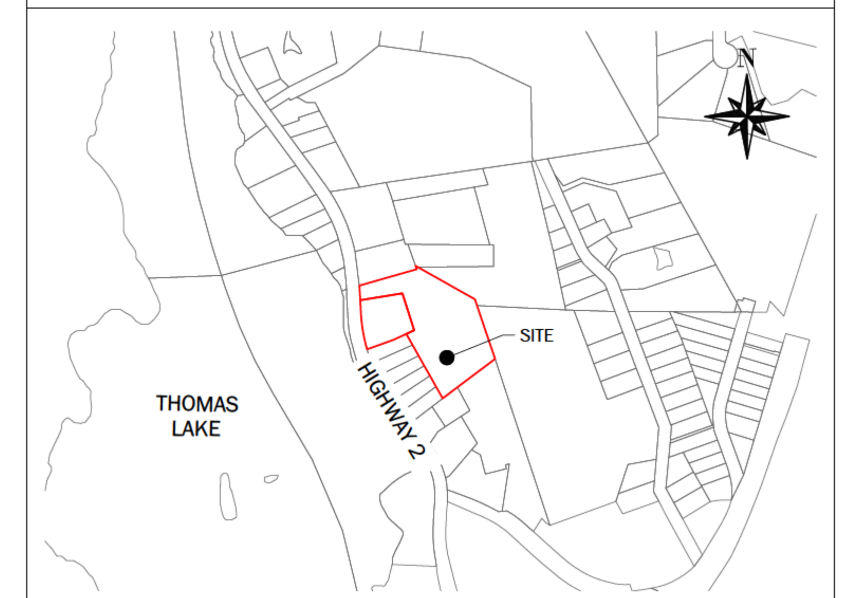
3 C500 INSTALLATION OF SILT FENCE ON LEVEL TOPOGRAPHY NTS.



4 C500 GRUBBING BERM NTS.



KEYPLAN



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PRELIMINARY
NOT FOR CONSTRUCTION

No.	MM/DD/YYYY	Revision Description	By
1	02/27/2023	ISSUED FOR REVIEW	AC

Seal

[redacted]

ABLE Engineering Services Inc.
CHESTER KENTVILLE TANTALLON
NOVA SCOTIA, CANADA
1-833-756-8433 info@ableinc.ca

SCALE: 1:400
0m 10m 20m 30m 40m 50m

Horizontal	Vertical	Plot
1:400	N/A	ARCH D (24"x36")

Project
THE TOWNHOMES OF LAKE THOMAS
3124 AND 3134 HIGHWAY 2, FALL RIVER
NOVA SCOTIA

Title
BASE PLAN

Project No.	Drawn	Sheet
210919-50	A. COLLICUTT	4 of 4
Ref.	Engineer J. PORTER	Plan No. C103
Date JANUARY 10, 2022	Check M.VISENTIN	

Appendix B

ABLE

PRO # 210919-50

Test Pit Record Form

Applicants Name: KEVIN RILES

Subdivision Name: 3124 HWY2

Site Layout: 40103202

Date: 03/03/2022

Time: 1130

Pit #: 4

Total Depth:	1500
Bedrock at:	/
Water Table:	/
Slope:	5-10
Roots to:	700
Mottling at:	/

Potential Hazard	Yes	No	Precautions Taken
Heavy Equipment	X		
Weather	X		SNOW
Traffic		X	
Water/Ice		X	

Soil Stratum	Soil Type	Thickness	Density	Moisture	Notes
Organic	N/A	200	L	M/W	BK
1st Layer	SASI	500	L	W	BR
2nd Layer	SICL	↓	D	D/M	RD BR COBBLES
3rd Layer					

HIGH % SLATE GRAVELS

#210919-50

ABLE

Test Pit Record Form

Applicants Name:

Subdivision Name:

Site Layout:

Date: 03/03/2022

Time: 1115

Pit #: 3

Total Depth:	1500
Bedrock at:	/
Water Table:	/
Slope:	60
Roots to:	500
Mottling at:	/

Potential Hazard	Yes	No	Precautions Taken
Heavy Equipment	X		
Weather	X		SNOW
Traffic		X	
Water/Ice		X	

Soil Stratum	Soil Type	Thickness	Density	Moisture	Notes
Organic	N/A	150	L	M/W	BK
1st Layer	SASI	350	L	W	BR
2nd Layer	SICL	↓	D	D/M	RD BR COBBLES
3rd Layer					

#210919-50

ABLE

Test Pit Record Form

Applicants Name:

Subdivision Name:

Site Layout:

Date: 03/03/2022

Time: 11

Pit #: 2

Total Depth:	1500
Bedrock at:	/
Water Table:	/
Slope:	3-5
Roots to:	800
Mottling at:	/

Potential Hazard	Yes	No	Precautions Taken
Heavy Equipment	X		
Weather	X		SNOW
Traffic		X	
Water/Ice		X	

Soil Stratum	Soil Type	Thickness	Density	Moisture	Notes
Organic	N/A	300	L	M/W	BK
1st Layer	SASI	500	L	W	BR
2nd Layer	SICL	↓	D	D/M	RD BR COBBLES
3rd Layer					

ABLE

Test Pit Record Form

Applicants Name:

Subdivision Name:

Site Layout:

Date: 03/03/2022

Time: 1045

Pit #: 1

Total Depth:	1800
Bedrock at:	/
Water Table:	/
Slope:	3
Roots to:	1500
Mottling at:	1000

Potential Hazard	Yes	No	Precautions Taken
Heavy Equipment	X		
Weather	X		SNOW
Traffic		X	
Water/Ice		X	

Soil Stratum	Soil Type	Thickness	Density	Moisture	Notes
Organic	N/A	50	L	m	BR
1st Layer	SA SI FILL	600	L	m	BR
2nd Layer	ORG	300	L	w	BK
3rd Layer	CL SI	↓	L	m	DK GY + BR

HIGH % OF SAND

SIMPLIFIED FALLING-HEAD PERMEAMETER TEST FOR SAND FILL

The permeameter consists of a clear plexiglass tube with one end covered by a fine mesh screen such as 60x60 mesh size or filter fabric with similar permeability. The cylinder is stood in a low plastic container with a layer of filter fabric or fine screen at bottom to allow free exit of permeating water. The details and general arrangement of the apparatus are shown in Figure C2.

The sand to be tested shall be 100% saturated with water. Care should be taken not to wash out fines from the sand. Approximately 60 mm of the sand to be tested is placed in the cleaned cylinder and compacted by allowing the cylinder to fall 200 mm five times onto a piece of wood or a firm surface. (The piece of wood may be placed in a shallow box to contain splashes). More sand is added to the 105 mm mark and again compacted. The cylinder is then placed in the container and the sand flooded from the bottom up to drive out any air. After allowing the sand to drain excess water, the sample is again compacted by dropping 200 mm five times. At this time the top of the sample should be at the 100 mm mark. If the top is above or below this level by any more than 5 mm, repeat the test procedure with a new sample.

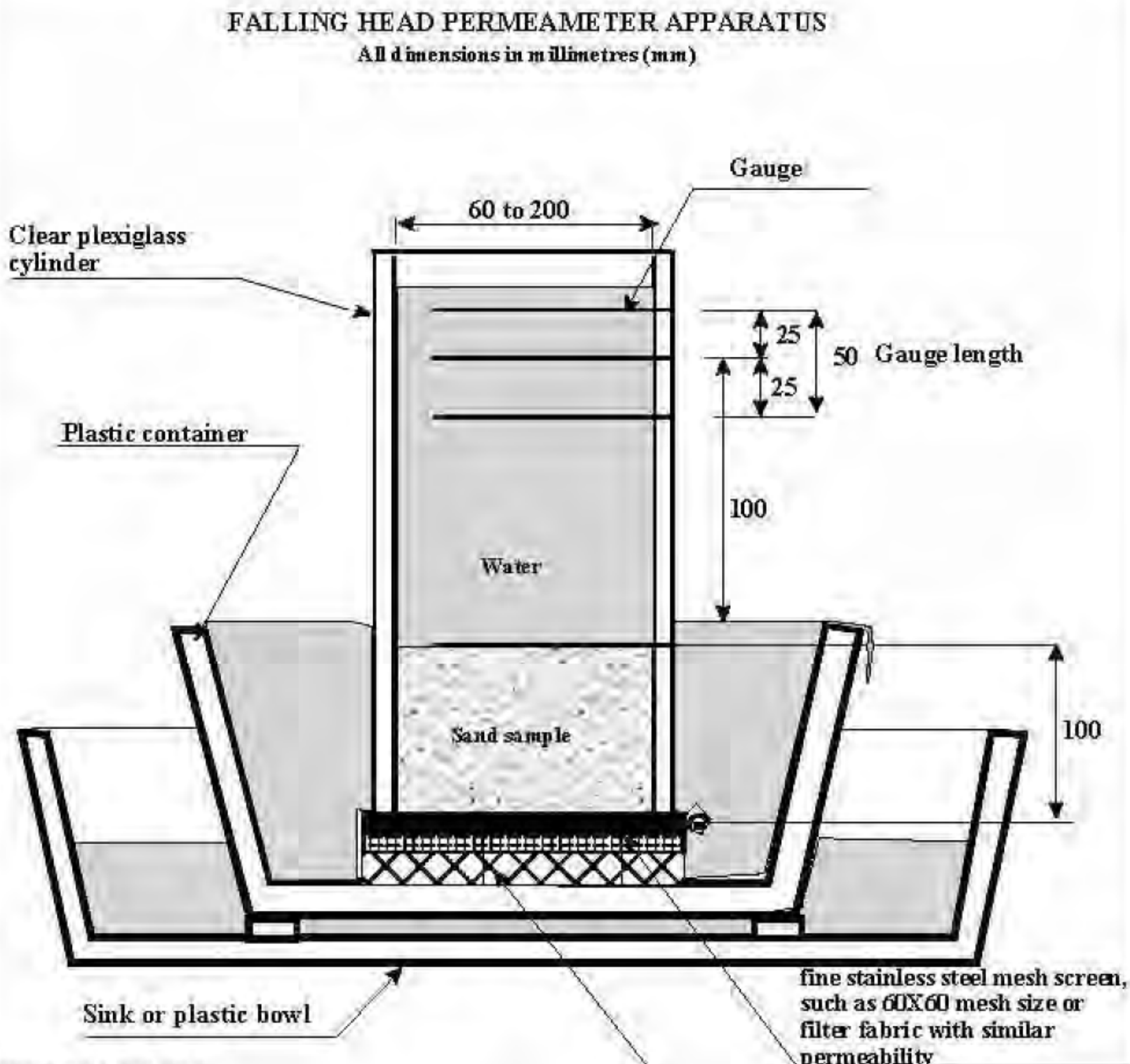
The cylinder is now returned to the container and flooded from the bottom up, then water is carefully poured into the top of the cylinder above the upper reference mark. The water level is now allowed to fall, noting the time in minutes that it takes to pass over the 50 mm gauge length. Measure the temperature of the water at the time of the test. Now refer to the **Figure C3** to determine the sand suitability for a septic system.

The test done on the sample taken from a stockpile or pit does not guarantee that all sand from that source is suitable for septic system. It must be confirmed by tests done on sand supplied to the site.

TEST:

1) Saturate the sand with water, avoiding ponding of the water on the top of the sample.
2) Add 60 mm (3 1/3") of the sand to cylinder and drop cylinder five times 200 mm onto a wooden block.
3) Add more sand to 105 mm (4 3/16") and drop again five times 200 mm.
4) Place cylinder into container with water. When the water surfaces over the sand, remove cylinder and allow water to drain. This will ensure saturation.
5) Compact sand again by dropping cylinder five times 200 mm. At this time the top of the sample should be at the 100 mm mark. If the top is above or below this level by any more than 5 mm, repeat the test procedure with a new sample.
6) Return cylinder to container with water. After the water surfaces, carefully pour water into the top of the cylinder to a level above the upper reference mark.
7) Allow the water level to fall noting the time in minutes that it takes to pass over the 50 mm (2") gauge length.
8) Refer to Figure C3 to determine the suitability of the sand for a septic system.

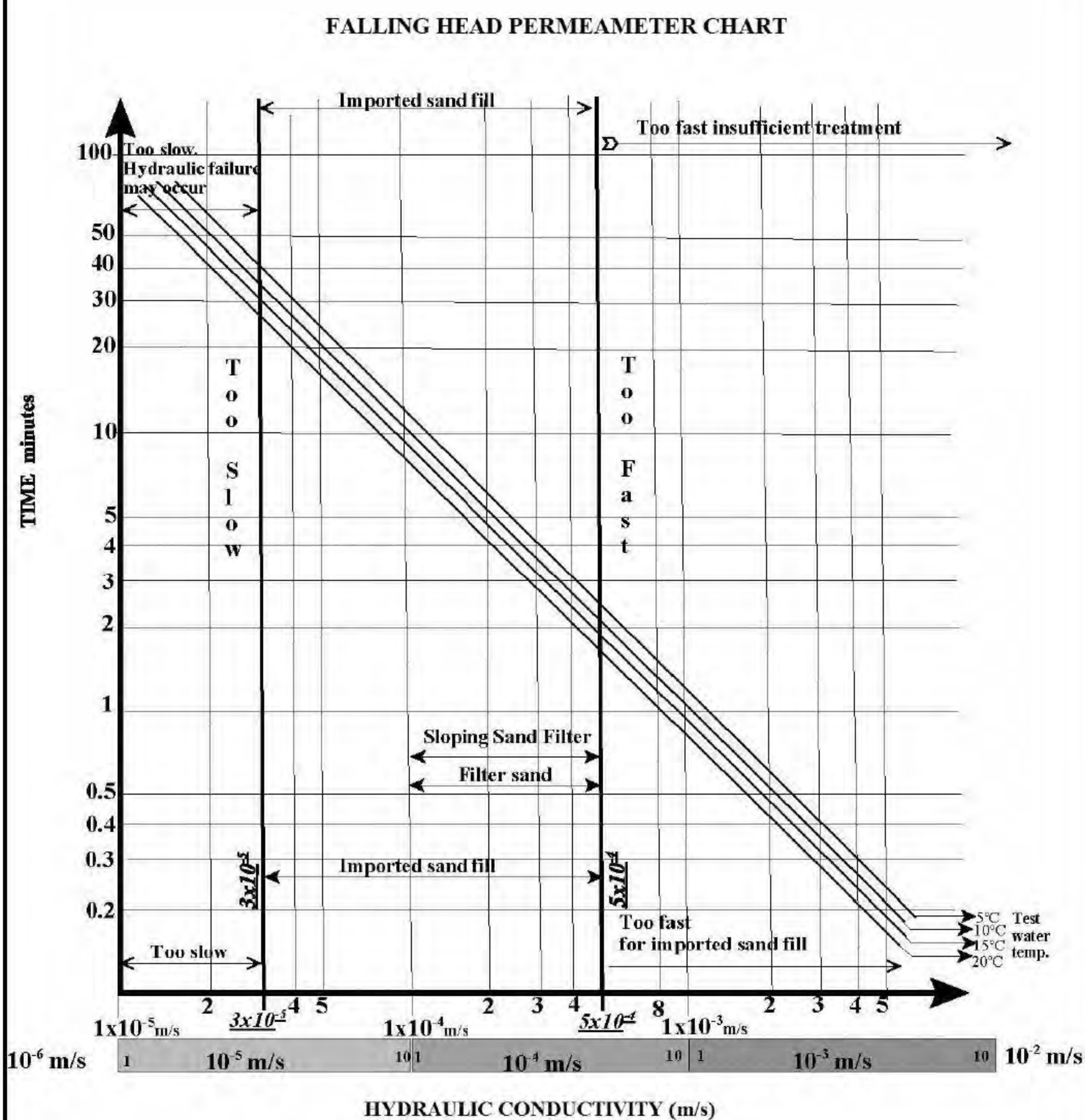
Figure C2

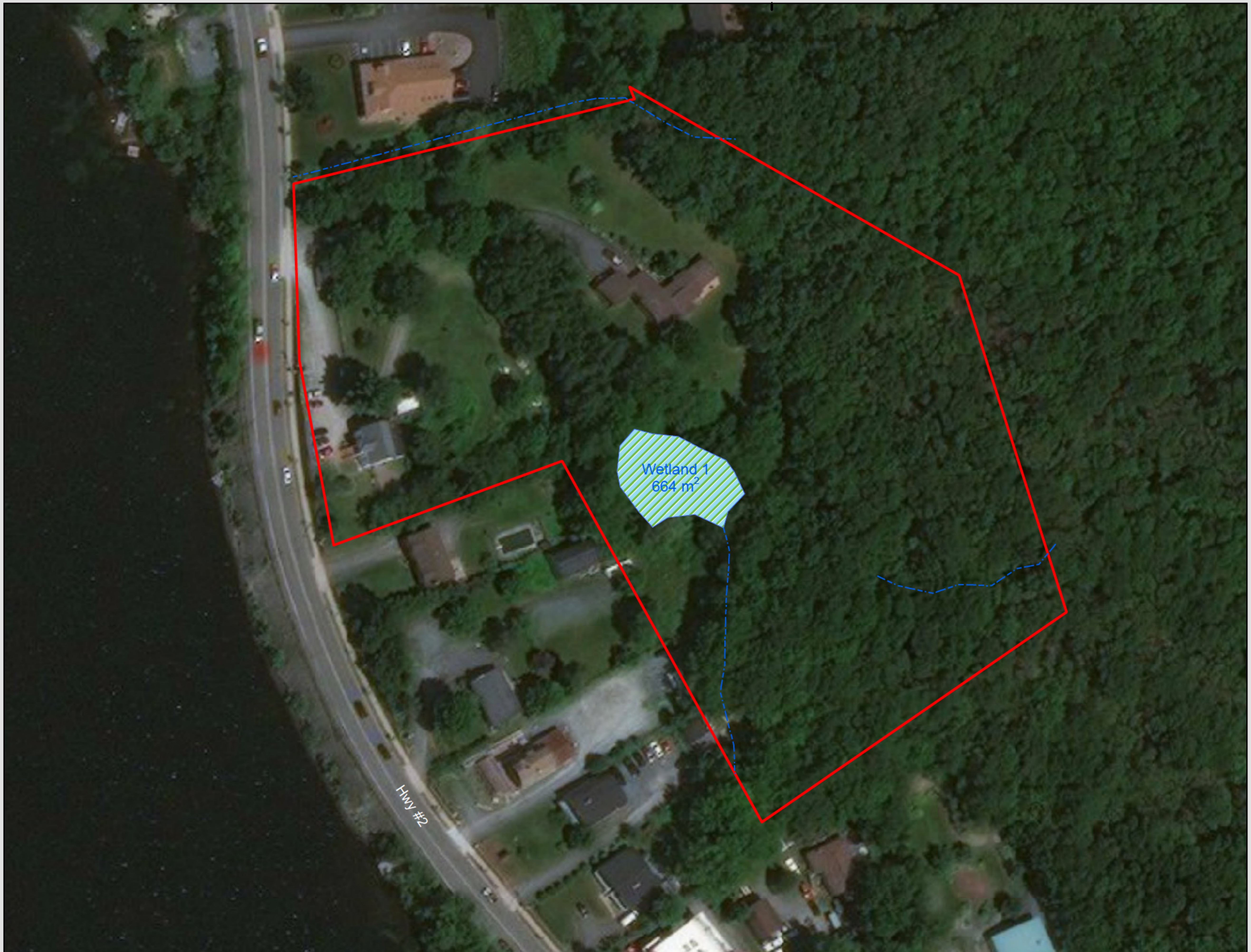


TESTING PROCEDURE

1. Saturate the sand to be tested with water avoiding ponding of the water on the top of the sample.
2. Add 60 mm of the sand to cylinder and drop cylinder five times 200 mm.
3. Add more sand to 105 mm and drop again five times 200 mm.
4. Place cylinder into container with water. When water surfaces remove cylinder and allow water to drain.
5. Compact sand again by dropping cylinder five times 200 mm. At this time the top of the sample should be at the 100 mm mark. If the top is above or below this level by more than 5 mm, repeat the test procedure with a new sample.
6. Return cylinder to container with water. After the water surfaces, carefully pour water into the top of the cylinder to a level above upper reference mark.
7. Allow the water level to fall noting the time in minutes that it takes to pass over the 50 mm gauge length.
8. Refer to FIGURE C3 to determine sand suitability for septic system.
9. Clean cylinder and backwash filter fabric cover.

Figure C3


FALLING HEAD PERMEAMETER CHART
Imported sand fill
Too fast insufficient treatment
Too slow. Hydraulic failure may occur
Too Slow
Too Fast
Sloping Sand Filter
Filter sand
Imported sand fill
3x10-5
5x10-4
Too fast for imported sand fill
Too slow
5°C
10°C
15°C
20°C
Test water temp.
TIME minutes
100
50
40
30
20
10
5
4
3
2
1
0.5
0.4
0.3
0.2
1x10-5 m/s
3x10-5
1x10-4 m/s
5x10-4
1x10-3 m/s
10-6 m/s
10-5 m/s
10-4 m/s
10-3 m/s
10-2 m/s
HYDRAULIC CONDUCTIVITY (m/s)



Prepared For:

KWR Approvals Inc.

FIGURE 1

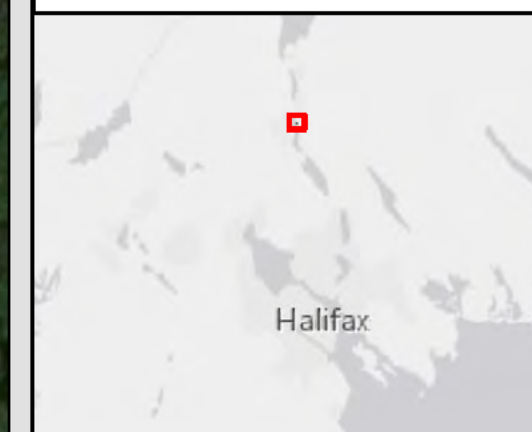
Wetland and Watercourse Delineation Results for PIDs 00504415 and 40103202

Fall River, NS

Drainage

Field Delineated Wetland

Study Area (PIDs 00504415 and 40103202)



Coordinate System: NAD 1983 UTM Zone 20N
Projection: Transverse Mercator
Datum: North American 1983
Units: Meter

0 12.5 25 50 m

1:1,000

Scale when printed @ 11" x 17"

Drawn By: R. Gardiner

Date: 2018-09-24

McCallum Environmental Ltd.

Document Name: 180924_DelinResults

Appendix C

Well Log Record

Well Log Record: # 950680

Well Number: 950680
Type: DRILLED
Date Well Completed (mm-dd-yyyy): 7-4-1995

Go Back

Well Owner/Contractor and Location

Well Drilled for: JOHN SAUNDERS
or Contractor/Builder/Consultant: n/a

Civic Address of Well: 3108 OLD TRURO HIGHWAY
Lot #: n/a
Subdivision: n/a
County: HALIFAX
Postal Code: n/a
Nearest Community in Atlas/Map Book: FALL RIVER

Certified Well Contractor

Driller Name: STEEVES, GEORGE
Certificate No: 170
Company: CLEARWATER WELL DRILLING (1991) LTD.

Well Status / Water Use

Final Status of Well: Deepened
Water Use: Domestic
Method of Drilling: n/a

Well Location

Nova Scotia Atlas or Map Book Reference

Atlas or Map Book: MAP
Map Page No.: 24
Reference Letter: A
Reference Number: 3
Roamer Letter: G
Roamer Number: 15

NTS Map Reference

Map Sheet: n/a
Reference Map: n/a
Tract No.: n/a
Claim: n/a

GPS (WGS84 UTM)

Northing (m): 4962126
Easting (m): 451931
Property (PID): 00504845
Well Location Sketch Available: n/a

Stratigraphy Log

Geology	Colour	Description	Lithology	Water Found
From (depth in ft): 0 to: 260				
Primary Geology	n/a	n/a	UNKNOWN	n/a
Secondary Geology	n/a	n/a	UNKNOWN	
From (depth in ft): 260 to: 400				
Primary Geology	n/a	n/a	QUARTZITE	n/a
Secondary Geology	n/a	n/a	UNKNOWN	

Well Construction Information

Total Depth Below Surface (ft): 400
Depth to Bedrock (ft): n/a
Water Bearing Fractures Encountered at (ft): n/a
Outer Well Casing: From (ft): n/a To: n/a
Diameter (in): 5.875
Length of Casing Above Ground (ft): n/a and (in): n/a
Driveshoe Make: n/a

Water Yield

Estimated Yield (igpm): n/a
Method: AIR LIFT
Rate (igpm): 1
Duration (hrs): n/a
Depth to Water at end of Test (ft): n/a

Total Drawdown (ft): n/a
Water Level Recovered to (ft): n/a
Recovery Time (hrs): n/a
Depth to Static Level (ft): n/a
Overflow: n/a

Comments

DIAMETER NOW 5 7/8"/DEEPE

Go Back

Well Log Record

Well Log Record: # 762561

Well Number: 762561 Go Back
Type: DRILLED
Date Well Completed (mm-dd-yyyy): 8-2-1976

Well Owner/Contractor and Location

Well Drilled for: JOHN MILLER
or Contractor/Builder/Consultant: n/a

Civic Address of Well: n/a
Lot #: X8
Subdivision: MACDREITH
County: HALIFAX
Postal Code: n/a
Nearest Community in Atlas/Map Book: FALL RIVER

Certified Well Contractor

Driller Name: VENIOT, ALBERT C.
Certificate No: 151
Company: VENIOT, ALBERT C.

Well Status / Water Use

Final Status of Well: n/a
Water Use: Domestic
Method of Drilling: Rotary

Well Location

Nova Scotia Atlas or Map Book Reference

Atlas or Map Book: NTS
Map Page No.: n/a
Reference Letter: n/a
Reference Number: n/a
Roamer Letter: n/a
Roamer Number: n/a

NTS Map Reference

Map Sheet: 11D13
Reference Map: A
Tract No.: 67
Claim: n/a

GPS (WGS84 UTM)

Northing (m): 4962198
Easting (m): 451995
Property (PID): 40103202
Well Location Sketch Available: n/a

Stratigraphy Log

Geology	Colour	Description	Lithology	Water Found
From (depth in ft): 0 to: 38				
Primary Geology	n/a	n/a	SAND & CLAY	n/a
Secondary Geology	n/a	n/a	n/a	
From (depth in ft): 38 to: 140				
Primary Geology	n/a	n/a	QUARTZITE	n/a
Secondary Geology	n/a	n/a	n/a	

Well Construction Information

Total Depth Below Surface (ft): 140
Depth to Bedrock (ft): 38
Water Bearing Fractures Encountered at (ft): 100
Outer Well Casing: From (ft): 6 To: 54
Diameter (in): 6
Length of Casing Above Ground (ft): n/a and (in): n/a
Driveshoe Make: unknown

Water Yield

Estimated Yield (igpm): n/a
Method: n/a
Rate (igpm): 9
Duration (hrs): 0.017
Depth to Water at end of Test (ft): n/a

Appendix D

The Waterloo EC-P

Permanently and cost-effectively removes **90-99%** of phosphorus from septic systems by mimicking natural iron-phosphate mineralization soil processes.

Available upgrade for *all* Waterloo Biofilter advanced wastewater treatment systems

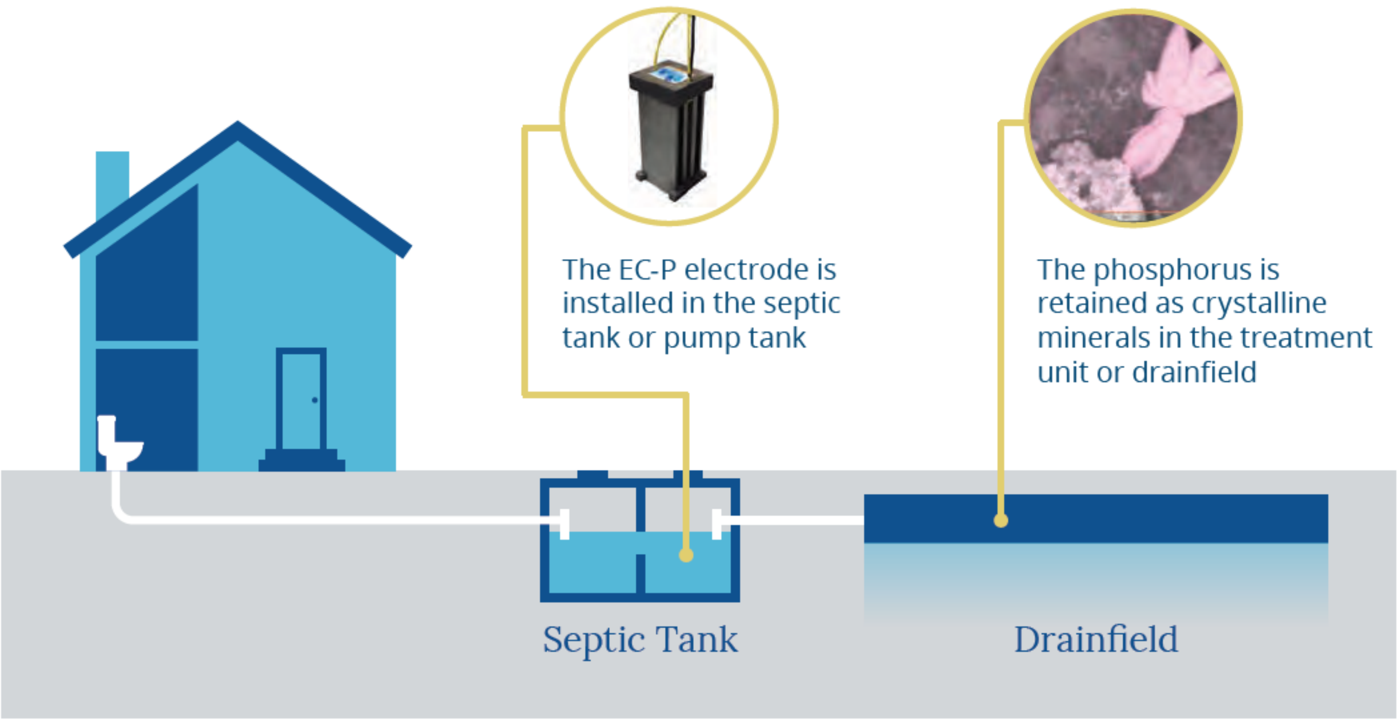
Phosphorus is a nutrient naturally found in human wastewater. Excess phosphorus in surface waters can result in algae blooms and lake eutrophication. Not only can this be a nuisance and interfere with the enjoyment of lakes - but serious health and ecosystem problems can result due to blue-green algae toxins and reduced oxygen levels that fish and other organisms rely on.

Excess phosphorus in freshwater lakes can:

- Limit Recreation Activities such as Swimming, Boating, and Fishing
- Lower Property Values by Impairing Quality of Lake Water
- Lower Dissolved Oxygen Levels and Reduce Fish Populations
- Produce Toxic Algae that is Harmful to Humans and Wildlife

How It Works

Using low-energy electrochemistry, the patent-pending **Waterloo EC-P™** dissolves natural iron electrodes into the wastewater. This iron reacts with phosphorus ions and precipitates out as an insoluble crystalline mineral. These iron-phosphate minerals are physically filtered out of the wastewater by the foam filter medium in the Waterloo Biofilter system, or by sand or soil in conventional septic systems – preventing the phosphorus from reaching the natural environment.



Waterloo EC-P Benefits

- Does not create additional sludge
- No chemical addition required
- Does not affect pH
- Works with filtration-based treatment units, sand, or soil
- Residential and commercial applications
- Phosphorus is permanently removed, not just separated as a sludge
- Low energy, less than $50/year
- Typical electrode life of 2-3 years
- Can easily be retrofitted
- Compact and easy to install

For more information:

www.waterloo-biofilter.com
1-866-366-4329
info@waterloo-biofilter.com

Waterloo BIOFILTER

The Simple Method for estimating phosphorus export

The Simple Method is a technique used for estimating storm pollutant export delivered from urban development sites. The method was developed to provide an easy yet reasonably accurate means of predicting the change in pollutant loadings in response to development. This information is needed by planners and engineers to make rational non-point source pollution decisions at the site level.

The Simple Method calculation is intended for use on development sites less than a square mile in area. As with any simple model, the method to some degree sacrifices precision for the sake of simplicity and generality. Even so, the Simple Method is still reliable enough to use as a basis for making non-point pollution management decisions at the site level. Phosphorus pollutant loading (L, in pounds per year) from a development site can be determined by solving equation 1, shown below.

Factors used in calculating phosphorus pollutant loading

Depth of rainfall (P)

The value of P represents the number of inches of precipitation that falls during the course of a normal year of rainfall. Long-term weather records around the state of Minnesota suggest that the average annual rainfall depth is about 26 inches. This can be used to estimate P or a user can substitute the average annual rainfall depth from the closest National Weather Service long-term weather station or other suitable locations for which a reliable record can be demonstrated (> 10 years).

Correction factor (P)

The P_j factor is used to account for the fraction of the annual rainfall that does not produce any measurable runoff. Many of the storms that occur during the year are so minor that all of the rainfall is stored in surface depressions and eventually evaporates. As a consequence, no runoff is produced. An analysis of regional rainfall/runoff patterns indicates that only 90 percent of the annual rainfall volume produces any runoff at all. Therefore, P_j should be set at 0.9.

Runoff coefficient (R_v)

The runoff coefficient (R_v) is a measure of the site response to rainfall events, and in theory is calculated as $R_v = r/p$, where *r* and *p* are the volume of storm runoff and storm rainfall, respectively, expressed as inches. The R_v for the site depends on the nature of the soils, topography, and cover. However, the primary influence on the R_v in urban areas is the amount of imperviousness of the site. Impervious area is defined as those surfaces in the landscape that cannot infiltrate rainfall consisting of building rooftops, pavement, sidewalks, driveways, etc. In the equation $R_v = 0.05 + 0.009(I)$, *I* represents the percentage of impervious cover expressed as a whole number. A site that is 75% impervious would use *I* = 75 for the purposes of calculating R_v. To see runoff coefficients for different land uses, link here.

Site area (A)

The total area of the site (in acres) can be directly obtained from site plans. If the total area of the site is greater than one square mile (640 acres), the Simple Method may not be appropriate and applicants should consider utilizing other approaches, such as modeling or monitoring.

Pollutant concentration (C)

Statistical analysis of several urban runoff monitoring datasets has shown that the average storm concentrations for total phosphorus do not significantly differ between new and existing development sites. Therefore, a pollutant concentration, *C*, of 0.30 milligrams per liter (mg/l) should be used in this equation as a default. However, if good local data are available or an adjustment is needed, this factor can be customized for local condition.

The phosphorus pollutant export calculation is described by

$$L=0.227PP_jR_vCA$$
L=0.227PPjRvCA

where

- L = Load of a pollutant in pounds per year;
- P = Rainfall depth per year (inches);
- P_j = Fraction of rainfall events that produce runoff;
- R_v = Runoff coefficient, which expresses the fraction of rainfall which is converted into runoff. Rv = 0.05 + 0.009(I);
- I = Site imperviousness (i.e., I = 75 if site is 75% impervious);
- C = Flow-weighted mean concentration of the pollutant in urban runoff (mg/l); and
- A = Area of the development site (acres).

The above equation can be simplified to

$$L=0.20PR_vCA$$
L=0.20PRvCA

Calculating pre-development and post-development phosphorus load

The methodology for comparing annual pre-development pollutant loads to post-development pollutant loads is a six-step process:

1. Calculate site imperviousness;
2. Calculate the pre-development phosphorus load;
3. calculate post-development pollutant load;
4. Calculate the pollutant removal requirement;
5. Identify feasible BMPs; and
6. Select off-site mitigation option.

Step 1: Calculate site imperviousness

In this step, the applicant calculates the impervious cover of the pre-development (existing) and post-development (proposed) site conditions.

Impervious cover is defined as those surfaces in the landscape that impede the infiltration of rainfall and result in an increased volume of surface runoff. As a simple rule, human-made surfaces that are not vegetated will be considered impervious. Impervious surfaces include roofs, buildings, paved streets and parking areas and any concrete, asphalt, compacted dirt or compacted gravel surface.

Step 2: Calculate pre-development phosphorus load

Caution: The following equations use default values for phosphorus loading. It is best to use site-specific data if possible. If site-specific data are not available, values from the literature can be used for loading from specific land uses. For more information and phosphorus load information for different land uses, see Phosphorus in stormwater.

In this step, the applicant calculates stormwater phosphorus loadings from the site prior to development. Loading estimates in a new development situation utilizes a benchmark load for undeveloped areas based on average phosphorus loadings for a typical mix of undeveloped land uses and is given by

$$L_{pre}=0.5A$$
Lpre=0.5A

where

L_{pre} = Average annual load of total phosphorus exported from the site prior to development (lbs/year);
0.5 = Annual total phosphorus load from undeveloped lands (lbs/acre/year); and
A = Area of the site (acres).

The equation to determine phosphorus loading in a redevelopment situation is based on the Simple Method and is given by

$$L_{pre}=0.20PR_vCA$$
Lpre=0.20PRvCA

where;

L_{pre} = Average annual load of total phosphorus exported from the site prior to development (lbs/year);
P = Rainfall depth over the desired time interval (inches);
R_v = Runoff coefficient, which expresses the fraction of rainfall which is converted into runoff = 0.05 + 0.009(Ipre);
I_{pre} = Pre-development (existing) site imperviousness (i.e., I = 75 if site is 75% impervious);
C = Flow-weighted mean concentration of the pollutant (total P);
A = Area of the development site (acres); and
0.20 is a regional constant and unit conversion factor

Step 3: Calculate post-development pollutant load

In this step, the applicant calculates stormwater phosphorus loadings from the post-development, or proposed, site. Again, an abbreviated version of the Simple Method is used for the calculations, and the equation is the same for both new development and redevelopment sites.

$$L_{post}=0.20PR_vCA$$
Lpost=0.20PRvCA

where:

L_{post} = Average annual load of total phosphorus exported from the post-development site (lbs/year);

P = Rainfall depth over the desired time interval (inches);

R_v = Runoff coefficient, which expresses the fraction of rainfall which is converted into runoff = 0.05 + 0.009(I_{post});

I_{post} = Post-development (proposed) site imperviousness (i.e., I = 75 if site is 75% impervious);

C = Flow-weighted mean concentration of the pollutant (total phosphorus) in urban runoff (mg/l)= 0.30 mg/l;

A = Area of the development site (acres); and

0.20 is a regional constant and unit conversion factor.

Step 4: Calculate the pollutant removal requirement

The phosphorus load generated from the post-development site must be reduced so that it is 90 percent or less of the load generated prior to development. In this example, a 10 percent reduction in phosphorus loading from pre-development conditions is used. This should not be construed as a recommended reduction for the State of Minnesota. Applicants should check with local stormwater authorities to determine if specific pre- to post-development phosphorus reduction requirements exist. The amount of phosphorus that must be removed through the use of stormwater BMPs is called the Pollutant Removal Requirement (RR) and is given by

$$RR = L_{post} - 0.9 L_{pre}$$

where

RR= Pollutant removal requirement (lbs/year);

L_{post} = Average annual load of total phosphorus exported from the post-development site (lbs/year);

L_{pre} = Average annual load of total phosphorus exported from the site prior to development (lbs/year); and

0.90 is suggested post-development phosphorus load reduction. Local requirements may vary.

Step 5: Identify feasible BMPs

Step 5 looks at the ability of the chosen BMP to meet the site's pollutant removal requirements. The pollutant load removed by each BMP is calculated using the average BMP removal rate, the computed post-development load, and the drainage area served. If the load removed is equal to or greater than the pollutant removal requirement computed in Step 4, then the on-site BMP complies. If not, the designer must evaluate alternative BMP designs to achieve higher removal efficiencies, add additional BMPs, design the project so that more of the site is treated by the proposed BMPs, or design the BMP to treat runoff from an off-site area.

$$LR = L_{post} BMP_{RE} DA$$

where

LR = Annual total phosphorus load removed by the proposed BMP (lbs/year);

L_{post} = Average annual load of total phosphorus exported from the post-development site prior to development (lbs/year);

BMP_{RE} = BMP removal efficiency for total phosphorus (%); and

DA = Fraction of the drainage area served by the BMP (%)

Step 6: Select off-Site mitigation option

If the pollutant removal requirement has been met through the application of on-site stormwater BMPs, the process is complete.

In the event that on-site BMPs cannot fully meet the pollutant removal requirement and on-site design cannot be changed, an offset fee should be charge (e.g. $X per pound of phosphorus).

General summary of comparative BMP phosphorus removal performance[a,e,f]

Link to this table

BMP Group	BMP Design Variation		Average TP Removal Rate (%)[b]	Maximum TP Removal Rate (%)[c]	Average Soluble P Removal Rate (%)[d,g]
	Bioretention	Underdrain	see Phosphorus credits for bioretention systems with an underdrain	see Phosphorus credits for bioretention systems with an underdrain	see Phosphorus credits for bioretention systems with an underdrain
		Infiltration	• 100 for infiltrated portion • 0 for non-infiltrated portion	• 100 for infiltrated portion • 0 for non-infiltrated portion	• 100 for infiltrated portion • 0 for non-infiltrated portion
	Filtration	Media Filter	50	55	0
		Vegetative Filters (dry)	50	55	0
		Wet Swale	0	35	0
	Infiltration[f,i]	Infiltration Trench	• 100 for infiltrated portion • 0 for non-infiltrated portion	• 100 for infiltrated portion	• 100 for infiltrated portion • 0 for non-infiltrated portion

BMP Group	BMP Design Variation	Average TP Removal Rate (%)[b]	Maximum TP Removal Rate (%)[c]	Average Soluble P Removal Rate (%)[d,g]
			• 0 for non-infiltrated portion	
	Infiltration Basin	• 100 for infiltrated portion • 0 for non-infiltrated portion	• 100 for infiltrated portion • 0 for non-infiltrated portion	• 100 for infiltrated portion • 0 for non-infiltrated portion
Stormwater Ponds	Wet Pond	50	75	0
	Multiple Pond	60	75	0
Stormwater Wetlands	Shallow Wetland	40	45	0
	Pond/Wetland			0

[a] Removal rates shown in table are a composite of five sources: ASCE/EPA International BMP Database; Caraco (CWP), 2001; MDE, 2000; Winer (CWP), 2000; and Issue Paper D P8 modeling
[b] Average removal efficiency expected under MPCA Construction General Permit sizing requirements
[c] Upper limit on phosphorus removal with increased sizing and design features, based on national review
[d] Average rate of soluble phosphorus removal in literature
[e] See also Calculating stormwater volume and pollutant reductions and credits
[f] Note that the performance numbers apply only to that portion of total flow actually being treated; it does not include any runoff that by-passes the BMP
[g] Note that soluble P can transfer from surface water to ground water, but this column refers only to surface water
[h] Note that 100% is assumed for all infiltration, but only for that portion of the flow fully treated in theinfiltration facility; by-passed runoff or runoff diverted via underdrain does not receive this level of treatment

Caution: Removal rates shown here are composite averages intended solely for use in comparing performance between BMP designs and for use in calculating load reduction in site-based TP models. They have been adapted, rounded and slightly discounted from statistical values published in BMP performance databases.