TOWN OF PETROLIA

MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT FOR DEVELOPMENT OF A STORMWATER DRAINAGE MASTER PLAN FOR THE SOUTHEAST SERVICE AREA

MASTER PLAN REPORT

BMROSS
engineering better communities

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August 25, 2021

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File No. 17065

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TOWN OF PETROLIA
MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT
STORMWATER MASTER PLAN SERVICING STUDY

MASTER PLAN REPORT

1.0 INTRODUCTION

1.1 Purpose of the Report

The Town of Petrolia initiated a Municipal Class Environmental Assessment (Class EA) process in August 2018 to develop a Stormwater Servicing Master Plan for Petrolia's southeast service area. The Master Plan provides inventory and evaluates existing stormwater facilities within developed portions of the service area and investigates the most cost effective and efficient manner to provide stormwater servicing, where required, within the established and future development areas. The process followed the procedures set out in the Municipal Class Environmental Assessment (Class EA) document, dated October 2000, as amended in 2007, 2011 & 2015. B. M. Ross and Associates Limited (BMROSS) was engaged to conduct the Class EA process on behalf of the proponent.

The purpose of this report is to document the Master Planning process followed for this project. The report includes the following major components:

- An overview of the general project area.
- An inventory of existing stormwater infrastructure serving the community.
- A summary of deficiencies associated with the existing stormwater infrastructure.
- A description of the alternative solutions considered for resolving the defined problems.
- A synopsis of the decision-making process conducted to select a preferred alternative.
- A detailed description of the preferred alternative.

The Stormwater Servicing Master Plan, established through this process, will recommend a stormwater servicing strategy that could be implemented in phases within the established areas of the study area; as well as recommending best practices and strategies for addressing stormwater servicing within future development areas.

1.2 General Description of Master Plans

Master Plans are long-range plans which integrate infrastructure requirements for existing and future land uses with environmental assessment planning principles. These plans examine existing infrastructure systems within defined areas in order to outline a framework for planning subsequent works. Master Plans typically exhibit several common characteristics. They:

- Address the key principles of successful environmental planning.
- Provide a strategic level assessment of various options to better address overall system needs and potential impacts and mitigation.
- Address at least the first two phases of the Municipal Class EA process.
- Are generally long-term in nature.
- Apply a system-wide approach to planning which relates infrastructure either geographically or by a particular function.
- Recommend an infrastructure servicing plan which can be implemented through the completion of separate projects.
- Include a description of the specific projects needed to implement the Master Plan.

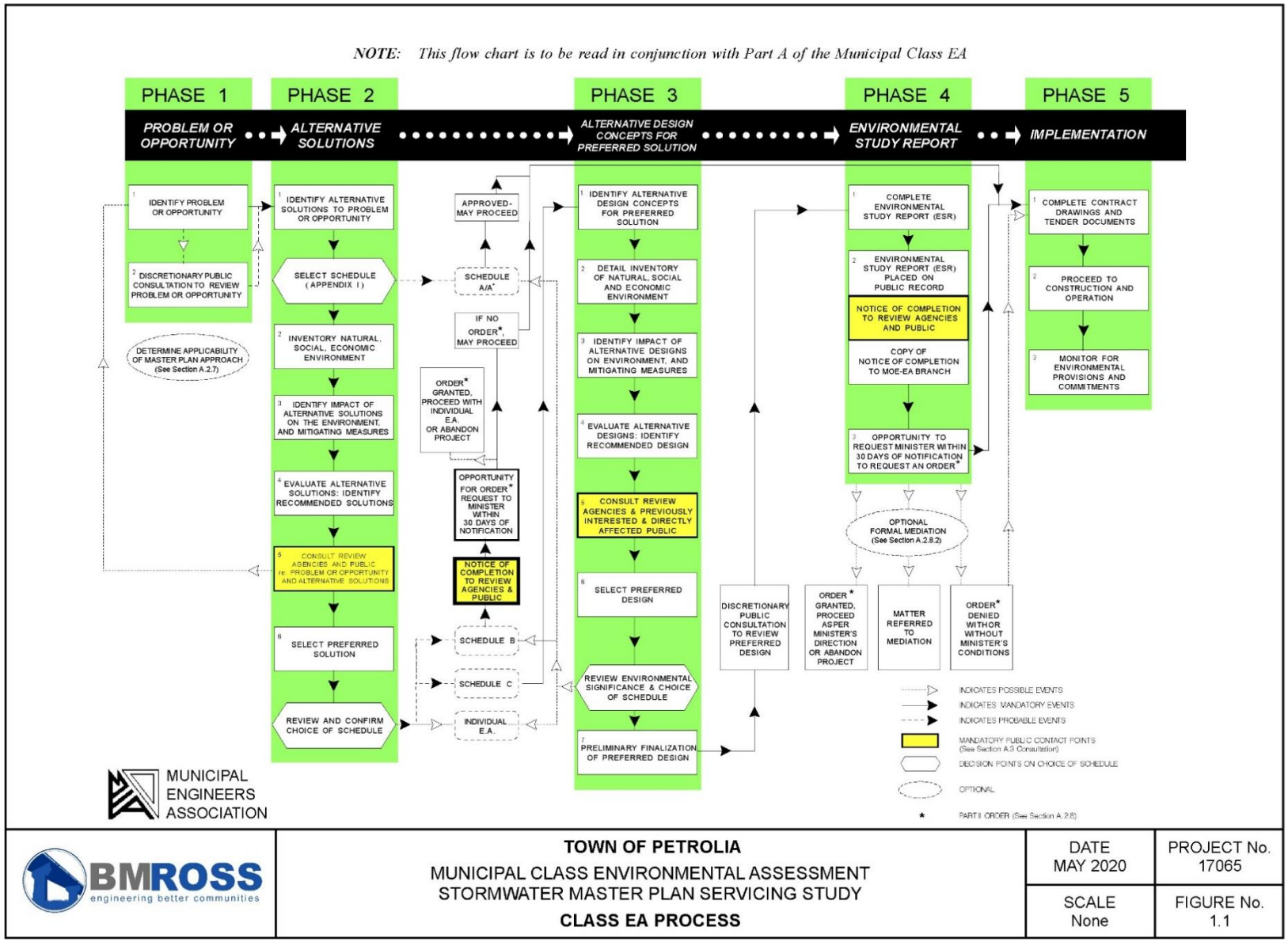
1.3 Integration with the Class EA Process

a) Class EA Project Phases

The Stormwater Servicing Master Plan has been completed in accordance with the planning and design process of the Municipal Class Environmental Assessment. The Class EA is an approved planning document which describes the environmental assessment process that proponents must follow in order to meet the requirements of the Environmental Assessment Act (EA Act).

The Class EA approach allows for the evaluation of alternative methods of carrying out a project and identifies potential environmental impacts. The Class EA planning process is divided into five project phases which are described below and illustrated in Figure 1.1.

Figure 1.1 - Class EA Process



- Phase 1 - Problem identification.
- Phase 2 - Evaluation of alternative solutions to the defined problems and selection of a preferred solution.
- Phase 3 - Identification and evaluation of alternative design concepts in selection of a preferred design concept.
- Phase 4 - Preparation and submission of an Environmental Study Report (ESR) for public and government agency review.
- Phase 5 - Implementation of the preferred alternative and monitoring of any impacts.

b) Classification of Project Schedules

Projects associated with Master Plans are classified to different project schedules according to the potential complexity and the degree of environmental impacts that could be associated with the project. There are four levels of schedules:

Schedule A – Projects that are approved with no need to follow the Class EA process.

Schedule A+ – Projects that are pre-approved but require some form of public notification.

Schedule B – Projects that are approved following the completion of a screening process that incorporates Phases 1 and 2 of the Class EA process, as a minimum.

Schedule C – Projects that are approved subject to following the full Class EA process.

The Class EA process is self-regulatory and municipalities are expected to identify the appropriate level of environmental assessment based upon the project they are considering.

1.4 Master Plan Framework

a) Alternative Approaches

The Class EA document provides proponents with four approaches for conducting Master Plan investigations, given the broad nature and scope of these studies. Proponents are encouraged to adapt and tailor the Master Planning process to suit the needs of the study being undertaken, providing that at a minimum, the assessment involves an evaluation of servicing deficiencies followed by a review of possible solutions (i.e., Phases 1 and 2 of the Class EA process). Table 1.1 summarizes the primary components associated with the four Master Plan approaches outlined within the MEA Class EA document.

Table 1.1 - Summary of Master Planning Approaches

Approach	Key Characteristics	Project Implementation
# 1	- Master Plan prepared at the conclusion of Phases 1 and 2 of the Class EA process. - Completed at a broad level of assessment. - Serves as basis for future investigations associated with specific Schedule B and C projects.	- Schedule B and C projects would require further Class EA investigations.
# 2	- Master Plan prepared at the conclusion of Phases 1 and 2 of MEA Class EA process. - More detailed level of investigation and consultation completed; such that it satisfies requirements for Schedule B screenings. - Final public notice for Master Plan serves as Notice of Completion for individual Schedule B projects.	- Schedule B projects are approved. - Schedule C projects must complete Phase 3 to 4 of Class EA process.
# 3	- Master Plan prepared at the conclusion of Phase 4 of Class EA process. - Level of review and consultation encompasses Phases 1 to 4 of the Class EA process. - Final public notice for Master Plan serves as Notice of Completion for Schedule B and C projects reviewed through the Master Plan.	- Class EA investigations are not required for projects reviewed through the Master Plan.
# 4	- Integration of Master Plan with associated Planning Act approvals. - Establishes need and justification in a very broad context. - Best suited when planning for a significant geographical area in the long term.	- Depending on level of investigation associated with the Master Plan, Class EA investigations may be required for specific projects.

b) Applied Framework

For the purposes of the Stormwater Servicing Master Plan, it was determined during the course of the investigation that Approach #1 would be the most appropriate planning framework to utilize for this assessment. The Master Plan therefore defines broad infrastructure requirements within the study area and will serve as a basis for additional infrastructure works associated with the implementation of project specific components.

The decision to apply Approach #1 for this Master Plan was based upon the following rationale:

- The level of review completed in conjunction with the Master Plan was not sufficient to satisfy the MEA Class EA process associated with Schedule B activities.
- The majority of the works identified through the Master Plan are Schedule A or Schedule A+ activities; therefore, the additional level of assessment was not warranted in conjunction with the study.
- There was insufficient detail associated with future stormwater detention facilities to complete the level of assessment required for Schedule B activities. It is also anticipated that future stormwater detention facilities will be designed and constructed by private developers under the under the Planning Act through site plan submissions.

Upon completion, the Master Plan document will form the basis for additional assessment required to support projects identified as part of the preferred infrastructure plan.

c) Approval Requirements

The Stormwater Servicing Master Plan is subject to approval from the Town of Petrolia but does not require formal approval under the EA Act. The Master Plan will be made available for public review. Subject to consideration of the proposed works and any comments received through consultation, the Master Plan will be approved by Municipal Council. However, if it is perceived that a project going through the Class EA process has significant environmental impacts, a person/party may convey their concerns to the Town of Petrolia for further consideration. A request may be made to the Ministry of the Environment, Conservation and Parks for an order requiring a higher level of study (i.e. requiring an individual/comprehensive EA approval before being able to proceed), or that conditions be imposed (e.g. require further studies); only on the grounds that the requested order may prevent, mitigate or remedy adverse impacts on constitutionally protected Aboriginal and treaty rights. Requests made on any other grounds will not be considered by the Ministry of Environment Conservation and Parks.

2.0 DESCRIPTION OF THE SERVICE AREA

2.1 General Environmental Setting

2.1.1 Town of Petrolia

The Town of Petrolia is a municipality centrally located within the upper-tier County of Lambton. The Town is situated approximately 25 km southeast of the City of Sarnia and is fully encompassed by the Township of Enniskillen. The Town of Petrolia has a land base of approximately 12.68 km^2 and a population of 5,742 residents as of 2016. The town has seen a rapid growth of new residential development in recent years, experiencing an increase in population of 3.9% since 2011. The urban settlement area

generally consists of a low-density residential community, with a central commercial core. The Town has also established a highway commercial area on the east side of the community, as well as an industrial area predominately in the northeast quadrant. The Bear Creek River corridor meanders in a southwest direction through the town and merges with Black Creek east of Wilksport, together forming the north branch of the Sydenham River. Figure 2.1 illustrates the general location of Petrolia within southwestern Ontario and the County of Lambton

2.1.2 Study Area Limits

The project study area is located within the southeast quadrant of the Town of Petrolia and is bounded by Oil Heritage Road to the east, the Town of Petrolia municipal boundary to the south, Bear Creek to the west and the existing residential developments on North Street to the north (Figure 2.2). The study area is approximately 2.7 km^2 (267.7 hectares) in size and contains over 550 properties, including: residential, institutional, commercial, open space/natural areas, and undeveloped agricultural land.

Developed properties within the study area limits are generally located along the north and west limits of the study boundary. The easterly extent of the project limits, located between Oil Heritage Road and First Avenue, are comprised of agricultural lands that are actively farmed. The south limit of the study area is comprised of natural features located adjacent to the Little Bear Creek riverine corridor.

2.2 Natural Environment

2.2.1 General Physiography

The Town of Petrolia is located within a bevelled till plain physiographic region, which is relatively flat, with soils consisting of silt and clay. The subject area consists of three different soil types: *Bottom Land, Perth Clay,* and *Brookston Clay* soils. Bottom Land soils are found adjacent to watercourses; therefore, they are typically moist at all times and subject to flooding periodically throughout the year (ON Soil Survey). Tree coverage in these areas generally consists of willow, elm and ash trees. The soil composition consists of layers of silt, sand and clay intermixed with layers of organic matter (ON Soil Survey). The Bottom Land soils within the subject area are located adjacent to both Bear Creek and Durham Creek tributaries. Surrounding the Bottom Land area are Perth Clay soils, which are classified as the imperfectly drained soils of the Huron catena. The natural vegetation within these areas generally consists of ash, elm, soft maple, as well as some oak and hickory. The northwest portion of the subject area, which includes lands north of 6th Street, consist of Perth Clay soils. The remaining area of the subject lands consist of Brookston Clay soils. The Brookston series soils are classified as the poorly drained soils of the Huron catena. These soils occupy the largest acreage within the County of Lambton. The natural vegetation within this soil area generally consists of ash, elm, basswood, as well as some hickory and sycamore.

Figure 2.1 General Location Plan

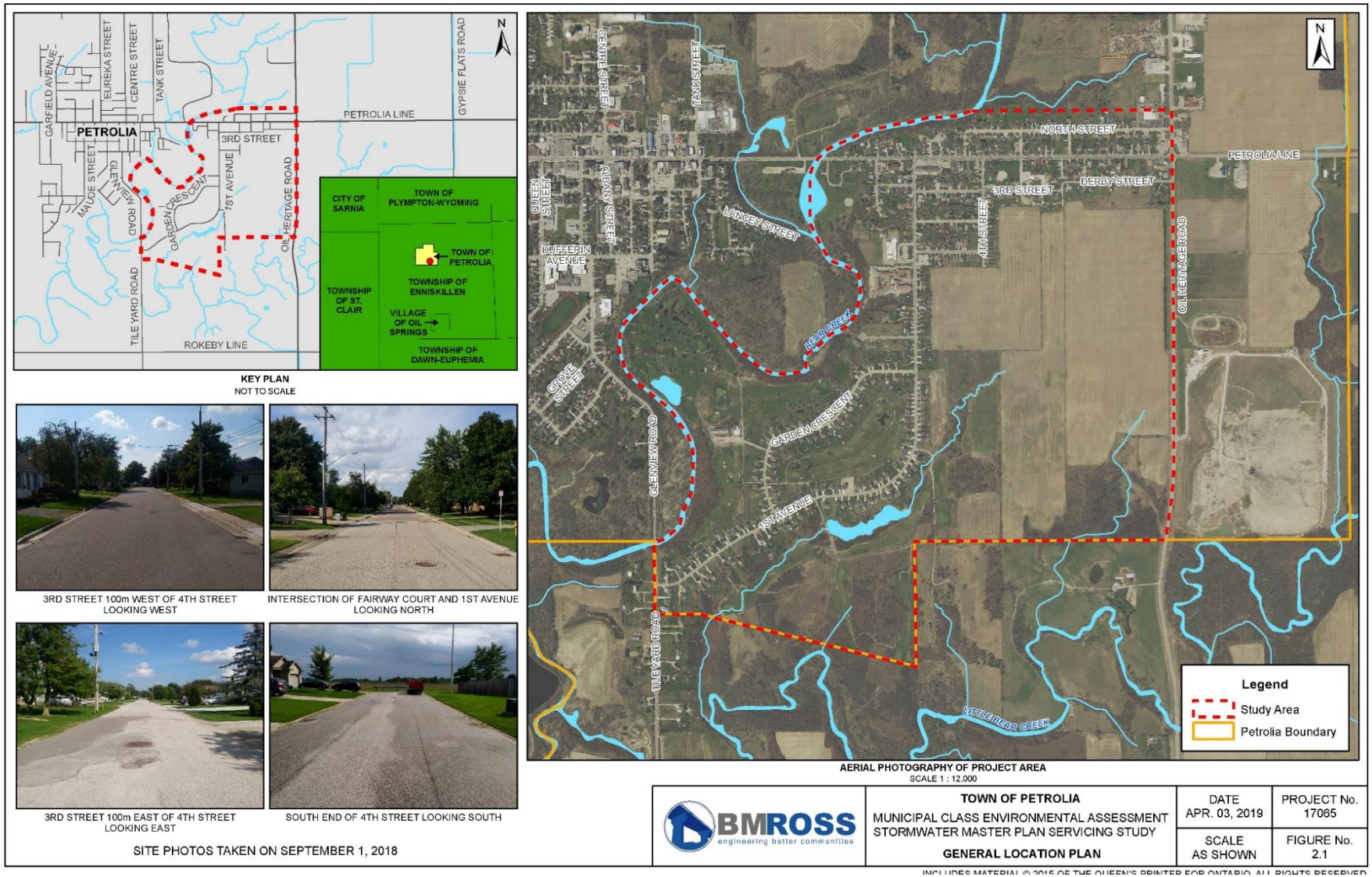
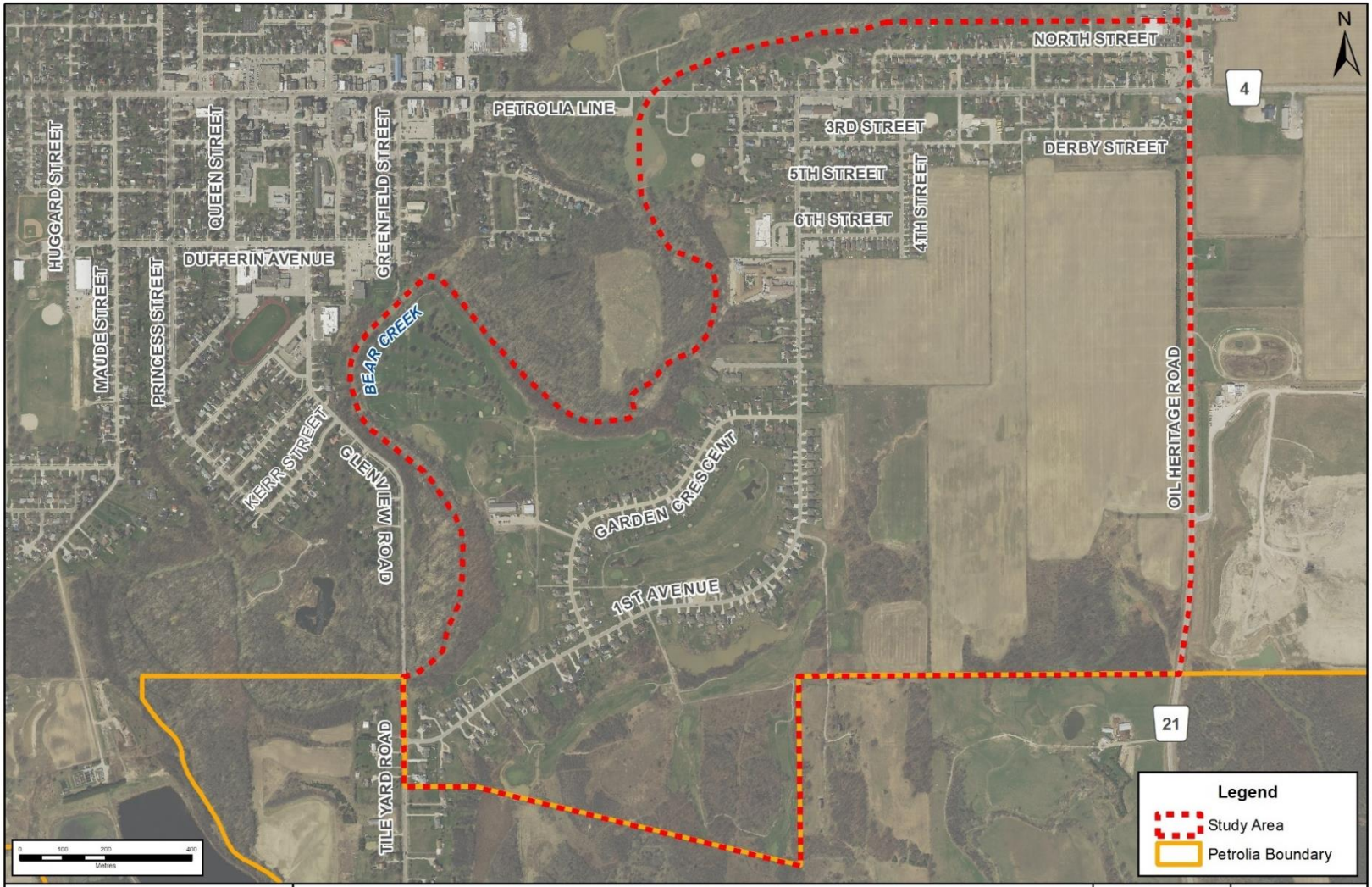


Figure 2.2 Project Study Area



2.3 Significant Natural Heritage Features

A general review of the natural heritage features within the study area was completed utilizing the Natural Heritage Area mapping provided by the Ministry of Natural Resources and Forestry (MNRF), Town of Petrolia and Lambton County Official Plans and the St. Clair Region Conservation Authority Watershed report cards. Natural heritage features located in close proximity to the study area are shown in Figure 2.3 and include:

- Bridgeview CA Wetland (SC37) (locally significant wetland);
- Lorne C. Henderson Conservation Area and wetland (Provincially significant wetland);
- Bear Creek; and
- Durham Creek (and associated tributaries).

2.3.1 Wetlands

One (1) locally significant wetland; the Bridgeview CA Wetland (SC37) occurs in close proximity to the study area and receives flows from Bear Creek and the surrounding drainage areas. This wetland is considered to be locally significant within the watershed landscape, and the lands are regulated by the St. Clair Region Conservation Authority (SCRCA) under O. Reg 147/06 (Regulation of development, interference, with wetlands and alterations to shorelines and watercourses).

One (1) provincially significant wetland is located approximately 3.5 km west of the study area within the Lorne C. Henderson Conservation Area.

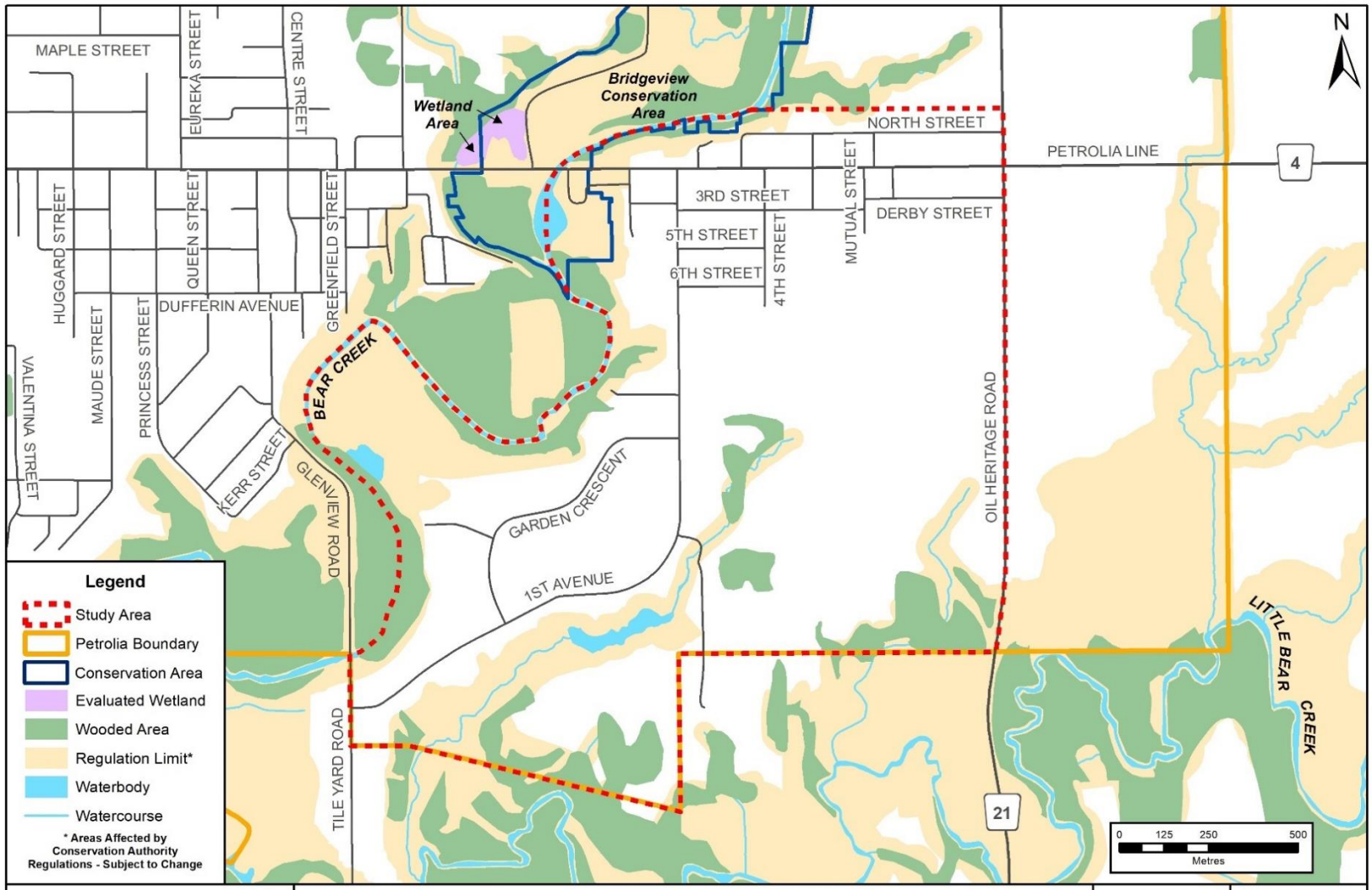
2.3.2 Significant Woodlands

A number of wooded areas exist within the study area limits, situated along the riparian corridors associated with Bear Creek and Durham Creek. Portions of these wooded areas meet the criteria for significance established through the Lambton County Natural Heritage Study and are mapped accordingly on Schedule A of the Petrolia Official Plan (OP) and Map 2 – Natural Heritage System, of the Lambton County OP. Several factors were examined to determine woodland significance including size, connectivity, proximity to other features, water protection, habitat for significant species, and interior forest habitat. These areas are illustrated on Figure 2.3.

2.3.3 Aquatic Habitats and Associated Species

Bear Creek and Little Bear Creek (Durham Creek) are located within the Bear Creek Headwaters watershed, which is managed by the SCRCA. The watershed includes a drainage area measuring 379 km^2 and watercourse length of 685 km forming northeast of the Village of Warwick and eventually discharging into Lake St. Clair (SCRCA, 2013). Within Bear Creek, the SCRCA has identified 30 species of fish, including Largemouth Bass and 10 freshwater mussel species to be present (SCRCA, 2013).

Figure 2.3 Natural Heritage



Appendix 'A' contains a copy of the watershed report card for Bear Creek. Figure 2.3 shows the location of Bear and Little Bear Creeks in relation to local natural heritage features.

Aquatic Resource Area data is available for Bear Creek, although it is assumed to be similar for Durham Creek given its close proximity and connectedness. The thermal regime of Bear Creek is warm, with the following species known to be present: Black Bullhead, Blackside Darter, Brook Stickleback, Channel Catfish, Blackstripe Topminnow, Fathead Minnow, Gizzard Shad, Green Sunfish, Johnny Darter/Tesselated Darter, Logperch, Redfin Shiner, Tadpole Madtom, White Crappie, and White Sucker. Both watercourses are regulated by SCRCA under O. Reg 147/06 (Development, interference with wetlands and alterations to shorelines and watercourses).

2.3.4 Species at Risk

An evaluation for the presence of significant species and their associated habitats has been incorporated into the planning process. A review of available information on species and habitat occurrences determined that the study area may contain species and/or habitat that is legally protected under Provincial and Federal species at risk legislation. The protection for species at risk and their associated habitats is directed by the following federal and provincial legislation:

- The Federal *Species at Risk Act, 2002* (SARA) provides for the recovery and legal protection of listed wildlife species and associated critical habitats that are extirpated, endangered, threatened or of special concern and secures the necessary actions for their recovery. On lands not federally owned, only aquatic species, and bird species included in the Migratory Bird Convention Act (1994), are legally protected; and
- The Provincial Endangered Species Act, 2007 (ESA) provides legal protection of endangered and threatened species and their associated habitat in Ontario. Under the legislation, measures to support their recovery are also defined. Based on the information available for the occurrence of species at risk and their associated habitats from the following sources, a summary of all known federally and provincially recognized species with the potential to be present are listed in Table 2.1:
    - Ministry of Natural Resources and Forestry, *Township of Enniskillen.* Municipal Species at Risk Reference Guide (Ministry of Natural Resources and Forestry, 2019b);
    - Natural Heritage Information Centre (NHIC), *Make a Natural Heritage Map* (Ministry of Natural Resources and Forestry, 2019a). Study area located within NHIC 1km grids: 17MH0647 and 17MH0747;
- Environment Canada, *Species at Risk Public Registry. SARA Schedule 1 Species List* (Environment Canada, 2019);
- Ontario Nature, Ontario Reptile and Amphibian Atlas, Mapping tool (Ontario Nature, 2019). Study area located within grid: 17MH04.

Table 2.1 Potential Species at Risk within the Township of Enniskillen and the Study Area

	Species		Status Designation		Suitable Habitat in the Study Area
	Common Name	*Scientific Name*	*SARA*[*] Schedule 1 *(Federal)*	*ESA*[**] *(Provincial)*	
Birds	Acadian Flycatcher	*Empidonax virescens*	Endangered	Endangered	No
	Bank Swallow	*Riparia virescent*	Threatened	Threatened	No
	Barn Swallow	*Hirundo rustica*	-	Threatened	Potential
	Barn Owl	*Tyto alba*	Endangered	Endangered	No
	Bobolink	*Dolichonyx oryzivorus*	-	Threatened	Potential
	Cerulean Warbler	*Dendroica cerulea*	Special Concern	Threatened	No
	Chimney Swift	*Chaetura pelagica*	Threatened	Threatened	Potential
	Eastern Meadowlark	*Sturnella magna*	-	Threatened	Potential
	Least Bittern	*Ixobrychus exilis*	Threatened	Threatened	No
	Prothonotary Warbler	*Protonotaria citrea*	Endangered	Endangered	No
	Yellow-breasted Chat	*Icteria virens*	Special Concern	Endangered	No
Fish and Mussels	**Blackstripe Topminnow**	***Fundulus notatus***	Special Concern	Special Concern	No
	Mapleleaf	*Quadrula quadrual*	Threatened	Special Concern	No
	Rainbow	*Villosa iris*	Endangered	Special Concern	No
	Round Pigtoe	***Pleurobema sintaoxia***	Endangered	Endangered	No
	Spotted Sucker	***Minytrema melanops***	Special Concern	Special Concern	No
Mammals	Eastern Small-footed Myosis	*Myotis leibii*	-	Endangered	Potential
	Little Brown Myotis	*Myotis lucifungus*	Endangered	Endangered	Potential
	Northern Myotis	*Myotis septentrionalis*	Endangered	Endangered	Potential
	Tri-colored Bat	*Perimyotis subflavus*	Endangered	Endangered	Potential

Table 2.1 Potential Species at Risk within the Township of Enniskillen and the Study Area

	Species		Status Designation		Suitable Habitat in the Study Area
	Common Name	*Scientific Name*	*SARA*[*] Schedule 1 *(Federal)*	*ESA*[**] *(Provincial)*	
Plants	American Chestnut	*Castanea dentata*	Endangered	Endangered	No
	American Ginseng	*Panax quinquefolius*	Endangered	Endangered	No
	Blue Ash	*Fraxinus quadrangulata*	Special Concern	Threatened	Potential
	Butternut	*Juglans cinerea*	Endangered	Endangered	No
	Eastern Flowering Dogwood	*Cornus florida*	Endangered	Threatened	No
	Kentucky Coffee-tree	***Gymnocladus dioicus***	Threatened	Threatened	Potential
Snakes and Lizards	Common Five-lined Skink	*Plestiodon fasciatus*	-	Endangered	No
	Eastern Milksnake	*Lampropeltis traingulum*	Special Concern	Special Concern	Potential
Turtles	Blanding's Turtle	*Emydoidea blandingii*	Threatened	Threatened	No
	Spotted Turtle	*Clemmys guttata*	Endangered	Endangered	No

Species in **bold** are those identified as potentially occurring within 1km of the study area based on historical observation records

Notes:
[*] As determined by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) under the Species at Risk Act (SARA), 2002 legislation. Species listed are designated as 'Schedule 1' species and are legally protected under the act.
[**] As determined by the Committee on the Status of Species at Risk in Ontario (COSSARO) under the Endangered Species Act (ESA), 2007 legislation.

The study area is located in the area covered by the *Township of Enniskillen Species List*, provided by MNRF. The list incorporates a large area and a wide variety of environs that include both terrestrial and aquatic habitat. Species listed in Table 2.1 were generated based on their occurrence within the entire Township; and may not necessarily occur within the study area. The NHIC 1 km grids (17MH0647 and 17MH0747) contain 4 historical observation records for species at risk potentially located within the study area:

- Kentucky Coffee-tree (*Gymnocladus diocus*) observation from 1995
- Blackstripe Topminnow (*Fundulus notatus*) observation from 1997
- Spotted Sucker (*Minytrema melanops*) observation from 1997
- Round Pigtoe (Pleurobema sintoxia) observation from 2013

Additional studies may be required, prior to implementation of capital projects associated with the Master Plan, to ensure that any identified Species at Risk and their habitats will not be negatively impacted by the proposed works.

2.3.5 Aquatic Species

Aquatic Species at Risk are aquatic based species that either live in, or rely on, an aquatic habitat for a significant portion of their life cycle. In conjunction with information gathered from the MNRF and Environment Canada Species at Risk Registry, a publicly available aquatic species at risk mapping tool was utilized in determining the potential presence of aquatic species at risk and their associated critical habitat within the vicinity of the proposed project.

Based on the results from the aquatic species at risk mapping tool, Table 2.2 summarizes the species (and their associated critical habitats) that have the potential to be located adjacent to the study area and may be impacted by the project. Associated federal and provincial status designations for each species can be found in Table 2.1.

Table 2.2 Potential Aquatic Species at Risk Occurrence Adjacent to the Study Area

Fish Species	Mussel Species
Blackstripe Topminnow (SC)	Fawnsfoot (TH)*
	Threehorn Wartyback (END)*****
Spotted Sucker (SC)	Mapleleaf (SC)
Northern Sunfish (SC)	Rainbow (SC)
	Round Pigtoe

******* *indicates critical habitat present (SARA protection)*

The portion of Bear Creek, along the west side of the study area, is identified as a critical habitat for two species at risk mussels: the Fawnsfoot mussel and Threehorn Wartyback mussel. Input will be sought from the SCRCA, the Ministry of Environment, Conservation and Parks (MECP) and the Federal Department of Fisheries and Oceans (DFO) as part of the approval process to identify any potential impacts to these species from the proposed stormwater servicing strategy.

2.3.6 Breeding Birds

The Atlas of Breeding Birds of Ontario was used to identify bird species with confirmed, probable and possible, breeding habitat in proximity to the study area (Bird Studies Canada, 2019). The survey area includes key habitat for the identified species, such as forests (in all stages of growth), riverine areas, agricultural areas and wetlands.

The study area lies within the 100 km^2 area identified by the Atlas as Square 17TMH04, in Region 3: Lambton Region. Within the square, a total of 36 bird species have confirmed breeding status in the survey region, including the Barn Swallow, a threatened species in Ontario. An additional 21 species were categorized as having probable breeding status and 18 are considered to have possible breeding status in the area (Bird Studies Canada).

Additional studies and investigations may be required prior to implementation of capital works identified through the Master Plan process to ensure that breeding or migratory birds are protected during the construction process.

2.3.7 Source Water Protection

The intent of the Clean Water Act (CWA), 2006, is to "*protect existing and future drinking water sources*" in Ontario. Under the Act, source protection areas and regions were established, giving Conservation Authorities the duties and powers of a drinking water source protection authority (Government of Ontario, 2006). A focus on the development, implementation, monitoring and enforcement of documentation, information and policies related to source water protection is highlighted within this duty.

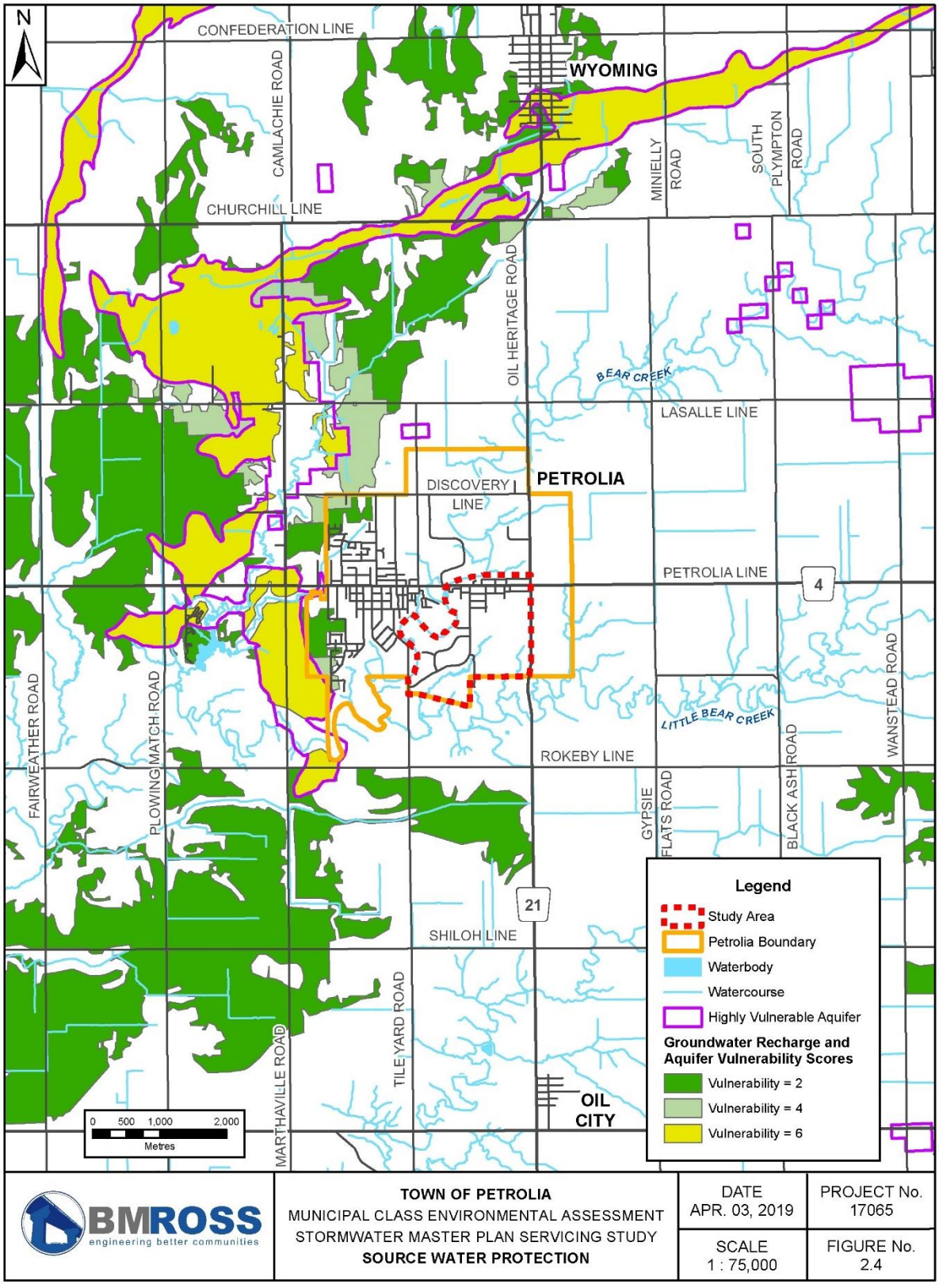
The study area is located within the Thames-Sydenham Source Protection Region under the jurisdiction of the St. Clair Region Conservation Authority. The Source Protection Region includes watersheds managed by the Lower Thames Valley Conservation Authority, St. Clair Region Conservation Authority and the Upper Thames River Conservation Authority.

The Town of Petrolia is currently serviced by the Petrolia Water Treatment Plant, which draws water from Lake Huron at Bright's Grove and services the Town of Petrolia, Township of Enniskillen, Village of Oil Springs, Township of Dawn- Euphemia, and parts of the Township of Brooke-Alvinston (Thames-Sydenham and Region Source Protection Committee, 2015).

The study area does not contain any vulnerable source water protection areas. West of the study area, a Highly Vulnerable Aquifer (HVA) and a Significant Groundwater Recharge Area (SGRA) with a vulnerability score of 6 exists. It is anticipated that a stormwater servicing strategy will have no impacts on the source water protection areas given their location in relation to the study area.

Consultation with Source Water Protection staff will be undertaken as part of the Class EA process to ensure that the implementation of the project will have no impact on the identified vulnerable areas outside of the study area. Figure 2.4 shows vulnerable areas in Petrolia identified through Source Water Protection investigations.

Figure 2.4 Source Water Protection



2.3.8 Climate Change

As part of the Class Environmental Assessment process, the impacts associated with climate change need to be evaluated. Some of the phenomena associated with climate change that will need to be considered include:

- Changes in the frequency, intensity and duration of precipitation, wind and heat events.
- Changes in soil moisture.
- Changes in sea/lake levels.
- Shifts in plant growth and growing seasons.
- Changes in the geographic extent of species ranges and habitat.

There are two approaches that can be utilized to address climate change in project planning. These are as follows:

1) Reducing a project's impact on climate change (climate change mitigation).
    a. Impact of greenhouse gas emissions related to the project.
    b. Are there alternative methods to completing the project that would reduce any adverse contributions to climate change?

2) Increasing the project's and local ecosystem's resilience to climate change (climate change adaptation).
    a. How vulnerable is the project to climate-related severe events?
    b. Are there alternative methods of carrying out the project that would reduce the negative impacts of climate change on the project?

Through the evaluation of alternatives phase of the Class EA, consideration of each of these approaches will be completed and included in the final determination of the preferred approach to completing the project. Extreme rainfall events associated with climate change will also be considered during modeling exercises conducted as part of the review.

Additional measures can also be incorporated into the design of end of pipe facilities to ensure that appropriate measures are installed to protect against overtopping and downstream erosion resulting from extreme rainfall events.

2.4 Socio-Economic Environment

2.4.1 Land Use Planning

a) Provincial Policy Statement

The Provincial Policy Statement (PPS) (2020) was issued under Section 3 of Planning Act and provides policy direction on matters of provincial interest. A number of the policies contained within the PPS have relevance to the current application. Excerpts from the Policy document are included below as follows:

Section 1.6.6 Sewage, Water and Stormwater

1.6.6.1 Planning for sewage and water services shall:

a) accommodate forecasted growth in a manner that promotes the efficient use and optimization of existing:

1. municipal sewage services and municipal water services; and

2. private communal sewage services and private communal water services, where municipal sewage services and municipal water services are not available or feasible;

b) ensure that these systems are provided in a manner that:

1. can be sustained by the water resources upon which such services rely;

2. prepares for the impacts of a changing climate;

3. is feasible and financially viable over their lifecycle; and

4. protects human health and safety, and the natural environment;

c) promote water conservation and water use efficiency;

d) integrate servicing and land use considerations at all stages of the planning process; and

1.6.6.7 Planning for stormwater management shall:

a) be integrated with planning for sewage and water services and ensure that systems are optimized, feasible and financially viable over the long term;

b) minimize, or, where possible, prevent increases in contaminant loads;

c) minimize erosion and changes in water balance, and prepare for the impacts of a changing climate through the effective management of stormwater, including the use of green infrastructure;

d) mitigate risks to human health, safety, property and the environment;

e) maximize the extent and function of vegetative and pervious surfaces; and

f) promote stormwater management best practices, including stormwater attenuation and re-use, water conservation and efficiency, and low impact development.

Section 2.2 Water

2.2.1 Planning authorities shall protect, improve or restore the quality and quantity of water by:

a) using the watershed as the ecologically meaningful scale for integrated and long-term planning, which can be a foundation for considering cumulative impacts of development;
b) minimizing potential negative impacts, including cross-jurisdictional and cross-watershed impacts;
c) evaluating and preparing for the impacts of a changing climate to water resource systems at the watershed level;
d) identifying water resource systems consisting of ground water features, hydrologic functions, natural heritage features and areas, and surface water features including shoreline areas, which are necessary for the ecological and hydrological integrity of the watershed;

e) maintaining linkages and related functions among ground water features, hydrologic functions, natural heritage features and areas, and surface water features including shoreline areas;

f) implementing necessary restrictions on development and site alteration to:

a. protect all municipal drinking water supplies and designated vulnerable areas; and

b. protect, improve or restore vulnerable surface and ground water, sensitive surface water features and sensitive ground water features, and their hydrologic functions;

g) planning for efficient and sustainable use of water resources, through practices for water conservation and sustaining water quality;

h) ensuring consideration of environmental lake capacity, where applicable; and

i) ensuring stormwater management practices minimize stormwater volumes and contaminant loads, and maintain or increase the extent of vegetative and pervious surfaces.

b) Lambton County Official Plan

The Lambton County Official Plan was recently updated and was adopted by County Council on September 6, 2017. The new plan was approved by the Province on March 21, 2018, with modifications. Map 1 Growth Strategy, of the new Official Plan, designates the subject lands as 'Urban Centre'. Map 2 identifies the County's Natural Heritage System and features. The subject lands contain areas identified as Primary Corridors (Group "C" Features). These areas surround surface water features including, Bear Creek and Durham Creek. The southeast corner of the subject lands includes a portion of a Group "B" Feature, identified as Feature 25 on Map 2, being Little Bear Creek in the Feature Inventory. This area is identified as an Environmentally Sensitive Area (ESA), meaning that it contains significant natural features.

Appendix Map A - Source Water Protection indicates that the subject lands do not contain areas of significant, moderate, or low drinking water threat. The subject lands also do not contain potential aggregate deposits as shown in Appendix Map B – Mineral Aggregate Resources. Appendix Map C, of the County of Lambton Official Plan, identifies oil, natural gas and salt resources within the County. This map indicates that the subject lands are almost entirely located within an Oil Pool area, which contains numerous inactive hydrocarbon wells.

Appendix Map D – Natural Hazards indicates that the subject lands do not contain potential hazardous forest types or potential Karst natural hazards. Appendix Map E – CLI Class for Agriculture indicates that the subject lands contain predominately Class 2 soil. The map also indicates that there are Class 1 and Class 5 soils located within the subject area.

Lambton County has projected populations up to the year 2031 for each municipality, which are summarized in a table within the County of Lambton Official Plan. The Town of Petrolia has a projected population of 6,410 to 7,372 by 2031, with an estimated 36 dwellings allocated annually. The majority of future urban growth is to be directed to Urban Centres and Urban Settlement areas, with full municipal services depending on the availability of sufficient municipal water and sewer services.

c) Petrolia Official Plan

The study area contains lands of various designations: including Residential; General Commercial, Open Space areas which include Kerr Park located east of the General Commercial area on Petrolia line, and the Kingswell Glen Golf Course located at the central south boundary of the study area; a Residential Special Policy Area adjacent to the Golf Course lands; Highway Commercial along the east boundary on Oil Heritage Road; and Hazard (SCRCA) and Significant Woodlot areas in the south, west, and northwest areas of the subject lands along Bear Creek and the Durham Creek tributaries. A majority of the site is designated Residential. The Town of Petrolia's Official Plan contains the following policies in regards to Stormwater Management:

Stormwater Management Section 4.3

The Town of Petrolia has traditionally managed stormwater through the removal of runoff from parking lots, roads, and lots using a system of subsurface drains to nearby watercourses. The Town of Petrolia Official Plan states that this traditional approach has a number of drawbacks including the potential for water pollution, erosion, lowered water tables, excessive loading of sewage treatment plants where storm sewers connect with sanitary sewers, and increased dependence upon costly public drainage works infrastructure. The Town of Petrolia's Official Plan states four objectives for stormwater management within the town:

4.3.1.1 Considering a changing climate and potential negative impacts, maintain the existing volume and rate of stormwater runoff; to control flooding, erosion and sedimentation; to enhance ground and surface water quality; and to promote a net gain in fisheries habitat and other natural features.

4.3.1.2 To minimize or mitigate adverse impacts on stream water quality that may occur as a result of development.

4.3.1.3 To encourage neighbouring municipalities to participate, in a coordinated manner, with the Town and the St. Clair Region Conservation Authority in implementing watershed and sub-watershed planning.

4.3.1.4 Considering a changing climate and potential negative impacts, provide appropriate guidelines for proper stormwater management and to form the basis for the development of stormwater collection and treatment systems in urban areas.

The Town of Petrolia's Official Plan contains polices for stormwater management through watershed and subwatershed plans, retention and detention, and management principles, separation of stormwater and sanitary, and municipal drains. The Official Plan provides the following policies:

4.3.2.1 The Town will consider programs, regulations and new technology that enhance the natural ability of the environment to reduce the rate of stormwater runoff, and to improve the quality of stormwater conveyed to the watercourses in the Town. The Town may support the St. Clair Region Conservation Authority in preparation and implementation of Watershed and Sub-Watershed Plans.

4.3.2.2 Development proponents will be encouraged to employ Best Management Practices as the preferred strategy for the management of stormwater. The following methods should be encouraged:

a. The use of greenspace for detention/retention ponds;

b. The use of cisterns or drywells on site which capture water for non-potable uses (lawn watering, car washing);

c. The use of infiltration trenches;

d. The use of natural systems and processes such as man-made wetlands and permeable landscape surfaces to absorb and distribute stormwater and recharge groundwater;

e. The use of oil grit separators and permeable surfaces.

f. The integration of detention/retention ponds into the municipal open space system.

4.3.2.3 To achieve no overall increase in the peak level and volume of stormwater runoff by requiring that all new development should provide suitable site grading and outlet facilities for storm drainage purposes, and will be guided by the following principles:

a) that the flow of water resulting from a stormwater facility(s) does not create or contribute to an erosion problem and/or water quality impairment;

b) that a stormwater facility does not contribute to a drainage problem on other lands where such lands are intended to be developed, utilized for agricultural purposes or utilized for active recreational open space;

c) that any stormwater facility is designed in accordance with accepted engineering standards;

d) that the stormwater facility does not adversely affect the hydrology of environmentally sensitive areas;

e) that the Town may consult the St. Clair Region Conservation Authority, and the Province when considering multiple consents and plans of subdivision.

f) stormwater management facilities require the issuance of a certificate of approval under the Ontario Water Resources Act.

4.3.2.4 The Town will encourage the separation of stormwater inflow/infiltration from municipal sanitary waste water systems and initiate the disconnection of rooftop leaders from sewers and elimination of other factors that have added stormwater to combined sewer.

4.3.2.5 The principles of natural channel design will be utilized in the construction or rehabilitation of drains. This may include the following:

a) grassed slopes and other forms of plantings should be introduced and should be maintained on the banks of drains which add to the stability of the drainage channel but which do not adversely affect the function of the drain;

b) tile outlets will be constructed to minimize erosion along watercourses;

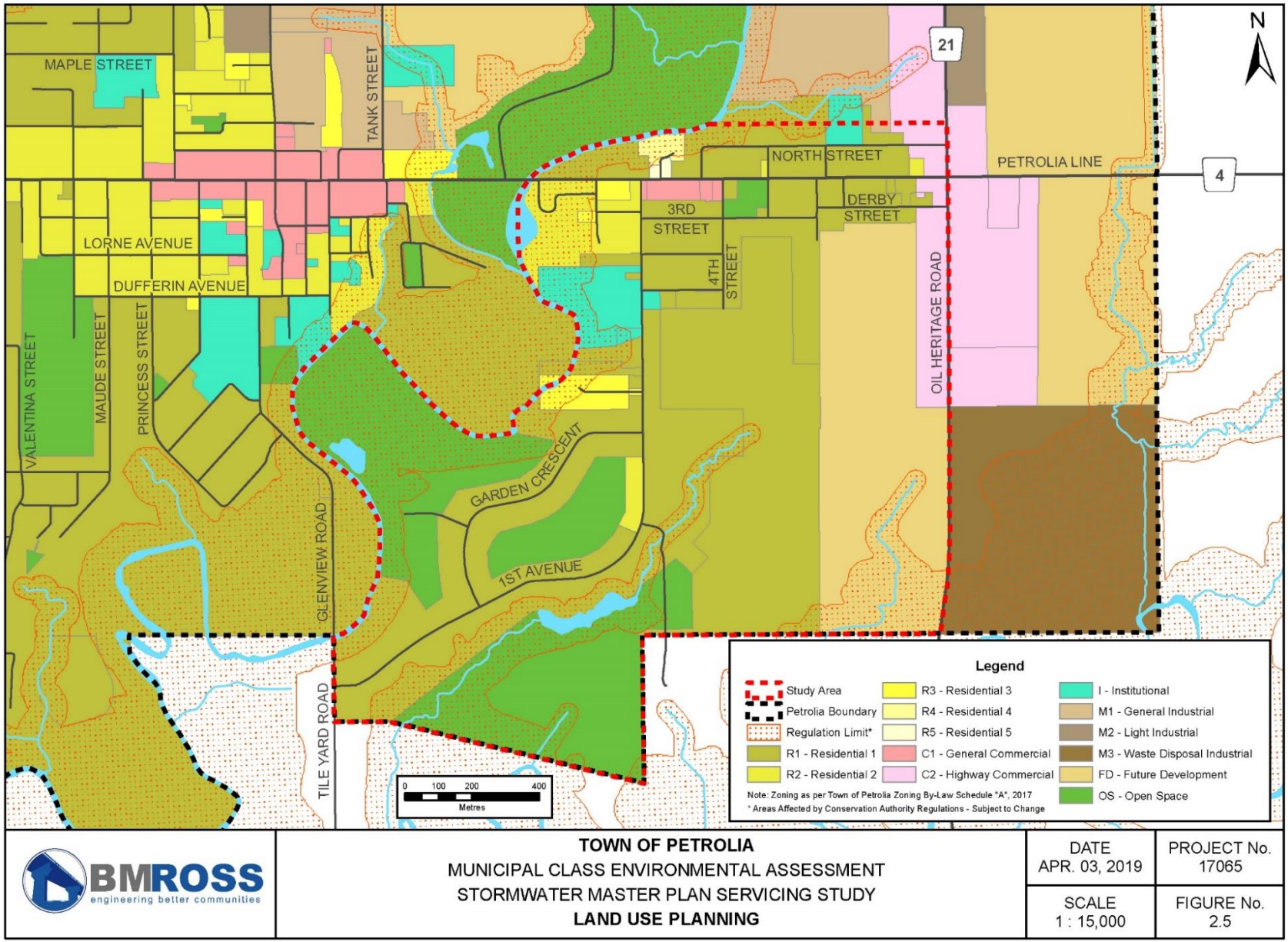
c) tree planting or other buffer measures should be installed where appropriate to act as a windbreak, protect drain banks, and act as a barrier for uses too close to drain banks;

d) ponding areas should be incorporated in drains to reduce the speed and volume of flow, act as settling areas for water borne particulate, enhance evaporation and serve as water storage areas.

d) Town of Petrolia Zoning By-Law 63 of 2017

The subject area contains approximately 19 different zones and site-specific zones, including Residential, Institutional, General Commercial, Highway Commercial, General Industrial, Open Space, Environmental Protection, and Future Development. There are seven site specific zones which provide exceptions to permitted uses and site regulations. A large portion of the lands are zoned FD-Future Development and R1-H-Residential-1 with a Holding Provision. The holding provision of these lands shall be removed pursuant to Section 36 of the Planning Act S.O. 1996, c.4 only upon the granting of draft approval plan of subdivision on the subject lands. A majority of the lands zoned for residential use are R1- Residential 1 and permit both single detached dwellings and duplex uses. Figure 2.5 illustrates existing land uses within the study area.

Figure 2.5 Land Use within the Study Area



2.4.2 Resident Questionnaire

a) General

In September 2018 a questionnaire was developed by BMROSS to gather background information from local property owners on existing drainage in the vicinity of their properties. The survey was mailed to all property owners located within the study area limits and included general questions about the nature of existing development on their property, as well as the condition of existing drainage conditions in the area. Of the 540 surveys that were initially mailed out 202 were completed and returned, representing an approximate return rate of 37%. A copy of the questionnaire and a summary of the responses is included within Appendix 'B'.

b) Results

Completed questionnaires were compiled in a database. The information was utilized to understand the type of properties affected by the project as well as to identify areas within the community where existing drainage was a concern. Based upon the results, a series of maps were created which highlight problem drainage areas within the study area. The intent was not to identify individual drainage concerns, but rather to confirm general areas within the community where several properties, or clusters of homes, were experiencing drainage issues. This information was then referenced, in conjunction with the results of the infrastructure assessment and hydraulic modeling, to identify problem areas with the existing drainage network.

Figure 2.6 illustrates the results of the first two questions on the questionnaire, being whether the properties are developed or vacant and the current use of the property. The next chart indicates how often study area properties experienced drainage problems in a year.

Figure 2.7 indicates that a majority of the respondents felt that drainage on their property is currently characterized as either good or fair, while a similar number of residents indicated that they had never or rarely experienced drainage problems on their property. This information is useful to the Town to better understand the extent of current drainage problems needing to be addressed within existing developed areas. By targeting the few areas where drainage is a concern, scarce resources can be better utilized elsewhere in the community rather than improving drainage facilities where there are few problems.

Figure 2.6 Property Status/Type of Development

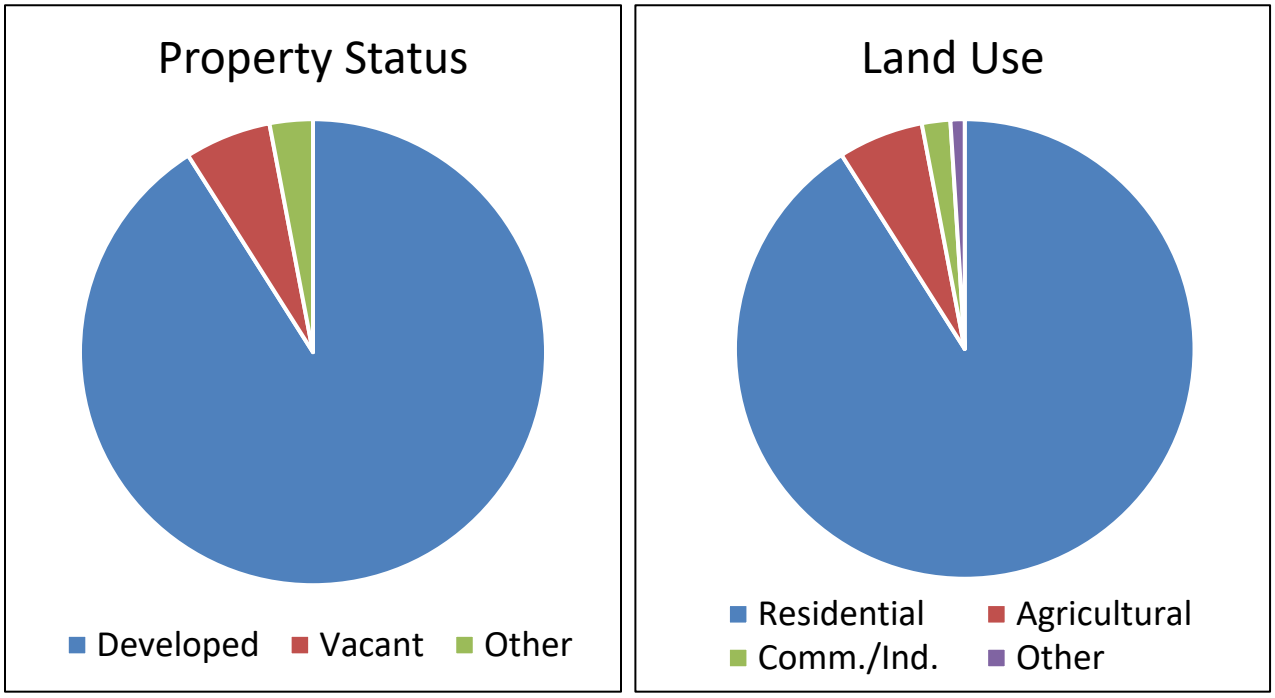
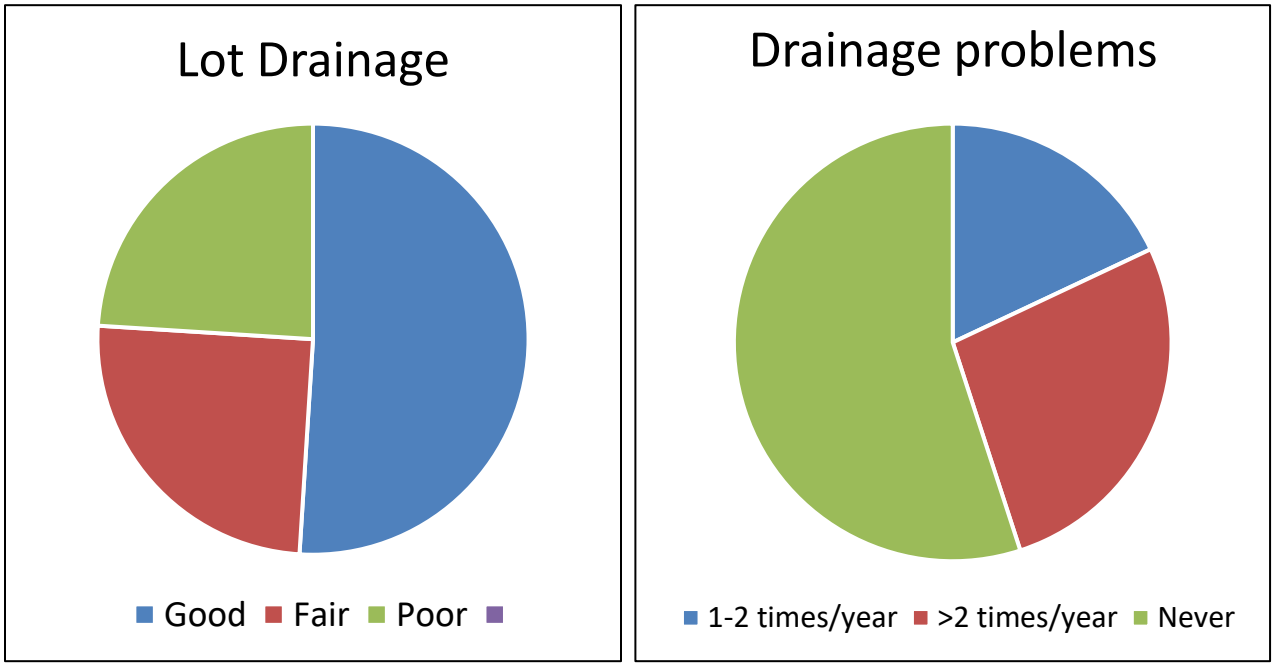


Figure 2.7 Lot Drainage/Drainage Problems



2.5 Cultural Environment

As part of the Class EA Master Plan process the proponent is required to consider potential impacts to cultural heritage resources within the study area. This would include archaeological resources, built resources and cultural heritage landscapes. Screening checklists are provided by the Ministry of Tourism, Culture and Sport (MTCS) to assist with determining whether a project might impact these resources. The archaeological potential checklist and the built heritage checklist were both completed and are saved in Appendix 'C'.

Based on the results of the screening checklists, the area has a potential to impact archaeological resources for work being proposed within undisturbed areas, including existing agricultural lands. The assessments may be undertaken as part of development applications associated with proposed residential subdivision developments within future growth areas. The Town will ensure that archaeological resources are assessed prior to work proceeding within these areas.

2.6 Technical Environment

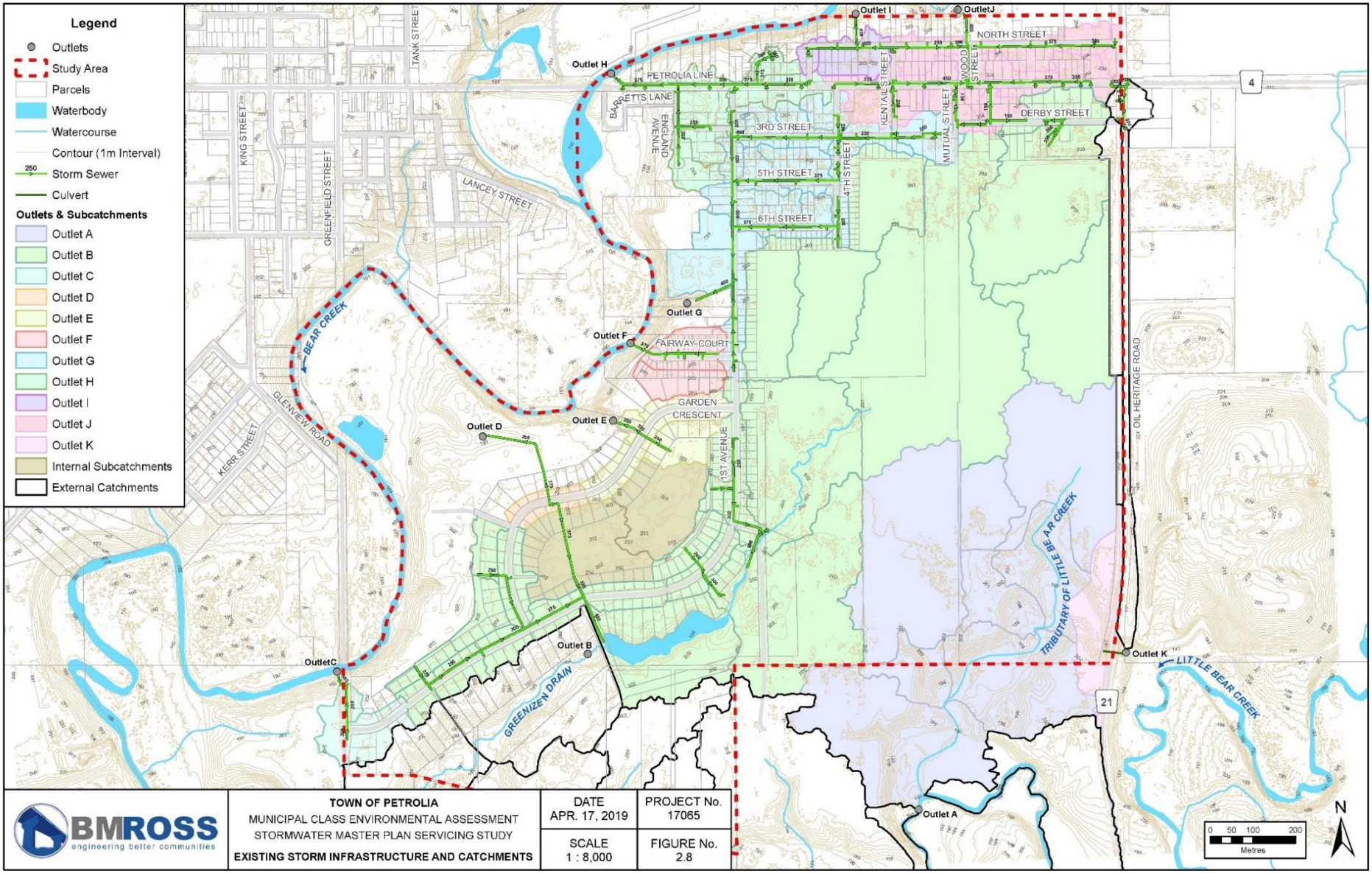
2.6.1 Inventory of Existing Stormwater Facilities

Establishing an inventory of the existing stormwater runoff conveyance infrastructure was a critical component of this study. A review was completed of available reports, drawings and development plans provided by the municipality. The general location of stormwater management facilities (SWMFs), storm sewer structures, sewer sizes, invert elevations and sewer slopes (some data gaps) were transferred into a geographic information system (GIS) database. A global positioning system (GPS) survey was completed by BMROSS to address data gaps and to resolve information discrepancies. The Provincial Digital Terrain Model (DTM), based on the 2015 SWOOP dataset, was used to establish manhole/catch basin grate elevations. The collected data was saved as GIS shapefiles which formed the basis of the PCSWMM model.

BMROSS relied on third party information for completing this study, including storm sewer sizes, types and slopes. Where discrepancies were evident, a reasonable effort was made to try and resolve them. However, BMROSS takes no responsibility for any errors or omissions in the third-party information that was provided for this study.

Figure 2.8 illustrates the location of existing drainage infrastructure as well as the outlet location and associated sub-catchment that drains to each outlet. The subcatchments are described in more detail in Sections 2.5.2. and 2.5.3.

Figure 2.8 Existing Drainage Infrastructure and Catchments



2.6.2 Watershed Overview

The study area shown in Figure 2.2 encompasses the southeast quadrant of the Town of Petrolia which is generally bound by North Street to the north, Bear Creek to the west, Little Bear Creek (Durham Creek) to the south and Highway 21 (Oil Heritage) to the east. The majority of the existing built area is serviced by several outlets that discharge to Bear Creek, with general overall drainage in a southwest or westerly direction. The southeastern portion of the study area, which encompasses existing agricultural lands subject to future development, some existing built areas and the Kingswell Glen Golf Course, drains towards the southwest outletting to Little Bear Creek via the Greenizen Drain and smaller tributaries of Little Bear Creek. The eastern limit of the site drains south along Highway 21 (Oil Heritage Road) via roadside ditches and the County Road Municipal Drain to Little Bear Creek. The confluence of Little Bear Creek and Bear Creek is located approximately 500 m to the west of the study area limit.

2.6.3 Catchment Areas

a) General

Twelve (12) overall catchment areas were established for the study area as summarized in Table 2.3 and illustrated on Figure 2.8. Catchment areas were established using GIS processing tools to automatically delineate drainage areas based on the provincial DTM, road network and storm sewer layout. The catchment areas were manually checked and refined based on the storm sewer network, field observations and aerial imagery. Catchment areas were subdivided into smaller subcatchments, for purposes of modelling. External catchments beyond those shown on Figure 2.8 were not included in the model.

Most streets in the built-up area have an urban road section (i.e. curbing or curb face sidewalk and storm sewer). First Avenue, from Fairway Court to Tile Yard Road consists of roll over curb and sections serviced by storm sewers. A few street segments (e.g. Derby, Holland, 3rd, Kentail, Mutual) have no curbs and runoff is conveyed along the edge of pavement and roadside ditches.

Table 2.3 Overall Drainage Catchments

Catchment	Outlet ID	Area (ha)	Description
Outlet A	Tributary of Little Bear Creek	46.5	Undeveloped lands, natural and agricultural, in the southeast corner of the study area discharging to a valley system, tributary of Little Bear Creek.
Outlet B	Greenizen Drain	91.4	Combination of agricultural lands, existing built area, and natural areas discharging to the Greenizen Drain. An existing online pond is located on the golf course lands, controlling flows to the downstream Greenizen Drain valley system. Rear lot swales and catch basins intercept drainage along some residential homes along the north side of First Avenue and Glenview Crescent, with discharge to the Greenizen Drain at three (3) storm sewer outlet locations.
Outlet C	Tile Yard Road	2.6	300 mm dia. sewer discharging directly to Bear Creek at Tile Road Bridge.
Outlet D	Garden Crescent NW	1.1	200 mm dia. sewer discharging to golf course lands. A storm sewer overflow connection exists at the low point along Garden Crescent via a 375 mm sewer running south through the golf course lands, with discharge to the Greenizen Drain (Outlet B).
Outlet E	Glenview SWMF	4.2	Portion of Garden Crescent and golf course lands is serviced by the Glenview SWMF, with discharge to Bear Creek.
Outlet F	Fairway Court	2.8	375 mm dia. sewer system discharges to Bear Creek. Water quality and water quantity controls are provided for via an oil-grit-separator and controlled drainage within rear lot swales, respectively.
Outlet G	First Avenue	15.4	450 mm dia. outlet sewer discharges to a valley system tributary to Bear Creek.
Outlet H	Petrolia Line - West	5.7	375 mm dia. outlet sewer discharges to Bear Creek, at the Petrolia Line Bridge.
Outlet I	North Street - West	1.8	450 mm dia. outlet sewer discharges to a tributary of Bear Creek north of North Street.
Outlet J	North Street - East	11.1	600 mm dia. outlet sewer discharges to a tributary of Bear Creek north of North Street.
Outlet K	Highway 21	3.5	A small portion of agricultural lands and undeveloped lands discharge east to Little Bear Creek via a 900 mm culvert crossing along Highway 21.
Internal	Golf Course Internal Ponds	8.6	The golf course lands, confined by First Avenue and Glenview Crescent drain internally to two ponds. Rear lot swales and catch basins intercept drainage

b) Catchment Area Descriptions

Brief descriptions of the 12 overall catchments are provided below, including the general location of each drainage area, a description of the outlet type and location, and general characteristics of the general ground cover, land uses and distinctive features that might be associated with each of the catchment areas.

Outlet A)

Comprised primarily of natural areas associated with the Little Bear Creek valley lands, Outlet A is the second largest catchment in the study area. Located in the southeast, discharging to a tributary of Little Bear Creek, portions of this drainage basin are located outside of the study area limits. There are no existing developments within this drainage catchment. The northerly portion is actively farmed and subject to future development. The photo below shows the north portion of this catchment area, where agricultural lands adjoin the natural valley lands of the creek.

View of Outlet A drainage catchment looking west from Oil Heritage Road – Google Maps Image

Outlet B)

Outlet B is the largest catchment in the study area, and receives flows from a combination of existing built areas, agricultural lands, and natural areas discharging to the Greenizen Drain. The upper agricultural lands are designated for future development.

The upper portion of the drain is considered a Municipal Drain under the Drainage Act R.S.O. 1990. The Greenizen Drain was originally constructed in 1919. Engineer's reports from 1919 and 1946 indicate that the drain was constructed from Derby Street, extending southwest for a total length of approximately 1520 m. Based on historical reports the closed tile upper section includes 200 mm, 250 mm, and 300 mm diameter tile for approximately 1310 m (4300 ft), with an open channel section for approximately 210 m. The remaining open channel is assumed to have no drain status. Topographic relief is extremely limited, and the closed portion of the drain is reported to have a slope of approximately 0.11%. No plans or profile drawings were included in the review documents.

As part the historical residential development along First Avenue and Glenview Crescent in the early the 1990's, an online pond was created on the golf course lands immediately downstream of the municipal drain. A sheet piling retaining wall and earthen embankment, approximately 4.5 m in height, forms the online pond along the Greenizen Drain valley system. A 600 mm vertical CSP pipe operates as the single outlet for the pond.

Based on BMROSS's field survey, only 0.6 m of freeboard is provided. It is assumed the online pond was constructed for irrigation purposes for the golf course lands. Design reports were not available for review on the pond construction or design features. Drainage from existing built areas along First Avenue are directed to three (3) outlets which discharge to the existing pond.

Existing Online Pond. Looking north from along retaining wall (left insert). Existing 600 mm CSP vertical pipe outlet (right insert).

Outlet C)

Outlet C is located in the southwest corner of the study area and is comprised of a 300 mm dia. sewer discharging directly to Bear Creek. The drainage shed is comprised entirely of larger estate style residential building lots located along Tile Yard Road and portions of First Ave. Tile Yard Road has no curb and gutter, however ditch inlets are located along shallow roadside drainage ditches. The photo below illustrates drainage features in this drainage catchment.

Photo sourced from Google Street View showing First Ave. and Tile Yard Road intersection looking south.

Outlet D) & Outlet E)

These two outlets drain portions of Garden Crescent to golf course lands located to the north and to Bear Creek, respectively. Both are relatively small catchments draining primarily residential developments along the roadway. Garden Crescent is a two-lane residential street with mountable curb and widely spaced drainage inlets. Residents noted the presence of water ponding on the roadway after rain fall events. Outlet E discharges to the Glenview Estates SWMF and then to Bear Creek. Outlet D discharges onto the golf course.

Outlet F)

Outlet F drains a 2.8 ha area along Fairway Court, a small recently completed residential subdivision extending west from First Avenue. A 375 mm dia. storm sewer discharges directly to Bear Creek west of the cul-de-sac. An oil and grit separator and rear yard swales provide some measure of quality control for stormwater runoff.

Outlet G)

Draining the north portion of First Avenue as well as Third, Fourth, Fifth and Sixth Streets, Outlet G discharges to Black Creek through a 450 mm dia. stormwater drainage outlet. The drainage basin is comprised of smaller residential developments primarily, although a Nursing Home and Public School are also located within the drainage catchment.

Outlet H)

The drainage catchment associated with Outlet H is located at the northwest corner of the study area draining Petrolia Line west towards Bear Creek. The subbasin is 5.7 ha in size and discharges directly to Bear Creek through a 375 mm dia. storm drainage outlet. England Avenue and Northridge Place, also drain to this catchment. Land uses are primarily residential although limited commercial and higher density residential uses are located along Petrolia Line. The photo at right shows England Ave at the junction with Petrolia Line.

Outlet I) and Outlet J)

North Street forms the northerly extent of the project study area, north of Petrolia Line. Two drainage outlets service this residential area, both discharging north of the road allowance to a tributary of Bear Creek, located north of the drainage area. Outlet I is a 450 mm dia. outlet draining the west extent of North Street and Outlet J is a 600 mm dia. outlet draining the east extent of the catchment area. Outlet J, which has a larger drainage area at 11.1 ha, also accepts drainage from portions of Petrolia Line as well as Mutual Street, Holland and Kentail.

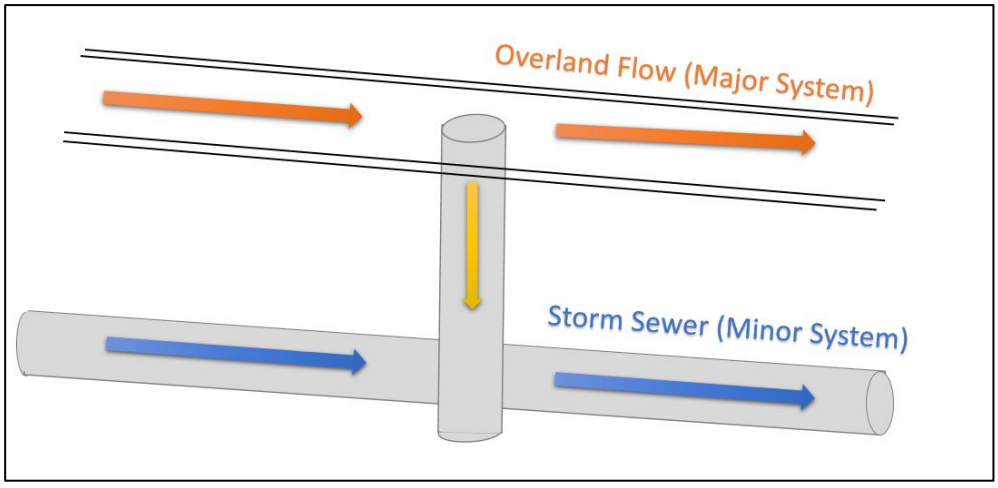
Outlet K)

Outlet K is located at the southeast corner of the study area, east of Highway 21 (Oil Heritage Road). This outlet drains a small portion of agricultural and undeveloped lands discharging east to Little Bear Creek via a 900 mm culvert crossing along Highway 21.

2.6.4 Hydrologic Modelling and System Performance Review

a) Model Assumptions and Setup

To evaluate storm runoff for existing and future conditions scenarios, a hydrological and hydraulic computer model of the study areas was developed. The software applied was PCSWMM™. PCSWMM™ is a GIS-based model and utilizes the EPASWMM engine developed by the US Environmental and Protection Agency (100% Compatible, free open-source software). The PCSWMM™ hydrology component generates flows from catchment areas based on drainage parameters established from land use, soil type and slope. Catchment flows are directed to a hydraulic component of in the model. The hydraulic component of the model was setup as a ‘dual drainage’ system wherein major flow routes such as roads and channels are simultaneously assessed with minor flow routes (i.e., ditches, culverts and/or storm sewers). Refer to the schematic below. The interconnection between the minor and major system provides a detailed assessment of both systems, capacity restrictions and ponding depths.



The major catchment areas (see Table 2.3) were subdivided into sub-catchments generally based on storm sewer sections, road culvert locations, and topographic subdivides.

Model “storage” nodes were established at select locations to determine flooding depths at existing SWMFs, ponds, confined low points in roadways, or at confined low points on properties that lie along overland flow routes. Stage-storage relationships were established for each of these storage nodes from the DTM.

Major system flow paths across private lands have been included as applicable in the model. There is a low point along First Avenue, approximately 200 m south of Sixth Avenue such that spill and major runoff discharge to the west through private property to Outlet G. Major flow spills to have also been accounted from rear lot swales along First Avenue and Garden Crescent.

The model did not include calibration using real time flow data, which was unavailable, and beyond the scope of this study.

Figure 2.9 provides a general depiction of the model, including the minor and major runoff links, storage nodes (at low or confined points), and catchments. A summary of hydrologic parameters and assumptions used in the model are provided in Appendix D. Model files are provided electronically.

b) Existing Conditions Model Runs

The PCSWMM^{TM} model was used for a high-level evaluation of the hydraulic capacity of the existing minor drainage systems and the overland major runoff flow paths. The results of the model runs are summarized in the following figures.

- Figure 2.10 – 2-year storm sewer capacity
- Figure 2.11 – 2-year storm surface ponding depths
- Figure 2.12 – 100-year storm surface ponding depths

The normal practice for an urban setting is to convey the minor design storm event flow through the storm sewer system and the major storm event flow that surpasses the capacity of the storm system to be conveyed along road allowances to a suitable outlet. Typical engineering servicing standards require the minor storm system to be sized to convey the 2-year design event without surcharging. Major storm system is to be sized to convey the 100-year design event and typically follows the path of the minor storm drainage system. However, there may be low point locations where the major system will spill from the road allowance to adjacent properties due to a lack of overland drainage or insufficient storm sewer capacity. Ponding up to 300mm is typically considered acceptable within roadway areas during a major storm event so long as it does not spill and impact adjacent private property. Therefore, in some cases, ponding may only be acceptable at shallower depths (e.g. 150mm, where there is barrier curb but the adjacent private property is lower than the curb).

Figure 2.9 Existing Condition PCSWM Model Overview

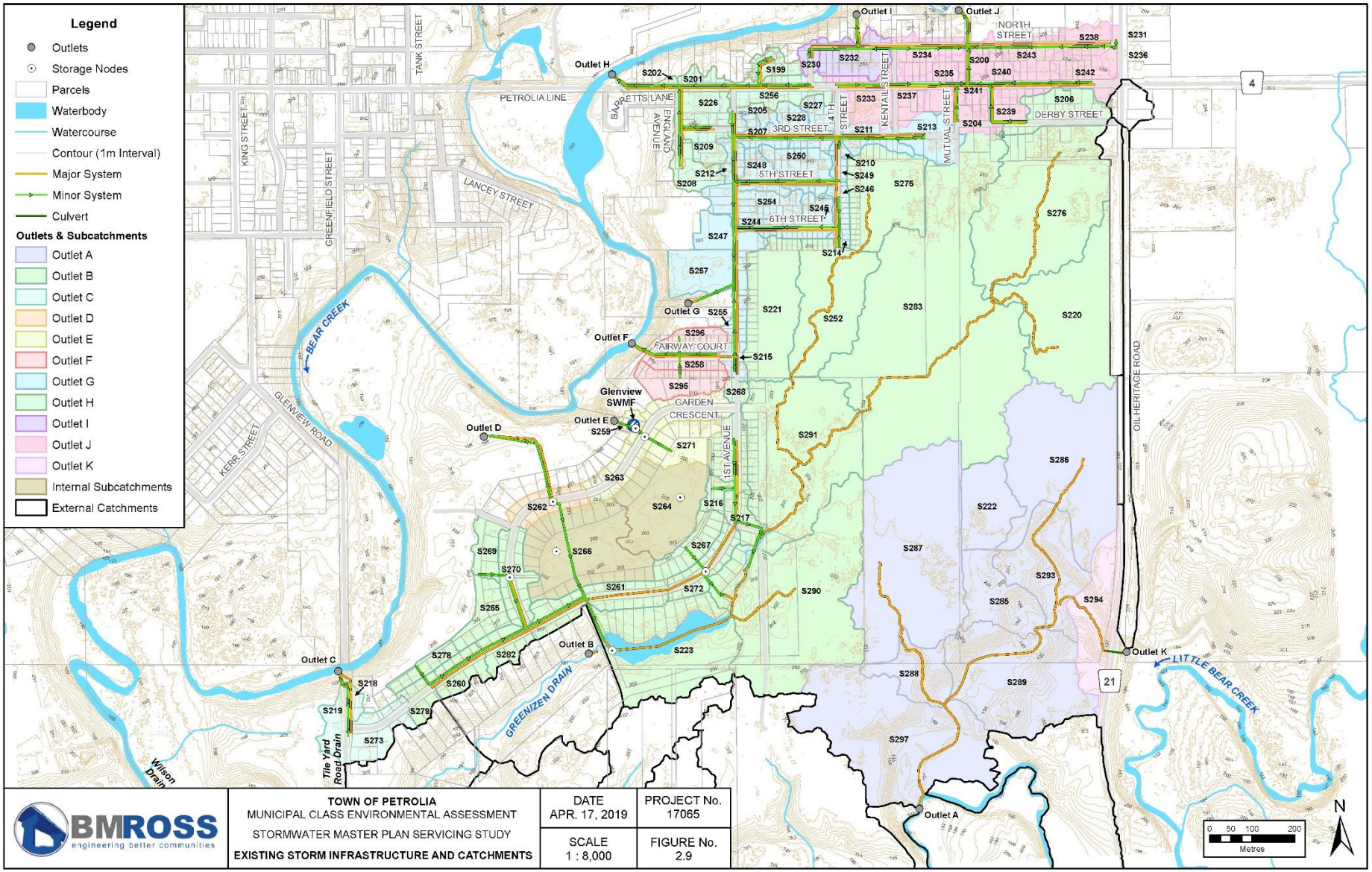


Figure 2.10 Existing 2 Year Storm Sewer Capacity

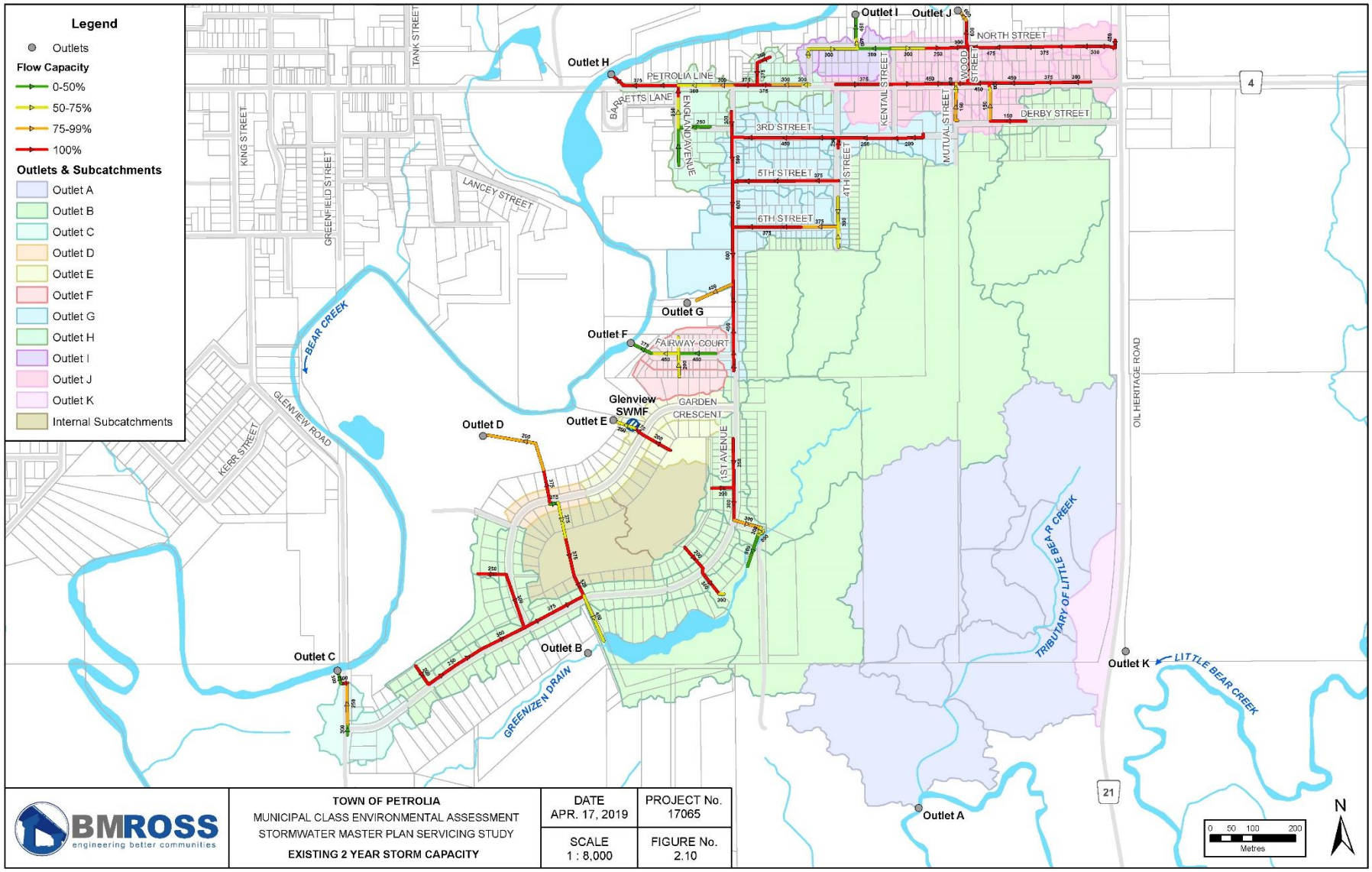


Figure 2.11 Existing 2 Year Surface Ponding

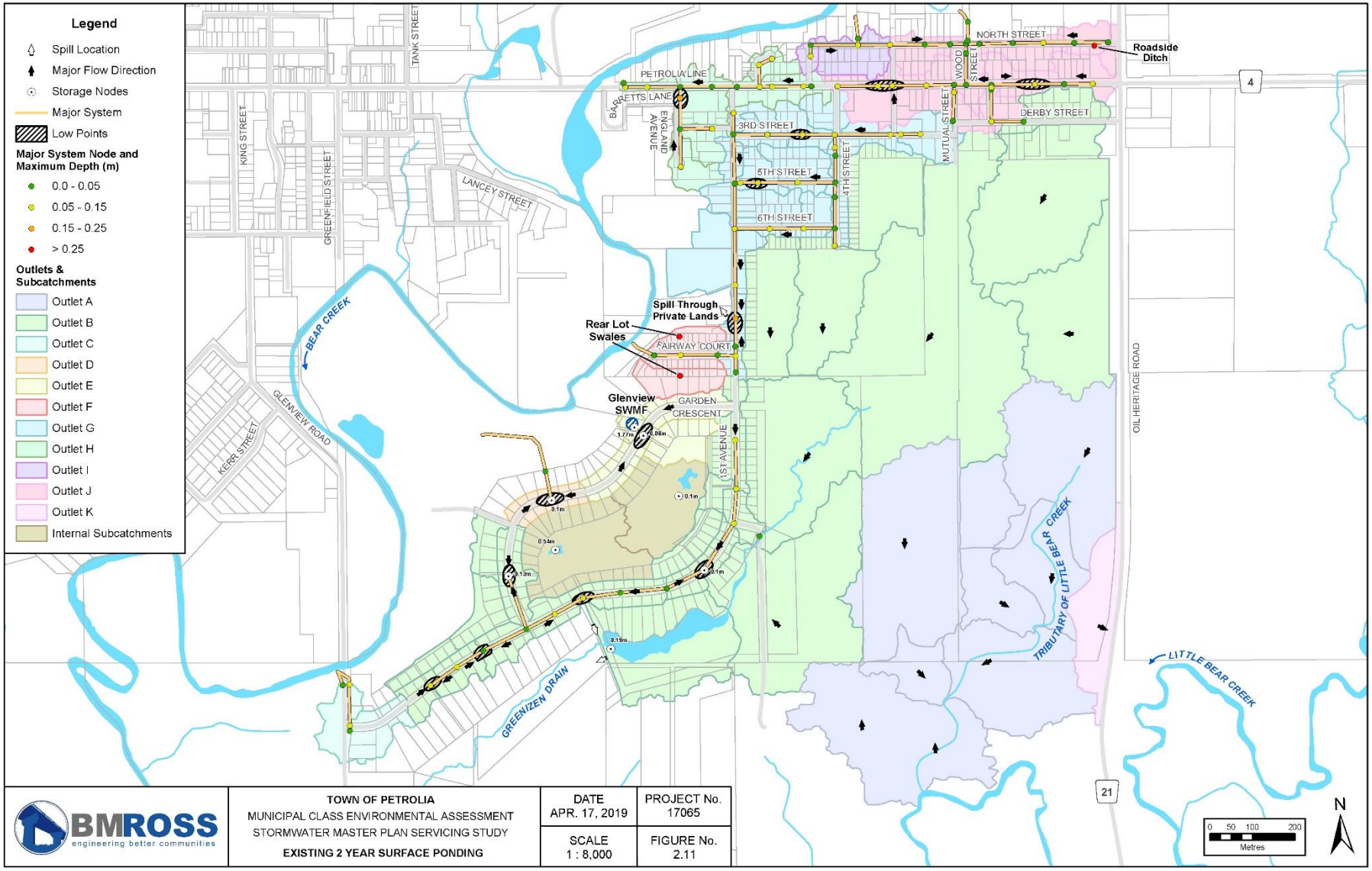
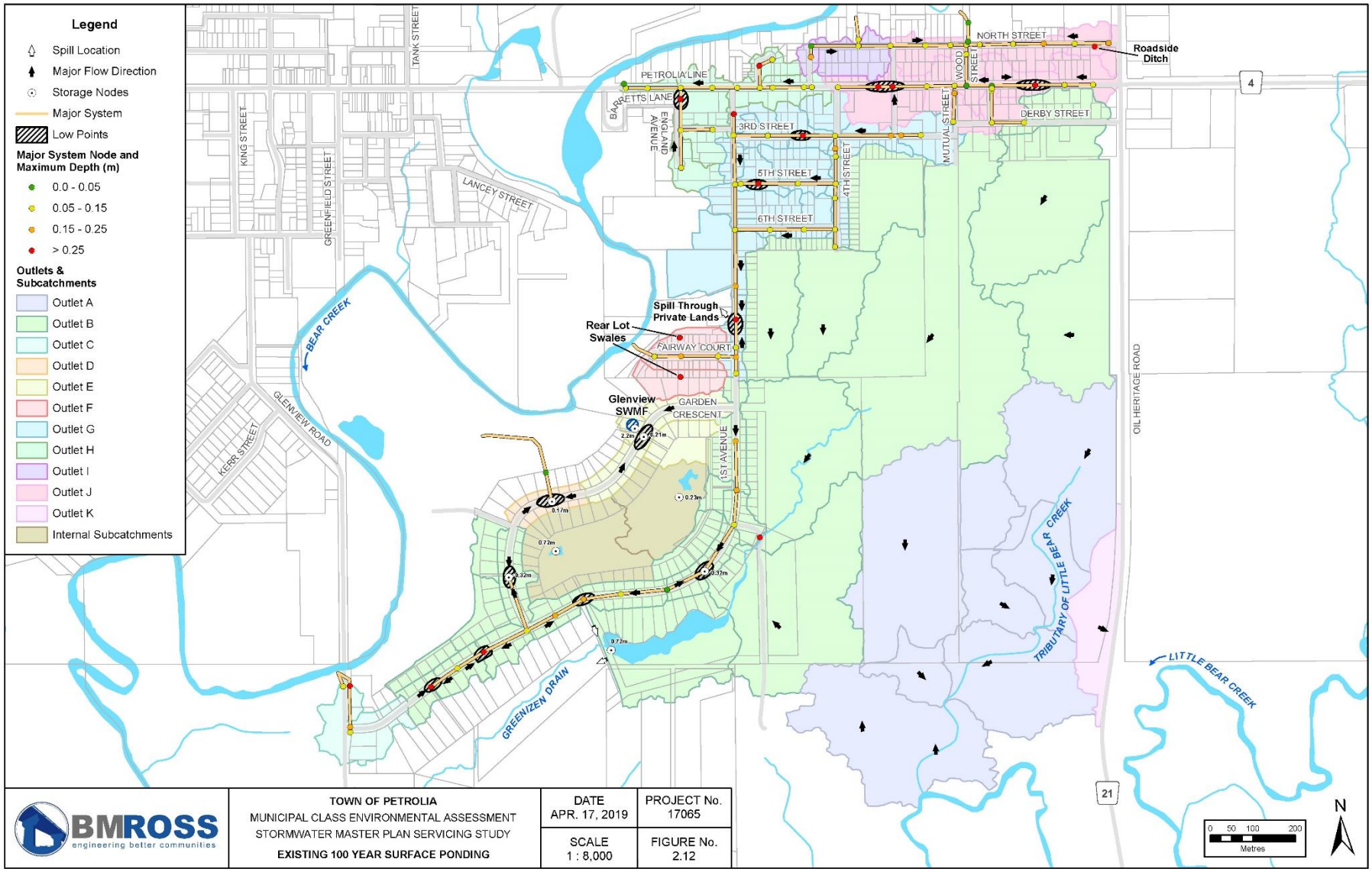


Figure 2.12 Existing 100 Year Surface Ponding



As shown in Figure 2.10 the majority of the storm sewer system is surcharged under a standard 2-year design event. Therefore, most of the system does not meet current engineering standards as recommended by the MECP. It is noted that the “flow capacity” of the storm sewers shown on Figure 2.10 are based on the model results and take into account backwater effects from downstream surcharged sewers, if applicable. Therefore, some sewer segments that are shown (in red) as operating at “100%” or more of their flow capacity may actually be an indication only that the pipe is “full” as a result of downstream surcharging. Therefore, if undersized downstream surcharged sewer segments are resolved to provide free discharge conditions, upstream sewer segments may have sufficient capacity contrary to what the red colour coding might otherwise indicate.

Figure 2.11 and Figure 2.12 illustrate surface ponding resulting from sewers with inadequate capacity, downstream surcharged sewers, or sewers with inadequate inlet capacity. Under the 2 year event, nuisance ponding is noted along several road right-of-way sag locations, specifically along First Avenue, Garden Crescent, Petrolia Line. Spills to private lands occurs along First Avenue at the identified major spill location, approximately 200 m south of Sixth Street. Under the 100 year event more significant ponding is realized across the study area. Future capital improvement projects should aim to increase the capacity of storm sewer to at minimum the 2-year design event and limit the depth of ponding along road allowances to less than 300 mm for the 100-year event.

A summary of existing condition flows per outlet location and catchment area are provided in Appendix D. In addition, peak outflows and water surface elevations at the existing online pond are also summarized in Appendix D. It is noted that model results indicated that for storm events greater than the 25 year event, overflow of the berm occurs. The operation of the existing online pond with upstream stormwater management facilities requires special consideration to limit potential flooding and peak flows.

c) Identification of Problem Areas

Following completion of the model runs a number of problem areas were identified. These areas are illustrated on Figure 2.13. Problem areas were cross-referenced against input received from residents through the questionnaire and were reinforced from these comments. Several areas were identified only through input from residents (P4) as no storm drainage infrastructure exists so modeling would not have considered these areas. Table includes a table summarizing the details associated with the identified problem areas.

Figure 2.13 Opportunities and Constraints

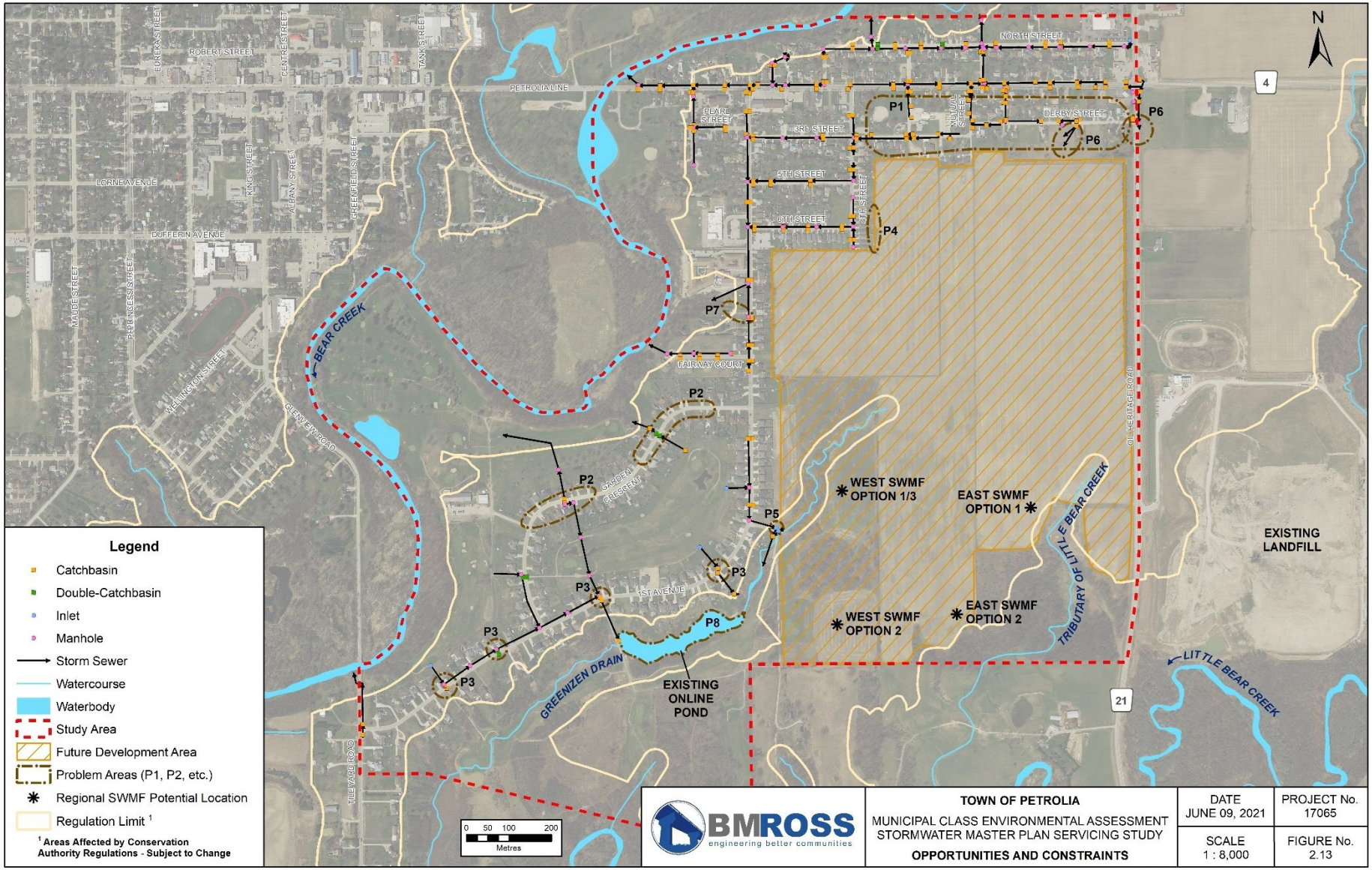


Table 2.3 Opportunities and Constraints: General Study Area and Problem Locations

	Problem or Opportunity Description	Recommendations
General Study Area		
G1	The future development of lands, located east of First Street and encompassing the southeast corner of the study area, requires stormwater management and conveyance infrastructure. Two existing outlets exist for these lands, the Greenizen Drain and a tributary to little Bear Creek.	A watershed approach is recommended to provide appropriate stormwater management. Two centralized facilities are recommended to service these lands. Alternatives for stormwater servicing is accessed. New developments, and significant redevelopments, are required to provide controlled discharge of storm runoff in accordance with the Municipality's policies and standards. Where properties lie within areas that are known to or expected to experience surface drainage problems, the Municipality should ensure development does not occur until those issues are satisfactorily resolved.
G2	Generally, the existing storm sewer system lacks capacity. The storm sewer system does not meet current standards, requiring minimum conveyance of the 2-year design storm.	Provide infrastructure upgrades as the opportunities arises, such as future road reconstruction or resurface work, unless it is determined that those identified problems need to be resolved sooner.
G3	The study area is subject to flat gradients and clay soils. Ponding on yards and roadways is common and exasperated in many areas due to the lack of or insufficient stormwater infrastructure.	
G4	Poor maintenance. Many catch basins located in grassed boulevards are obstructed with sediment build-up and vegetation.	Conduct routine maintenance on all catch basins.
G5	There are a number of storm sewer outlets that cross private property. It is unknown if there are registered easements.	It is recommended the Municipality do a title search to establish the presence/absence of drainage easements. Where there are no registered easements, the Municipality could seek a legal opinion regarding the applicability of "prescriptive easements" to those existing works located on private property. However, the Municipality may still wish to proceed with securing registered easements to ensure uninterrupted access for use and maintenance of those drainage works, or for possible future upgrades.
Problem Locations		
P1	Lack of consistent stormwater infrastructure within the southeast portion of the study area, specifically along Derby Street, Holland Street, Mutual Street, Kentail Street and Third Street (east of Fourth Street). Rural cross-section with ad-hoc drainage infrastructure including varying CB inlet types, and a combination of small diameter storm sewers and shallow drainage tile drainage (Big O). Many catch basins within the grassed boulevard require maintenance. The east end of Derby Street appears to be connected to the Greenizen Drain.	This is related to G2, G3 and G4. Servicing of lands along Derby Street, from HWY 21 to 100 m east of Holland Street is to be accommodated in the future development of the lands to the south. Upgrades to stormwater conveyance infrastructure is recommended along Holland Street, Mutual Street, Kentail Street and Third Street (east of Fourth Street) at the time of future road reconstructions.
P2	Lack of storm conveyance infrastructure along Garden Crescent. Low road gradient and significant catch basin spacing (>110 m maximum recommended spacing) leads to nuisance water ponding on road, also identified through the public survey. Catch basins provided at low points discharge to outlet sewers through the Golf Course lands (private lands).	This is related to G2 and G3.
P3	Surface ponding along First Avenue at low points. Insufficient storm sewer capacity to convey flows.	This is related to G2 and G3.
P4	Drainage from agricultural lands ponds on private property along Fourth Avenue.	This is a private drainage matter. At the time of future development of the agricultural lands, stormwater works will be required captured and conveyed from impacted lands.
P5	Maintenance required on Inlet grate south of First Avenue. Filter cloth requires removal on bolted inlet grate south of First Avenue.	This is related to G4.
P6	Locations with stormwater discharge to old municipal drains (Greenizen Drain and County Road Drain).	This is related to G2.
P7	Location with major flow spill to private lands. Major flows spill from road allowance towards outlet G.	This is related to G2. As upgrades to stormwater infrastructure is conducted, consideration of oversizing sewers and provision of additional catch basins is recommended to limit spills and ponding along the road allowance.
P8	The existing online pond along the Greenizen Drain has limited freeboard. Model results indicate spills across the berm will occur for 25 year storm event and above, resulting in existing public safety concerns.	Future SWMFs upstream must account for the operation of the online pond, to ensure flooding and peak flows are maintained at or below existing conditions.

3.0 CLASS EA MASTER PLAN PROCESS

3.1 Overview

The Town of Petrolia is developing a stormwater servicing Master Plan for the southeast development area of Petrolia to address deficiencies present within existing aging and undersized facilities currently servicing portions of the community, as well as to develop comprehensive policies which would apply to new development applications brought forth within the community in the future. In order to address this situation, the Town authorized BMROSS to undertake a Stormwater Servicing Master Plan utilizing the Class Environmental Assessment planning process, to investigate potential outcomes associated with the study. The overall goal of the Master Planning process can be summarized as follows:

To develop a long-range Stormwater Servicing Master Plan for the southeast development area of Petrolia to address deficiencies with existing infrastructure servicing the community and to develop policies for future development areas. These recommendations will be considered in conjunction with other road and infrastructure needs within the study area and will be implemented over a 20 year timeframe.

The following sections of this report document the environmental assessment process conducted during the Master Planning process, as well as the identification of a preferred outcome for the Stormwater Servicing Master Plan. The key components of the process are summarized below:

- A description of the identified stormwater infrastructure deficiencies.
- Identification of practical options to resolve deficiencies in the long-term
- An evaluation of potential impacts associated with the identified alternatives
- Selection of a preferred infrastructure alternative.
- Identification of a conceptual implementation plan.
- Synopsis of issues related to the implementation of the stormwater servicing plan.

3.2 Problem Identification

Section 1.4 of this report indicates that the investigation followed Master Plan Approach #1, which addresses Phases 1 and 2 of the Class EA process and satisfies the requirements for Schedule ‘A’ and Schedule ‘A+’ activities. Phase 1 of this process involves the identification of the problem, or problems, which need to be addressed. As discussed in Sections 2.3 and 2.5 of this report, existing infrastructure deficiencies have been identified through completion of the questionnaire and modeling of the existing stormwater drainage collection system serving the developed portions of the community. The following problem statements have been developed to summarize issues central to this analysis:

Existing storm drainage infrastructure servicing portions of the Petrolia southeast development area are aging, undersized, and in poor condition. These facilities have insufficient capacity to service the needs of the existing community.

Future growth areas have been identified within the southeast development area of Petrolia. Several new residential developments are in the early planning stages within this area. Comprehensive stormwater management policies are therefore required to ensure that new development occurs in a manner that does not result in negative impacts to the surrounding natural features and receiving watercourses.

3.3 Identification of Alternative Solutions

3.3.1 General

The second phase of the Class EA process involves the identification and evaluation of alternative solutions to address the defined problems. The evaluation of alternatives is conducted by examining the technical, economic, and environmental considerations associated with implementing any of the alternatives. Mitigation measures that could lessen environmental impacts are also defined. A preferred solution or solutions is then selected.

3.3.2 Identification of Alternatives: Existing Stormwater Infrastructure

A limited number of practical solutions, to the defined problems associated with existing stormwater infrastructure, were identified at the outset of this Class EA Master Plan process. The alternatives, stated below, build upon the findings of the engineering investigations conducted during the process as well as input received from residents through questionnaire responses and from review agencies.

Alternative 1 – Upgrade/replace existing stormwater drainage infrastructure determined to be undersized or deteriorated. This alternative would involve the replacement of aging or deteriorated drainage infrastructure within developed areas of the study area based on condition and state of deterioration.

Alternative 2 – Implement upgrades to existing stormwater drainage infrastructure in conjunction with other infrastructure renewal activities. This alternative would involve the replacement/upgrading of aging or deteriorated drainage infrastructure within the study area in conjunction with other infrastructure activities. Planned works would be coordinated through the Town's Asset Management Plan to target areas in the greatest need of upgrades to all infrastructure categories such as roads, sewers, watermains and stormwater drainage.

Alternative 3 - Do Nothing. This option proposes that no improvements or changes be made to address existing deficiencies with storm drainage infrastructure. During the Class EA Master Plan design process, the "Do Nothing" alternative may be implemented at any time prior to the commencement of construction. A decision to "Do Nothing" would typically be made when the costs of all other alternatives, both financial and environmental, significantly outweigh the benefits.

3.3.3 Identification of Alternatives: Future Development Lands

A limited number of practical solutions were identified to address stormwater management requirements associated with future development lands at the outset of this Class EA Master Plan process. The alternatives, stated below, build upon the findings of the engineering investigations conducted during the process as well as input received from residents through questionnaire responses and from review agencies.

Alternative 1 – Coordinate stormwater management planning for all future development areas. This alternative would involve the development of recommendations for all lands identified for future development in the southeast development area. As developments proceed, stormwater planning and facilities would conform to recommendations contained within the Master Plan.

Alternative 2 – Allow each parcel to address stormwater management requirements on a parcel by parcel basis. This alternative would mean that individual stormwater management plans would be created for each parcel, as they are developed, with no overall coordination or sub-watershed basis for planning.

Alternative 3 - Do Nothing. This option proposes that no recommendations be developed for stormwater management within future development lands. The “Do Nothing” alternative may be implemented at any time prior to the commencement of construction. A decision to “Do Nothing” would typically be made when the costs of all other alternatives, both financial and environmental, significantly outweigh the benefits.

3.4 Evaluation of Alternatives

3.4.1 General

The next component of the investigation involved the evaluation of the identified alternatives. The purpose of the evaluation was to examine the potential environmental impacts associated with the proposed works and to examine potential mitigation for any identified impacts. The evaluation generally involved the following activities:

- Preliminary technical review of alternatives;
- Selection of a preferred option (preliminary);
- Consultation with the general public and review agencies;
- Selection of a preferred option (final).

3.4.2 Summary of Required Works

Based upon the results of a preliminary engineering analysis, a brief description of the works associated with each of the Master Plan alternatives being considered in conjunction with the review of alternatives is described in Table 3.1. and Table 3.2.

Table 3.1 Primary Components of Identified Alternatives: Existing Infrastructure

Stormwater Options	Related Works
Alternative 1 – Correct deficiencies without coordination with other infrastructure	- Replace aging or deteriorated storm drainage infrastructure within developed portions of the study area with new stormwater servicing infrastructure designed to meet current regulatory requirements, including a consideration of climate change impacts. - Develop a priority list for upgrades based strictly on stormwater deficiencies identified through the modelling exercise.
Alternative 2 – Coordinate the upgrading of stormwater infrastructure with other infrastructure needs in the study area.	- Replace aging or deteriorated storm drainage infrastructure within developed portions of the study area with new stormwater servicing infrastructure designed to meet current regulatory requirements, including a consideration of climate change impacts. - Develop a priority list for upgrades based on other municipal infrastructure needs including sanitary, watermain and road infrastructure. - Develop a priority list for upgrades by reviewing existing asset management plan recommendations in conjunction with priority stormwater upgrades identified through the Master Plan.
Do Nothing	- No works would occur to address existing stormwater drainage infrastructure deficiencies.

Table 3.2 Primary Components of the Identified Alternatives: Future Growth Areas

Stormwater Options	Related Works
Alternative 1 – Coordinate stormwater management planning on a subwatershed basis.	- Develop stormwater management policies for future development areas on a subwatershed basis so that all developments within a defined catchment area are developed in a coordinated manner. - Identify locations and general criteria for detention facilities to service each subcatchment. - Develop general guidelines for conveyance measures and lot level controls within each subcatchment.
Alternative 2 – Review developments on a parcel by parcel basis as developments proceed within future growth areas.	- Review stormwater management plans for each development as it is proposed. - Develop general guidelines for conveyance measures and lot level controls within each parcel. - Seek input from the SCRCA on stormwater policies for each development.
Do Nothing	- No policies would be developed to address stormwater management planning within future development lands.

3.4.3 Environmental Considerations

Section 3.3 of this report lists the alternative solutions that were identified to resolve deficiencies with existing stormwater drainage infrastructure and future growth areas in the southeast development area of Petrolia. As part of the evaluation process, it is necessary to assess what effect each of the options may have on the environment and what measures can be taken to mitigate the identified impacts. The two main purposes of this exercise are to:

- Minimize or avoid adverse environmental effects associated with a project.
- Incorporate environmental factors into the decision-making process.

Under the terms of the EA Act, the environment is divided into five general elements:

- Natural environment
- Social environment
- Cultural environment
- Economic environment
- Technical environment

The identified environmental elements can be further subdivided into specific environmental components that have the potential to be affected by the implementation of the alternative solutions. Table 3.3 provides an overview of the Specific Environmental Components considered of relevance to this investigation. These components were identified following the initial round of public and agency input, and after a preliminary review of each alternative with respect to technical considerations and the environmental setting of the project area.

The environmental effects of each study alternative on the specific components and sub-components are generally determined through an assessment of various impact predictors (i.e. impact criteria). Given the works associated with the alternative solutions, the following key impact criteria were examined during the course of this assessment:

- Magnitude (e.g. scale, intensity, geographic scope, frequency, duration).
- Technical complexity.
- Mitigation potential (e.g. avoidance, compensation, degree of reversibility).
- Public perception.
- Scarcity and uniqueness of affected components.
- Likelihood of compliance with applicable regulations and public policy objectives.

Table 3.3 Evaluation of Alternatives: Identification of Environmental Components

Element	Component	Sub-Component
Natural	Aquatic	• Aquatic Resources
	Atmosphere	• Air Quality/Noise
	Surface Water	• Water Quality/ Quantity • Drainage Characteristics
	Terrestrial	• Amphibians & Reptiles • Birds & Mammals • Vegetation
	Geologic	• Physiographic Features • Groundwater Quality/ Quantity
Social	Neighbourhood	• Disruption
	Community	• Health and Safety • Quality of Life
Cultural	Heritage	• Historical/ Cultural Resources
Economic	Project Area	• Capital and Operational Costs
	Community	• Property Taxes
Technical	Transportation	• Traffic Patterns/ Volumes • Pedestrian/ Vehicular Safety
	Infrastructure	• Condition/ Age • Servicing Capacity • Technologies • Utilities

The evaluation process described above provides the proponent with a methodology to predict the potential effects of alternative solutions. The significance of the identified impacts is largely based on the anticipated severity of the following:

- Direct changes occurring at the time of project completion (e.g., habitat disruption);
- Indirect effects following project completion (e.g., increased sedimentation/ erosion);
- Induced changes resulting from a project (e.g., additional activity in sensitive areas)

3.4.4 General Review of Alternatives

Table 3.4 provides a summary of the key considerations for each alternative associated with existing stormwater drainage infrastructure with respect to the environmental components described in Table 3.3. To this end, the table identifies those benefits and impacts that were identified as significant during the initial evaluation of alternatives. Potential mitigation measures for the identified impacts are also presented. Table 3.5 summarizes the same considerations for the alternatives identified for future development lands.

Table 3.4 Preliminary Evaluation of Alternatives: Existing Stormwater Drainage Infrastructure

Study Alternative	Benefit	Impacts	Remediation
Alternative 1 *(Correct deficiencies without coordination with other infrastructure)*	- Results in an improved drainage system for local road infrastructure and affected properties. - Minimizes potential impacts to natural and cultural environments, as works occur predominately within existing road allowances. - Presents few long-term impacts to air quality, noise levels and local aesthetics. - Utilizes technology that is familiar to local public works staff. - May be less expensive, initially.	- Will result in impacts to traffic movement due to the installation of infrastructure within local roads.	- Implement traffic control measures to limit construction-related impacts (lane restrictions may be required).
		- May result in disturbances to terrestrial and aquatic habitat during construction due to increased sedimentation.	- Implement sediment and erosion control measures during construction to minimize impacts to environmental features. - Consult with St. Clair Region Conservation Authority regarding additional mitigation measures required to limit construction-related impacts.
		- May result in economic impacts to municipal residents due to capital and operating costs associated with the upgrades. - Does not address other infrastructure needs within the community therefore may have long term impacts on economic growth and prosperity.	- Municipality could seek grant funding to help with implementation costs.
Alternative 2 *(Coordinate the upgrading of stormwater infrastructure with other infrastructure needs in the study area)*	- Results in improved drainage and other infrastructure needs within areas identified for upgrades. - Minimizes potential impacts to natural and cultural environments, as works occur predominately within existing road allowances. - Presents few long-term impacts to air quality, noise levels and local aesthetics.	- Some stormwater deficiencies may not be addressed immediately if other infrastructure components such as roads, sewers and watermains are in good condition. - May not provide immediate relief for areas experiencing existing drainage problems.	- Short term solutions involving modifications to existing facilities or short-term measures may need to be implemented in some areas to address immediate drainage problems. - Enhanced maintenance activities may improve some problem areas until more definitive repairs/replacements can be implemented.

	- Results in improved infrastructure assets over the long term by coordinating all sewage, water and stormwater needs.		
	- Least expensive option for the Town over the long term, when all infrastructure needs are considered. - Conforms with Sections 6.6.1 & 6.6.7 of the PPS 2020. - Rehabilitated infrastructure will be more resilient and be designed to address extreme storm events associated with climate change.	- May result in economic impacts to municipal residents due to capital and operating costs associated with project.	- Municipality could seek grant funding to help with implementation costs.
Alternative 3 *(Do Nothing)*	- Least expensive option. - Will result in no construction related impacts to the natural, social and economic environments.	- May prove to be more costly in the long term as existing storm drainage infrastructure continues to deteriorate. - May have a negative impact on other municipal infrastructure such as roads and utilities.	- Impact cannot be mitigated.
		- Will result in negative impacts to existing residents experiencing significant drainage issues.	- Impact cannot be mitigated.

Table 3.5 Preliminary Evaluation of Alternatives: Future Development Lands

Study Alternative	Benefit	Impacts	Remediation
Alternative 1 *(Coordinate stormwater management planning on a sub-watershed basis)*	- Results in an improved drainage system for future development lands. - Minimizes potential impacts to natural and cultural environments, as works occur predominately within vacant future development lands. - Provides the Town with an integrated system for storm drainage conveyance and outlet. - Presents few long-term impacts to air quality, noise levels and local aesthetics, following completion of construction. - Utilizes technology that is familiar to local public works staff. - Provides the development community with clear guidelines and criteria to address stormwater requirements. Conforms with Sections 6.6.1 & 6.6.7 of the PPS 2020.	- Regional stormwater facility will need to be constructed as part of initial development proposals to ensure that stormwater management measures are implemented.	- Town may need to bankroll initial construction costs and recover over time through an area–rated by-law or through development charges.
		- May result in disturbances to terrestrial and aquatic habitat during construction.	- Implement sediment and erosion control measures during construction to minimize impacts to environmental features. - Studies conducted as part of the development process should assess natural features and incorporate appropriate protection measures.
		- A financing model needs to be developed which outlines how regional stormwater management facilities will be financed and constructed. - Will require coordination amongst owners of future development lands.	- Petrolia will assist with coordination amongst owners of future development lands.
Alternative 2 *(Review developments on a parcel by parcel basis as developments proceed within future growth areas)*	- Would address drainage requirements for each development parcel as development proceeds. - Minimizes potential impacts to natural and cultural environments, as works occur	- Does not address drainage needs for entire sub-watershed and may result in long term impacts to the receiving watercourse. - May result in disturbances to terrestrial and aquatic habitat during construction.	- Impact cannot be mitigated. - Implement sediment and erosion control measures during construction to minimize impacts to environmental features. - Studies conducted as part of

	predominately within vacant future development lands. - Presents few long-term impacts to air quality, noise levels and local aesthetics. - Utilizes technology that is familiar to local public works staff.	- May result in significant hydraulic impacts to downstream receiving watercourses if accumulated impact of development-related runoff is not managed on a watershed basis. - Will result in increased maintenance requirements for Municipality associated with multiple storm drainage facilities for each development site.	the development process should assess natural features and incorporate appropriate protection measures. - Impact cannot be mitigated
Alternative 3 *(Do Nothing)*	- Least expensive option. - Will result in few construction related impacts to the natural, social and economic environments.	- Provides no guidance to the development community on how to address stormwater impacts associated with development. - May result in significant impacts to receiving watercourses if unconstrained flows are allowed to discharge from development lands to sensitive receiving streams. - May result in localized flooding on properties in development areas.	- Impact cannot be mitigated.

3.4.5 Analysis

Based upon the results of the preliminary analysis and discussions with the Town of Petrolia, Alternative 2: Implement upgrades to existing stormwater drainage infrastructure in conjunction with other infrastructure renewal activities, was selected as the preliminary preferred alternative to address existing deficiencies with the stormwater drainage system serving the community in the southeast development area. This option was selected due to the opportunity to address other infrastructure needs within the community in coordination with the stormwater deficiencies identified through the study. It also better aligns with long-term asset management planning initiatives being undertaken by the Town.

The Town also selected Alternative 1: Coordinate stormwater management planning for all future development areas, as the preliminary preferred alternative for future development lands. Similar to the option selected above, this alternative provided the most efficient long-term approach to managing drainage on future development lands.

To further examine these preliminary conclusions a more comprehensive environmental effects analysis was completed which examined potential interactions between the identified alternatives and environmental components (Table 3.2). The purpose of this analysis was to determine the environmental effects of constructing and operating each identified option on the environmental components and sub-components. The level of effect for the environmental interactions was rated as High, Moderate, Low and Minimal/ Nil. Potential mitigation measures were also considered as part of this evaluation. Tables 3.6 and 3.7 summarizes the outcome of this analysis for each of the alternatives initially identified.

Table 3.6 Alternative Solutions: Existing Infrastructure: Environmental Effects Analysis

Environmental Component	Alternative Solution	Level of Effect	Impact Considerations (Construction and Operational Activities)
Natural			
• Aquatic	**(1)** Correct deficiencies without coordination with other infrastructure	Low	• Aquatic habitat impacts may occur during construction of the proposed works. Impacts are expected to be minor in nature providing that suitable sediment and erosion control measures are implemented during construction to minimize potential impacts. • No impacts anticipated with operation of the proposed works.
	(2) Coordinate stormwater infrastructure upgrades with other infrastructure needs	Low	• Aquatic habitat impacts may occur during construction of the proposed works. Impacts are expected to be minor in nature providing that suitable sediment and erosion control measures are implemented during construction to minimize potential impacts. • No impacts anticipated with operation of the proposed works.
	(3) Do Nothing	Low to Moderate	• Existing deficient drainage network could result in uncontrolled flows during extreme storm events, resulting in increased erosion and pollution at the outlets.
• Terrestrial	**(1)** Correct deficiencies without coordination with other infrastructure	Minimal/Nil	• Limited vegetation removal will be required to facilitate implementation of this option as a majority of the work will occur within existing disturbed road allowances. • No impacts anticipated from the operation of the proposed works.
	(2) Coordinate stormwater infrastructure upgrades with other infrastructure needs	Minimal/ Nil	• Limited vegetation removal will be required to facilitate implementation of this option as a majority of the work will occur within existing disturbed road allowances. No impacts anticipated from the operation of the proposed works.
	(3) Do Nothing	Low	• Existing deficient drainage network could result in uncontrolled flows during extreme storm events, resulting in increased erosion and pollution at the outlets.
• Hydrogeology	**(1)** Correct deficiencies without coordination with other infrastructure	Low	• No impacts anticipated during construction. • An improved drainage collection system may result in lowering of elevated groundwater elevations in some areas which are creating drainage issues for some properties. • Will provide increased capacity to address climate change impacts.

Environmental Component	Alternative Solution	Level of Effect	Impact Considerations (Construction and Operational Activities)
	(2) Coordinate stormwater infrastructure upgrades with other infrastructure needs	Low	No impacts anticipated during construction. • An improved drainage collection system may result in lowering of elevated groundwater elevations in some areas which are creating drainage issues for some properties. • Conforms with recommendations in PPS 2020. • Will provide increased capacity to address climate change impacts.
	(3) Do Nothing	Low to Moderate	• No relief would be provided for residents experiencing drainage problems associated with high groundwater conditions.
Social			
• Community	**(1)** Correct deficiencies without coordination with other infrastructure	Low to Moderate	• Implementation of this alternative may cause disruption to local residents during the construction component of the project. Traffic control measures will be implemented to minimize the impact on residents. • No immediate impacts anticipated during operation of the proposed works; however, impacts may be aggravated if upgrades require additional capital costs or trigger reconstruction in subsequent years to address other infrastructure needs.
	(2) Coordinate stormwater infrastructure upgrades with other infrastructure needs	Low to Moderate	• Implementation of this alternative may cause disruption to local residents during the construction component of the project. Traffic control measures will be implemented to minimize the impact on residents. • Drainage issues in some areas may not be addressed as quickly as residents demand if other infrastructure needs are not as high a priority as the drainage issues.
	(3) Do Nothing	Moderate	• No relief would be provided for residents experiencing drainage problems associated with deteriorated infrastructure. Poor drainage of roads and other infrastructure could impact the entire community.
Cultural			
• Heritage	**(1)** Correct deficiencies without coordination with other infrastructure	Minimal/ Nil	• No Impacts anticipated from implementation or operation of the proposed works.

Environmental Component	Alternative Solution	Level of Effect	Impact Considerations (Construction and Operational Activities)
	(2) Coordinate stormwater infrastructure upgrades with other infrastructure needs	Minimal/ Nil	• No Impacts anticipated from implementation or operation of the proposed works.
	(3) Do Nothing	Minimal/ Nil	• No Impacts anticipated.
Economic			
• Municipal	**(1)** Correct deficiencies without coordination with other infrastructure	Moderate	• Although immediate drainage needs would be addressed, long-term infrastructure needs would not be resolved and asset management planning would be negatively impacted.
	(2) Coordinate stormwater infrastructure upgrades with other infrastructure needs	Low	• Best approach to address long-term infrastructure needs of the entire community and to address asset management planning requirements established by federal and provincial governments.
	(3) Do Nothing	Moderate	• As existing infrastructure continues to age and deteriorate, repair costs may grow and result in bigger inputs in the future to address drainage issues.
• Community	**(1)** Correct deficiencies without coordination with other infrastructure	Low to Moderate	• Although immediate drainage needs may be addressed, long-term infrastructure needs of the entire community may have to be deferred leading to future impacts.
	(2) Coordinate stormwater infrastructure upgrades with other infrastructure needs	Low to Moderate	• Drainage needs of individual properties may not be addressed which may result in additional homeowner costs in the short term. • Long-term efficiencies should be realized by coordinating infrastructure upgrades over time, leading to improved municipal infrastructure within the entire community and reduced capital costs.
	(3) Do Nothing	Moderate	• If no community wide drainage improvements are implemented, costs to individual homeowners may increase if they are forced to address drainage issues on their own.

Environmental Component	Alternative Solution	Level of Effect	Impact Considerations (Construction and Operational Activities)
Technical			
• Transportation	**(1)** Correct deficiencies without coordination with other infrastructure	Minimal/ Nil	• Traffic movement in the vicinity of the project site will be temporarily impacted during construction (traffic control measures will be implemented to maintain traffic flow along the affected street sections). Impacts are anticipated to be low given the volume of traffic along the affected roadways. • No impacts are anticipated from the operation of the proposed works.
	(2) Coordinate stormwater infrastructure upgrades with other infrastructure needs	Minimal/ Nil	• Traffic movement in the vicinity of the project site will be temporarily impacted during construction (traffic control measures will be implemented to maintain traffic flow along the affected street sections). Impacts are anticipated to be low given the volume of traffic along the affected roadways. • No impacts are anticipated from the operation of the proposed works. • Improved road infrastructure will provide increased capacity to address climate change impacts. • In conformance with recommendations from PPS 2020.
	(3) Do Nothing	Low to Moderate	• Lack of adequate drainage may have a long-term impact on the integrity of the road network.
• Infrastructure	**(1)** Correct deficiencies without coordination with other infrastructure	Minimal/ Nil	• Although immediate drainage infrastructure needs may be addressed, long-term infrastructure needs of the entire community may have to be deferred leading to future impacts and potential deterioration of key infrastructure components. • Will provide increased capacity to address climate change impacts.
	(2) Coordinate stormwater infrastructure upgrades with other infrastructure needs	Low to Moderate	• Best approach to address long-term infrastructure needs of the entire community and to address asset management planning requirements established by federal and provincial governments. • Long-term efficiencies should be realized by coordinating infrastructure upgrades over time, leading to improved municipal infrastructure within the entire community and reduced capital costs. • Will provide increased capacity to address climate change impacts. • In conformance with PPS 2020 recommendations.
	(3) Do Nothing	Low to Moderate	• Deficient drainage network could result in uncontrolled flows during extreme storm events, resulting in increased erosion and pollution at the outlets and continued deterioration of drainage &other municipal infrastructure.

Table 3.7 Alternative Solutions: Future Development Lands Environmental Effects Analysis

Environmental Component	Alternative Solution	Level of Effect	Impact Considerations (Construction and Operational Activities)
Natural			
• Aquatic	**(1)** Coordinate stormwater management planning on a sub-watershed basis	Low	• Aquatic habitat impacts may occur during construction of the proposed works. Impacts are expected to be minor in nature providing that suitable sediment and erosion control measures are implemented during construction to minimize potential impacts. • No impacts anticipated with operation of the proposed works.
	(2) Review developments on a parcel by parcel basis as developments proceed	Low to Moderate	• Aquatic habitat impacts may occur during construction of the proposed works and may be aggravated downstream by not addressing stormwater on a watershed basis. • Construction-related impacts could be addressed through implementation of suitable sediment and erosion control measures during construction, however downstream impacts cannot be mitigated.
	(3) Do Nothing	Moderate to High	• Not addressing stormwater management requirements could result in localized flooding and significant impacts downstream to existing infrastructure and natural systems.
• Terrestrial	**(1)** Coordinate stormwater management planning on a sub-watershed basis	Low	• It is anticipated that environmental studies will be undertaken as part of the development review process to ensure that sensitive habitat features are identified at the design stage and protected during construction and implementation of the regional stormwater drainage components.
	(2) Review developments on a parcel by parcel basis as developments proceed	Low	• It is anticipated that environmental studies will be undertaken as part of the development review process to ensure that sensitive habitat features are identified at the design stage and protected during design, construction and implementation of the on-site stormwater drainage components.
	(3) Do Nothing	Low	• Not addressing stormwater management requirements could result in localized flooding and significant impacts downstream to existing natural systems.

Environmental Component	Alternative Solution	Level of Effect	Impact Considerations (Construction and Operational Activities)
• Hydrogeology	**(1)** Coordinate stormwater management planning on a sub-watershed basis	Low	• No impacts anticipated during construction. • An improved drainage collection system may result in lowering of elevated groundwater elevations in some areas which could result in improved drainage for some properties. • Conforms with PPS 2020 recommendations. • Will address potential impacts associated with climate change.
	(2) Review developments on a parcel by parcel basis as developments proceed	Low	No impacts anticipated during construction. • An improved drainage collection system may result in lowering of elevated groundwater elevations in some areas which could result in improved drainage for some properties.
	(3) Do Nothing	Low to Moderate	• Not addressing stormwater management requirements could result in localized flooding and aggravate subsurface drainage conditions.
Social			
• Community	**(1)** Coordinate stormwater management planning on a sub-watershed basis	Low	• Given that most developments will occur on vacant future development lands, few impacts to existing residents should occur, except those properties located immediately adjacent to the proposed development sites. • No impacts anticipated during operation of the proposed works given that downstream impacts should be avoided by planning works on a sub-watershed basis. • May result in improved drainage conditions for existing developments that are negatively impacted by existing agricultural drainage from future development lands.

Environmental Component	Alternative Solution	Level of Effect	Impact Considerations (Construction and Operational Activities)
	(2) Review developments on a parcel by parcel basis as developments proceed	Low to Moderate	• Given that most developments will occur on vacant future development lands, few impacts to existing residents should occur, except those properties located immediately adjacent to the proposed development sites. • Downstream impacts may occur within other parts of the community due to the lack of a coordinated approach with addressing stormwater management planning. • May result in improved drainage conditions for existing developments that are negatively impacted by existing agricultural drainage from future development lands.
	(3) Do Nothing	Moderate	• Not addressing stormwater management requirements could result in localized flooding and aggravate existing drainage concerns.
Cultural			
• Heritage	**(1)** Coordinate stormwater management planning on a sub-watershed basis	Minimal/ Nil	• No Impacts anticipated from implementation or operation of the proposed works.
	(2) Review developments on a parcel by parcel basis as developments proceed	Minimal/ Nil	• No Impacts anticipated from implementation or operation of the proposed works.
	(3) Do Nothing	Minimal/ Nil	• No Impacts anticipated.
Economic			
• Municipal	**(1)** Coordinate stormwater management planning on a sub-watershed basis	Low	• Costs associated with stormwater management on future development lands are financed by the development community. • Will reduce long-term maintenance costs for facilities once they become the responsibility of the Town.

Environmental Component	Alternative Solution	Level of Effect	Impact Considerations (Construction and Operational Activities)
	(2) Review developments on a parcel by parcel basis as developments proceed	Medium	• Costs associated with stormwater management on future development lands are financed by the development community. • Will result in increased maintenance costs for the municipality in the long-term.
	(3) Do Nothing	Moderate	• Not addressing stormwater management requirements could result in localized flooding and aggravate existing drainage concerns, resulting in potential infrastructure repairs or additional deterioration.
• Community	**(1)** Coordinate stormwater management planning on a sub-watershed basis	Low	• Costs associated with stormwater management on future development lands are financed by the development community. • A coordinated approach to stormwater planning should not result in additional costs to developers and may result in efficiencies.
	(2) Review developments on a parcel by parcel basis as developments proceed	Low to Moderate	• Costs associated with stormwater management on future development lands are financed by the development community. • Additional costs to the development community may result by individually addressing stormwater needs, rather than coordinating detention facilities within subwatersheds.
	(3) Do Nothing	Moderate	• Not addressing stormwater management requirements could result in localized flooding and aggravate existing drainage concerns, resulting in potential infrastructure repairs or additional deterioration.
Technical			
• Transportation	**(1)** Coordinate stormwater management planning on a sub-watershed basis	Minimal/ Nil	• No Impacts anticipated from implementation or operation of the proposed works. • No impacts are anticipated from the operation of the proposed works.

Environmental Component	Alternative Solution	Level of Effect	Impact Considerations (Construction and Operational Activities)
	(2) Review developments on a parcel by parcel basis as developments proceed	Minimal/ Nil	• No Impacts anticipated from implementation or operation of the proposed works. • No impacts are anticipated from the operation of the proposed works.
	(3) Do Nothing	Low to Moderate	• Lack of adequate drainage may have a long-term impact on the integrity of the road network.
• Infrastructure	**(1)** Coordinate stormwater management planning on a sub-watershed basis	Minimal/ Nil	• Coordinating the stormwater needs for all future development lands will result in reduced maintenance requirements for the Town in the long term. • Conforms with PPS 2020 guidelines and recommendations. • Will address long-term impacts associated with climate change by addressing stormwater within entire sub-basin.
	(2) Review developments on a parcel by parcel basis as developments proceed	Low to Moderate	• Additional maintenance requirements may be needed for municipal staff due to the number of stormwater facilities associated with multiple development sites.
	(3) Do Nothing	Moderate	• Not addressing stormwater management requirements could result in localized flooding and aggravate existing drainage concerns, resulting in potential infrastructure repairs or additional deterioration.

3.5 Identification of a Preliminary Preferred Solution

The relative merits of each option were examined during the preliminary technical review of the study alternatives. Based on this assessment, the Town indicated a preference for **Alternative 2 – Implement upgrades to existing stormwater drainage infrastructure in conjunction with other infrastructure renewal activities,** for existing stormwater drainage infrastructure and a preference for **Alternative 1 – Coordinate stormwater management planning for all future development areas,** for future development areas. There were a number of attributes associated with these alternatives that justified their consideration as the preferred Master Plan alternatives.

- Provides the southeast development area with a comprehensive plan to upgrade existing drainage infrastructure and to deal effectively with new developments.
- Provides an infrastructure plan which will minimize impacts to receiving streams while providing improved drainage where required.
- Incorporates new technologies while still addressing existing deficiencies.
- Would integrate effectively with existing storm drainage infrastructure within the community.
- Addresses long-term infrastructure needs of the entire community and is the most cost-effective approach when considering asset management planning requirements.
- Is in general conformance with recommendations and guidelines from the Provincial Policy Statements (PPS 2020).
- Will improve resilience of existing infrastructure and address some impacts associated with climate change.
- It is the most cost-effective solution over the long term.

4.0 PUBLIC CONSULTATION PROGRAM

4.1 General

Public consultation is an integral component of the Class EA process. Public consultation allows for an exchange of information, which assists the proponent in making informed decisions during the evaluation of alternative solutions. During Phases 1 and 2 of the study process, consultation was undertaken to obtain input from the general public, stakeholders and review agencies that might have an interest in the project. The components of the public consultation program employed during the initial phases of the Class EA study are summarized in this section of the screening report and documented in Appendix ‘E’. Comments received through the consultation program and related correspondence are also discussed below and documented in the appendix.

4.2 Initial Public Notice

Contents:	General study description, summary of proposed works, key plan
Issued:	September 5, 2018
Placed In:	Sarnia This Week (September 5 and 12th, 2018), Municipal Website and Social Media Accounts
Input Period:	Concluded October 5, 2018

Two comments were received from members of the public as a result of the Initial Notice. These are summarized in Table 4.1.

Table 4.1 Summary of Public Comments

Individual	Comments/Concerns	Action Taken/Future Action
Petrolia Resident Sept. 17, 2018 (via phone)	- Lives on 1st Ave in Petrolia. - They have issues with water ponding at the back of their property at the edge of the agricultural field. - They don't see how the study will be able to help their problems.	- Explained how to complete the survey. - Advised that policies for future development lands might improve the problem with drainage at the rear of residential properties.
Petrolia Resident Oct. 12, 2018 In person at Brights Grove Office	- Lives on 4th Ave. with agricultural fields behind their property. - During periods of heavy rainfall and in the Spring they have significant drainage issues in their backyards. - Existing drainage cannot keep up with the volume of water that collects at the back of the residential properties. Town installed a larger inlet on the drain in the backyard, which helped a little, but didn't correct the bigger problem with runoff off from the agricultural lands. Left pictures and a video of the problem area.	- Collected information and advised that policies for future development lands might improve the problem with drainage at the rear of residential properties.

4.3 Questionnaire

As noted in Section 2.4.2, a questionnaire was developed at the start of the project to solicit background information from residents on the condition of existing drainage infrastructure within the community. A copy of the Notice of Study Commencement was also attached to the Questionnaire in order to explain to residents the purpose of the survey. The Notice and questionnaire were circulated to all property owners located within the study area limits and was also posted on the Municipal website. Information about the study and questionnaire were also posted on the Town's social media sites (Facebook, Twitter).

4.4 Review Agency Circulation

Input into the Class EA Master Plan process was solicited from government review agencies by way of direct mail correspondence. Agencies that might have an interest in the project were sent an information package detailing the nature of the project and an outline of the assessment process being completed. The information was circulated to nine review agencies September 10, 2018. Appendix 'E' contains a copy of the information that was circulated to the review organizations and a list of the agencies that were requested to comment on this project. Table 4.2 summarizes the comments received.

Table 4.2 Summary of Agency Comments

Review Agency	Comments	Action Taken
Ministry of the Environment, Conservation and Parks (MECP) September 7, 2018 (via e-mail)	- The crown has a duty to consult with First Nations on projects that might impact their treat rights. - This duty has been transferred to the municipality for projects such as this. - Provided a list of First Nation Communities, including: Aamjiwnaang FN, Bkejwanong Territory (Walpole Island), Chippewas of Kettle and Stony Point FN, Caldwell FN, Oneida Nation of the Thames FN, Delaware FN - Advised that potential impacts associated with Source Water Protection and Climate change should be considered during the Master Plan process.	- Comments noted and filed.
Union Gas September 21, 2018 (via e-mail)	- Advised that they have no plans to upgrade their facilities in the Petrolia Area. - If conflicts arise a mitigation plan will be developed jointly with UG and municipal representatives. - Provided as built drawings showing the location of facilities within the affected project area.	- Information noted and filed.
Infrastructure Ontario (IO) September 24, 2018 (via email)	- Indicated that a property currently owned by Infrastructure Ontario may be located within the study area limits. - Please advise if the land is required to implement the project and a process to retain the property will be undertaken.	- Information noted and filed.
St. Clair Region Conservation Authority (SCRCA) October 11, 2018 (via email)	- Received Notice of Commencement. - Interested as a landowner and as a review agency, in the outcome of the study. - Provided some resources from other Conservation Authorities related to low impact development.	- Arranged for staff from BMROSS to present MP information to SCRCA.
Ministry of Natural Resources and Forestry (MNRF) October 15, 2018 (via email)	- Provided information and current lists of possible species at risk as well as sensitive natural heritage features that might be present in the study area. - Advised that petroleum wells might be present within the study area along with a link to assist with identifying locations. - Indicated that some lands might be subject to the Public Lands Act or the Lakes and Rivers Improvement Act and to consult the MNRF website for more information.	- Information noted and filed.
Ministry of Tourism, Culture and Sport (MTCS) October 16, 2018 (via mail)	- Interested in preserving and protecting archaeological, cultural heritage and built heritage resources potentially impacted by the project. - Provided screening checklists for cultural heritage and archaeological resources to assist with the identification.	- Completed screening check-lists to identify potential impacts.

4.5 Aboriginal Consultation

4.5.1 Aboriginal Consultation Process

The Crown has a duty to consult with First Nation and Métis communities if there is a potential to impact on Aboriginal or treaty rights. This requirement is delegated to project proponents as part of the Class EA process, therefore the project proponent has a responsibility to conduct adequate and thorough consultation with Aboriginal communities as part of the Class EA consultation process. The project study area contains a number of sensitive natural features which may be of concern to First Nation and Métis communities in the area. These features include Bear Creek and Durham Creek and the natural areas located along tributaries discharging to the watercourses at the southeast corner of the study area.

4.5.2 Background Review

In order to identify Aboriginal Communities potentially impacted by the project the Aboriginal and Treaty Rights Information System (ATRIS) was consulted. A search was conducted for Aboriginal Communities, including their traditional territories that would lie within a 50 km radius of the project study area. Utilizing this process and feedback received from the MECP, nine aboriginal communities/organizations were identified in conjunction with this project including: Aamjiwnaang FN, Kettle and Stony Point First Nation, Chippewas of the Thames FN, Oneida Nation of the Thames, Bkejwanong Territory (Walpole Island FN), Caldwell FN, Delaware Nation, Metis Nation of Ontario, and Great Lakes Métis Council. Correspondence was subsequently forwarded to each community/organization detailing the proposed project and asking for input. A response was received from Aamjiwnaang First Nation which is summarized below.

Table 4.3 Summary of Aboriginal Comments

Review Agency	Comments	Action Taken
Aamjiwnaang First Nation September 7, 2018 (Via mail)	- Concerned with road mortalities during construction – how would this be mitigated. - Wants any areas of natural habitat to be restored upon completion of the work. - Interested in any archaeological or species at work field work completed in conjunction with the study.	- Included recommendations in the report regarding concerns.

4.6 Stakeholder Meetings

4.6.1 Meeting with Developers

On June 17, 2019, BMROSS and Petrolia staff organized a meeting with landowners and their representatives, for the future development lands located in the east and southeast portion of the study area. The purpose of the meeting was to present the preliminary preferred approach for dealing with stormwater runoff within future development lands and to get feedback from landowners on this approach. The presentation included information on development of the PCSWMM model, a summary of Master Plan

investigations, and recommendations for future development lands. Following the presentation, questions were accepted from landowners and their representatives. A summary of key concerns and questions is listed below:

- Questions regarding the distribution of costs amongst landowners for shared SWM facilities constructed within future development lands;
- Questions regarding the ownership and future maintenance of the shared facilities;
- Questions regarding the location of the proposed SWMF and whether alternative locations could be considered;
- Questions regarding the timing of the Master Plan process and how quickly current development applications could move forward.

Additional Meetings with Developers

In 2020 and 2021 there were several additional meetings with property owners and their engineers representing the development community, to discuss implementation options associated with future development lands. During the meetings, various locations for the central stormwater management facility were discussed, as well as different financing approaches to share the costs amongst the benefiting property owners. Staging approaches were also discussed to ensure that flows from the Greenizen Drain can be accommodated if developments at the north end of the site move forward first. The meetings concluded with general agreement amongst the property owners that they would work together to confirm a location and design for the communal stormwater management facility to service the west basin and develop a cost sharing agreement to fairly distribute capital costs associated with the communal stormwater facilities that will be shared. Copies of the meeting notes are provided within Appendix 'D'.

4.6.2 Presentation to SCRCA

On June 24, 2019 a meeting was held with representatives from the St. Clair Region Conservation Authority so that BMROSS staff could present the proposed stormwater management approach to staff for their input. At the meeting, PCSWMM™ modelling results were presented, along with recommendations for future development lands and for existing developed areas. SCRCA staff agreed to review the information and provide input to BMROSS staff before the Master Plan is finalized. Some questions raised during the meeting include:

- What is the area being diverted from the west basin to the east basin;
- Has there been any consideration of downstream impacts to the receiving watercourse that might result from a modification to the drainage catchments;
- Questions regarding how modifications to the existing pond would be implemented.

A follow-up meeting with SCRCA was held on November 13th, 2021. The meeting was held virtually due to public health restrictions. At the meeting, BMROSS staff updated staff from SCRCA on the status of the Master Plan, and specifically on the approaches recommended for future development lands. SCRCA confirmed that they are supportive of the approach being recommended by BMROSS and will forward correspondence confirming this later in the fall.

4.6.3 Meeting with Golf Course Owners

When the Class EA Master Plan process was initiated in 2018, the irrigation pond serving the golf course lands and adjacent residential developments, was owned by a property owner with land holdings within the future development lands. The plan to utilize the pond as part of the comprehensive stormwater management approach for the west basin made sense if one of the owners would benefit from the pond they owned and managed. Subsequently, the golf course and pond were sold to a third party. When the Master Plan was being finalized, it was determined that consultation with the new owners of the pond would be necessary for the proposed plan to be successful.

A meeting was subsequently arranged on April 14, 2021 with representatives from BMROSS, the Town of Petrolia, and the Kingswell Glen Golf Club owners. Background on the Stormwater Master Plan process was provided, along with the anticipated upgrades to the pond, including a lowering of the water level by approximately 1 metre, reconstruction of the retaining wall at the west end, and new outlet facilities. The owners indicated that they are supportive of the proposed modifications but would like to be consulted during finalization of the design for the proposed upgrades and want to ensure that they are visibly appealing. The group also discussed irrigation requirements for the golf course lands and determined that the irrigation needs should not conflict with its use as a stormwater management facility. Additional detailed design and consideration during construction is required to ensure irrigation purposes and irrigation pump house is maintained. A copy of the meeting notes is contained within Appendix ‘D’.

4.7 Public Information Meeting

A Public Information Centre (PIC) was held on July 10, 2018 at the Petrolia Town Hall from 5:00 p.m. to 6:12 p.m. The meeting included a formal presentation with display boards explaining the study process and other project components and a question and answer period following the presentation. Representatives from the Town of Petrolia and BMROSS were available to answer questions from those in attendance. The meeting was arranged to serve several purposes:

- Provide local residents and other stakeholders with additional details on the Class EA Master Plan study investigations and a forum to express their views.
- Provide Petrolia residents with an overview of the recommendations identified in conjunction with the Master Plan.
- Provide residents with an opportunity to ask questions and review mapping and other display material prepared in support of the Master Plan.

Approximately 45 residents and stakeholders attended the meeting. A copy of the presentation material is included within Appendix ‘E’.

4.8 Consultation Summary

The public consultation program developed for this project was directed toward Petrolia residents who live within the project study area limits and will be potentially impacted by recommendations from the study. Input was also sought from federal/provincial review agencies and Aboriginal communities. The feedback received from residents was helpful in identifying and confirming problem areas identified through the questionnaire and modelling exercise as well as additional areas of concern.

Agency consultation included feedback from the St. Clair Region Conservation Authority, who is also a landowner within the study area, the Ministry of Environment, Conservation and Parks, Ministry of Tourism, Culture and Sport, Ministry of Natural Resources and Forestry, Infrastructure Ontario and Union Gas. A response was received from one Aboriginal community, the Aamjiwnaang First Nation.

Additional consultation was undertaken with the development community during the course of the Master Plan to ensure that they were supportive of the proposed approach being suggested for future development lands. Several meetings were held with property owners and their engineering consultants to review possible locations and design criteria associated with the communal stormwater management facility. The Master Plan was not finalized until we had assurances that the proposed approach presented for future development lands, was supported by the development community.

5.0 EVALUATION OF THE PRELIMINARY PREFERRED ALTERNATIVE

5.1 Framework of Analysis

Following selection of **Alternative 2 – Implement upgrades to existing stormwater drainage infrastructure in conjunction with other infrastructure renewal activities,** for existing stormwater drainage infrastructure and **Alternative 1 – Coordinate stormwater management planning for all future development areas,** for future development areas, a study framework was developed to further evaluate the potential impacts of implementation. The purpose of this review was to assess the environmental interactions resulting from the construction and operation of the project, and to determine if the identified interactions would generate potential environmental impacts. The assessment of the preferred alternative incorporated these activities:

- Assessment of the construction and operational requirements of the proposed works.
- Examination of the project implementation plan.
- Results of consultation with the public, stakeholder groups and government agencies.
- Review of engineering methodologies associated with the different SWM concepts.
- Evaluation of the potential impacts of the project on the environmental features, including residual effects following mitigation.

The following section of the report summarizes the findings of the evaluation process.

5.2 General Project Scope

5.2.1 Storm Drainage Design – Existing Urban Areas

Storm drainage investigations completed in conjunction with the Master Plan process have identified deficiencies with the existing storm drainage collection system in established areas of Petrolia, within the study area limits. Storm drainage facilities (existing inlet structures and drainage collection systems) generally lack sufficient capacity to address the needs of the service area.

Apart from a few areas with newer infrastructure installed when the street was constructed (e.g. Fairway Court), there has been no significant stormwater related infrastructure work completed in the past couple of decades. Accordingly, a major component of the preferred alternative is to provide the study area with a strategy to upgrade and replace aging and undersized existing (or non-existent) drainage infrastructure.

Where possible during the replacement of aging infrastructure, consideration should be given to retrofitting the system to include in-line devices to promote the separation of oil and grit from the stormwater runoff. It is recognized that there is not a lot of opportunity to implement LID measures in the existing road allowance given the established nature of the drainage areas, however, where practical, efforts should be made to promote infiltration prior to discharge of storm runoff to the proposed pipe system.

5.2.2 Storm Sewer Design Criteria

In general, storm sewers should be provided to service all of the existing community, where drainage deficiencies have been identified and should be located in the street right-of-way or in an approved easement. The storm sewer discharge must be carried to an appropriate outlet with sufficient capacity so that no damage is done to lands or road. Storm sewers should be designed to accept all drainage from the contributing area and should be sized in accordance with the following:

- The system of street gutters, catch basins, storm sewers and roadside swales, shall be designed at a minimum the 1:2 year storm (Sarnia rainfall). Culverts or sewers crossing major County roads or Provincial highways shall be designed and approved in accordance with the requirements of the County Highways Department or the Ministry of Transportation, respectively.
- In general, the Rational Method shall be used for the sizing of the minor storm sewer system at the final design stage. Calculations based on a hydrologic simulation model are required for systems serving large areas or involving treatment and/or storage systems.
- The identified road sections will be subject to full road reconstruction, including the replacement of municipal watermain, sanitary sewers and storm sewers.

The current municipal standard calls for an urban cross-section with curb and gutter. In established areas where curb and gutter currently does not exist, some modifications to boulevard areas will be required to modify existing swales and ditches and convert the drainage system to a traditional storm drainage collection system. This may also require an adjustment to road grades in order to direct runoff to the roadway where runoff can be collected within the storm drainage collection system.

5.2.3 Implementation Phasing

Projects identified for implementation through the Master Plan process have been categorized into a proposed phasing plan, based upon the following criteria:

- **Input received from residents through the questionnaire and other public consultation efforts;**
- **Existing condition of infrastructure based on inspection data and municipal records;**
- **Results of the modeling exercise.**

Anticipated timing for implementation will be subject to the availability of funding and other Town priorities within developed areas of the community. The proposed phasing plan will be coordinated with other municipal infrastructure needs (roads/sanitary sewers/watermains) so that all infrastructure needs are addressed. Coordination with Petrolia's Asset Management Plan will also be required to be consistent with Provincial Asset Management Planning. Table 5.1 illustrates the proposed phasing plan for developed areas and identifies the associated Class EA Schedule for each infrastructure project. The location of the proposed phases is also illustrated on Figure 5.1.

Figure 5.1 Proposed Storm Drainage Phasing Plan – Existing Developed Areas

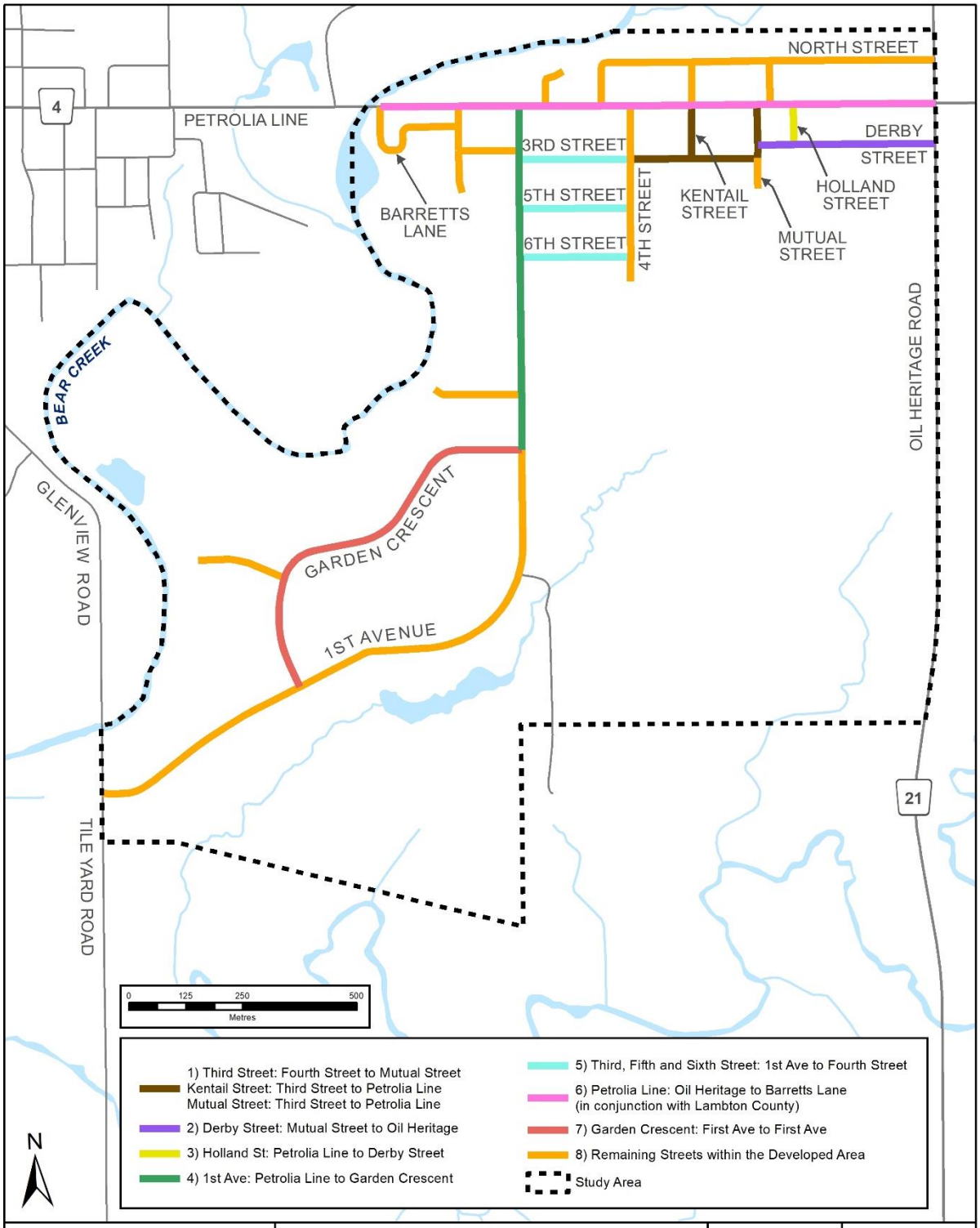


Table 5.1 Proposed Phasing Plan: Existing Developed Areas

Master Plan Project Component – Suggested Priorities	Class EA Schedule
1. Third Street: Fourth Street to Mutual Street; Kentail Street: Third Street to Petrolia Line; Mutual Street: Third Street to Petrolia Line	A+
2. Derby Street: Mutual St to Oil Heritage Rd	A+
3. Holland St: Petrolia Line to Derby Street	A+
4. 1st Ave: Petrolia Line to Garden Crescent	A+
5. Third, Fifth and Sixth Street: 1st Ave to Fourth Street	A+
6. Petrolia Line: Oil Heritage to Barretts Lane – in conjunction with Lambton County	A+
7. Garden Crescent: First Ave to First Ave	A+
8. Remaining Streets within the Developed Area	A+

5.3 Storm Drainage Recommendations – Future Development Lands

As noted previously in Section 3.5, **Alternative 1 – Coordinate stormwater management planning for all future development areas,** was selected as the preliminary preferred Master Plan Alternative for future development lands. The implementation of this alternative will involve the construction of individual or communal stormwater management facilities at the downstream end of all future drainage areas established through the Master Plan. These facilities should be constructed to address quality and quantity control of stormwater run-off from the tributary drainage areas.

5.3.1 Future Drainage Areas

Figure 2.8 illustrates the existing drainage catchments identified within existing and developed areas of the southeast Petrolia study area. Future development lands are comprised of two major sub-basins currently discharging to two different outlets as follows:

a) Drainage Area A – This sub-basin is 46.5 ha in size and is located in the southeast corner of the study area, discharging to Durham Creek. Land use is primarily agricultural with a small percentage of natural cover in the extreme south adjacent to the outlet.

b) Drainage Area B – Outlet B is the largest sub-basin comprised of a majority of future development lands and portions of existing developed areas adjacent to First Avenue and Garden Crescent. The Greenizen Municipal Drain comprises the primary flow path which discharges through the existing online pond on golf course lands to Durham Creek and then to Bear Creek, west of Tile Yard Road.

Based on the modeling exercise, it was determined that the existing pond facility had insufficient capacity to accommodate anticipated flows from all future development lands located within Drainage Area B. Retrofits to the existing facility are required.

Given the limited topographic relief within the upper limits of both catchments, an approach was considered where a portion of Drainage Area B could be diverted to Drainage Area A, providing some relief to the Area B outlet and improve overall storm sewer servicing. This approach would not be feasible within a more defined sub-basin, but with elevations in the upper catchment relatively flat, modifications could be implemented during construction of the road network and site grading, to divert drainage to a different outlet. It was determined that a balance of 10.5 ha could be diverted to the east basin from the west basin in conjunction with the different outlet options being considered. An evaluation exercise was developed to examine different outlet alternatives for the two drainage basins.

5.4 Evaluation of Drainage Outlet Alternatives – Future Development Lands

5.4.1 Servicing for Future Development – Outlet A (East)

Alternatives evaluated for the Outlet A, the east side of the future development area are illustrated in Figure 5.2 and further discussed below.

5.4.2 East SWMF Option 1

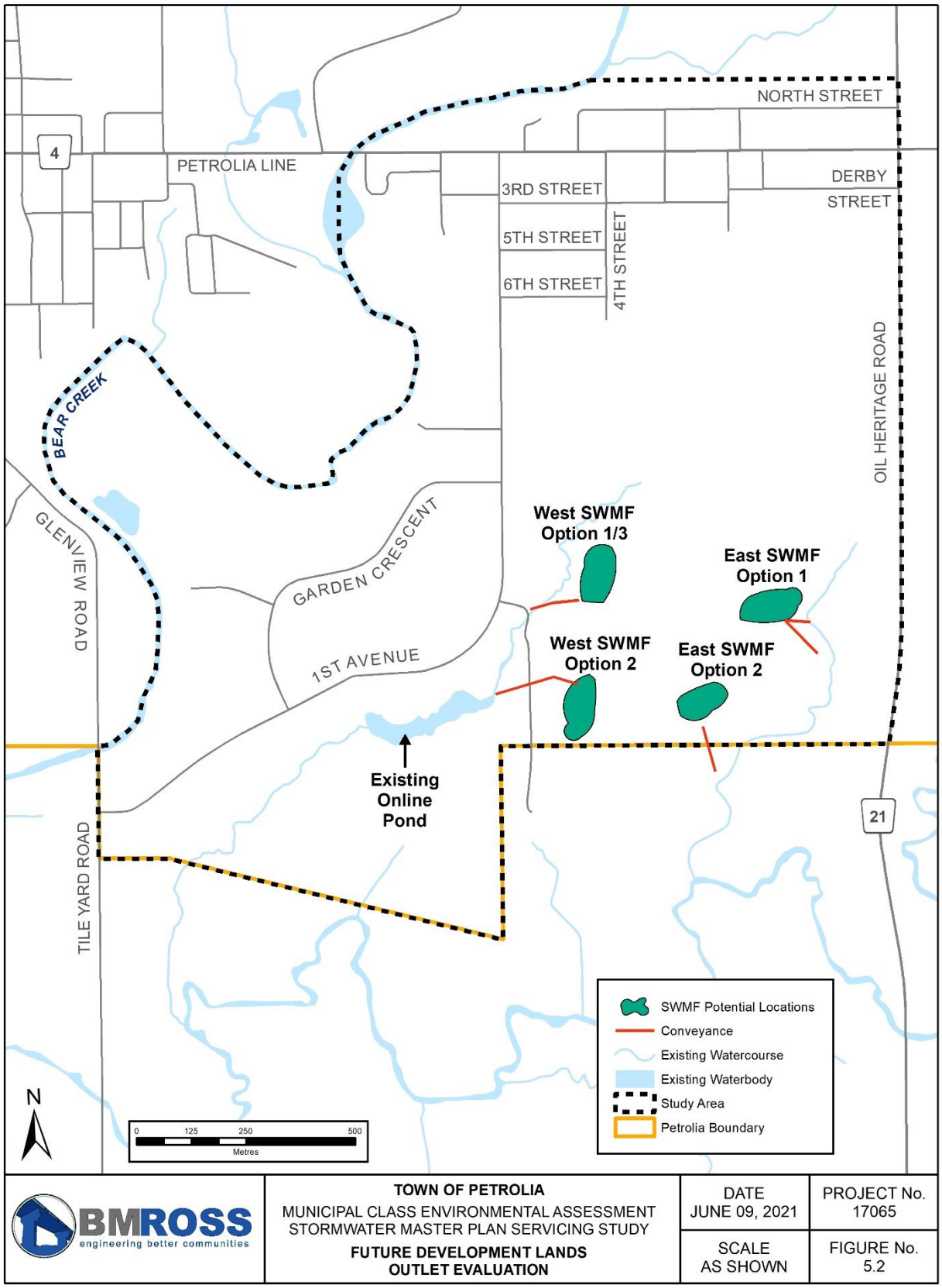
Option 1 involves the construction of an East SWMF adjacent to the tributary of Little Bear Creek valley system. The SWMF would provide water quantity, water quality and erosion control for upstream future development areas discharging to Outlet A. The adjacent valley system provides design flexibility and sufficient grade for a suitable SWMF outlet and upstream storm sewer servicing.

Opportunities to divert a portion of the Greenizen Drain catchment is also feasible for this option with potential overall servicing grades of 0.35%. Diverting the northeastern portion of the Greenizen Drain catchment to the East SWMF would improve overall service grades for a West SWMF. In an effort to maintain drainage areas, some of the agricultural lands currently draining to the tributary of Little Bear Creek would be diverted to the West SWMF upon development. This option would streamline development staging and implementation of regional controls, as the east SWMF may be developed by a single developer.

5.4.3 East SWMF Option 2

Option 2, similar to Option 1 above, involves the construction of an East SWMF adjacent to the tributary of Little Bear Creek valley system to provide water quantity, water quality and erosion control for upstream future development areas. Sufficient grade is provided for a suitable SWMF outlet and servicing. Opportunities to divert upper portions of the Greenizen Drain catchment are limited for this option, based on the facility's spatial location. Under Option 1, lands in the vicinity of the East SWMF Option 2, are proposed to be diverted to a West SWMF. Therefore, significant over control and increase pond sizing would be required if portions of the Greenizen Drain were diverted to this SWMF location.

Figure 5.2 - Future Development Lands – Outlet Evaluation



5.4.4 Recommendation

Outlet options were reviewed with municipal staff and there was a preference for Option 1, which allowed for a diversion of portions of the Greenizen Drain catchment to the East SWMF.

5.5 Servicing for Future Development – Outlet B (West Basin)

Alternatives evaluated for the West Outlet are illustrated in Figure 5.2, and further discussed below.

5.5.1 West SWMF Option 1: Wet Pond

Option 1 involves the construction of a SWMF adjacent to the open channel section of the Greenizen Drain, providing water quantity, water quality and erosion control for upstream future development areas, discharging to the Greenizen Drain (Outlet B). Based on preliminary servicing calculations and SWMF sizing requirements, this option is subject to significant outlet and inlet design constraints.

The SWMF outlet is constrained by the existing Greenizen Drain open channel invert and operation of the downstream online pond. With the existing online pond and SWMF operating in series, over control is required by the proposed SWMF to not increase flood volumes or peak flows downstream. As noted previously, limited freeboard is provided by the existing online pond. Any increase in runoff volume to the pond under extreme events will result in higher peak flows overflowing the existing berm. Therefore, the proposed SWMF would be required to over control for extreme events resulting in a larger active storage volume and larger footprint for the proposed facility.

Servicing of upstream lands is constrained by the SWMF inlet requirements. SWMF's inlet pipes should be located above the 2-year ponding depth to ensure free discharge under frequent storm events and limit backwater impacts on upstream storm sewers. The resulting available grade to service either the northwest or northeast limit of the future development area results in extremely flat servicing gradients (less than 0.15%). The extremely flat gradient would result very large flat sewers, and potentially significant fill requirements.

5.5.2 West SWMF Option 2: Wet Pond

Option 2 involves the construction of a SWMF immediately east of the existing online pond, providing water quantity, water quality and erosion control for upstream future development areas discharging to the Greenizen Drain (West Outlet B).

Similar to Option 1 above, significant inlet and outlet design constraints exist on the West SWMF Option 2. Servicing of upstream lands would be more constrained due to the facility location, with overall servicing gradients less than 0.11%.

5.5.3 West SWMF Option 3: Existing Pond Retrofit (Lower Cell) and Wet Pond (Upper Cell)

Option 3 involves retrofitting the existing online pond along the Greenizen Drain into a Lower SWMF Cell and the construction of an Upper SWMF Cell adjacent to the open channel section of the Greenizen Drain. The Upper and Lower SWMFs would operate as a joint facility for water quantity control. Water quality for upstream future development areas would be provided by the Upper SWMF cell.

This option aims to mitigate significant design and servicing constraints presented by constructing a separate SWMF upstream of the online pond, as identified for Option 1 and 2 above. For the Upper Cell, a central shared basin is preferred to improve storm servicing, grading and reduce fill requirements. It is recommended that the proposed SWMF be also located in close proximity to the existing online pond. The final SWMF location may be subject to change due to land negotiations and detailed design by the developers.

It is proposed to retrofit the existing online pond by dropping the permanent pool elevation by 1 m to increase the overall active storage volume provided. A new outlet would be constructed to limit peak flows to existing levels. With the proposed retrofits, overflows of the existing berm embankment would also be eliminated, with a minimum 0.25 m freeboard provided for the 100 year event. This would improve existing safety concerns on the overtopping of the existing berm.

The proposed Upper Cell would provide water quality and partial water quantity control for the upstream future development. By lowering the permanent pool of the existing online pond and providing adequate grade between the two cells, servicing of upstream lands would be significantly improved. The resulting available grade to service the northwest or northeast limit of the future development area is 0.40% to 0.25%, respectively. It is therefore advantageous to divert the northeast area to the East SWMF. This was reviewed in more detail for Outlet A.

As part of the retrofit, grading works may be required along existing banks. It is noted that phragmites (an invasive plant species) is present along a significant portion of the existing pond banks. Mitigation measures may include the removal of invasive plant species with native vegetation. The existing retaining wall at the west end of the pond needs to be relocated further west as part of the modifications to allow additional room for water and sewage servicing that is proposed adjacent to the existing retaining wall.

5.5.4 Recommendation

Outlet options for the west basin were reviewed with municipal staff and with landowners proposing residential plans of subdivision within the catchment areas. Input was also sought from the St. Clair Region Conservation Authority on the various outlet approaches. Following this review, there was a preference for Option 3, which would require modifications to the existing pond facility. This option was preferred because it created more storage within the existing pond, reduced overtopping of berm during extreme storm events, and provided a better outlet for upstream lands within the basin.

A central shared basin is recommended to improve storm servicing, grading and reduce fill requirements for all benefiting properties. It is recommended that the proposed SWMF be also located in close proximity to the existing online pond. A final location for the proposed communal stormwater facility located upstream of the existing pond, will be subject to land negotiations and detailed design by the developers. A concept of the proposed Upper Cell wet pond and lower pond retrofit is provided in Appendix D.

5.6 Recommended SWMF Design Summary

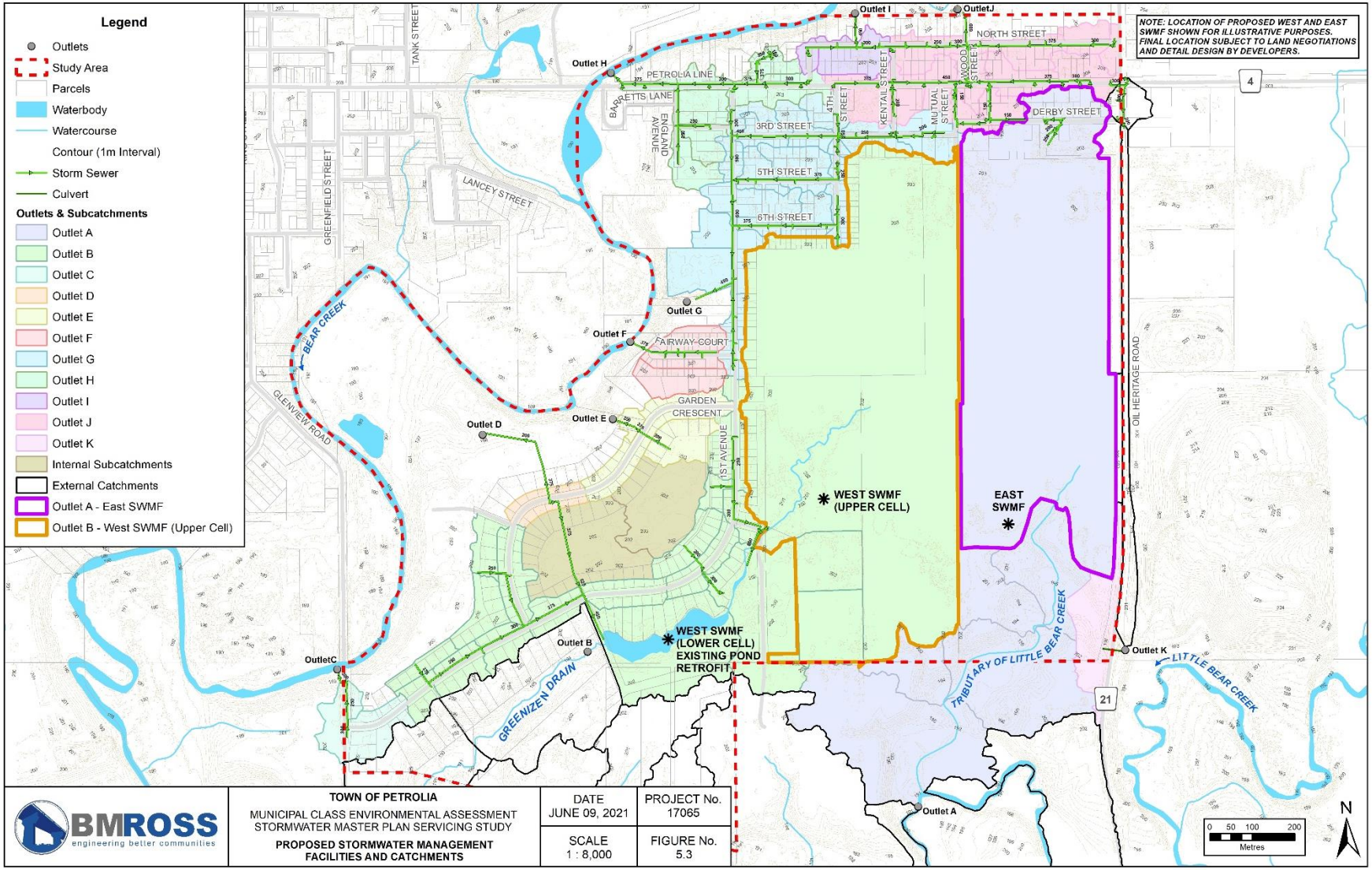
The recommended SWMFs locations and service catchment areas recommended in Sections 5.4.4 and 5.5.4 are illustrated in Figure 5.3. Table 5.2 summarizes the design parameters identified for the three stormwater management facilities. Further details on stormwater management design criteria are presented in Section 6.

Table 5.2 Stormwater Management Facility Design Summary Future Drainage Areas

Drainage Area	Contributing Area	Impervious Level	Total Water Quality Storage Volume Requirements			Total Active Storage
			Required Water Quality Storage	Permanent Pool	Extended Detention	
	(ha)	(%)	(m^3/ha)	(m^3)	(m^3)	(m^3)
East SWMF	36.72	55	190	5,510	1,470	14100
West Upper SWMF	50.76	55	190	7,610	2,030	14900
West Lower – Existing Pond	81.31	49	-	-	-	12500

Note: 1. All facilities designed as extended detention wet pond configurations
2. Total Active Storage as required for 100 yr event. Includes required Extended Detention volume for East SWMF and West Upper SWMF.
2. Required volumes are concept level and to be confirmed at final design of each facility.

Figure 5.3 - Proposed Stormwater Facilities and Catchments



6.0 Stormwater Management Design Criteria and Suggested Standards

6.1 Design Guidelines

Current stormwater management design standards require the restriction of stormwater flows discharging from a new development to not exceed existing values. The impact of future flows on downstream systems should be no greater than at present but will also be contingent on the condition of the outlet. All new development proposals should undergo a pre-consultation process with the Town of Petrolia and St. Clair Region Conservation Authority (SCRCA) to review design criteria relative to the proposal and the current environmental conditions of the subbasin.

A Stormwater Management Report setting out the existing and proposed drainage pattern shall be submitted to and approved by the Town, the SCRCA and the Ministry of Environment, Conservation and Parks (MECP). The design of the stormwater management system shall be in accordance with the latest version of the "Stormwater Management Practices, Planning and Design Manual" as prepared by MECP (and as revised). Should the development be of a size or location where the Conservation Authority has no requirement to regulate the stormwater management criteria, or in the event that specific design details are not provided by the Conservation Authority, the Town has the following objectives for the management of storm drainage within its boundaries:

- Reduce to acceptable levels, the potential risk of health hazards, loss of life and property damage from flooding.
- Reduce to acceptable levels, the incidence of inconvenience caused by surface ponding and flooding.
- Ensure that any development or redevelopment minimizes the impact of change to the groundwater regime; increased pollution; increased erosion or increased sediment transport, especially during construction; and impact to surrounding lands and areas of existing development.
- Maintain, where applicable, any natural stream channel geometry insofar as it is feasible, while achieving the above objectives.

General design requirements are described in the following sections.

6.1.1 Water Quantity Control

Quantity controls shall restrict post-development runoff flows to pre-development flows between the 2 year and 100 year storm events, unless higher control measures are required.

The capacity of the receiving system should be reviewed to identify any hydraulic constraints or existing flooding hazards that require strict quantity control measures. Outlet works, including open channels and trunk storm sewers, may be proposed to improve conveyance of stormwater. SWM controls are required to ensure pre-development levels are not exceeded to receiving system.

The stormwater management system shall be designed using an approved hydrologic model. Assumptions and justifications for the choice of hydrologic/hydraulic model are to be provided. All hydrologic modelling parameters are to be summarized and modeling schematics provided for pre and post development conditions. Stage-storage relationship of proposed SWMFs and operating characteristics during design events are required.

The SCRCA should be contacted with respect to the appropriate storm distribution and duration to be used. The Developer's Engineer shall advise the Town in writing as to the Authority's requirements. Typically, variable event duration and durations (i.e. 3-hour Chicago, 12-hr AES, 24-hr SCS, etc.) are required with the most conservative results used for the design basis for SWMF outlet design and storage requirements.

6.1.2 Water Quality Control

Water quality controls are to be provided to Level 1 (enhanced) 80% long-term total suspended solids removal water as per MECP guidelines. Controls may be provided by existing or planned SWMFs with a water quality design component.

For infill or retrofit sites, water quality controls may be provided by the use of oil-grit-separators (OGS) or Low Impact Development (LID) measures upon approval by the Town and the SCRCA.

Where applicable, oversizing of the water quality storage volumes in SWMFs should be considered to reduce long-term maintenance frequency and requirements. The sizing of OGS units should limit cleanout requirements to once a year as feasible.

6.1.3 Extended Detention and Erosion Control

All end-of-pipe facilities are to provide 40 m^3/ha of extended detention storage, as per MECP requirements. At a minimum erosion control is to be provided in all SWM facilities such that a 25 mm, 4-hour Chicago storm event is detained and release over a 24-hour period.

Future studies and assessments on receiving watercourses may identify the need for higher erosion control measures. A site specific geomorphological/fluvial assessment may be required to establish additional erosion control requirements.

6.1.4 Conveyance – Major and Minor Systems

The design of major and minor systems is to be provided. The minor system comprises swales, street gutters, ditches, catch basins and storm sewers. The major system comprises the natural streams and valleys and man-made channels, roads, or other overland conveyance systems. Minor and major system components should be located in the street right-of-way or in an approved easement.

- Detailed calculations and engineering drawings for all elements of the SWM system are required including grading and servicing plans, and major/minor system layout.

- The major system shall be designed to convey the regional storm event. Calculations substantiating the capacity of the proposed major system are required.
- The design storm for the minor systems shall be the 2 year storm for new local storm sewers (the system of street gutters, catch basins, storm sewers or open ditches, where permitted). Use of shallow grassy swales for storm water conveyance is recommended where it can be practically implemented.
- The Rational Method shall be used for the sizing of the minor sewer system at the final design stage. Calculations based on a hydrologic simulation model (such as MIDUSS, OTTHYMO, PCSWMM or other such methods as approved by the SCRCA, and the Town are required for systems serving large areas or involving treatment and/or storage systems.
- Storm sewers shall be connected to the municipal storm sewer system (where feasible) or discharged to a natural watercourse/receiving drain as approved by the Town, Conservation Authority, and MECP. If storm sewers are installed in easements, the major storm flow system can be included as an overland swale or ditch within an easement. The hydraulic grade line should be checked to ensure the major storm event does not overtop of major flow route to result in unacceptable flooding of buildings, roadways or other infrastructure.
- Culverts or sewers crossing of County or Provincial highways shall be designed and approved in accordance with the requirements of the County Highways Department or the Ministry of Transportation, respectively.
- Hydraulic gradeline studies are required when a free discharge is not provided for the storm system. This is applied to SWMF inlets, SWMF outlets, and storm sewers with direct outlets to watercourses. Inlets to SWMFs should be located above the projected 2 year ponding elevation. SWMF outlets shall consider impacts of any tailwater conditions in the receiving watercourse from the 2 to 100 year design storm event, including additional storage requirements. A free draining outlet to the 100 year is preferred for a SWMF. Storm sewer outlets to watercourses shall be above the 2 year level of the receiving watercourse at a minimum. In cases where a free outlet cannot be provided, the hydraulic gradeline study shall ensure sewers are not surcharging for design event and properties are protected from excess surface ponding.

6.1.5 Infill Developments

Small infill developments or redevelopment of lands should promote best management practices and low impact development measures as feasible and appropriate. Infill developments within the existing settlement area are to provide site controls for water quality (80% long-term total suspended solids removal) and water quantity control to predevelopment levels, or overcontrolled to allowable release rates to existing infrastructure.

6.1.6 Rationalization of SWM Facilities

Large-scale planning and implementation of SWM facilities on a catchment basis is encouraged to reduce land requirements, capital and long-term maintenance costs.

For large site developments, approximately 5% (minimum, up to what is required) of the proposed development lands should be used for storm water retention in order to satisfy the storage and retention requirements established through the pre-consultation process. This will ideally be located in lower areas of the site.

Restoration and design of the SWMF's should have regard for landscape ecology and is to be reviewed with the Town and SCRCA prior to plan finalization.

6.1.7 Best Management Practices and Low Impact Development Measures

The design phase for developments, redevelopments and infrastructural renewal programs should give consideration for reducing runoff and promoting onsite infiltration. Best management practices can be achieved by:

- decreasing impervious areas,
- intercepting runoff to onsite gardens or grassed areas,
- increasing topsoil depth, and
- reducing lot grading.

Low Impact Development (LID) methods should be incorporated as technically feasible and appropriate, as determined through consultation with the Town and the Conservation Authority.

LID measures located within municipal road ROWs or Town property are to be owned and maintained by the Town. LID measures for municipal road right-of-way or easements may include:

- Grassed swales – similar to rural road cross-section with ditches/swales designed to infiltration runoff and/or slow flows.
- Bio-retention systems - a shallow basin designed to collect, filter and infiltrate storm water and may include a connection to a storm sewer system. Bio-retention facilities landscaping can be grassed, naturalized or landscaped.
- third pipe systems (perforated exfiltration pipes in a granular bedding) or French drain systems.

For new developments with single family lots, LID systems should be located within the proposed municipal right-of-way or dedicated easement to ensure access and maintenance.

For new developments of multifamily, commercial and institutional sites, LID systems are encouraged with maintenance conducted by private owners.

It is noted that the soils within the study area are generally clay and clayey till soil types. LIDs may be implemented in “tight soils” with adaptations such as underdrains and overflows with connections to downstream storm sewers/conveyance systems. It is also noted that there are no applicable Source Water Protection policies for the study area limiting the use of LIDs.

6.1.8 Climate Change and Resiliency

The impact of climate change should be considered in consultation with the Town and the SCRCA. This should include the impact of extreme storm events on stormwater collection systems and end of pipe facilities as well as the resultant implications on the ongoing maintenance of the facilities.

To reduce risk, a suite of synthetic storms given a fixed frequency (i.e. 100 year), should be applied with different durations, distributions and intensities to assess system performance. A minimum freeboard of 0.3 m should be provided in SWM facilities as a safety factor to extreme events and climate change resiliency.

6.1.9 Maintenance and Operation Easements

Maintenance and operation easements are to be identified and included as part of proposed development lands. Easements are required to ensure the Town can properly install and maintain storm sewers, drains, stormwater management facilities, channels and/or access roads. Easement width requirements depend on the nature and extent of the proposed infrastructure.

6.1.10 Sediment and Erosion Control

Sediment and erosion control plans are to be prepared and detailed on Site Plans or a separate plan as part of SWM submissions. Measures shall be identified for works to be included during the construction and for permanent measures.

6.1.11 Municipal Drain Works

The upper portion of the Greenizen Drain has municipal drain status. Proposed works that require modifications, maintenance or repair to the existing drains to support future development may be completed under the Drainage Act. The design of municipal drain works servicing urban areas should meet all MECP criteria with respect to sizing, minimum diameter, velocity, slope, maintenance hole spacing and catch basin spacing required for urban servicing.

Infrastructure designed and constructed under the Drainage Act may be assumed under the Water Resource Act at a future date. The Drainage Act may be used to obtain an outlet for a new urban drainage system across private agricultural lands. Alternatively, an easement can be obtained for a drainage infrastructure under the Water Resource Act initially (as outlined in Section 6.4.10) The decision to use either act can be made based on site specific details, drainage area land uses, and timing future developments.

Upon urbanization of catchment areas, the Town may elect to abandon a municipal drain or branches, and/or assume existing infrastructure under the Ontario Water Resource Act.

6.2 Reporting Criteria

Hydrologic studies should describe the model parameters and criteria for their selection as well as input and output data. Reports shall include a section outlining the following:

Water Quantity Control

- Address the impact of the minor and major storm as required in these guidelines for both pre development and post development regimes.
- Address erosion control volume and detention requirements.

Water Quality Control

- Address best management practices proposed to achieve desired treatment.
- Make reference to MECP Stormwater Management Planning and Design manual.

Low Impact Development Measures

For SWM plans including LID measures, a detailed design brief included as part a Functional Stormwater Management Report is required. The design of the LIDs should include (as applicable):

- detailed design calculations,
- design drawings,
- field testing,
- soil specifications,
- landscaping plans,
- construction sequencing and temporary by-passes,
- erosion and sediment plans to protect LID features, and
- operation and maintenance requirements.

Erosion and Sediment Control Plan

- Provide comments and detail on a Site Plan or a separate plan as part of the submission.

Major System/Overland Flow Routes

- Provide extent of flood for the Major Storm or Site Plan
- Show major storm route
- Comment on a right to access of major storm routes based on land ownership on adjacent lands

Maintenance Considerations

- Address ownership and obligation for maintenance

- A maintenance manual outlining maintenance tasks and frequency of maintenance activities shall be provided as part of the Stormwater Management Report process.

Facility Access

- Access to all areas of any proposed facility needs to be detailed and commented on in the report.

6.3 Construction Details

Upon implementation of the preferred Master Plan alternatives, the construction plan for this project would typically include the following general tasks:

- Contractor mobilization to the site.
- Provide traffic signs and barricades at the limits of the construction area, as required.
- Complete site layout, including service locates.
- Remove deteriorated or undersized facilities, if present.
- Place new piping, including bedding (native or granular backfill).
- Install structures and complete additional grading around inlets to create storage.
- Install trash screens to improve water quality.
- Re-grade roadside ditches and swales as required to facilitate overland flow.
- Restore site: topsoil and sod to the property line.
- Remove traffic barricades and signs, as appropriate.
- Complete all required documentation and reporting on the works.

a) Construction Mitigation

Construction-related activities associated with project implementation have the potential to impact upon existing environmental features, the general public and construction workers. The Contractor will therefore be responsible for carrying out these activities in accordance with industry safety standards and all applicable legislation. Mitigation measures will also be incorporated into the construction specifications to ensure that operations are conducted in a manner that limits detrimental effects to the environment.

Table 6.1 outlines a series of mitigation measures that are typically incorporated into construction specifications. For this project, contract specifications may need to be modified depending upon the nature of the construction activity and any additional requirements of the regulatory agencies.

Table 6.1 Typical Mitigation for Construction-Related Activities

Construction Activity	Typical Mitigation Measure
Refuelling and Maintenance	- Identify locations for designated refuelling and maintenance areas. - Restrict refuelling or maintaining equipment near watercourses. Non-spill equipment is required within 30 m of any watercourse. Fuelled equipment shall be stored overnight not less than 30 m from the edge of water. - Avoid cleaning equipment in watercourses and in locations where debris can gain access to sewers or watercourses. - Prepare to intercept, clean up, and dispose of any spillage that may occur (whether on land or water).
Traffic Control	- The Contractor shall prepare and submit a traffic plan to the Project Engineer for review and acceptance. - Traffic flow should be maintained at all times during construction for private access. The Contractor will provide adequate signage and barricades.
Disposal	- Dispose of all construction debris in approved locations. - Do not empty fuel or lubricants into sewers or watercourses.
Pesticides	- Co-ordinate the use of pesticides and herbicides with affected landowners and the local pesticide control officer.
Sensitive Areas	- Avoid encroachment on unique natural areas; do not disturb habitats of rare or endangered species.
Silt Control	- Silt fences shall be installed and maintained down slope from any stockpile locations or disturbed areas.
Dust Control	- Cover or wet down dry materials and rubbish to prevent blowing dust and debris. - Avoid the use of chemical dust control products adjacent to wetlands and watercourses.
Site Clearing	- Protective measures shall be taken to safeguard trees from construction operations. - Equipment or vehicles shall not be parked, repaired or refuelled near the dripline area of any tree not designated for removal. Construction and earth materials shall also not be stockpiled within the defined dripline areas. - Restrict tree removal to areas designated by the Contract Administrator. - Minimize stripping of topsoil and vegetation.
Sedimentation/ Erosion Control	- Erect sediment fencing to control excess sediment loss during construction period. - Minimize removal of vegetation from sloped approaches to watercourses. - Protect watercourses, wetlands, catch basins and pipe ends from sediment intrusion.

Construction Activity	Typical Mitigation Measure
	- Complete restoration works following construction. - Install straw bale check dams in ditch lines following rough grading of ditches.
Noise Control	- Site procedures should be established to minimize noise levels in accordance with local by-laws. - Provide and use devices that will minimize noise levels in the construction area. - Night time or Sunday work shall not be permitted, except in emergency situations.

6.4 Maintenance and Operations

The Town should ensure routine monitoring, inspection, and maintenance is being completed for its stormwater infrastructure including stormwater management facilities, outlets, sewers (e.g. CCTV), sewer structures (CBs; MHs), major runoff flow paths, and drainage routes. Inspections should be logged and any “Action Items” addressed. Routine maintenance may include removed of debris, minor sediment accumulations or minor structural repairs to outlet structures. It is noted that any significant remedial works will require the submission of a revised engineering design for the stormwater management system to the Town, the SCRCA and MECP. Remedial works are considered to be major maintenance activities completed to repair failed components of the stormwater management system (ex. Modifications to outlet structures, structural failure, significant erosion sites, channel works, etc.)

In general maintenance considerations for both existing and proposed SWMFs should follow the requirements detailed in Chapter 6.0 of the Stormwater Management Planning & Design Manual, (MECP 2003) regarding “Operation, Maintenance and Monitoring” and meet the following requirements:

Monitoring

- Monitoring requirements for SWM facilities are identified as part of the MECP environmental compliance approval (ECA) for a facility and may include short-term and long-term requirements for sampling. Where it is deemed necessary for monitoring to be completed, the program shall be developed based on the requirements of the SCRCA and/or the MECP.

Inspection

Observations made during the collection of inspection data will provide an indicator of overall system performance and help identify when maintenance is required for the various components of the stormwater management system. The maintenance activities performed over the first few years will also provide the basis for recommendations of long-term maintenance schedules. In order to identify the need for maintenance, the following inspection program is recommended.

- It is recommended that sediment depth monitoring be completed for all water quality infrastructure, including SWM facilities, OGS units, and low impact development infrastructure. Long-term monitoring will help confirm frequency of required cleanouts and cost.

- Inspection of the facility is to be completed during and after significant rainfall events (if possible) and should include a review of the following:
    - The integrity of the basin side slopes and vegetated areas;
    - The condition of the pond inlet and overflow facilities;
    - The depth of water in the basin;
    - The colouring of the top few centimetres of the soil;
    - The depth of the accumulation in the pond bottom.

- Photographs should be taken to document the condition of the stormwater management facility and the surrounding area at the time the inspection is completed.

Maintenance

Maintenance requirements will be identified and scheduled based on field observations made during both scheduled and unscheduled inspections of the facility. The types of maintenance activities needed, and the frequency with which they are required, will provide the basis for scheduling long-term maintenance operations. Anticipated maintenance requirements have been categorized as: General Maintenance Operations, Sediment Removal and Disposal Operations; and Remedial Works.

- General Maintenance Operations
    - General maintenance operations are defined as minor, routine maintenance activities required to ensure that the stormwater management system provides the intended stormwater management functions. Example activities include, but are not limited to:
        - Removal of debris from the inlet swale to the facility;
        - Minor structural repairs to the overflow pipes as may be necessary;

- Sediment Removal and Disposal Operations
    - The frequency with which sediment will have to be removed will vary depending on the effectiveness of erosion and sediment control measures implemented during construction, the frequency and magnitude of winter sanding applications, the frequency and magnitude of rainfall events, and other related factors.
    - If there is a visible accumulation of sediment in the bottom of the pond or if there is standing water in the basin 24 hours after a storm event this may be an indication that the permeability of the underlying soils has decreased and sediment removal may be necessary.

- In order to establish protocols for disposal of the excavated material, a quality evaluation of sediment deposits will be required prior to removal of the sediment. Two separate sediment samples should be collected from different locations within the SWMF to obtain a representative cross-section of the facility's sediment characteristics.
- All sediment samples are to be initially screened for contaminant levels by undertaking the bulk analysis testing of the MECP Guidelines for Use at Contaminated Sites in Ontario (GCSO). If sample contaminants exceed GCSO criteria then leachate toxicity analyses will be completed on each sample as per the requirements of the appropriate regulation of the Environmental Protection Act. Following the completion of the sample analyses, the results shall be documented together with recommendations for sediment disposal methods.
- SWMF sediment accumulations are to be removed down to the original elevation of the facility bottom using a small rubber-tired backhoe and a dump truck. The excavated material is to be disposed of off-site in accordance with the recommendations of the sediment quality analyses.
- After the sediment has been removed and disposed of, the bottom of the pond should be tilled to maintain the infiltration potential of the soil and reverse any soil consolidation that may have occurred as a result of the sediment removal.

Remedial Works and Contingencies

- Remedial works are considered to be major maintenance activities completed to repair failed components of the stormwater management system. Example activities include, but are not limited to:
    - Structural modifications to the existing overflow piping and chamber;
    - Reconfiguration of the basin to increase storage capacity;
    - Restoration of eroded areas at the facility inlet.
    - The need for remedial works will typically be identified by structural failures in the basin, erosion sites, and sediment accumulations in the overflow chamber. If contingencies are determined necessary, the MECP would be contacted in order to involve them in the reassessment procedure.

- Any significant remedial works will require the submission of a revised engineering design for the stormwater management system to the Town of Petrolia, the SCRCA and MECP.

7.0 IMPACT ASSESSMENT AND MITIGATION

7.1 Environmental Impacts

Based upon the findings of the general impact assessment (Tables 3.4 and 3.5) and the environmental effects analysis (Tables 3.6 and 3.7), the project has the potential to impact upon a limited number of specific environmental components. They are as follows:

- Natural Environment
- Social Environment
- Economic Environment

The potential impacts to each identified feature are described in detail within this section of the report. Measures designed to minimize the impacts are also presented. The determination of appropriate mitigation measures included an assessment of previous studies and investigations, site specific requirements and an evaluation of a broad range of alternatives. This assessment was based on consideration of three broad approaches to impact mitigation; avoidance, minimization of adverse effects and compensation.

7.2 Natural Environment – Aquatic Habitat

a) Existing Developed Areas

There are a number of existing storm drainage outlets serving the developed portion of the southeast Petrolia study area. A majority of these discharge directly to Bear Creek, although several developments in the south along 1st Avenue and Garden Crescent, discharge to the Greenizen Drain. The investigation of existing facilities identified a number of deficiencies at the existing outlets, including poor maintenance of inlet facilities, undersizing of the outlet piping, and erosion adjacent to the outlet. As upgrades to various upstream road sections are implemented in conjunction with the Master Plan recommendations, existing downstream outlets will be examined to ensure that they are sized appropriately and that suitable erosion protection measures are in place to minimize impacts to receiving to the receiving watercourse. If vegetation removal is required to address potential upgrades, it will be minimized as much as practical and will be restored after completion of the work.

b) Future Development Lands

As noted in Section 5.4, there are two primary sub-basins located within the future development lands area; an east basin and a west basin. The east basin will discharge to Durham Creek at the southeast corner of the study area with runoff being controlled through a proposed stormwater management facility that would be developed in conjunction with a future development application. There is a potential for impacts to the receiving watercourse when the facility is constructed as well as concerns associated with diverting portions of the west basin to the east facility. Additional investigations may

be required when developments are proposed to ensure that the downstream receiving watercourses are not negatively impacted for erosion. Oversizing of the SWMF may be required to address this concern.

The west basin will discharge through the Greenizen Drain and the existing pond facility before eventually discharging to Durham Creek and then Bear Creek. A new stormwater management facility will be constructed upstream of the pond and alterations to the pond are recommended in order to increase storage capacity and reduce overtopping of the existing berm.

By lowering the pond elevation, this will alter the current shoreline and may impact species that currently inhabit the nearshore habitat, including turtles. Additional investigations may be required to ensure that modifications to the pond occur in a manner that does not negatively impact existing species. Removal of existing phragmites, an invasive species that has dominated habitat around the pond, with native species, may be one way to address impacts to existing habitat.

7.3 Social Environment - Community Level Impacts

a) Disruption Posed by Construction

Installation of new stormwater drainage works will primarily occur within the limits of the existing road allowance. Construction activities associated with the project may therefore inconvenience local residents by restricting vehicular traffic movement and disturbing private property. Traffic-related impacts resulting from the proposed works are expected to be similar to those experienced during normal road construction activities. The mitigation measures discussed in Table 5.2 of this report will therefore be implemented to minimize the restrictions to vehicular movement, as well as other construction-related impacts (e.g. excessive dust and noise levels). Generally, at least one lane of travel will remain open at all times during construction.

b) Impacts to Private Property

i) Construction Related Impacts

Some residual impacts to private property may result from construction-related activities such as vegetation removal and disturbance to driveways and lawns. Disturbed areas will be restored following construction with material of a similar nature to pre-construction conditions. In addition, temporary access limitations may occur during replacement of watermains and sanitary sewers along road rights-of-way.

ii) Timing of Implementation

As discussed in more detail below, the Town of Petrolia has developed the Stormwater Servicing Master Plan in order to provide guidelines for future development applications and to address existing drainage problems within the community. However, the funding

needed to implement the proposed upgrades is currently not available. Therefore, residents within the community that are currently experiencing drainage issues that may be resolved by implementation of the plan, will be impacted if it is a number of years before the planned upgrades can occur. Some remedial measures may be completed in the interim (minor ditch re-grading/private drainage initiatives) however until sufficient funding can be obtained, this impact cannot be mitigated.

iii) Development of Future Development Lands

During the initial consultation phase of the Master Plan process, several residents located immediately adjacent to lands identified for future development in the east portion of the study area, indicated that there are significant concerns associated with drainage runoff from agricultural fields abutting residential properties on Fourth Street. and 1st Ave. These problem areas are difficult to address at present as no stormwater drainage infrastructure is currently located within these areas. Therefore it is essential that drainage from these lands is addressed through the development review process to ensure that drainage from future development lands does not continue to negatively impact existing properties after they are developed.

Lot grading and drainage plans for future development lands need to ensure that drainage runoff is collected at the property limits and directed to proposed stormwater management facilities planned in conjunction with the new developments, and not permitted to flow unrestricted onto adjacent developed residential properties.

7.4 Economic Environment

Implementation of all recommendations associated with the Stormwater Servicing Master Plan would represent a significant capital cost to the Town of Petrolia. At present, the municipality has committed to moving forward with implementation of the plan using a phased approach will be coordinated with other infrastructure priorities within the community. By coordinated the upgrades with other infrastructure needs within the study area the limited funds that are available will be put to the best use.

Recommendations associated with future development lands will be implemented in conjunction with planned development applications for these lands, with a majority of the costs being borne by developers. However, some components of the projects could be implemented by the Town initially with costs being recovered at a later date through a Development Charge or through an Area Rating By-Law.

The Town of Petrolia may also apply for grants to assist with the capital costs associated with reconstruction within existing developed areas. If grant funding is not available, infrastructure priorities identified through the Master Plan process, will be coordinated with other infrastructure needs within the community as part of Petrolia’s Asset Management planning.

8.0 CONCLUSIONS AND PROJECT IMPLEMENTATION

8.1 Master Plan Study Conclusions

Based upon the findings of the environmental impact evaluation and input received from agencies, stakeholders and the general public following the public meeting, no significant impacts were identified with the preferred alternatives that could not be adequately mitigated. In this regard, implementation of the proposed Master Plan projects appears to be appropriate for the study area and should not result in significant adverse environmental effects (particularly if the mitigation measures are incorporated into the construction plan).

8.2 Selection of a Preferred Alternative

Given the foregoing, **Alternative 2 – Implement upgrades to existing stormwater drainage infrastructure in conjunction with other infrastructure renewal activities,** was selected for existing stormwater drainage infrastructure and **Alternative 1 – Coordinate stormwater management planning for all future development areas,** was selected in conjunction with development of future development areas. This recommendation was presented to, and supported by, Municipal Council and staff.

8.3 Approvals

Implementation of Master Plan projects will be subject to the receipt of all necessary approvals. Following a review of existing legislation, it was determined that two formal approvals will be required to permit construction of the proposed works.

8.3.1 Conservation Authorities Act

Implementation of some components of the preferred alternative may involve construction on lands regulated by the St. Clair Region Conservation Authority (SCRCA). In accordance with the Conservation Authorities Act, applications will be submitted to the SCRCA for approval prior to construction. The application will define measures to protect sensitive lands during construction in order to minimize the negative impacts of the project on the natural features of the area. Site restoration and post-construction enhancements to disturbed areas will also be presented.

8.3.2 Ontario Water Resources Act

Construction of stormwater management facilities, which are a component of the Master Plan implementation associated with future development lands, will be subject to the Ontario Water Resources Act. Consequently, the project cannot proceed until the Municipality has received the necessary Environmental Compliance Approvals from the MECP.

8.3.3 Drainage Act

The upper portion of the Greenizen Drain has municipal drain status. Proposed works that require modifications, maintenance or repair to the existing drains to support future development may be completed under the Drainage Act. The design of municipal drain works servicing urban areas should meet all MECP criteria with respect to sizing, minimum diameter, velocity, slope, maintenance hole spacing and catch basin spacing required for urban servicing. Upon urbanization of catchment areas, the Town may elect to abandon a municipal drain or branches, and/or assume existing infrastructure under the Ontario Water Resource Act.

8.4 Implementation Phasing

Projects identified for implementation through the Master Plan process have been categorized into a proposed phasing plan, based primarily upon existing drainage concerns identified through the public consultation process, the state of deterioration of existing infrastructure, and the availability of funding. Table 5.1 illustrated the proposed phasing plan for existing developed areas and identifies the associated Class EA Schedule. The proposed phases are illustrated on Figure 5.1.

For future development lands phasing is dependent upon the anticipated schedule for development of individual parcels within each catchment. Generally, the SWM facility proposed adjacent to the outlet must be constructed prior to development occurring on lands within the basin. It may be possible to stage the construction of the facility in the east basin if only portions of the site are initially developed, however a suitable staging plan would need to be developed and approved in conjunction with the initial development, before moving ahead with construction.

For the west basin, upgrades to the existing pond facility will need to be implemented before additional developments can be constructed within the sub-basin. A cost sharing structure will be developed amongst the benefiting landowners so that costs associated with the upgrades are shared between all landowners contributing drainage to the catchment. Based on the timing of developments, an interim drainage arrangement may be required for lands within the Greenizen Drain (Outlet B) to be diverted to Outlet A. Costs of interim drainage infrastructure should be allocated to benefiting landowners.

8.5 Anticipated Costs

It is anticipated that the Master Plan will be implemented over a 20-25 year time frame. Project costs associated with existing developed areas will be financed initially through the annual capital works budget as required upgrades are incorporated into planned infrastructure upgrades. Some project costs could be offset through provincial or federal grant programs, as these programs become available. As noted, the suggested priority phasing projects for storm sewer drainage work within existing developed areas is summarized on Figure 5.1.

Table 8.1 Proposed Phasing Plan: Preferred Master Plan Alternatives

Master Plan Project Component – Suggested Priorities	Class EA Schedule
1. Third Street: Fourth Street to Mutual Street; Kentail Street: Third Street to Petrolia Line; Mutual Street: Third Street to Petrolia Line	A+
2. Derby Street: Mutual St to Oil Heritage Rd	A+
3. Holland St: Petrolia Line to Derby Street	A+
4. 1st Ave: Petrolia Line to Garden Crescent	A+
5. Third, Fifth and Sixth Street: 1st Ave to Fourth Street	A+
6. Petrolia Line: Oil Heritage to Barretts Lane – in conjunction with Lambton County	A+
7. Garden Crescent: First Ave to First Ave	A+
8. Remaining Streets within the Developed Area	A+
Works Associated with Future Development Lands	
Modifications to the Existing Golf Course Pond Facility	A+
Detention Facility planned as Plan of Subdivision Review	A
Stormwater collection system to connect to detention facility – If located within existing road allowances – If located outside of existing road allowances or easements – If approved in conjunction with draft Plan of Subdivision	 A+ B A

8.6 Environmental Commitments

A series of remediation measures have been identified which should be implemented in order to minimize the environmental impacts associated with construction of the proposed works. The following represent the key measures of the proposed mitigation plan:

- Additional input will be sought from the St. Clair Region Conservation Authority on the design of the proposed stormwater management facilities for the east and west basin to ensure that impacts to the receiving watercourse are minimized.
- Low Impact Development (LID) methods should be incorporated as technically feasible and appropriate, as determined through consultation with the Town and the Conservation Authority.

- Impacts associated with climate change should be considered as part of the engineering design for each project component. This should include the impact of extreme storm events on stormwater collection systems and end of pipe facilities. To reduce risk, a suite of synthetic storms given a fixed frequency (i.e. 100 year), should be applied with different durations, distributions and intensities to assess system performance. A minimum freeboard of 0.3 m should be provided in SWM facilities as a safety factor to extreme events and climate change resiliency.
- That lot grading and drainage plans prepared for future development lands will direct all drainage runoff away from existing residential properties located adjacent to the sites. In particular, properties located in the vicinity of 1st Ave and 4th Street that back onto agricultural lands designated for future development.
- Additional mitigations measures may be required prior to planned upgrades to the existing pond facility, to ensure that existing wildlife and habitat features are not negatively impacted by lowering of the pond water level.
- If archaeological investigations are undertaken in conjunction with proposed development applications, that consultation with the Aamjiwnaang First Nation be undertaken as part of the scope of work.
- Plans for erosion and sedimentation control will be formulated and implemented in accordance with the requirements of applicable regulatory agencies.
- Construction activities will be conducted in accordance with contract documentation and the impact mitigation requirements of various regulatory agencies. The work will be monitored through on-site supervision.
- That signage be installed along roadways located adjacent to existing natural features, warning of the presence of wildlife.
- Any areas which are disturbed as a result of construction will be restored following completion of the project using native plant material.
- Any necessary approvals will be obtained from regulatory review agencies prior to implementation of the proposed works.

8.7 Class EA Requirements

a) Master Plan Approval

The Stormwater Servicing Master Plan for the southeast development area in Petrolia was developed following an approved Master Planning process, as set out by the Class EA document. The Master Planning process incorporated the completion of Phases 1 and 2 of the Class EA process. The Master Plan will be approved for implementation subject to successful completion of the Class EA Master Plan Process.

b) Additional Class EA Investigations

As an outcome of this assessment, a series of projects have been identified to implement the Master Plan. These projects are classified as Schedule 'A', A+ or 'B' activities under the terms of the Class EA document. Schedule 'A', 'A+', activities have been assessed in conjunction with the current Master Plan process and do not require additional Class EA review prior to implementation. However additional environmental assessment will be required prior to implementation of any Schedule 'B' Activities. Table 8.1 summarizes the proposed activities and the Class EA Schedule associated with implementation of specific phases of the Master Plan.

c) Requirements for Master Plan Completion

The following activities are required in order to complete the formal Class EA Master Plan process:

- Issue a Notice of Study Completion for the Master Plan.
- Make Master Plan Report available for public review in conjunction with publication of the Notice of Study Completion.
- Obtain feedback from public, stakeholders and agencies.
- Make the revised Master Plan report available for public/agency review.
- Address outstanding issues resulting from the Notice of Completion.
- Advise the Town of Petrolia and the Ministry of the Environment, Conservation and Parks (MECP) when the Master Plan process is complete.

8.8 Final Public Consultation

A Notice of Master Plan Completion was recently circulated to local residents, stakeholders and government review agencies. The notice identified the preferred Master Plan alternative and indicated the approval process needed to move forward with implementation. The following summarizes the distribution of the notice.

Contents:	Identification of preferred solution, key project components
Issued:	August 25, 2021
Placed In:	Sarnia This Week (August 25 and September 1, 2021), Municipal Website and Social Media Accounts
Distributed To:	9 review agencies
Concludes:	September 24, 2021

8.9 Master Plan Recommendations

The following represent the key study recommendations developed following the evaluation of alternatives phase of the Master Planning process:

1. That **Alternative 2 - Implement upgrades to existing stormwater drainage infrastructure in conjunction with other infrastructure renewal activities,** be adopted as the preferred long-term strategy to address stormwater drainage deficiencies in developed areas of the community of Petrolia's southeast study area.

2. That **Alternative 1 – Coordinate stormwater management planning for all future development areas,** be adopted as the preferred strategy to implement in conjunction with future development lands located within the east and southeast portion of the project study area.

3. Implementation of the Master Plan will require additional investigations to evaluate the potential environmental impacts of any specific projects considered Schedule 'B' activities under the terms of the Class EA document (refer to Table 8.1). Schedule 'A' and 'A^{+}' projects have been approved through the Master Plan process.

4. Implementation of the Master Plan should be conducted with reference to the project phasing strategy detailed in Section 8.4 of this report.

5. Impact mitigation measures discussed in Section 7.0 of this report should be incorporated into the detailed construction plans for each proposed activity, as appropriate.

6. Recommended components of the Preferred Master Plan Alternative should be considered for incorporation into the next Official Plan update for the Town of Petrolia.

7. The Master Plan should be reviewed on a regular basis to evaluate the accuracy of key assumptions (e.g., condition of existing infrastructure/availability of funding) and to confirm the suitability of the implementation sequence. The Master Plan should be modified, as required, to address changes to the environmental setting and local drainage conditions.

9.0 SUMMARY

This report documents the Master Plan process which was conducted for the southeast development area in the Town of Petrolia to resolve deficiencies identified with existing stormwater drainage infrastructure serving the community and to identify stormwater servicing policies to be utilized for development of future development lands located adjacent to existing developed portions of the community.

The Master Plan process included a background review of the study area in order to characterize and identify potential impacts associated with the natural, cultural and built environments. A questionnaire was mailed to all property owners in the study area limits seeking their input, in order to involve the general public and affected property owners in the process. A public meeting was also held to seek input on the proposed

recommendations. Agencies and stakeholders were also engaged through a direct mail-out. The outcome of the Master Plan process, which identified a preferred implementation alternative, being to implement the Stormwater Drainage Master Plan in conjunction with other infrastructure priorities within established areas, and to coordinate development of future development lands on a catchment area approach, was reached following an analysis of a range of potential Master Plan options.

The Stormwater Servicing Master Plan developed through the Class EA Master Planning process will require the construction of major infrastructure works (e.g., new stormwater drainage infrastructure, stormwater detention facilities, new outlets to Durham Creek), and will be implemented over a twenty to twenty five year time frame. The Master Plan sets out a series of recommendations for project implementation, including a proposed phasing plan for implementation of priority drainage upgrades. Schedule B activities identified through the plan will require additional Class EA investigation prior to implementation. All other projects identified in conjunction with the Master Plan have been reviewed in conjunction with the Class EA process and are therefore pre-approved.

All of which is respectfully submitted.

B. M. ROSS AND ASSOCIATES LIMITED

Per _____
Dale Erb, P. Eng.

Per _____
Bryanne Verhoeven, P. Eng.

Per _____
Kelly Vader, MCIP, RPP
Environmental Planner

:es

References

1. Municipal Engineers Association, Municipal Class Environmental Assessment, October 2000, as amended in 2007, 2011 & 2015.
2. Department of Fisheries and Oceans Canada. Aquatic Species at Risk Mapping. Website. 2021.
3. Chapman, L.J. and Putnam, D.F. The Physiography of Southern Ontario. Third Edition. 1984.
4. Province of Ontario, Provincial Policy Statement, 2020.
5. County of Lambton, Lambton County Official Plan, October 1, 2020, Office Consolidation.
6. County of Lambton Planning and Development Dept., Petrolia Official Plan, February 2016
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9. Ministry of Natural Resources and Forestry (Ontario). Species at Risk in Ontario. *Species list for the Township of Enniskillen. 2019.*
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APPENDIX A

BEAR CREEK WATERSHED REPORT CARD

Bear Creek Headwaters

SUBWATERSHED
Report Card 2018

The St. Clair Region Conservation Authority has prepared this series of 14 subwatershed report cards as a summary of the state of the forests, wetlands, and water resources in the St. Clair Region.

St. Clair Conservation

Watershed Checkup

Surface Water Quality

Using a provincial grading system, the three surface water quality indicators score two C grades and one F grade, producing an overall grade of D for the Bear Creek Headwaters subwatershed. Total phosphorus (TP) levels are the third highest in the St. Clair Region at nearly seven times the provincial guideline. Maintaining TP levels below the Interim Provincial Water Quality Objective is intended to control excessive plant growth in rivers and streams and to protect aquatic life. *Escherichia coli (E. coli)* levels are slightly above average for the St. Clair Region and are nearly three times the provincial guideline for safe recreational use of water, indicating ongoing fecal contamination. The stream health grade measured by sampling benthic invertebrate communities is better than the average for the St. Clair Region but still suggests that fairly substantial organic pollution is likely.

Local Actions to Improve Water Quality

- Develop an Environmental Farm Plan and implement agricultural Best Management Practices;
- Plant and maintain vegetated streamside buffers on one side of municipal drains and along both sides of other watercourses to stabilize the banks, shade the water, and capture nutrients;
- Fix faulty septic systems and establish a septic maintenance plan;
- Create or restore wetlands to trap nutrients, mitigate flooding, and improve habitat;
- Properly store chemicals and dispose of them through household hazardous waste days or drop-off locations (never dump down household or storm drains).

INDICATOR	BEAR CREEK HEADWATERS			ST. CLAIR REGION AVERAGE	PROVINCIAL GUIDELINE	INDICATOR DESCRIPTION
	2001-2005	2006-2010	2011-2015	2011-2015		
Total Phosphorus (mg/L)	0.22 F	0.22 F	0.20 F	0.15 D	0.03 B	Phosphorus is found in products such as detergents, fertilizers, and pesticides. Phosphorus contributes to excess algae growth and low oxygen levels in streams and lakes.
Bacteria (CFU *E. coli*/100ml)	263 C	192 C	279 C	211 C	100 B (recreational use)	*Escherichia coli* (*E. coli*) bacteria is found in human and animal (e.g., livestock, wildlife) waste. Its presence in water indicates fecal contamination and is a strong indicator that other disease-causing pathogens are present in the watercourse.
Benthic Score (FBI)	5.79 D	5.71 C	5.57 C	5.73 C	<5.00 B (unofficial)	Benthic invertebrates are small animals without backbones that live in stream sediments. The pollution tolerances of taxa present in benthic samples are used to calculate the Family Biotic Index (FBI). The FBI ranges from 0 (excellent water quality) to 10 (very poor water quality).
Overall Grade	**D**	**D**	**D**	**D**		

BEAR CREEK HEADWATERS FOREST CONDITIONS

D GRADE

Forest Conditions

For the Bear Creek Headwaters subwatershed, the three forest conditions indicators score two D grades and an F grade, producing an overall grade of D. The percent forest cover (11.5%) is close to the average for the St. Clair Region but is still less than half of the recommended cover needed to support natural species diversity and water quality. The percent forest interior (1.8%) is below the average for the St. Clair Region and is considered very poor as it is one-sixth of the recommended value. This indicates that most woodlots are too narrow to support area-sensitive species, such as Scarlet Tanager and Ovenbird. The Environment Canada guideline for southern Ontario is 10% forest interior. The percentage of the riparian zone that is forested (23.2%) is close to the average for the St. Clair Region though only half the 50% target.

Any changes in forest cover, either from forest loss or reforestation efforts, is visible using aerial photography. Although there have been a significant number of recent tree planting projects in this subwatershed, forests grow slowly, and young trees are not considered to be forests until they are at least 3 m tall and are developing a canopy.

Local Actions to Improve Forest Conditions

- Establish and enlarge woodlots using a variety of native species to reduce the impact of aggressive insects and extreme weather events on tree health;
- Woodlot owners should prepare and follow Woodlot Management Plans;
- Connect woodlots by planting shelterbelts, windbreaks, and buffers along fields and watercourses to enhance wildlife habitat, protect against soil erosion, and improve water quality.

INDICATOR	BEAR CREEK HEADWATERS			ST. CLAIR REGION AVERAGE	PROVINCIAL GUIDELINE	INDICATOR DESCRIPTION
	2001-2005	2006-2010	2011-2015	2011-2015		
Percent Forest Cover (%)	11.8 D	11.7 D	11.5 D	12.0 D	30.0 B	Percent forest cover is the percentage of the watershed that is forested. Forests are necessary to produce oxygen, store carbon, and offer many ecological services that are essential to the well-being of both humans and wildlife.
Percent Forest Interior (%)	1.7 F	1.8 F	1.8 F	2.1 F	10.0 B	Percentage of the watershed that is forest interior. Forest interior is the core area inside a woodlot that is more than 100 m from the edge. The outer 100 m is 'edge' habitat and is prone to high predation, sun/wind damage, and alien species invasion.
Percent Forested Riparian Buffer (%)	No data	23.6 D	23.2 D	23.1 D	50.0 B	Percent forested riparian buffer is the percentage of forest cover within a 30 m zone along both sides of all open watercourses. Natural cover in this zone prevents sediment and nutrients from entering the water.
Overall Grade	**D**	**D**	**D**	**D**		

BEAR CREEK HEADWATERS WATERSHED FEATURES

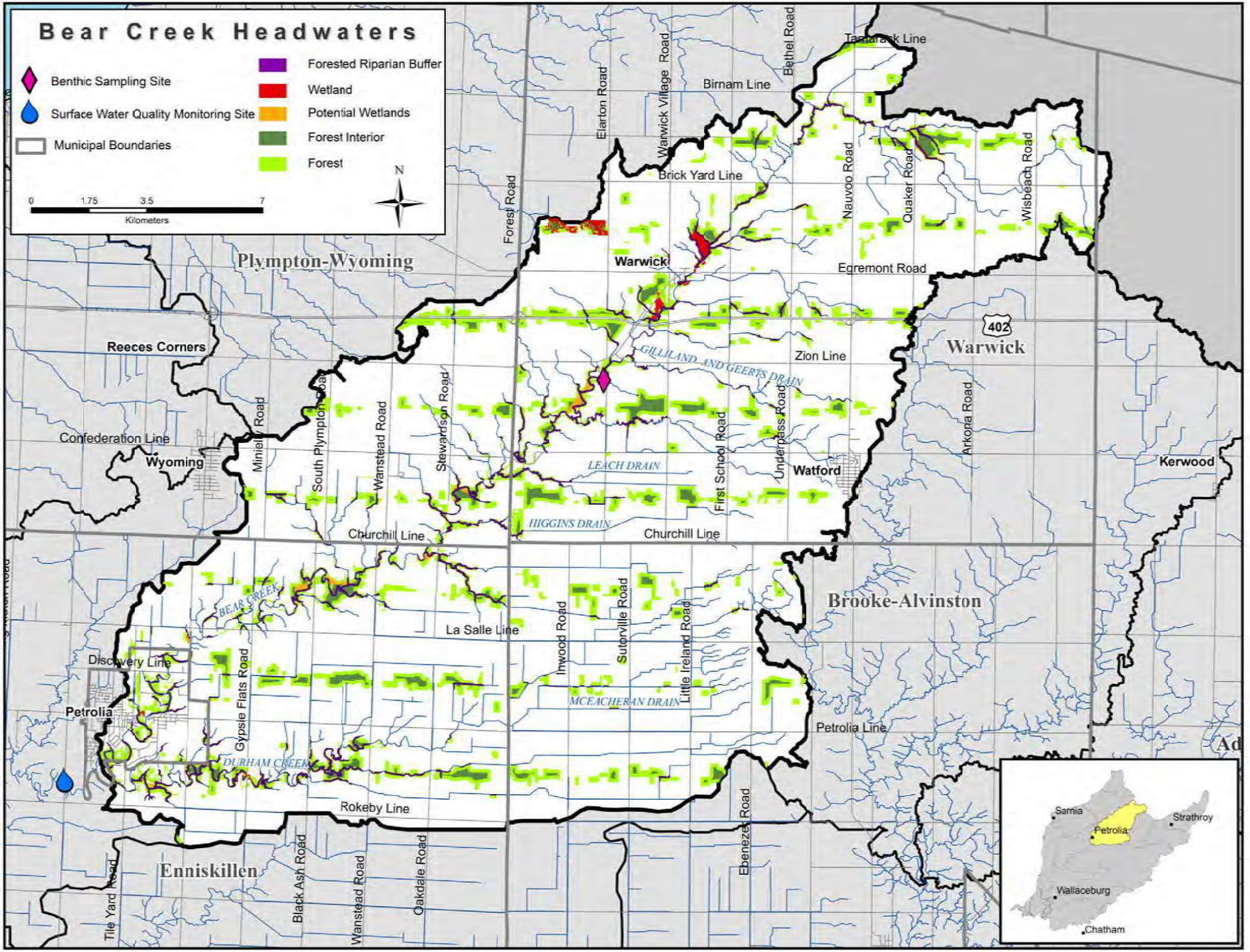
Area	379 km^2, 9.2% of the St. Clair Region watershed
Municipalities	Warwick (166 km^2, 44%), Enniskillen (89 km^2, 24%), Brooke-Alvinston (67 km^2, 18%), Plympton-Wyoming (47 km^2, 12%), Petrolia (10 km^2, 3%), Adelaide Metcalfe (1 km^2, <1%)
Physiography	70% bevelled till plains; 16% till moraines; 10% till plains (undrumlinized); 4% sand plains; <1% beaches and shorecliffs
Soil Type	84% silt and clay; 5% silt and clay loams; 5% loam; 4% bottom land and beach; 2% sand loams
Streamflow	The mean annual streamflow was 3.41 m^3/s from 2003 to 2015, as measured in Bear Creek just upstream of Petrolia. From 2011 to 2015, annual flows were above the mean, ranging from 4.07 to 4.34 m^3/s. The previous period, 2006 to 2010, flows varied widely around the mean, from 1.89 to 5.30 m^3/s.
Precipitation	The average annual precipitation at Petrolia from 2002 to 2015 was 897 mm. From 2011 to 2015, the annual precipitation varied widely around this value ranging from 625 to 1,118 mm. The previous period, 2006 to 2010, was wetter with levels close to or above the mean ranging from 760 to 1,131 mm.
Air Temperature	The average annual temperature at Petrolia from 2002 to 2015 was 8.9°C. From 2011 to 2015, average annual temperatures ranged more widely (7.4 to 10.4°C) than during the previous period, 2006 to 2010, which experienced more stable temperatures ranging of 8.0 to 9.8°C.
Tile Drainage	30% not tiled; 12% randomly tiled; 58% systematically tiled
Watercourse Length and Type	Total length: 540 km Watercourse type: 21% natural, 61% municipal drain, 18% unclassified
Dams and Barriers	Five dams, including two public dams at Bridgeview CA and at Warwick CA
Sewage Treatment	The Watford Sewage Lagoons discharge treated effluent through Moffat Drain to Bear Creek just upstream of Courtright Line, at the middle portion of this subwatershed. The Petrolia Water Pollution Control Plant discharges treated effluent to Bear Creek at the downstream end of Petrolia, near the bottom of this subwatershed.
Fisheries Resources	Fifty-eight fish species and 10 freshwater mussel species recorded. Game fish include Largemouth Bass.

BEAR CREEK HEADWATERS WATERSHED FEATURES

Species at Risk	Birds: Acadian Flycatcher, Bank Swallow, Barn Swallow, Bobolink, Cerulean Warbler, Chimney Swift, Eastern Meadowlark, Least Bittern, Prothonotary Warbler, Yellow-breasted Chat Fishes: Blackstripe Topminnow, Brindled Madtom, Eastern Sand Darter, Lake Sturgeon, Pugnose Minnow, Pugnose Shiner, Spotted Sucker Mammals: American Badger, Eastern Small-footed Myotis, Little Brown Myotis, Northern Myotis Mulloscs: Eastern Pondmussel, Kidneyshell, Northern Riffleshell, Rayed Bean, Round Hickorynut, Round Pigtoe, Salamander Mussel, Snuffbox, Wavy-rayed Lampmussel Plants: American Chestnut, American Ginseng, Blue Ash, Butternut, Eastern Flowering Dogwood, False Hop Sedge, Goldenseal, Kentucky Coffee-tree, Willow-leaved Aster Reptiles: Blanding's Turtle, Butler's Gartersnake, Common Five-lined Skink, Eastern Foxsnake, Queensnake, Spiny Softshell
Groundwater	The shallow unconfined aquifers associated with the Wyoming Moraine to the northwest and the Seaforth Moraine to the southeast provide groundwater for agricultural purposes. For the majority of the region, the deeper aquifer at the interface between the overburden and the bedrock, known as the Fresh Water Aquifer, is limited in quantity and has elevated chloride. Therefore, most of the residents are supplied by municipally-piped water from intakes on Lake Huron.
Wetland Cover	97 ha or 0.3% of the subwatershed is identified as wetlands by the Ministry of Natural Resources and Forestry. An additional 53 ha (0.1% of the subwatershed) are identified by the St. Clair Region Conservation Authority (SCRCA) as potential wetlands. Wetlands are vital to the landscape as they reduce flooding and filter water. Environment Canada recommends a minimum of 6% wetland cover at a subwatershed scale.

Woodlot Size

Size Category	Number of Woodlots	% of Woodlots	Total Woodland Area (ha)	% of Total Woodland Area	Largest Woodlot (ha)
<5 ha	163	48	328	8	135
5-10 ha	62	18	457	10	
10-30 ha	69	20	1,119	26	
>30 ha	43	12	2,465	56	
Total	337		4,369		


Bear Creek Headwaters
Benthic Sampling Site
Surface Water Quality Monitoring Site
Municipal Boundaries
Forested Riparian Buffer
Wetland
Potential Wetlands
Forest Interior
Forest
N
0
1.75
3.5
7
Kilometers
Plympton-Wyoming
Warwick
Brooke-Alvinston
Enniskillen
Reeces Corners
Wyoming
Watford
Kerwood
Petrolia
Tarlarask Line
Birnam Line
Brick Yard Line
Egremont Road
Zion Line
Confederation Line
Churchill Line
La Salle Line
Discovery Line
Petrolia Line
Rokeby Line
Elarton Road
Warwick Village Road
Bethel Road
Forest Road
Nauvoo Road
Quaker Road
Wisbeach Road
Arkona Road
Minielly Road
South Plympton Road
Wanstead Road
Stewardson Road
First School Road
Underpass Road
Inwood Road
Sutorville Road
Little Ireland Road
Gypsie Flats Road
Tile Yard Road
Black Ash Road
Oakdale Road
Ebenezer Road
GILLILAND AND GEERTS DRAIN
LEACH DRAIN
HIGGINS DRAIN
MCEACHERAN DRAIN
BEAR CREEK
DURHAM CREEK
402
Samia
Petrolia
Strathroy
Wallaceburg
Chatham

Highlights and Progress Since 2011

- There were 19 landowner stewardship projects completed in the Bear Creek Headwaters subwatershed from 2011 to 2018. These projects included the restoration of wetlands, stabilization of streambanks, and the planting of trees and windbreaks. More than 43,700 trees were planted and the total value of all the projects was $173,400 (65% grants).
- A 2-hectare assisted tree migration research plot was planted in 2016 at the Warwick Conservation Area to study the effects of climate change. Over the years, the 1,500 trees planted will be monitored to compare their relative survivability and growth success.

- New meteorological equipment was installed at the Warwick Conservation Area in 2015.
- To close research knowledge gaps, the SCRCA performed surveys of native mussel populations in 2017 and 2018, covering 28 km of the North Sydenham River.
- To aid in the future sustainability of local forestry, each year the SCRCA collects native tree seed, which is adapted to local growing conditions. In 2017, the SCRCA established a Tree Seed Collector Mentorship and Training Program through funding from Enbridge (left photo).
- Through the 2010-2012 Lambton Natural Heritage Study, regionally rare birds or plants were noted at every survey site, stressing the importance of maintaining and enhancing even small natural areas.
- Waste Management has been undertaking habitat creation and enhancement projects at the Twin Creeks Landfill for over a decade. A pair of calling Bobolinks, a Species at Risk, were sighted at Twin Creeks during an biological inventory performed by the SCRCA in 2017 (right photo, PC: Rick Battson).

St. Clair Conservation

St. Clair Region Conservation Authority
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APPENDIX B

QUESTIONNAIRE

TOWN OF PETROLIA
STORMWATER SERVICING MASTER PLAN FOR THE SOUTHEAST SERVICE AREA

Questionnaire

The following survey has been prepared to gather information from residents on future growth potential and drainage issues affecting the southeast service area in the Town of Petrolia. This questionnaire is being completed in conjunction with a Stormwater Servicing Master Plan Study for the southeast Petrolia service area and will include established residential areas as well as future development lands located in the southeast of the community. In accordance with the Municipal Freedom of Information and Protection of Privacy Act, personal information is collected under the authority of the Municipal Act and will **only** be used for the purpose of data collection. **Please return by October 12, 2018.**

Name: _____

Mailing Address: _____

Property Address: _____

Lot No. _____

Plan No. _____

Road: _____

Block: _____

Size: _____(ha/acres)

PROPERTY INFORMATION:

1. Is your property:

- ☐ Developed
- ☐ Vacant
- ☐ Other (please specify)

_____

_____

2. If vacant, do you plan to develop the property:

- ☐ Yes (0-5 years)
- ☐ Yes (5-10 years)
- ☐ Yes (10+ years)
- ☐ No

If Yes, what type of development?

_____

3. What are the current uses of the property (check all that apply)

- ☐ Residential
- ☐ Agricultural
- ☐ Commercial
- ☐ Industrial
- ☐ Other (please specify)

_____

4. Does your property have frontage on an open Municipal Road?

Yes ☐ No ☐ Other _____

DRAINAGE INFORMATION:

1. Have you experienced drainage problems with your property?

- ☐ Never
- ☐ 1-2 times a year
- ☐ More than 2 times a year

2. Would you describe your lot drainage as:

- ☐ Good
- ☐ Fair
- ☐ Poor
- ☐ (Other (please specify)

_____

_____

_____

3. If you have experienced drainage issues, please circle all that apply:

- ☐ Water ponding in yard
- ☐ Water in basement
- ☐ Water ponding on road surface
- ☐ Other (please specify)

_____

_____

4. If you have a sump pump, how often does it run:

- ☐ Frequently
- ☐ Intermittent
- ☐ Not often
- ☐ We don't have a sump pump

ADDITIONAL COMMENTS/INPUT:

If there is any additional information that you think would be useful to this study, or any additional comments that you wish to make, please include them here:

_____

_____

_____

_____

_____

_____

_____

Please return completed questionnaires to the Petrolia Municipal Office or to BMROSS at 2695 Hamilton Road, P.O. Box 400 Brights Grove, ON. N0N 1C0. Questionnaires can be scanned and emailed to the address above. An on-line questionnaire is also available at **www.bmross.net.** If you have any questions regarding the questionnaire or the Stormwater Master Plan Study process, please contact: Kelly Vader, Environmental Planner at BMROSS (Toll Free) 1-888-524-2641 (F) 519-908-9564. Email: **kvader@bmross.net.**

#	Timestamp	1. Is your property?	2. If vacant, do you plan to develop the property?	2a. If vacant, and you plan on developing the property, what type of development?	3. What are the current uses of the property (check all that apply)	4. Does your property have frontage on an open Municipal Road?	5. Have you experienced drainage problems with your property?	6. If you have experienced drainage issues, please check all that apply?	7. Would you describe your lot drainage as:	5. If you have a sump pump, how often does it run?
1	Before September 24, 2018	Developed			Residential	Yes	Never		Good	Intermittent
2	Before September 24, 2018	Developed			Residential	Yes	1-2 times a year	Water ponding in yard, water podning on road surface		Frequently
3	Before September 24, 2018	Developed		Update to Residential - townhouse	Update to Residential - townhouse	No	Never		Good	Not Often
4	Before September 24, 2018	Developed			Residential	Yes	Never		Good	Not Often
5	Before September 24, 2018	Developed			Residential	Yes	More than 2 times a year	Water ponding in yard, Water in basement	Poor	Frequently
6	Before September 24, 2018	Developed			Residential	Yes	Never	Water ponding in yard - some small areas in front yard	Fair	Frequently
7	Before September 24, 2018	Developed			Residential	No	Never	Water ponding in yard	Fair	Frequently
8	Before September 24, 2018	Vacant	5-10 Years	Beautiful Retirement Home	residential - grassed & treed lot	Yes - Tile Yd. Rd.	Never	Water in convervation on ravine up to 8 ft	Super	we don't have a sump pump/vacant lot
9	Before September 24, 2018	Developed			Residential	Yes	Never		Good	Intermittent
10	25-Sep-18	Developed			Industrial	Yes	Never		Good	we don't have a sump pump
11	Before September 24, 2018	Developed			Residential	Yes	Never		Good - Lot is highly sloping on 2 sides so it drains well	we don't have a sump pump
12	Before September 24, 2018	Developed			Residential	Yes	1-2 times a year	Water ponding in yard	Poor	Frequently
13	Before September 24, 2018	Developed			Residential	Yes				
14	Before September 24, 2018	Developed			Residential	Yes	1-2 times a year	Other - Paced sump pump discharge line (2017)	Good	
15	Before September 24, 2018	Developed			Residential, Commercial	Yes	Never		Good	Intermittent
16	Before September 24, 2018	Developed			Residential	Yes	Never		Good	Intermittent
17	Before September 24, 2018	Developed			Residential	Yes	More than 2 times a year	Water ponding in yard, water in basement/crawlspace	Poor	we don't have a sump pump
18	Before September 24, 2018	Developed			Residential	Yes	Never		Good	Intermittent, only after & during rains
19	Before September 24, 2018	Developed			Residential	Third St.	More than 2 times a year	Water ponding in yard, water in basement, water ponding on road surface	Poor	Frequently
20	Before September 24, 2018	Developed			Residential	?	1-2 times a year	Water in basement, Water ponding on road surface	Fair	Intermittent

21	Before September 24, 2018	Developed			Residential	Yes	1-2 times a year	Water ponding in yard	Good	Not Often
22	Before September 24, 2018	Developed			Residential	Yes	1-2 times a year	Water ponding in yard - Clay soil	Fair	Intermittent, frequently during heavy rains
23	Before September 24, 2018	Developed			Residential	Yes	More than 2 times a year	Water ponding in yard	Fair - Front yard good, back yard poor	Frequently
24	Before September 24, 2018	Developed			Residential	Yes	Never	Water ponding in yard	Fair	Frequently
25	Before September 24, 2018	Developed			Residential	Yes	Never		Good	Intermittent
26	Before September 24, 2018	Developed			Residential	Yes	Never		Good	Intermittent
27	Before September 24, 2018	Developed			Residential	No, Other - Street	Never		Good	Frequently
28	Before September 24, 2018	Developed			Residential	Yes	Never		Good	Not Often
29	Before September 24, 2018	Developed			Residential	Yes	More than 2 times a year	Water ponding in yard, Water ponding in basement	Good	Intermittent
30	Before September 24, 2018	Developed			Residential	Yes	1-2 times a year	Water ponding in yard		Frequently
31	Before September 24, 2018	Developed			Residential	Yes	More than 2 times a year	Water ponding in yard, Water ponding on road surface	Other - Extremely poor. After heavy rains water lays for long period.	Frequently
32	Before September 24, 2018	Developed			Other - Trucking Terminal	Yes	1-2 times a year	Water ponding in yard	Good	we don't have a sump pump
33	Before September 24, 2018	Developed			Residential	Yes	Never		Good	Intermittent
34	Before September 24, 2018	Developed			Residential	Yes	Never		Good	Not Often
35	Before September 24, 2018	Developed			Residential	Yes				
36	Before September 24, 2018	Developed			Residential	Yes	More than 2 times a year	Water ponding in yard	Poor	Frequently
37	Before September 24, 2018	Developed			Residential	Yes	More than 2 times a year	Water ponding in yard	Poor - Back yard	Not Often
38	Before September 24, 2018	Developed			Residential	Yes	Never		Good	Not Often
39	Before September 24, 2018	Developed			Residential	Yes	Never		Good	Intermittent
40	Before September 24, 2018	Developed			Residential	Yes	More than 2 times a year	Water ponding in yard, Water ponding in basement, Water ponding on road surface	Poor	Frequently
41	Before September 24, 2018	Developed			Residential	Yes	Never		Good	Not Often
42	Before September 24, 2018	Developed			Residential	No	Never	Water ponding in yard - Springtime at back of yard. Backs onto farmer's field.	Good	
43	Before September 24, 2018	Developed			Residential	Yes	Never	None	Good	we don't have a sump pump
44	Before September 24, 2018	Developed			Residential	Yes	Never		Good	Frequently
45	Before September 24, 2018	Developed			Residential	Other - Boulevard on North Street	1-2 times a year	Water ponding on road surface	Fair	Frequently
46	Before September 24, 2018	Developed			Residential	Yes	Never		Good	Not Often

47	Before September 24, 2018	Other - Farm			Residential, Agricultural	Yes	Never	My property is at the head of the Grenizen Drain (12" Concrete tile)	Good	we don't have a sump pump
48	Before September 24, 2018	Developed			Residential, Agricultural	No	Never		Good	Not Often
49	Before September 24, 2018	Developed			Residential	Yes	Never		Good	Not Often
50	Before September 24, 2018	Developed			Residential	Yes	Never		Good	Not Often
51	Before September 24, 2018	Other - Farm, zoned industrial		For sale - looking for interested buyer	Residential, Agricultural, Commercial, Industrial	Yes	More than 2 times a year	Water ponding in yard	Fair	we don't have a sump pump
52	Before September 24, 2018	Developed			Residential	No	Never		Fair	Intermittent
53	Scan October 12, 2018	Vacant	Yes (0-5 Years)	Yes	Agricultural	Yes	Never		Other - No Use	we don't have a sump pump
54	Scan September 13, 2018	Other - Parkland	No		Other - Parkland	Yes	More than 2 times a year - but it is a floodplain	Water ponding in yard	Poor - CA is in a flood plain, and we are not concerned	we don't have a sump pump
55	Before October 4,2018	Developed			Residential	Yes	More than 2 times a year	Water ponding in yard - Other lots drain onto 544 First Ave, lot #37	Poor - Pump runs 250 - 300 days a year	Frequently
56	Before October 4,2018	Developed			Residential	Yes	Never		Good	Not Often
57	Before October 4,2018	Developed			Residential	Yes	More than 2 times a year - Culvert is crushed. No storm sewer drain		Fair	Intermittent
58	Before October 4,2018	Other - Farm Land			Agricultural	Yes	Never		Poor	we don't have a sump pump
59	Before October 4,2018	Developed			Residential	No	1-2 times a year	Water ponding in yard	Fair	Frequently
60	Before October 4,2018	Developed			Residential	Yes		Water ponding in yard	Fair	Not Often
61	Before October 4,2018	Developed			Residential	Yes	Never		Fair	Frequently
62	Before October 4,2018	Developed	Yes (10+ Years)		Residential	Yes	1-2 times a year		Fair	Frequently
63	Before October 4,2018	Developed			Residential	Yes	More than 2 times a year	Water in basement - crawlspace	Poor	we don't have a sump pump
64	Before October 4,2018	Developed			Residential	Yes	Never		Good	Frequently
65	Before October 4,2018	Developed			Residential	Yes				
66	Before October 4,2018	Developed			Residential		Never		Good	Frequently
67	Before October 4,2018	Developed			Residential	Yes	Never		Good	Intermittent
68	Before October 4,2018	Vacant	No		Residential, Other - Vacant Lot		Never		Good	we don't have a sump pump
69	Before October 4,2018	Developed			Residential	Yes		Other - Very soggy in yard. Seldom dries out completely.	Fair	Intermittent
70	Before October 4,2018	Developed			Residential	Yes	Never		Good	we don't have a sump pump
71	Before October 4,2018	Developed			Residential	Yes	Never		Good	Not Often

72	Before October 4,2018	Developed			Residential	Yes	More than 2 times a year	Water ponding in yard	Poor	we don't have a sump pump
73	Before October 4,2018	Developed			Residential	Yes	Never	Water ponding in yard (rear), due to neighbour driveway drainage.	Good	Frequently - during storms, heavy rain
74	Before October 4,2018	Developed			Residential	Yes	Never		Good	Intermittent
75	Before October 4,2018	Developed			Residential	Yes	Never		Good	Not Often
76	Before October 4,2018	Developed			Residential	Yes - Town Street	Never	Water ponding in yard - After very heavy rains	Fair	Frequently
77	Before October 4,2018	Developed			Residential	Yes - England Ave.	Constant!	Water ponding in yard	Poor	not sure - the drainage problems are well below the level of the house
78	Before October 4,2018	Developed			Residential	Yes				
79	Before October 4,2018	Developed			Residential	Yes				
80	Before October 4,2018	Developed			Residential		Never		Good	Frequently
81	Before October 4,2018	Developed			Residential	Yes	More than 2 times a year	Water ponding in yard, Water ponding on road surface	Poor	we don't have a sump pump
82	Before October 4,2018	Vacant	Yes (0-5 Years)	House	Residential - Vacant Lot	Yes	More than 2 times a year	Water ponding in yard, Water ponding on road surface	Poor	we don't have a sump pump
83	Before October 4,2018	Developed			Residential	Yes	Never		Good	we don't have a sump pump
84	Before October 4,2018	Developed			Residential		Never	Water ponding on road surface	Good	Intermittent
85	Before October 4,2018	Developed			Residential	Yes	More than 2 times a year	Water ponding in yard, Water ponding on road surface	Fair	Frequently - When Raining
86	Before October 4,2018	Developed			Residential	Yes	Never		Good	Frequently
87	Before October 4,2018	Developed			Residential	No	Never		Good	Not often
88	Before October 4,2018	Developed			Residential	Yes	Never		Good	Frequently- When it's raining
89	Before October 4,2018	Developed			Residential	Yes	Never		Good	Not often
90	Before October 4,2018	Developed			Residential	Yes	More than 2 times a year	Water ponding in yard, water ponding in basement, Other - Basement Flooding	Poor	Frequently
91	Before October 4,2018	Developed			Commercial	Yes	Never		Good	we don't have a sump pump
92	Before October 4,2018	Developed			Residential	Yes	Never		Good	Not often
93	Before October 4,2018	Developed			Residential	Yes	Never		Good	Never comes on
94	Before October 4,2018	Developed			Residential	Yes	Never		Good	we don't have a sump pump
95	Before October 4,2018	Developed			Residential	Yes	Never	Water ponding on road surface - Ponding for forst 40m of First Ave after heavy rainfall	Fair	we don't have a sump pump
96	Before October 4,2018	Developed			Residential	Yes	1-2 times a year - Average rainfall More than 2 times a year - Some years	Water ponding in yard	Fair	Intermittent

97	Before October 4,2018	Developed			Residential	Frontage is right on first ave, petrolia	1-2 times a year	other - water pondin in vacant lot beside me & in field behind & sometimes into my back yard	Fair	Intermittent
98	Before October 4,2018	Developed			Residential	Yes	1-2 times a year	Water ponding in yard	Fair	Intermittent
99	Before October 4,2018	Developed			Residential	Yes	Never		Good	we don't have a sump pump
100	Before October 4,2018	Developed			Residential	Yes	More than 2 times a year	Water ponding in yard, water ponding in crawlspace	Poor	we don't have a sump pump
101	Before October 4,2018	Developed			Residential	Yes	Never		Good	Intermittent
102	18-Sep-18	Developed			Residential	Yes	1-2 times a year		Good	Not Often
103	Before October 4,2018	Developed			Residential	Yes	Never		Good	we don't have a sump pump
104	Before October 4,2018	Developed			Residential	Yes	More than 2 times a year	Water ponding in yard, water in basement, water ponding on road surface	Poor	Frequently
105	Before October 4,2018	Developed			Residential	No	More than 2 times a year	Water ponding in yard, other - There is always water draining into the sump pit	Poor	Frequently
106	Before October 4,2018	Developed			Residential	Yes	Never	Water ponding in yard	Good	we don't have a sump pump
107	Before October 4,2018	Developed			Residential	Yes	Never		Good	Not Often
108	Before October 4,2018	Developed			Residential	Yes	1-2 times a year	Water ponding in yard	Good	Not Often
109	Before October 4,2018	Other - Residential & agricultural			Agricultural	Yes	Never		Good	we don't have a sump pump
110	Before October 4,2018	Developed			Agricultural	Yes	Never		Good	Intermittent, Not often
111	Before October 4,2018	Developed			Residential	Yes	1-2 times a year	Water ponding in yard	Fair	we don't have a sump pump
112	Before October 4,2018	Developed			Residential	Yes	Never		Good	Not Often

113	Before October 4,2018	Developed			Residential	Yes	More than 2 times a year	Water ponding in yard	Poor - Very Poor	we don't have a sump pump
114	Before October 4,2018	Vacant	Yes (0-5 Years)	Storage Warehousing	Agricultural, Industrial	Yes	1-2 times a year	Water ponding in yard	Poor	we don't have a sump pump
115	Before October 4,2018	Developed			Residential	Yes	Never		Good	Intermittent
116	Before October 4,2018	Developed			Residential	Yes	Never		Good	Intermittent
117	Before October 4,2018	Developed			Residential	Yes	More than 2 times a year	water ponding in basement, Water ponding on road surface	Poor	Intermittent - with rain = frequently
118	Before October 4,2018	Developed			Residential	Yes	More than 2 times a year	Water ponding in yard, Water ponding on road surface	Fair	Frequently
119	Before October 4,2018	Developed			Residential	Yes	More than 2 times a year - every rain	Water ponding on road surface - at road edge. Worse at neighbours front yard	Good - House drainage fine - water pools at raod/edge of property	Not Often
120	Before October 4,2018	Developed			Residential	Yes	1-2 times a year	Water ponding in yard, Water ponding on road surface	Fair	Intermittent
121	Before October 4,2018	Developed			Residential	Yes	More than 2 times a year	Water ponding in yard	Poor	Intermittent
122	Before October 4,2018	Developed			Residential	Yes	More than 2 times a year - There was about ten days that the sewer was hardly working and we believe that there was a problem with the main line	Water ponding in yard	Fair	Intermittent
123	Before October 4,2018	Developed			Residential	Yes	1-2 times a year	Water ponding in yard - High frequency of sump pump running	Fair	Frequently - Very frequently during rainfall
124	Before October 4,2018	Developed			Residential	Yes	Never	Other - Neighbour behind us had ponding in their back yard & needed to put a big black tile draining into our ditch	Good	Not Often
125	Before October 4,2018	Developed			Residential	Yes	Never		Good	Intermittent
126	Before October 4,2018	Developed			Residential	Yes	More than 2 times a year	Water ponding in yard - Ponds at back of property at golf course - Manitoba Maples, Poplar trees planted near drain	Good	Frequently
127	Before October 4,2018	Developed			Residential	Yes	Twice in 6 years	Water ponding in yard, water ponding in basement	Fair	Intermittent
128	Before October 4,2018	Vacant	No		Other - Vacant lot	Yes	Never		Good	we don't have a sump pump
129	Before October 4,2018	Developed			Residential	Yes	Never		Good	we don't have a sump pump

130	Before October 4,2018	Developed			Residential	Yes	1-2 times a year	Water ponding in yard	Fair - There is a dutch drain that works in about 2 days after moisture arrives	Intermittent
131	Before October 4,2018	Developed			Residential	No	More than 2 times a year	Water in basement	Fair	we don't have a sump pump
132	Before October 4,2018	Developed				Yes	Never		Good	Frequently
133	Before October 4,2018	Other - Residential			Agricultural	Yes	More than 2 times a year	Flood will occur	Very bad in the spring of the year. Severe Flooding	Frequently
134	Before October 4,2018	Developed			Residential	Yes	Never		Good	Intermittent
135	Before October 15, 2018	Developed			Residential	Yes	More than 2 times a year	Water ponding in yard, water ponding on road surface	Other - Awful - field behind drains into my lot	Frequently
136	Before October 15, 2018	Developed			Residential	Yes	More than 2 times a year	Water ponding in yard	Poor	Frequently
137	Before October 15, 2018	Developed			Residential			water ponding on road surface - and backing up onto front yard & driveway during heavy rainfall		Frequently
138	Before October 15, 2018	Developed			Residential	Yes	1-2 times a year, more than 2 times a year	Watyer ponding in yard, water ponding in basement, water ponding on road surface	Poor	Frequently - Many times everyday
139	Before October 15, 2018	Developed			Residential	Yes	Never		Good	Not often
140	Before October 15, 2018	Developed			Residential	Yes	1-2 times a year	Watyer ponding in yard, water ponding in basement, water ponding on road surface	Fair	Frequently
141	Before October 15, 2018	Developed			Residential	Yes	1-2 times (flooded once)	Water in basement - sump pump failure when power goes out	Good	Frequently (only when in rains / snow melts), intermittent
142	Before October 15, 2018	Developed			Residential	Yes	1-2 times a year	Watyer ponding in yard, water ponding in basement	Poor	Frequently
143	Before October 15, 2018	Developed			Commercial	Yes	Never		Good	we don't have a sump pump
144	Before October 15, 2018	Developed			Residential	Yes	More than 2 times a year	Water ponding in yard, Water ponding on road surface, other - back ressure on sump pump drain	Poor	Frequently - During rain/snow melt
145	Before October 15, 2018	Developed			Residential	Yes	Never	water ponding in basement	Fair	Frequently
146	Before October 15, 2018	Developed			Residential	Yes	Never	other - After heavy rain it sometimes pondsa t town drain	Good	Not Often
147	Before October 15, 2018	In progress			Residential	Yes	Never		Good	Do not know
148	Before October 15, 2018	Developed			Residential		Never		Fair	Intermittent
149	Before October 15, 2018	Developed			Residential	Yes	Never		Fair	Frequently
150	Before October 15, 2018	Developed			Residential	Yes	Never		Fair	we don't have a sump pump
151	Before October 15, 2018	Developed			Residential	Yes	Never		Fair	we don't have a sump pump
152	Before October 15, 2018	Developed			Residential	Yes	More than 2 times a year	Water ponding in yard	Fair, Poor	we don't have a sump pump

153	Before October 15, 2018	Developed			Residential	Yes	Never		Good	Do not know
154	Before October 15, 2018	Vacant	No		Residential	No	1-2 times a year	Water ponding in yard	Good	we don't have a sump pump
155	Before October 15, 2018	Developed			Residential	Yes	1-2 times a year	Water ponding in yard	Good	Frequently
156	Before October 15, 2018	Vacant	No		Residential	No	Never		Good	we don't have a sump pump
157	Before October 15, 2018	Developed			Residential	Yes	Never		Good	we don't have a sump pump
158	Before October 15, 2018	Developed			Residential	Yes	1-2 times a year	Water ponding in yard	Fair	Intermittent
159	Before October 15, 2018	Developed			Residential	Yes	Never		Good	Not Often
160	Before October 15, 2018	Developed			Residential	Yes	Never		Good	we don't have a sump pump
161	Before October 15, 2018	Developed			Residential	Yes	More than 2 times a year	Water ponding in yard	Fair - in front, poor - in back	Frequently
162	Before October 15, 2018	Developed			Residential	Yes	Never		Good	Intermittent
163	Before October 15, 2018	Developed			Residential	Yes	More than 2 times a year	Water ponding in yard	Fair	Intermittent
164	Before October 15, 2018	Developed			Residential	Yes	Never		Good	Intermittent
165	Before October 15, 2018	Developed			Residential	Yes	More than 2 times a year	Water ponding in yard, Water ponding on road surface	Poor	we don't have a sump pump
166	Before October 15, 2018	Developed			Residential	Yes	More than 2 times a year	Water ponding in yard	Poor	Intermittent
167	Before October 15, 2018	Developed			Residential	Yes	Never		Good	Intermittent - When it rains
168	Before October 15, 2018	Developed			Residential	Yes	More than 2 times a year	Water ponding in yard	Poor	Intermittent
169	Before October 15, 2018	Developed			Residential	Yes	1-2 times a year	Water ponding in yard	Good	Intermittent
170	Before October 15, 2018	Developed			Residential	Yes	1-2 times a year	Water ponding in yard, water ponding in basement	Fair	Intermittent
171	Before October 15, 2018	Developed			Residential	Yes	1-2 times a year	Water ponding in yard	Poor	Intermittent
172	Before October 15, 2018	Developed			Residential, Commerial	Yes	Never	Water ponding in basement	Good	Intermitent - when it rains, other than that - Not Often
173	Before October 15, 2018	Developed			Residential		1-2 times a year	Water ponding in yard - Poor drainage between back yard & golf course	Fair	Frequently
174	Before October 15, 2018	Developed			Residential	Yes	Never	Other - sump pump drains underground to golf course - Root problems.	Fair	Frequently
175	Before October 15, 2018	Developed			Residential		Never		Good	Intermittent
176	Before October 15, 2018	Developed			Residential	Yes	Never		Good	Intermittent

177	Before October 15, 2018	Developed			Residential	Yes	More than 2 times a year - Driveway has huge puddle with every heavy rainfall	Other - Water ponding in driveway	Good - Other than the driveway issue is question 1 (5 excel)	Not Often - only during heavy rainfalls
178	Before October 15, 2018	Developed			Residential	Yes	More than 2 times a year	Water ponding in yard, water ponding on raod surface - drainage from other properties around	Poor	we don't have a sump pump
179	Before October 15, 2018	Developed			Residential	Yes	More than 2 times a year	Water ponding in yard, water ponding on raod surface - drainage from other higher properties	Poor	Frequently - when it rains, intermittent
180	9-29-2018 15:19:14	Developed			Residential	Yes	Never		Good	Intermittent
181	10-1-2018 18:51:23				Residential	Yes	More than 2 times a year	Water ponding in yard	Fair	Intermittent
182	Before November 1, 2018	Developed			Residential	Yes	1-2 times a year	Water ponding in yard	Good	Intermittent
183	Before November 1, 2018	Developed			Residential	Yes	More than 2 times a year	Water ponding in yard, Water ponding in basement, Water ponding on road surface	Fair	Intermittent
184	Before November 1, 2018	Developed			Residential	Yes	Never		Fair	Intermittent
185	Before November 1, 2018	Developed			Residential	No	More than 2 times a year	Water ponding in yard	Poor	Frequently
186	Before November 1, 2018	Developed			Residential	Yes				
187	Before November 1, 2018	Vacant	No		Agricultural - Farmland	Yes	Never			we don't have a sump pump
188	Before November 1, 2018	Vacant	No		Agricultural - Farmland	Yes	Never			we don't have a sump pump
189	Before November 1, 2018	Developed			Residential	No	More than 2 times a year	Water ponding in yard	Poor	Not Often
190	Before November 1, 2018	Developed			Residential	No	Never	Water ponding in yard, Water ponding in basement	Poor	Frequently
191	Before November 1, 2018	Vacant	Yes (0-5 Years)		Agricultural	Yes				
192	Before November 1, 2018	Vacant	Yes (0-5 Years)		Other - Open space / Golf Course	Yes				
193	Before November 1, 2018	Developed			Residential	Yes	1-2 times a year	Water ponding in yard, Water ponding on road surface	Poor	Not Often
194	Before November 1, 2018	Developed			Residential	Yes				
195	Before November 1, 2018	Developed			Residential	Yes	Never		Good	Frequently
196	Before November 1, 2018	Developed			Residential	Yes	Never		Good	Intermittent

197	Before November 1, 2018	Developed			Residential	Yes	More than 2 times a year	Water ponding in yard - Farm draining onto property during thaw / spring melt	Other - Very Poor	Frequently
198	Before November 1, 2018	Developed			Residential	Yes	Never		Good	we don't have a sump pump
199	Before November 1, 2018	Developed			Residential	Yes	Never		Fair	Intermittent
200	Before November 1, 2018	Developed			Residential	Yes				Intermittent
201	Before November 8, 2018	Vacant	No		Agricultural, Ot	Yes	Never	Water ponding in yard	Good	we don't have a sump pump
202	Before November 8, 2018	Developed			Residential	Yes	More than 2 times a year	Water ponding in yard, water ponding on road surface	Poor	Frequently

If there is any additional information that you think would be useful to this study, please include them here.	Long Comment	GISCOMMENT	UniID	Property Address	Mailing Address	Lot No.	Plan No.	Farm Lot and Concession/BLOCK	Property Size (ha/acre)
			1	484 First Ave., Petrolia	484 First Ave., Petrolia				
			2	4338 Garden Crescent	4338 Garden Crescent				3-4
		Assume Property	3		4323 Fairway Crt., Petrolia, ONT N0N 1R0				
			4	4327 Fairway Court Petrolia, On N0N 1R0	4327 Fairway Court Petrolia, On N0N 1R0	19	25M-29		32.51'x131.07'
			5	4325 Garden Cres.	4325 Garden Cres.				1/2
			6	556 First Ave.	556 First Ave.	31	757		0.82AC
			7	517 First Ave.	517 First Ave.	11	783		Frontage = 77.82' Depth = 148.06'
This area is in the township not the town. Do not feel this idea involves tile yard homes as they have a ravine. The golf course would be more involved. No homes could be built in conservation area with a creek there getting rid of water. All bottom of ravine a small ditch goes to the creek.	OUTSIDE OF PETROLIA		8	3922 Tile Yard Rd.	6008 Aberfeldy Line, RR2 Oil Springs	PT Lot 4 RP25R6333 part2	Plan 13PT Lot 3		2 acres. 166'Fr, 520'Dp
			9	515 First Ave.	515 First Ave.	24		60	N 30.290 S 23.720 W 45.347 E 46.549
	Outside Study Area	Prop match but size diff	10	4491 Discovery Line	4491 Discovery Line	15	25R 1599		0.4215ha
Should I have a check valve on sewer line to prevent backups? I don't want anything done to raise property taxes. Mine are over $6000.00 for a 2 person home than more than enough.			11	538 First Ave	538 First Ave				0.73 acre +-
			12	4312 Garden Cres	4312 Garden Cres				
		has 2nd property?	13	same + 1488 First Ave	490A First Ave Petroilia On, N0N 1R0	17	790	40	N 65.61 S 80.93 W 174.37 E 181.59
In 2017, had new solid line installed from sump pump discharge (approx. 150') to "Trunk" line on Golf Course, also had catchbasin w/grading installed at tie-in, can visibly see water come out of my discharge to basin. (Perforated line was originally used, this should NOT be done.). Cost to me was $5000.			14	4314 Garden Crescent N0N 1R0	4314 Garden Crescent N0N 1R0				1/3 Acre
			15	4331 Garden Cres.	4331 Garden Cres.	34	717		
			16	557 First Ave, Petrolia	557 First Ave, Petrolia				
Just purchased property			17	422 First Ave, Petrolia	558 Valentina St. Petrolia	90	6		
			18	541 First Avenue, Petrolia ONT	541 First Avenue, Petrolia ONT	12	757		0.32, 82.02 FR
I have called the town about this situation. Mike Thompson came over and inspected in. Town of Petrolia tried to snake. Did not help. Water pools on the road in front of house, and sump pump runs non stop when we get rain. Even a little rain. Please note I have copied this for my records.			19	4413 Third St. Petrolia	4413 Third St. Petrolia				50' x 150'
		Diff Name	20	4297 Garden Cres., Petrolia N0N 1R0	4297 Garden Cres., Petrolia N0N 1R0				

			21	4449 Petrolia Line	4449 Petrolia Line	Lot 2 Lot 3 RP	11		60 Frt 120 Dp
Some type of water discharge pipe draining into ditch between golf course and next door. We have standing water at one end of yard close to ditch in heavy rains, sometimes for 2-3 days. Sump pump sometimes struggling to keep up in heavy rains, otherwise OK.		Using 489A	22	489 First Ave, Petrolia N0N1R0	489 First Ave, Petrolia N0N1R0				
Town drain which sump drains to is not working due to tree grwoth on golf course			23	4319 Garden Screscent	4319 Garden Screscent	28	717		0.45 acres
			24	4368 Sixth St.	4368 Sixth St.	157 + Part 156	6		
			25	4441 Petrolia Line	4441 Petrolia Line	6 PT Lot 5RP	11		58' x 120'
			26	4298 Garden Cres.	4298 Garden Cres.				
			27	4381 Sixth St., Petrolia ONT. N0N 1R0	4381 Sixth St., Petrolia ONT. N0N 1R0	10	793		40' x 150'
			28	4407 North St Petrolia	4407 North St Petrolia				
			29	480-A First Ave., Petrolia	480-A First Ave., Petrolia	27	790		
There is no storm sewer on our part of the street. So there is no good place to send water from the sump pump. Water saturates our lawn and drains to the adjacent farm field.			30	484A First Ave.	484A First Ave.				
Exisitng drain in back yard does not remove water it just lays until it disappears on it's own.			31	474 First Ave.	474 First Ave.				
		New owners now	32	4278 Old Heritage Road, Petrolia	4278 Old Heritage Road, Petrolia	Part lot 16 Enniskillin Concession 11	RP#25R10038 Part 1&2		4.12 acres
			33	4354 Third Street	4354 Third Street	32 and 33	6		100' x 165'
Golf course behind our property drains water into what looks like a storm sewer. Why don't they have it permanently hooked up so they don't have to pump hours at a time after a water event i.e. rain/snow melt etc.??			34	4303 Garden Screscent, Petrolia N0N 1R0	4303 Garden Screscent, Petrolia N0N 1R0				
			35	475A First Ave.	475A First Ave.	1RP25R9278	790 PT		7306.11 SF
Farm land behind me turns into a lake every heavy rain			36	470 First Ave.	470 First Ave.				
			37	4352 Fifth St., Petrolia, ONT. N0N 1R0	4352 Fifth St., Petrolia, ONT. N0N 1R0				
			38	4331 Fairway Crt.	4331 Fairway Crt.	17	25M29		0.15AC
			39	489 First Avenue, Petrolia, ON N0N 1R0	489 First Avenue, Petrolia, ON N0N 1R0	8	790		11463.00SF, 74.46Fr x 169.04Dp
Sump pump does not drain into storm system. Gardens in back yard flood, washing mulch out into yard. Yard stays swampy until mid summer. Can't walk on it or cut it.			40	553 First Ave. N0N 1R0	553 First Ave. N0N 1R0	18	757		1/2
			41	4363 Fifth Street	4049 Petrolia Line	147	6		50' x 150'
			42	458 First Ave.	458 First Ave.				50' x 150'
			43	4471 Petrolia Line	4471 Petrolia Line				
			44	4478 North Street	4478 North Street	5	8		0.12 acres
During the spring thaw, heavy rains or constant rain for days, my sump pump runs every 15 minutes approximately. The south part of my yard takes a very long time to dry out in between rains. The street in front of my house, close to the curb, also takes longer to dry than other residences along my street.			45	4467 North St., Petrolia ON	4467 North St., Petrolia ON	10S/S	8		
			46	492A First Ave., Petrolia	492A First Ave., Petrolia	15	790		75.46 FR 173.50Dp

	Will count in 2 parcel/responses	Double	47	4185 Oil Heritage Road	4185 Oil Heritage Road				3 1/2 Ac
			48	4146 Oil Heritage Rd.	4146 Oil Heritage Rd.	Lot 16	Con 10 N. Pt		9.7 Acres
			49	510 First Ave. N0N 1R0	510 First Ave. N0N 1R0				
			50	4365 Sixth St.	4365 Sixth St.	2	793		12.000m x 45.720m, 40' x 150'
I am interested in selling land or possibly joint-venture with new business	Can't find address, likely outside of Study Area		51	4322 Discovery Line	12853 Longwoods Rd., Thamesville				38.35 acres
			52	4431 North St., Petrolia	4431 North St., Petrolia	18	8		5000SF, 50'Fr x 100'Dp
			53	4509 Petrolia Line	266 Corner Ridge Rd. Aurora ON L4G 6L6	Enniskillen Con10 N PT Lot 16 RP 25R2474	Part 1	Con 10N Pt Lot 16 EXC RP 25 R 874 Part 1	
	Will use, owner correct for 4301	Using 4301	54	4300 or 4278 Petrolia Line	205 Mill Pond Cres., Strathroy				
The town chaged the grading plan in phase II of the lot development. Grading plan was raised higher 2-3%. My 3 lots are in the first phase , so the water drains to me. We need to talk.			56	540 First Ave., Petrolia	Box 226	540 First Ave.	757 Lots 38 & 39		
			57	4367 North St	4367 North St	31	57		5000.00 SF
	Outside Study Area		58	4321 Discovery Lane	4321 Discovery Lane, Petrolia	25	26		
		same as 168?543 first	59	Farmland east of 1st Avenue	543 First Avenue				36 ACRES
		owner correct, not sure of property	60	SS, Petrolia, ON N0N 1R0	4296 Garden Crescent	3	757	1 REG	0.4 AC
			61	4480 Petrolia Line	4480 Petrolia Line, Petrolia, ON				
	Outside Study Area		62	4311 Discovery Line	4311 Discovery Line	30	26		162 x 163.61 AC
			63	4336 Pearl St. Petrolia N0N 1R0	4625 Shilogh Line				
This is in a low lying area. The home has a crawl space only, no basement. This has been a issue for close to 30 years that I have owned the home. It is a rental home that was in our family for many years.			64	4362 Sixth St. Petrolia	389 Wood St. Petrolia Ont N0N 1R0	154	6		0.17
			65	389 Wood St. Petrolia	389 Wood St. Petrolia Ont N0N 1R0	16 + 17	8		0.22
		Assume Property	66		4345 Garden Cres	41	717		16145.64 SF or 0.37 acres
			67	511 First Ave, Petrolia	511 First Ave, Petrolia ON N0N 1R0	8	783		
			68	4329 Fairway Crt	4329 Fairway Crt	18	25M-29		
			69	509 First Ave. Petrolia	511 First Ave. Petrolia	7	783		
			70	4383 Sixth St. Petrolia	4383 Sixth St. Petrolia	11	793		Under 1 acre
			71	4438 North St.	4438 North St. Petrolia ON	Pt Lot 15	8		0.47 acres
			72	4332 Fairway Court?	4332 Fairway Court				

			73	4421 Petrolia Avenue?	4421 Petrolia Avenue	Pt. 7 & 8	2		52 x 165, 0.19 acres
			74	4359 Sixth St	4359 Sixth St Petrolia ON N0N1R0	167 S Side 6th St	6 (PA)		50x130
Clean Bear Creek from dead heads			75	501 First Ave. Petrolia	501 First Ave. Petrolia	3	783		77.43FR x 177.23 D, 114.1 SF
			76	4335 Fairway Court	4335 Fairway Court				
			77	4348 Garden Cres	4348 Garden Cres Petrolia ON N0N 1R0				
We have noticed a drainage problem at the back of our property for several years. Water sits at the back corners of the property and into Bridgewiew Park. These areas never dry up. This water has caused issues with our pool - shifting pool lines, shifting concrete, rotting fencing...This water never used to accumulate - something has changed over the last 10 years. We have contacted the town of Petrolia a few times and they said they inspected drainage pipes and could find nothing. We would welcome a review of these drainage issues.			78	415 England Ave., Petrolia					
Don't know - a rental but live in the basement too.			79	4482 Petrolia Line	4035 Petrolia Line				
Don't know - a rental but live in the basement too.			80	4425 Petrolia Line	4035 Petrolia Line				
		Assume Property	81		4365 Third St.				
Continuous water ponding			82	4470 Derby St, Petrolia	4338 Pearl St. Petrolia	20	16		60FR x 120D
Continuous water ponding			83	4472 Derby St, Petrolia	4338 Pearl St. Petrolia	21	16		85Frx120D
			84	4338 Pearl St. Petrolia	4338 Pearl St. Petrolia	3 E PT Lot 4	12		60FR X 100D
			85	516 First Ave	516 First Ave	3	785		0.47 acres
Water usage is an issue as the rates are very high. However, sewage charges are incredible. There is no consideration for water usage for watering plans, washing the car, etc. Water that does not end up as sewage. Also the taxes on the 1st Ave are too high when you consider we do not even have sidewalks.			86	549 First Ave, Petrolia	549 First Ave, Petrolia ON				
			87	513 First Ave	513 First Ave				
We have no problems regarding stormwater.			88	521 First Ave, Petrolia	521 First Ave, Petrolia	48			
			89	4474 Petrolia Line	4474 Petrolia Line	5 PT Lot 4 Lot 6	8		0.34 Ac, 104.86 FR X 150D
			90	563 First Ave	563 First Ave				
2 Basement Foods. 15 Years ago, 20 years ago.			91	4324 Garden Cres	4324 Garden Cres	4	717		0.37 AC
			92	4359 Petrlolia Line	4326 Fairway Court				
			93	4326 Fairway Court	4326 Fairway Court				
			94	4431 Third St?	4431 Third St				
			95	4369 Fifth St	4369 Fifth St N0N1R0				
			96	4343 Petrolia Line	4343 Petrolia Line				
Does the servicing of the stormwater issues include developled properties or are the 'yet-to-be' developed areas the primary (if not the sole) focus of this study? I applaud the study; however, I'm curious as to the 'initiative' behind it.			97	452 First Ave.	452 First Ave., Petrolia ON	69	6S PT		43.92' x 150.0 '

I have both an insubmersible sump pump and a water powered back up pump. In a bad storm if I lose hydro the water powered pump only prevents a flood in the basement for so long, It does not keep up. If the hydro does not come on, eventually my baasement will flod. It came very close twice this year (summer 2018). It has floodedtwice in the last 20 years that I ahve lived here.			98	466 First Ave?	466 First Ave				
			99	4362 Fifth St	4362 Fifth St, Pretolia ON N0N1R0	109 & 110	6		
			100	407 First Ave.?	407 First Ave.	1	12		
For older east-end homes: There is a lack of a drainage plan, lack of swales, lack of surface/subsurface catchments and drain pipes. Soils are heavy clay, this area is all surface drainage to creek/road-storm drains/ponding in yards			101	4370 Fifth St., Petrolia	453 Lawson Rd, London ON	111	6	REG	0.17 acres
Any information I have used a ? You can obtain from the town of Petrolia			102	4432 Petrolia Line	4432 Petrolia Line, Petrolia	?	?	?	50' x 175'?
Do not want wetlands associated with Bear Creek to be developed.			103	562 First Avenue	562 First Avenue, Petrolia N0N1R0				
I would like to bring to your attention: There is a 20' Storm sewer easement immediately north of our property which in turn drains into an open drain. There is also another storm drain (pipe) draining from the south to this ditch. This open drain crosses our property, also the property to the southm which drains into Bear Creek. This open drain has been eroding with occuding bank movement over the past several years. We request that advance notice is required for permission to gain access to our property to inspect this drain.			104	451 First Ave	451 First Ave	44 PT 45	6PT		
I have two catchbasins 200' apart along Third St. But the ditch is not properly graded to allow the water to flow to either basin. During heavy rains the ditch fills and spills over ont the roadway and my lawn. Because the ditch retains water my back lots cannot drain and remain wet days after any storms.			105	420 Kentail St.	420 Kentail St.	10,11,12,13	2(PA)		100' x 200'
		Assume Property	106		4360 Third St, Petrolia	29	6		50' x 165'
			107	4462 Petrolia Line	4462 Petrolia Line	9 North Side & 110	8		76 x 150
			108	4426 North Street?	4426 North Street	15RP25R7189	8		0.23 acres
			109	4369 Sixth St.		4	793		6004.5SF, 40.03FR x 150.00D
	OUTSIDE OF PETROLIA		110	3854 Tile Yard Rd.?	RR1 3854 Tile Yard Rd.	13 Con 12			100
			111	477A First Ave.	477A First Ave.				
			112	4412 Petrolia Line		2E PT Lot 3 W PT	8		116F x 150D
			113	477 First Ave	477 First Ave	2RP	790 PT	25RQ, 72 Part 1	1532.55 SF, 49.21FR, D

Drainage tiles cut & not repaired. Poor municipal Drainage. Building too close to municipal drain.	Outside Study Area, same add, diff plan#, same answers. Not using 115 for now.	Same - 114, 115?	114	4423 Oil Heritage Rd	4423 Oil Heritage Rd. Petrolia	Conc. 12 PT Lot 15	RP 25 R 7785	Part 2	4acres
Building too close to municipal drain (ditch). Many field tiles cut & not repaired	Outside Study Area, same add, diff plan#, same answers. Not using 115 for now.	Same - 114, 115?	115	Pt Lot 15 Conc 12	4423 Oil Heritage Rd. Petrolia	Pt lot 15	25R9393	Parts 4 & 7	4.94 acres
			116	389 Hartford St.	389 Hartford St., Petrolia ON				
			117	536 First Ave.?	536 First Ave.	41	757		0.72 Acre
			118	4191 Oil Heritage Rd.	4072 Juniper Cres.	?	?	?	120 x 80 estimate
			119	4341 Garden Cr.		39	717		80' x 196'
Roads in poor condition. Derby & Holland.			120	4463 Derby St,					
Backyard was constantly wet for long period of time. A new house was built behind us. The contractor put in a French drain or dry well in that yard and now the yard is not as wet. I only remember one time when street was flooded over. Several years back it rained so fast and furious water had no place to go. Our street looked like a river. I think sewer system was overloaded.			121	4363 Third Street	4363 Third Street	97	6		150' x 150'
Water ponding in backyard - specifically on the golf course property backing up onto our property.			122	555 First Ave	555 First Ave Petrolia	19	757		0.32 acres
			123	4370 Petrolia Line	70121 Shipka RR#2 Dashwood Ont. N0M1N0	8	57		
The sump pump runs extremely frequently during wet seasons & during rainfall			124	505 First Avenue	505 First Avenue, Petrolia	5	783		77.43FR x 167.32D
We have only been living here for one year as of Oct. 1, 2018.			125	4337 Fairway Court	4337 Fairway Court, Petrolia On N0N 1R0	14	25M29 (25R)	9426	49.54 FR x 131 D estimate.
			126	539 First Ave.	539 First Ave.	11	757		0.37 AC
The drain should be cleaned			127	4311 Garden Cr	4311 Garden Cr. N0N1R0	24	717	51	0.34 ha?
Re: 1 and 3 above (drainage problems timing, what issues) 2014 and 2016. Our basement flooded due to calcification in the drainage (sewer_ line from the house, at the point where it connects with the city line at the street. It was cleared with a grinder - no problems since.			128	4310 Garden Cr.	4310 Garden Cr.	16	717	48	0.2268 acres
			129	518 First Ave.	520 First Ave, Petrolia N0N1R0	518			
			130	520 First Ave.	520 First Ave, Petrolia N0N1R0				

			131	4476 Petrolia Line	4476 Petrolia Line	Lot 3 E PT Lot 4	8		1/4
			132	422 England Ave	422 England Ave, Petrolia ON N0N1R0	12-14 Plan 12	Being part 4&5 on Plan 25R6330	England Ave	
			133	4444 Derby St	4444 Derby St				
I would be very co-operative in new drainage system to be installed and new sewer put in	Outside Study Area		134	4305 Discovery Line	Box 1894 RR#1 Petrolia ONT	30 Con, 28.			1/2
			135	4317 fairway Court	4317 fairway Court Petrolia ON N0N 1R0				
AS NOTEPAD FILE IN SURVEY FOLDER			136	458 Fourth St.	458 Fourth St., Petrolia, ON N0N1R0	13	793		
Water lays in back yard adjacent to neighbours lot line caused by improper lot slope			137	4289 Garden Crescent	4289 Garden Crescent Petrolia Ontario N0N 1R0	51	757		0.41 acres?
			138	551 First Ave	551 First Ave				1/4 acres
Storm water drainage at this address is surface runoff. There is no storm water drainage subsurface except the piping from our summp pump into a drainage conduit behind the back yard on a public right of way. PICTURES FILE IN SURVEY FOLDER			139	4304 Garden Cres.	4304 Garden Cres.				
			140	4465 Derb St	4465 Derb St				
			141	4334 Garden Cres	4334 Garden Cres				2.33
We constantly worry whenever there is inclimate weather. If our power goes out and we are not home, there is a good chance that we will come home to water in our basement. We have a submercible sump pump but no backup when power goes out.			142	446 First Avenue	446 First Avenue	74	6		50' x 150'
			143	4361 Third St.	4361 Third St.	96	6		50' frontal
		using 4347-4351	144	434 Petrolia Line, 4347-4353 Pretolia Line	41 Scarsdake Rdm Unit 6, Toronto Ontario M3B 2R2	1,2,3,5	6		1
Municipal drain at rear of property appears to be too small to handle heavy rain periods or snow melt resulting in frequent ponding on property and large flooded areas on adjacent golf course - sump pump pressure has created a spring pushing water up through the ground			145	4308 Garden Cres.	4308 Garden Cres.	17	717 Petrolia		1/2
			146	4332 Petrolia Line	4332 Petrolia Line	Lot S E PT Lot 4 Lot 49	Plan 33 Plan 26 PT		60 x 310
			147	490 First Ave	490 First Ave	18 1RReg	790		13500.00 SF
			148	4328 Fairway Court	4328 Fairway Court				
			149	4481 North St.	4471 Courtright Line N0N 1H0				
			150	525 First Ave	525 First Ave SS1	50	757		
			151	4317 Petrolia Line	4334 Garden Cres				
We sold this house Oct1/18 to Curtis Slyvester			152	4416 North St.	4334 Garden Cres				
			153	4402 North St.?	4402 North St.	25R5623 Part 1 & Part 2			

We live on Bear Creek, near top of hill in east end, probably have best drainage in Petrolia. We back onto a flood plain, this does erode our property from time to time but that's mother nature. * The town keeps the storm sewers clean on our hill. No problems.			154	4330 Petrolia Line	4330 Petrolia Line	Plan 33 Lot 3 Pt Lot 4	Plan 26 Pt Lot 49 1RREG		19650 SF, 65.50FR x 300.00D
Runs behind other properties	Double - will be input for 2 parcels	same - 157, 155?	155	North St	4418 North St	15A to 20A & Pt 12A Lot 13A	39		2.24 AC
Main property with house, pool & back buildings & garage. Didn't collect water until neighbours to east built.			156	4418 North St	4418 North St	24 & 25 3A & 4A	Plan 8 and Plan 39		82F x 176.95D
This property runs behind other property		same - 157, 155?	157	Kentail St?	4418 North St	14A	39		40 x 211.2
We paid for drainage to Enniskillen Twp because First Ave storm drainage runs that way off street			158	559 First Ave?	559 First Ave	21	757		
			159	495 First Ave.	495 First Ave.	12	790		
			160	497 First Ave?	497 First Ave	1	783		83 x 183
			161	404 First Ave	4334 Garden Cres				
Poor drainage in backyard results of no drainage on fifth St lots backing onto us. Our ponding caused by ponding in their yards coming into ours			162	4356 Sixth Street	4356 Sixth Street	169	6		50R 150D, 7500SF
			163	3962 Tile Yard Rd SS1	3962 Tile Yard Rd SS1	26	757		32m x 64.3m
			164	4313 Garden Cres	4313 Garden Cres	Part Lot 25	717 REF 25R8415		82.02/82.26 x 205.5/215.82, 1800 SF
			165	414 First Av	414 First Av	92 RP 25R3311	6 PT		50ft x 100ft
			166	4443 Derby St	4443 Derby St	PT Block A	59	Block A	117 x 190
			167	385 Hartford St.	385 Hartford St.		57 PT North St RP		0.15AC
			168	543 First Avenue	543 First Avenue	13	77		0.31 ac
There aren't any drainage issues in my front yard, but my backyard, which overlooks a farmers field is terrible! It is frequently a flooded, messy swamp despite the fact that there is a drain in the centre of the yard.			169	444 Fouth Street	444 Fouth Street				
			170	459 First Ave	459 First Ave, Petrolia	Part Lot 46	6(PA)		0.7ha
			171	512 First Ave	512 First Ave				0.5 acres
			172	4360 Sixth St.	4360 Sixth St., Petrolia	153	6		50FR x 150D, 7500SF
NOTE FROM #5 - 22 years ago - was our tile needing replaced. We did it & Have no problems since.END. Only thing we can think of is the town sidewalk ifront of our south neighbours sinking. (415 First) when it rains the whole sidewalk is under water.			173	413 First Ave	413 First Ave	24 & 25	12		0.21 ACRE
Golf course drainage is poor. A river of water runs infront of house along the street. * By the way - on another note…Our water prices are ridiculous and way to expensive for our tax paid.			174	4328 Garden Crest.	4328 Garden Crest.				
Cannot drain sump pump to ground as there is no swail.			175	4322 Garden Cres	4322 Garden Cres				
My driveway is gravel and storm sewer at end of my driveway recieves gravel runoff during rain.			176	4322 Petrolia Line	4322 Petrolia Line	49E	26		
			177	530 First Ave	530 First Ave	44	757		0.63 acre

			178	4466 Derby St.	4466 Derby St.				
There has been flooding since other newer houses built around			179	4435 Petrolia Line	416 Mutual St, Petrolia	7	11		0.3 AC
There has been flooding since the newer houses built higher than mine.			180	416 Mutual St	416 Mutual St, Petrolia	34 & 35	11		0.30 AC
			181	503 FIRST AVE., Petrolia	503 FIRST AVE., Petrolia, ON, N0N 1R0	4	783		0.267 acres
			182	431 1/2 First Ave	421 1/2 First Ave				
			183	528 First Ave	528 First Ave	45	757		0.61ac
			184	4415 Third St.	4415 Third St.				
Sump pump runs more during heavy rain			185	434 First Ave.	434 First Ave.	81	6		7500.00 SF
Drainage Issues - Back of Yard - Draining onto town -			186	485 First Ave	485 First Ave	6	790		
Our home has good drainage since we put in buried pipes from our downspouts. However, the pond that was behind our lot when we built here 13 yrs ago has totally been taken over by phragmites. The water that flowed into our small pond and then into the larger pond west of us has been 99% choked by these invasive plants.			187	494 First Ave, Petrolia	494 First Ave, Petrolia				60' x 75'
			188	Conc 10 N Pt lot 16	350 Front St. N, Apt. 1006, Sarnia ON, N7T O1A	N Pt lot 16	BP 25R3898 Part 5		0.58 Acres
			189	Conc 10 N Pt lot 16	350 Front St. N, Apt. 1006, Sarnia ON, N7T O1A	N Pt lot 16	BP 25R3898 Part 5		1.21 Acres
We had to move the fence in our back yard as water pools at the back of our yard. There is also a farm field behind us.			190	436 Fourth St	436 Fourth St				
			191	4480 North St.	4480 North St.				
Proposal to develop 13.9 ha land currently for agriculture located east of First Avenue into single family residential within 2 years. Phase 6 of Glenview Estates. To use existing storm water management pond located south of First. Ave. for storm runoff control. Has capacity for this development and also development of phases 4 & 5 of Glenview Estates located south of pond.			192	38190000 6004160, 6014990	Ray Dobbin / R. Dobbin Engineering Inc.				13.91
Proposal to develop 13.9 ha land currently for agriculture located east of First Avenue into single family residential within 2 years. Phase 4 & 5 of Glenview Estates. To use existing storm water management pond located south of First. Ave. for storm runoff control. Has capacity for this development and also development of phases 6 of Glenview Estates located east of First Avenue.			193	38190000600410 5,6,7,8,etc	Ray Dobbin / R. Dobbin Engineering Inc.				18.3
We should have catchbasin in the back of the lot where our sump pump lines runs to the other tile that runs to a drain sump or ditch			194	4342 Garden Cres. Petrolia	4342 Garden Cres. Petrolia	49	6		196.85' x 82.02'
			195	4371 Sixth St.	4371 Sixth St.	5	6		0.5
			196	464 1st Ave	464 1st Ave				50' x 150'
House sits 20" above grand with only partial, undeveloped basement. Lot is at top of hill, overlooking Little Lake.			197	409 England Avenue	409 England Avenue				100' x 245'

Field basically drains onto our property during spring thawe and heavy riains during that time. This fall we noticed that the "lake" on the field formed after a heavy rainfall in late Sept. We are surrounded by water - back and south side.			198	460 Fourth St.	460 Fourth St.	12	793	Zone R1 - 4	
My yard has a good number of trees, helps drink up water. Plus there is drainage in the yard now.			199	4357 Fifth Street	4357 Fifth Street				
			200	4367 Sixth St	4367 Sixth St				
			201	4288 Garden Cres.	4288 Garden Cres.				
				4055 Oil heritage Road	3068 Tileyard Road, oil Springs				103 acres
So glad this is finally being looked into and hopefully resoved. The road in front of my house in the winter is inches of solid ice!				478 First Ave	478 First Ave				

APPENDIX C

CULTURAL HERITAGE CHECK-LISTS

Ontario

Ministry of Tourism, Culture and Sport

Programs & Services Branch
401 Bay Street, Suite 1700
Toronto ON M7A 0A7

Criteria for Evaluating Archaeological Potential

A Checklist for the Non-Specialist

The **purpose of the checklist** is to determine:

- if a property(ies) or project area may contain archaeological resources i.e., have archaeological potential
- it includes all areas that may be impacted by project activities, including – but not limited to:
  - the main project area
  - temporary storage
  - staging and working areas
  - temporary roads and detours

Processes covered under this checklist, such as:

- *Planning Act*
- *Environmental Assessment Act*
- *Aggregates Resources Act*
- *Ontario Heritage Act* – Standards and Guidelines for Conservation of Provincial Heritage Properties

Archaeological assessment

If you are not sure how to answer one or more of the questions on the checklist, you may want to hire a licensed consultant archaeologist (see page 4 for definitions) to undertake an archaeological assessment.

The assessment will help you:

- identify, evaluate and protect archaeological resources on your property or project area
- reduce potential delays and risks to your project

Note: By law, archaeological assessments **must** be done by a licensed consultant archaeologist. Only a licensed archaeologist can assess – or alter – an archaeological site.

What to do if you:

- **find an archaeological resource**

  If you find something you think may be of archaeological value during project work, you must – by law – stop all activities immediately and contact a licensed consultant archaeologist

  The archaeologist will carry out the fieldwork in compliance with the *Ontario Heritage Act* [s.48(1)].

- **unearth a burial site**

  If you find a burial site containing human remains, you must immediately notify the appropriate authorities (i.e., police, coroner's office, and/or Registrar of Cemeteries) and comply with the *Funeral, Burial and Cremation Services Act.*

Other checklists

Please use a separate checklist for your project, if:

- you are seeking a Renewable Energy Approval under Ontario Regulation 359/09 – separate checklist
- your Parent Class EA document has an approved screening criteria (as referenced in Question 1)

Please refer to the Instructions pages when completing this form.

Project or Property Name

Stormwater Master Plan for Petrolia Southeast Development Area

Project or Property Location (upper and lower or single tier municipality)

County of Lambton, Town of Petrolia

Proponent Name

Town of Petrolia

Proponent Contact Information

Mike Thompson, Director of Operations - Town of Petrolia

Screening Questions

	Yes	No
1. Is there a pre-approved screening checklist, methodology or process in place?	☐	☑

If Yes, please follow the pre-approved screening checklist, methodology or process.

If No, continue to Question 2.

	Yes	No
2. Has an archaeological assessment been prepared for the property (or project area) and been accepted by MTCS?	☐	☑

If Yes, do **not** complete the rest of the checklist. You are expected to follow the recommendations in the archaeological assessment report(s).

The proponent, property owner and/or approval authority will:

- summarize the previous assessment
- add this checklist to the project file, with the appropriate documents that demonstrate an archaeological assessment was undertaken e.g., MTCS letter stating acceptance of archaeological assessment report

The summary and appropriate documentation may be:

- submitted as part of a report requirement e.g., environmental assessment document
- maintained by the property owner, proponent or approval authority

If No, continue to Question 3.

	Yes	No
3. Are there known archaeological sites on or within 300 metres of the property (or the project area)?	☐	☑

	Yes	No
4. Is there Aboriginal or local knowledge of archaeological sites on or within 300 metres of the property (or project area)?	☐	☑

	Yes	No
5. Is there Aboriginal knowledge or historically documented evidence of past Aboriginal use on or within 300 metres of the property (or project area)?	☐	☑

	Yes	No
6. Is there a known burial site or cemetery on the property or adjacent to the property (or project area)?	☐	☑

	Yes	No
7. Has the property (or project area) been recognized for its cultural heritage value?	☐	☑

If Yes to any of the above questions (3 to 7), do **not** complete the checklist. Instead, you need to hire a licensed consultant archaeologist to undertake an archaeological assessment of your property or project area.

If No, continue to question 8.

	Yes	No
8. Has the entire property (or project area) been subjected to recent, extensive and intensive disturbance?	☐	☑

If Yes to the preceding question, do **not** complete the checklist. Instead, please keep and maintain a summary of documentation that provides evidence of the recent disturbance.

An archaeological assessment is not required.

If No, continue to question 9.

	Yes	No
9. Are there present or past water sources within 300 metres of the property (or project area)?	☑	☐

If Yes, an archaeological assessment is required.

If No, continue to question 10.

	Yes	No
10. Is there evidence of two or more of the following on the property (or project area)?	☑	☐

- elevated topography
- pockets of well-drained sandy soil
- distinctive land formations
- resource extraction areas
- early historic settlement
- early historic transportation routes

If Yes, an archaeological assessment is required.

If No, there is low potential for archaeological resources at the property (or project area).

The proponent, property owner and/or approval authority will:

- summarize the conclusion
- add this checklist with the appropriate documentation to the project file

The summary and appropriate documentation may be:

- submitted as part of a report requirement e.g., under the *Environmental Assessment Act, Planning Act* processes
- maintained by the property owner, proponent or approval authority

Ontario

Ministry of Tourism, Culture and Sport

Programs & Services Branch
401 Bay Street, Suite 1700
Toronto ON M7A 0A7

Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes

A Checklist for the Non-Specialist

The **purpose of the checklist** is to determine:

- if a property(ies) or project area:
  - is a recognized heritage property
  - may be of cultural heritage value
- it includes all areas that may be impacted by project activities, including – but not limited to:
  - the main project area
  - temporary storage
  - staging and working areas
  - temporary roads and detours

Processes covered under this checklist, such as:

- *Planning Act*
- *Environmental Assessment Act*
- *Aggregates Resources Act*
- *Ontario Heritage Act* – Standards and Guidelines for Conservation of Provincial Heritage Properties

Cultural Heritage Evaluation Report (CHER)

If you are not sure how to answer one or more of the questions on the checklist, you may want to hire a qualified person(s) (see page 5 for definitions) to undertake a cultural heritage evaluation report (CHER).

The CHER will help you:

- identify, evaluate and protect cultural heritage resources on your property or project area
- reduce potential delays and risks to a project

Other checklists

Please use a separate checklist for your project, if:

- you are seeking a Renewable Energy Approval under Ontario Regulation 359/09 – separate checklist
- your Parent Class EA document has an approved screening criteria (as referenced in Question 1)

Please refer to the Instructions pages for more detailed information and when completing this form.

Project or Property Name

STormwater Master Plan for Petrolia Southeast Development Area

Project or Property Location (upper and lower or single tier municipality)

County of Lambton, Town of Petrolia

Proponent Name

Town of Petrolia

Proponent Contact Information

Mike Thompson, Director of Operations - Town of Petrolia

Screening Questions

	Yes	No
1. Is there a pre-approved screening checklist, methodology or process in place?	☐	☑

If Yes, please follow the pre-approved screening checklist, methodology or process.

If No, continue to Question 2.

Part A: Screening for known (or recognized) Cultural Heritage Value

	Yes	No
2. Has the property (or project area) been evaluated before and found **not** to be of cultural heritage value?	☐	☑

If Yes, do **not** complete the rest of the checklist.

The proponent, property owner and/or approval authority will:

- summarize the previous evaluation and
- add this checklist to the project file, with the appropriate documents that demonstrate a cultural heritage evaluation was undertaken

The summary and appropriate documentation may be:

- submitted as part of a report requirement
- maintained by the property owner, proponent or approval authority

If No, continue to Question 3.

	Yes	No
3. Is the property (or project area):		
a. identified, designated or otherwise protected under the *Ontario Heritage Act* as being of cultural heritage value?	☐	☑
b. a National Historic Site (or part of)?	☐	☑
c. designated under the *Heritage Railway Stations Protection Act*?	☐	☑
d. designated under the *Heritage Lighthouse Protection Act*?	☐	☑
e. identified as a Federal Heritage Building by the Federal Heritage Buildings Review Office (FHBRO)?	☐	☑
f. located within a United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Site?	☐	☑

If Yes to any of the above questions, you need to hire a qualified person(s) to undertake:

- a Cultural Heritage Evaluation Report, if a Statement of Cultural Heritage Value has not previously been prepared or the statement needs to be updated

If a Statement of Cultural Heritage Value has been prepared previously and if alterations or development are proposed, you need to hire a qualified person(s) to undertake:

- a Heritage Impact Assessment (HIA) – the report will assess and avoid, eliminate or mitigate impacts

If No, continue to Question 4.

Part B: Screening for Potential Cultural Heritage Value

	Yes	No
4. Does the property (or project area) contain a parcel of land that:		
a. is the subject of a municipal, provincial or federal commemorative or interpretive plaque?	☐	☑
b. has or is adjacent to a known burial site and/or cemetery?	☐	☑
c. is in a Canadian Heritage River watershed?	☐	☑
d. contains buildings or structures that are 40 or more years old?	☐	☑

Part C: Other Considerations

	Yes	No
5. Is there local or Aboriginal knowledge or accessible documentation suggesting that the property (or project area):		
a. is considered a landmark in the local community or contains any structures or sites that are important in defining the character of the area?	☐	☑
b. has a special association with a community, person or historical event?	☐	☑
c. contains or is part of a cultural heritage landscape?	☐	☑

If Yes to one or more of the above questions (Part B and C), there is potential for cultural heritage resources on the property or within the project area.

You need to hire a qualified person(s) to undertake:

- a Cultural Heritage Evaluation Report (CHER)

If the property is determined to be of cultural heritage value and alterations or development is proposed, you need to hire a qualified person(s) to undertake:

- a Heritage Impact Assessment (HIA) – the report will assess and avoid, eliminate or mitigate impacts

If No to all of the above questions, there is low potential for built heritage or cultural heritage landscape on the property.

The proponent, property owner and/or approval authority will:

- summarize the conclusion
- add this checklist with the appropriate documentation to the project file

The summary and appropriate documentation may be:

- submitted as part of a report requirement e.g. under the *Environmental Assessment Act, Planning Act* processes
- maintained by the property owner, proponent or approval authority

Instructions

Please have the following available, when requesting information related to the screening questions below:

- a clear map showing the location and boundary of the property or project area
  - large scale and small scale showing nearby township names for context purposes
- the municipal addresses of all properties within the project area
- the lot(s), concession(s), and parcel number(s) of all properties within a project area

For more information, see the Ministry of Tourism, Culture and Sport's Ontario Heritage Toolkit or Standards and Guidelines for Conservation of Provincial Heritage Properties.

In this context, the following definitions apply:

- **qualified person(s)** means individuals – professional engineers, architects, archaeologists, etc. – having relevant, recent experience in the conservation of cultural heritage resources.
- **proponent** means a person, agency, group or organization that carries out or proposes to carry out an undertaking or is the owner or person having charge, management or control of an undertaking.

1. Is there a pre-approved screening checklist, methodology or process in place?

An existing checklist, methodology or process may already be in place for identifying potential cultural heritage resources, including:

- one endorsed by a municipality
- an environmental assessment process e.g. screening checklist for municipal bridges
- one that is approved by the Ministry of Tourism, Culture and Sport (MTCS) under the Ontario government's Standards & Guidelines for Conservation of Provincial Heritage Properties [s.B.2.]

Part A: Screening for known (or recognized) Cultural Heritage Value

2. Has the property (or project area) been evaluated before and found not to be of cultural heritage value?

Respond 'yes' to this question, if all of the following are true:

A property can be considered not to be of cultural heritage value if:

- a Cultural Heritage Evaluation Report (CHER) - or equivalent - has been prepared for the property with the advice of a qualified person and it has been determined not to be of cultural heritage value and/or
- the municipal heritage committee has evaluated the property for its cultural heritage value or interest and determined that the property is not of cultural heritage value or interest

A property may need to be re-evaluated, if:

- there is evidence that its heritage attributes may have changed
- new information is available
- the existing Statement of Cultural Heritage Value does not provide the information necessary to manage the property
- the evaluation took place after 2005 and did not use the criteria in Regulations 9/06 and 10/06

Note: Ontario government ministries and public bodies [prescribed under Regulation 157/10] may continue to use their existing evaluation processes, until the evaluation process required under section B.2 of the Standards & Guidelines for Conservation of Provincial Heritage Properties has been developed and approved by MTCS.

To determine if your property or project area has been evaluated, contact:

- the approval authority
- the proponent
- the Ministry of Tourism, Culture and Sport

3a. Is the property (or project area) identified, designated or otherwise protected under the *Ontario Heritage Act* as being of cultural heritage value e.g.:

i. designated under the *Ontario Heritage Act*

- individual designation (Part IV)
- part of a heritage conservation district (Part V)

Instructions

Please have the following available, when requesting information related to the screening questions below:

- a clear map showing the location and boundary of the property or project area
  - large scale and small scale showing nearby township names for context purposes
- the municipal addresses of all properties within the project area
- the lot(s), concession(s), and parcel number(s) of all properties within a project area

In this context, the following definitions apply:

- **consultant archaeologist** means, as defined in Ontario regulation as an archaeologist who enters into an agreement with a client to carry out or supervise archaeological fieldwork on behalf of the client, produce reports for or on behalf of the client and provide technical advice to the client. In Ontario, these people also are required to hold a valid professional archaeological licence issued by the Ministry of Tourism, Culture and Sport.
- **proponent** means a person, agency, group or organization that carries out or proposes to carry out an undertaking or is the owner or person having charge, management or control of an undertaking.

1. Is there a pre-approved screening checklist, methodology or process in place?

An existing checklist, methodology or process may be already in place for identifying archaeological potential, including:

- one prepared and adopted by the municipality e.g., archaeological management plan
- an environmental assessment process e.g., screening checklist for municipal bridges
- one that is approved by the Ministry of Tourism, Culture and Sport under the Ontario government's Standards & Guidelines for Conservation of Provincial Heritage Properties [s. B.2.]

2. Has an archaeological assessment been prepared for the property (or project area) and been accepted by MTCS?

Respond 'yes' to this question, if all of the following are true:

- an archaeological assessment report has been prepared and is in compliance with MTCS requirements
  - a letter has been sent by MTCS to the licensed archaeologist confirming that MTCS has added the report to the Ontario Public Register of Archaeological Reports (Register)
- the report states that there are no concerns regarding impacts to archaeological sites

Otherwise, if an assessment has been completed and deemed compliant by the MTCS, and the ministry recommends further archaeological assessment work, this work will need to be completed.

For more information about archaeological assessments, contact:

- approval authority
- proponent
- consultant archaeologist
- Ministry of Tourism, Culture and Sport at archaeology@ontario.ca

3. Are there known archaeological sites on or within 300 metres of the property (or project area)?

MTCS maintains a database of archaeological sites reported to the ministry.

For more information, contact MTCS Archaeological Data Coordinator at archaeology@ontario.ca.

4. Is there Aboriginal or local knowledge of archaeological sites on or within 300 metres of the property?

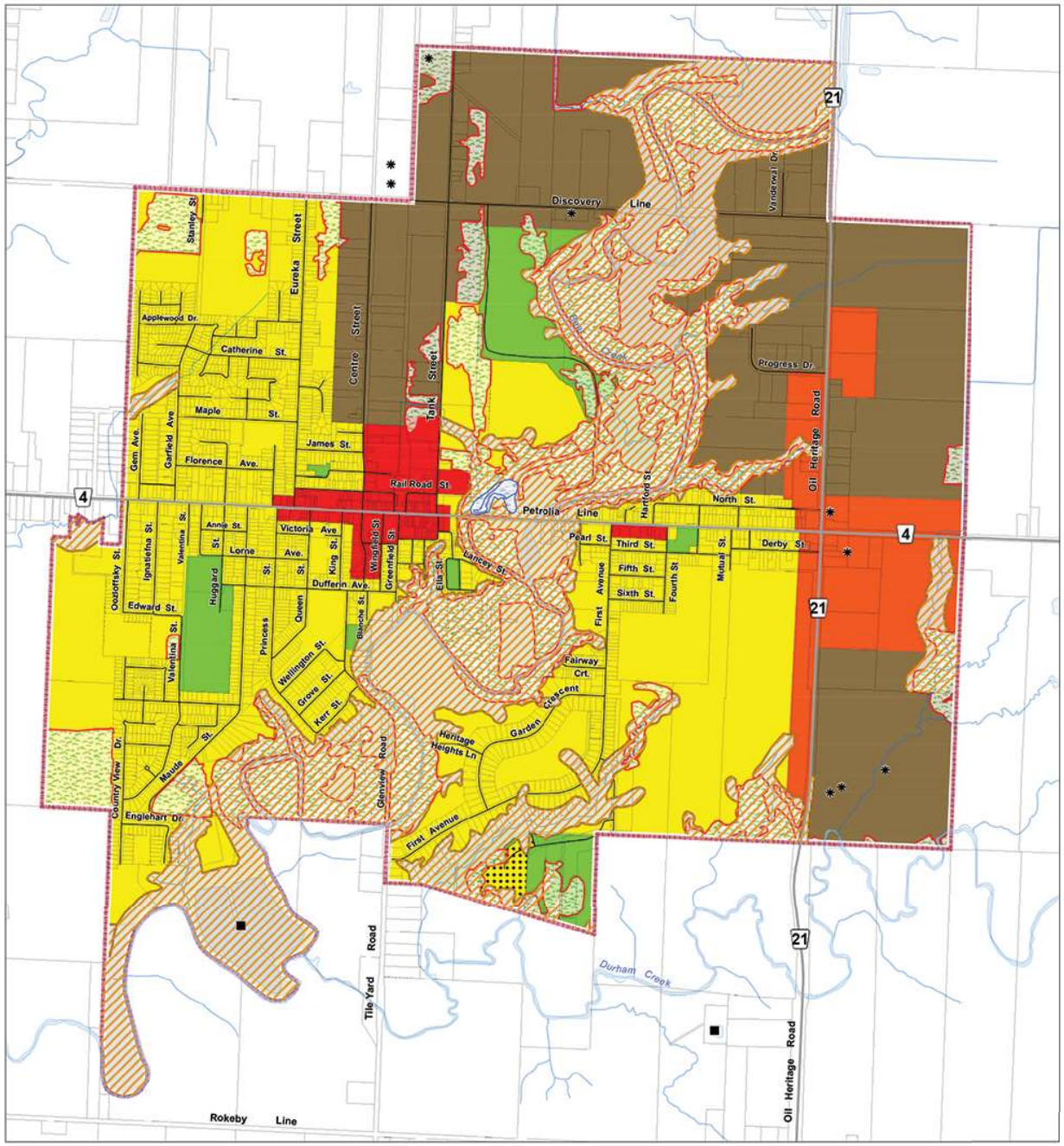
Check with:

- Aboriginal communities in your area
- local municipal staff

They may have information about archaeological sites that are not included in MTCS' database.

Other sources of local knowledge may include:

- property owner
- local heritage organizations and historical societies
- local museums
- municipal heritage committee
- published local histories



Town of Petrolia
OFFICIAL PLAN
SCHEDULE "A"

LEGEND

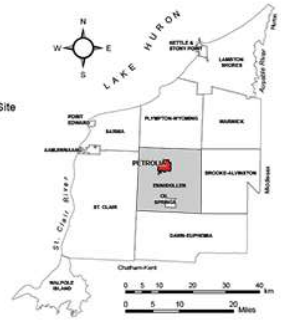
- Assessment Parcels
- Rivers - Streams - Drainage
- Roads
- County Roads
- Municipal Boundary
- Waterbodies
- Sewage Treatment Works
- Active or Former Waste Disposal Site (Anderson Dataset : Lambton GWS 2004)

Official Plan - Designations

- Residential
- Residential Special Policy Area
- General Commercial
- Highway Commercial
- Industrial
- Major Open Space

Hazard and Environmental Protection

- Wetland (MNR - OWES)
- Hazard (SCRCA)
- Significant Woodlot (LCNHS)



Reference

Disclaimer: These digital mapping products have been produced on the County of Lambton's Geographic Information System. Data provided herein is derived from sources with varying levels of accuracy and currency. This is not a survey product. The County of Lambton disclaims all responsibility for the accuracy or completeness of information contained herein. The County of Lambton assumes no responsibility for errors arising from use of these digital mapping products.

The Official Plan information contained herein is current as of the last recorded amendment noted under "Official Plan Amendments".

- Cadastral database is current to January 2015.
- Wetlands database is current to June 2014 (MNR)
- General Regulation and Hazard Areas are determined by local Conservation Authorities and are Subject to Change (Dec 2013).

Projection: UTM NAD 83 Zone 17

COUNTY OF LAMBTON
Planning and Development Services, February 8, 2016.

www.lambtononline.ca

Area Estimator

Notes: Area measures shown at left are typical of Concession/Lot arrangements in the Town of Petrolia.

Acre area measures can be converted to hectares (ha) by dividing by (2.471).

N
W E
S

0 125 250 500 Metres

0 250 500 1,000 Feet

TOWN OF PETROLIA
INCORPORATED 1874

Town of
Petrolia
OFFICIAL PLAN
SCHEDULE "A"

to By-law No. 13 of 2016

Passed this 8 day of February ,2016

John McCharles, Mayor

Manny Baron, CAO/Clerk

Official Plan Amendments

OPA# xx, xxxxxx xx, 20xx

APPENDIX D

Stormwater Calculations and Model Summary

PCSWMM Model Assumptions

The model and its hydrologic parameters were established based on the following:

- GIS Storm Inventory database and GSP Survey Information
- Provincial DTM topographical dataset.
- Rainfall data from the Environment Canada Mount Sarnia Climate Station, 2019 Rainfall Intensity Duration Frequency Values
    - 2 and 100-year 3-hour Chicago rainfall distribution
- Catchments:
    - Limits (areas) determined using GIS processing tools to automatically delineate watersheds based on the provincial DTM, road network and storm sewer layout
    - Catchment overland flow length for urban areas set to 50 m. For large undeveloped areas, flow lengths were determined using a weighted average of GIS measured flow lengths.
    - Catchment width calculated by dividing the catchment area by the assigned flow length.
    - Overland flow slope derived by using GIS processing tools to calculate average slopes based on the provincial DTM for each catchment area.
    - Percent impervious values derived using GIS processing tools based on land use values (assumed to be directly connected impervious). A land use shape file was established based on 2015 SWOOP aerial imagery, parcel fabric, and Official Plan mapping files.
    - Impervious Manning n = 0.015
    - Pervious Manning n = 0.250
    - Impervious Initial abstraction = 2 mm
    - Pervious Initial abstraction = 5 mm
    - Weighted Soil Curve Numbers (CN) were calculated based on land use and surficial soil types. Surficial soil types were established based on GIS dataset of the Soils of Lambton County, Ontario, Soil Survey Report No. 22.
- Assumed existing sewers and culverts are being maintained and kept in good working condition.
- Generally, tile drains and CB laterals, were not included in the model. The model is a skeleton of sections of main storm sewers.
- Number of catch basin inlets were added to adjacent model junctions, as applicable. Catch basin inlet capacity based on Ministry of Transportation (MTO) Drainage Manual Design Charts (Marsalek, 1982) and research conducted by Townsend, Wisner, and Moss (1980), obtained from the City of Toronto Infoworks CS Basement Flooding Model Studies Guidelines (Draft, 2014). It is noted that a range of catch basin types are found in the study area. A standard catchbasin was assumed for the purposes of modelling.
- Except for the identified future development area, the model assumes catchment boundaries will not be altered.
- Existing sewers assumed to be smooth interior wall piping, unless otherwise known (i.e. Manning's n=0.013).
- Road links used for major system routing included a full transect cross-sections with curb (0.15 m), rollover curb (0.10 m) and no curb as applicable to each road segment. Road and boulevard cross slopes assumed at 2%. Manning's n = 0.015 for road width, and 0.03 for grassed boulevard.
- Generally, capacities of ditches and culverts were not evaluated. This was considered to be beyond the scope of this study. Ditches and culverts included in the model are for hydrologic routing purposes.

Petrolia SE - Existing Development Catchment Input Summary

Existing Conditions											
Catchment Number	Area	TIMP	Routed	CN[1]	Length	Width	Slope	Pervious		Impervious	
								IA	Manning's n	IA	Manning's n
	(ha)	(%)	(%)		m	m	(%)	(mm)		(mm)	
S199	0.61	51	14	79	50	122	3.5	5	0.250	2	0.015
S200	0.40	44	16	81	50	80	2.5	5	0.250	2	0.015
S201	0.55	62	9	79	50	110	5.3	5	0.250	2	0.015
S202	0.32	76	2	79	50	64	8.1	5	0.250	2	0.015
S204	0.65	55	12	84	50	130	0.9	5	0.250	2	0.015
S205	0.50	56	20	79	50	100	1.8	5	0.250	2	0.015
S206	1.72	44	18	84	50	344	1.3	5	0.250	2	0.015
S207	0.69	54	13	79	50	138	1.3	5	0.250	2	0.015
S208	1.00	46	18	79	50	200	3.1	5	0.250	2	0.015
S209	0.77	48	17	79	50	154	2.2	5	0.250	2	0.015
S210	0.17	62	10	79	50	34	1.3	5	0.250	2	0.015
S211	0.77	50	12	80	50	154	0.8	5	0.250	2	0.015
S212	0.48	52	14	79	50	96	1.4	5	0.250	2	0.015
S213	1.30	46	17	83	50	260	1.1	5	0.250	2	0.015
S214	0.23	68	8	84	50	46	1.7	5	0.250	2	0.015
S215	0.45	64	7	84	50	90	1.7	5	0.250	2	0.015
S216	0.43	28	29	81	50	86	2.2	5	0.250	2	0.015
S217	0.76	48	16	79	50	152	2.1	5	0.250	2	0.015
S218	0.33	23	32	79	50	66	9.1	5	0.250	2	0.015
S219	0.78	5	100	79	50	156	6.6	5	0.250	2	0.015
S220	6.67	5	100	80	91	735	0.3	5	0.250	2	0.015
S221	3.81	17	37	81	93	410	1.2	5	0.250	2	0.015
S222	2.38	5	100	76	75	317	0.6	5	0.250	2	0.015
S223	6.48	27	15	72	68	946	5.1	5	0.250	2	0.015
S226	1.03	45	20	79	50	206	6.3	5	0.250	2	0.015
S227	0.83	54	21	79	50	166	1.1	5	0.250	2	0.015
S228	0.88	52	19	79	50	176	1.2	5	0.250	2	0.015
S230	0.32	58	10	79	50	64	8.7	5	0.250	2	0.015
S231	0.10	81	3	84	50	20	1.0	5	0.250	2	0.015
S232	1.52	48	17	79	50	304	2.7	5	0.250	2	0.015
S233	1.34	32	16	79	50	268	1.0	5	0.250	2	0.015
S234	1.16	53	14	79	50	232	1.7	5	0.250	2	0.015
S235	0.81	43	17	79	50	162	1.4	5	0.250	2	0.015
S236	0.26	70	21	84	50	52	1.3	5	0.250	2	0.015
S237	0.91	55	12	79	50	182	1.2	5	0.250	2	0.015
S238	0.74	68	22	84	50	148	0.8	5	0.250	2	0.015
S239	0.74	50	16	84	50	148	1.4	5	0.250	2	0.015
S240	1.10	54	13	84	50	220	1.7	5	0.250	2	0.015
S241	0.47	54	12	83	50	94	2.1	5	0.250	2	0.015
S242	1.15	60	18	84	50	230	1.4	5	0.250	2	0.015
S243	1.27	51	14	84	50	254	1.6	5	0.250	2	0.015
S244	0.38	68	9	80	50	76	1.9	5	0.250	2	0.015
S245	0.96	46	15	83	50	192	1.4	5	0.250	2	0.015
S246	0.41	62	10	84	50	82	1.1	5	0.250	2	0.015
S247	1.41	63	24	80	50	282	1.3	5	0.250	2	0.015
S248	0.78	50	16	79	50	156	1.3	5	0.250	2	0.015
S249	0.21	66	9	79	50	42	0.3	5	0.250	2	0.015
S250	1.39	46	19	79	50	278	1.7	5	0.250	2	0.015
S252	4.47	8	68	80	71	631	0.6	5	0.250	2	0.015
S254	1.53	52	19	79	50	306	1.3	5	0.250	2	0.015
S255	0.45	54	13	84	50	90	1.7	5	0.250	2	0.015
S256	1.43	68	15	79	50	286	1.3	5	0.250	2	0.015
S257	1.56	64	31	79	50	312	7.4	5	0.250	2	0.015
S258	1.08	63	11	83	50	216	7.1	5	0.250	2	0.015
S259	0.31	14	42	84	50	62	5.9	5	0.250	2	0.015

S260	1.01	40	12	79	50	202	2.0	5	0.250	2	0.015
S261	2.13	47	11	79	50	426	2.6	5	0.250	2	0.015
S262	1.07	56	11	83	50	214	2.0	5	0.250	2	0.015
S263	2.46	55	11	84	50	492	2.2	5	0.250	2	0.015
S264	3.64	10	57	82	50	728	1.8	5	0.250	2	0.015
S265	1.15	30	29	79	50	230	2.0	5	0.250	2	0.015
S266	4.92	21	35	82	50	984	1.8	5	0.250	2	0.015
S267	1.15	31	28	79	50	230	1.8	5	0.250	2	0.015
S268	1.67	51	13	84	50	334	1.8	5	0.250	2	0.015
S269	0.87	36	22	79	50	174	1.3	5	0.250	2	0.015
S270	1.44	56	11	81	50	288	2.2	5	0.250	2	0.015
S271	1.39	24	32	84	50	278	2.1	5	0.250	2	0.015
S272	1.21	51	10	79	50	242	2.5	5	0.250	2	0.015
S273	1.50	40	16	79	50	300	3.4	5	0.250	2	0.015
S275	3.74	17	36	80	103	363	1.1	5	0.250	2	0.015
S276	9.38	6	84	81	108	869	0.5	5	0.250	2	0.015
S278	0.63	35	25	79	50	126	3.0	5	0.250	2	0.015
S279	0.69	42	12	79	50	138	2.5	5	0.250	2	0.015
S282	0.93	39	13	79	50	186	1.7	5	0.250	2	0.015
S283	21.23	6	91	80	108	1970	0.4	5	0.250	2	0.015
S285	2.50	5	100	70	59	426	6.0	5	0.250	2	0.015
S286	8.60	5	100	78	116	743	0.9	5	0.250	2	0.015
S287	10.96	5	100	75	88	1249	0.7	5	0.250	2	0.015
S288	1.94	5	100	75	57	338	8.5	5	0.250	2	0.015
S289	6.94	5	100	76	74	937	7.2	5	0.250	2	0.015
S290	11.25	7	78	76	119	948	2.3	5	0.250	2	0.015
S291	8.59	8	65	80	86	996	1.6	5	0.250	2	0.015
S293	3.63	5	100	70	39	926	7.4	5	0.250	2	0.015
S294	3.49	22	18	73	70	502	6.0	5	0.250	2	0.015
S295	1.26	40	22	84	50	252	3.2	5	0.250	2	0.015
S296	0.50	48	21	84	50	100	5.2	5	0.250	2	0.015
S297	9.52	5	97	77	70	1363	4.9	5	0.250	2	0.015

Petrolia SE - Proposed Developement Catchment Input Summary

Proposed Conditions												
Catchment Number	Area	TIMP	Routed	CN[1]	Length	Width	Slope	Pervious		Impervious		
								IA	Manning's n	IA	Manning's n	
	(ha)	(%)	(%)		m	m	(%)	(mm)		(mm)		
P101	17.21	55	18	80	50	3442	0.8	5	0.250	2	0.015	
P102	4.14	55	18	80	50	828	0.5	5	0.250	2	0.015	
P103	20.33	56	21	80	50	4066	0.4	5	0.250	2	0.015	
P104	10.13	52	19	80	50	2026	1.5	5	0.250	2	0.015	
P105	3.92	55	18	80	50	784	0.4	5	0.250	2	0.015	
P106	14.67	55	18	78	50	2934	0.7	5	0.250	2	0.015	
P107	10.50	55	18	75	50	2100	0.7	5	0.250	2	0.015	
P108	2.68	54	18	74	50	536	2.4	5	0.250	2	0.015	
P109	5.63	20	24	78	50	1126	2.4	5	0.250	2	0.015	
P110	3.00	26	15	73	50	600	6.8	5	0.250	2	0.015	
P111	2.68	8	66	70	50	536	5.3	5	0.250	2	0.015	
P112	2.18	55	18	70	50	436	2.4	5	0.250	2	0.015	
P113	5.32	32	12	70	50	1064	5.1	5	0.250	2	0.015	
P114	5.53	55	18	79	50	1106	2.0	5	0.250	2	0.015	
S199	0.61	52	14	79	50	122	3.5	5	0.250	2	0.015	
S200	0.40	49	16	81	50	80	2.5	5	0.250	2	0.015	
S201	0.55	62	9	79	50	110	5.3	5	0.250	2	0.015	
S202	0.32	76	2	79	50	64	8.1	5	0.250	2	0.015	
S204	0.65	55	12	84	50	130	0.9	5	0.250	2	0.015	
S205	0.50	56	20	79	50	100	1.8	5	0.250	2	0.015	
S206	1.72	52	18	84	50	344	1.3	5	0.250	2	0.015	
S207	0.69	54	13	79	50	138	1.3	5	0.250	2	0.015	
S208	1.00	46	18	79	50	200	3.1	5	0.250	2	0.015	
S209	0.77	48	17	79	50	154	2.2	5	0.250	2	0.015	
S210	0.17	62	10	79	50	34	1.3	5	0.250	2	0.015	
S211	0.77	50	12	80	50	154	0.8	5	0.250	2	0.015	
S212	0.48	52	14	79	50	96	1.4	5	0.250	2	0.015	
S213	1.30	50	16	83	50	260	1.1	5	0.250	2	0.015	
S214	0.23	68	8	84	50	46	1.7	5	0.250	2	0.015	
S215	0.45	64	7	84	50	90	1.7	5	0.250	2	0.015	
S216	0.43	28	29	81	50	86	2.2	5	0.250	2	0.015	
S217	0.76	57	10	79	50	152	2.1	5	0.250	2	0.015	
S218	0.33	23	32	79	50	66	9.1	5	0.250	2	0.015	
S219	0.78	5	100	79	50	156	6.6	5	0.250	2	0.015	
S226	1.03	45	20	79	50	206	6.3	5	0.250	2	0.015	
S227	0.83	54	20	79	50	166	1.1	5	0.250	2	0.015	
S228	0.88	52	19	79	50	176	1.2	5	0.250	2	0.015	
S230	0.32	58	10	79	50	64	8.7	5	0.250	2	0.015	
S231	0.10	82	3	84	50	20	1.0	5	0.250	2	0.015	
S232	1.52	48	17	79	50	304	2.7	5	0.250	2	0.015	
S233	1.34	32	16	79	50	268	1.0	5	0.250	2	0.015	
S234	1.16	53	14	79	50	232	1.7	5	0.250	2	0.015	
S235	0.81	48	17	79	50	162	1.4	5	0.250	2	0.015	
S236	0.26	70	21	84	50	52	1.3	5	0.250	2	0.015	
S237	0.91	55	12	79	50	182	1.2	5	0.250	2	0.015	
S238	0.74	68	22	84	50	148	0.8	5	0.250	2	0.015	
S239	0.74	50	16	84	50	148	1.4	5	0.250	2	0.015	
S240	1.10	54	13	84	50	220	1.7	5	0.250	2	0.015	
S241	0.47	56	12	83	50	94	2.1	5	0.250	2	0.015	
S242	1.15	60	18	84	50	230	1.4	5	0.250	2	0.015	
S243	1.27	53	14	84	50	254	1.6	5	0.250	2	0.015	
S244	0.38	68	9	80	50	76	1.9	5	0.250	2	0.015	
S245	0.96	55	15	83	50	192	1.4	5	0.250	2	0.015	
S246	0.41	64	10	84	50	82	1.1	5	0.250	2	0.015	
S247	1.41	63	24	80	50	282	1.3	5	0.250	2	0.015	

S248	0.78	50	16	79	50	156	1.3	5	0.250	2	0.015
S249	0.21	66	9	79	50	42	0.3	5	0.250	2	0.015
S250	1.39	46	19	79	50	278	1.7	5	0.250	2	0.015
S254	1.53	52	19	79	50	306	1.3	5	0.250	2	0.015
S255	0.45	54	13	84	50	90	1.7	5	0.250	2	0.015
S256	1.43	68	15	79	50	286	1.3	5	0.250	2	0.015
S257	1.56	64	31	79	50	312	7.4	5	0.250	2	0.015
S258	1.08	63	11	83	50	216	7.1	5	0.250	2	0.015
S259	0.31	21	35	84	50	62	5.9	5	0.250	2	0.015
S260	1.01	40	12	79	50	202	2.0	5	0.250	2	0.015
S261	2.13	47	11	79	50	426	2.6	5	0.250	2	0.015
S262	1.07	57	11	83	50	214	2.0	5	0.250	2	0.015
S263	2.46	56	11	84	50	492	2.2	5	0.250	2	0.015
S264	3.64	10	57	82	50	728	1.8	5	0.250	2	0.015
S265	1.15	30	29	79	50	230	2.0	5	0.250	2	0.015
S266	4.92	21	35	82	50	984	1.8	5	0.250	2	0.015
S267	1.15	31	28	79	50	230	1.8	5	0.250	2	0.015
S268	1.67	52	13	84	50	334	1.8	5	0.250	2	0.015
S269	0.87	36	22	79	50	174	1.3	5	0.250	2	0.015
S270	1.44	56	11	81	50	288	2.2	5	0.250	2	0.015
S271	1.39	25	32	84	50	278	2.1	5	0.250	2	0.015
S272	1.21	51	10	79	50	242	2.5	5	0.250	2	0.015
S273	1.50	40	16	79	50	300	3.4	5	0.250	2	0.015
S278	0.63	35	25	79	50	126	3.0	5	0.250	2	0.015
S279	0.69	42	12	79	50	138	2.5	5	0.250	2	0.015
S282	0.93	39	13	79	50	186	1.7	5	0.250	2	0.015
S288	1.94	7	75	75	57	338	8.5	5	0.250	2	0.015
S289	6.94	5	100	76	74	937	7.2	5	0.250	2	0.015
S293	3.63	6	88	70	39	926	7.4	5	0.250	2	0.015
S295	1.26	45	22	84	50	252	3.2	5	0.250	2	0.015
S296	0.50	48	21	84	50	100	5.2	5	0.250	2	0.015
S297	9.52	5	97	77	70	1363	4.9	5	0.250	2	0.015

SE Petrolia - Existing Land Use

Existing Conditions - Land Use														
Catchment Number	Total Area	Agriculture	Open Space	Water	Wooded	Estate Residential	Low Residential	Medium Residential	Commercial	Institutional	ROW	Net % XImp	Net % TImp	%Routed
	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)			
TIMP		0.05	0.05	1.00	0.05	0.15	0.40	0.55	0.65	0.65	0.85			
XIMP		0.00	0.00	1.00	0.00	0.10	0.30	0.45	0.45	0.45	0.85			
S199	0.61	0.00	0.02	0.00	0.00	0.00	0.39	0.04	0.00	0.00	0.16	44	51	14
S200	0.40	0.00	0.05	0.00	0.00	0.00	0.26	0.00	0.00	0.00	0.08	37	44	16
S201	0.55	0.00	0.00	0.00	0.00	0.00	0.29	0.00	0.00	0.00	0.26	56	62	9
S202	0.32	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.26	75	76	2
S204	0.65	0.00	0.00	0.00	0.00	0.00	0.42	0.00	0.00	0.00	0.23	49	55	12
S205	0.50	0.00	0.00	0.00	0.00	0.00	0.27	0.00	0.14	0.00	0.09	45	56	20
S206	1.72	0.00	0.43	0.00	0.00	0.00	0.71	0.00	0.22	0.00	0.36	36	44	18
S207	0.69	0.00	0.00	0.00	0.00	0.00	0.48	0.00	0.00	0.00	0.21	47	54	13
S208	1.00	0.00	0.00	0.00	0.00	0.00	0.85	0.00	0.00	0.00	0.14	38	46	18
S209	0.77	0.00	0.00	0.00	0.00	0.00	0.63	0.00	0.00	0.00	0.15	40	48	17
S210	0.17	0.00	0.00	0.00	0.00	0.00	0.04	0.07	0.00	0.00	0.06	56	62	10
S211	0.77	0.00	0.19	0.00	0.00	0.00	0.12	0.23	0.00	0.00	0.23	44	50	12
S212	0.48	0.00	0.00	0.00	0.00	0.00	0.36	0.00	0.00	0.00	0.13	45	52	14
S213	1.30	0.10	0.00	0.00	0.00	0.00	0.95	0.00	0.00	0.00	0.25	39	46	17
S214	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.10	62	68	8
S215	0.45	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.00	0.24	60	64	7
S216	0.43	0.00	0.17	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.01	20	28	29
S217	0.76	0.01	0.01	0.00	0.00	0.00	0.57	0.00	0.00	0.00	0.16	41	48	16
S218	0.33	0.00	0.15	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00	16	23	32
S219	0.78	0.00	0.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	5	100
S220	6.67	6.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	5	100
S221	3.81	2.70	0.04	0.00	0.00	0.00	0.74	0.25	0.00	0.00	0.08	10	17	37
S222	2.38	2.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	5	100
S223	6.48	0.00	2.87	1.30	0.54	1.79	0.02	0.00	0.00	0.00	0.00	23	27	15
S226	1.03	0.00	0.00	0.00	0.00	0.00	0.93	0.00	0.00	0.00	0.10	36	45	20
S227	0.83	0.00	0.08	0.00	0.00	0.00	0.29	0.00	0.29	0.00	0.16	43	54	21
S228	0.88	0.00	0.00	0.00	0.00	0.00	0.59	0.00	0.13	0.00	0.16	42	52	19
S230	0.32	0.00	0.00	0.00	0.00	0.00	0.19	0.00	0.00	0.00	0.13	52	58	10
S231	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.09	79	81	3
S232	1.52	0.00	0.00	0.00	0.00	0.00	1.27	0.00	0.00	0.00	0.26	39	48	17
S233	1.34	0.00	0.70	0.00	0.00	0.00	0.34	0.00	0.00	0.00	0.30	27	32	16
S234	1.16	0.00	0.00	0.00	0.00	0.00	0.84	0.00	0.00	0.00	0.32	45	53	14
S235	0.81	0.00	0.13	0.00	0.00	0.00	0.54	0.00	0.00	0.00	0.15	35	43	17
S236	0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.00	0.07	55	70	21
S237	0.91	0.00	0.01	0.00	0.00	0.00	0.59	0.00	0.00	0.00	0.32	49	55	12
S238	0.74	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.54	0.00	0.16	52	68	22
S239	0.74	0.00	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.00	0.16	42	50	16
S240	1.10	0.00	0.00	0.00	0.00	0.00	0.77	0.00	0.00	0.00	0.33	47	54	13
S241	0.47	0.00	0.03	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.17	48	54	12
S242	1.15	0.00	0.01	0.00	0.00	0.00	0.45	0.00	0.39	0.00	0.30	49	60	18
S243	1.27	0.01	0.04	0.00	0.00	0.00	0.87	0.00	0.00	0.00	0.36	44	51	14
S244	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.00	0.00	0.16	62	68	9
S245	0.96	0.00	0.25	0.00	0.00	0.00	0.12	0.39	0.00	0.00	0.19	39	46	15
S246	0.41	0.00	0.02	0.00	0.00	0.00	0.05	0.20	0.00	0.00	0.15	56	62	10
S247	1.41	0.00	0.00	0.00	0.00	0.00	0.23	0.07	0.00	0.91	0.21	48	63	24
S248	0.78	0.00	0.00	0.00	0.00	0.00	0.61	0.00	0.00	0.00	0.17	42	50	16
S249	0.21	0.00	0.00	0.00	0.00	0.00	0.04	0.08	0.00	0.00	0.09	60	66	9
S250	1.39	0.00	0.00	0.00	0.00	0.00	1.20	0.00	0.00	0.00	0.19	37	46	19
S252	4.47	4.24	0.00	0.00	0.00	0.00	0.00	0.23	0.00	0.00	0.01	2	8	68
S254	1.53	0.00	0.00	0.00	0.00	0.00	0.75	0.47	0.00	0.15	0.16	42	52	19
S255	0.45	0.00	0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.14	47	54	13
S256	1.43	0.00	0.00	0.00	0.00	0.00	0.25	0.03	0.62	0.00	0.54	58	68	15
S257	1.56	0.00	0.00	0.00	0.01	0.00	0.03	0.00	0.00	1.53	0.00	45	64	31
S258	1.08	0.00	0.00	0.00	0.01	0.00	0.06	0.66	0.00	0.00	0.35	56	63	11
S259	0.31	0.00	0.16	0.00	0.01	0.09	0.05	0.00	0.00	0.00	0.00	8	14	42
S260	1.01	0.00	0.00	0.00	0.00	0.49	0.24	0.00	0.00	0.00	0.28	35	40	12
S261	2.13	0.00	0.00	0.00	0.00	0.67	0.76	0.00	0.00	0.00	0.70	42	47	11
S262	1.07	0.00	0.00	0.00	0.00	0.00	0.68	0.00	0.00	0.00	0.39	50	56	11
S263	2.46	0.00	0.01	0.00	0.00	0.15	1.41	0.00	0.00	0.00	0.89	49	55	11
S264	3.64	0.00	3.12	0.00	0.00	0.00	0.52	0.00	0.00	0.00	0.00	4	10	57
S265	1.15	0.00	0.33	0.00	0.00	0.00	0.82	0.00	0.00	0.00	0.00	21	30	29
S266	4.92	0.00	2.67	0.00	0.00	0.00	2.25	0.00	0.00	0.00	0.00	14	21	35
S267	1.15	0.00	0.31	0.00	0.00	0.00	0.85	0.00	0.00	0.00	0.00	22	31	28
S268	1.67	0.00	0.10	0.00	0.00	0.00	1.09	0.00	0.00	0.00	0.49	45	51	13
S269	0.87	0.00	0.23	0.00	0.00	0.00	0.52	0.00	0.04	0.00	0.09	28	36	22
S270	1.44	0.00	0.00	0.00	0.00	0.00	0.93	0.00	0.00	0.00	0.52	50	56	11
S271	1.39	0.00	0.61	0.00	0.00	0.00	0.77	0.00	0.00	0.00	0.00	17	24	32
S272	1.21	0.00	0.00	0.00	0.00	0.25	0.52	0.00	0.00	0.00	0.44	46	51	10
S273	1.50	0.00	0.13	0.00	0.00	0.37	0.70	0.00	0.00	0.00	0.30	33	40	16
S275	3.74	2.81	0.00	0.00	0.00	0.00	0.08	0.82	0.00	0.00	0.02	11	17	36
S276	9.38	7.67	1.41	0.00	0.00	0.00	0.29	0.00	0.00	0.00	0.00	1	6	84
S278	0.63	0.00	0.11	0.00	0.00	0.00	0.51	0.00	0.00	0.00	0.02	26	35	25
S279	0.69	0.00	0.00	0.00	0.00	0.29	0.21	0.00	0.00	0.00	0.19	36	42	12
S282	0.93	0.00	0.00	0.00	0.00	0.45	0.24	0.00	0.00	0.00	0.24	34	39	13

S283	21.23	20.37	0.49	0.00	0.00	0.00	0.36	0.00	0.00	0.00	0.00	1	6	91
S285	2.50	0.03	0.00	0.00	2.46	0.00	0.00	0.00	0.00	0.00	0.00	0	5	100
S286	8.60	8.48	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0	5	100
S287	10.96	10.68	0.01	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0	5	100
S288	1.94	0.08	1.10	0.00	0.76	0.00	0.00	0.00	0.00	0.00	0.00	0	5	100
S289	6.94	0.00	4.66	0.00	2.27	0.00	0.00	0.00	0.00	0.00	0.00	0	5	100
S290	11.25	2.23	5.46	0.00	2.94	0.15	0.48	0.00	0.00	0.00	0.00	1	7	78
S291	8.59	1.52	4.76	0.00	1.47	0.00	0.83	0.00	0.00	0.00	0.00	3	8	65
S293	3.63	0.06	0.00	0.00	3.57	0.00	0.00	0.00	0.00	0.00	0.00	0	5	100
S294	3.49	0.52	0.68	0.00	1.54	0.00	0.00	0.00	0.00	0.00	0.76	18	22	18
S295	1.26	0.00	0.00	0.00	0.00	0.24	0.59	0.43	0.00	0.00	0.00	31	40	22
S296	0.50	0.00	0.00	0.00	0.00	0.00	0.23	0.27	0.00	0.00	0.00	38	48	21
S297	9.52	0.00	7.37	0.01	2.13	0.00	0.00	0.00	0.00	0.00	0.00	0	5	97
Totals	194.6	70.5	39.7	1.3	18.1	4.9	35.9	4.6	2.6	2.6	14.4			

SE Petrolia - Proposed Land Use

Proposed Conditions - Land Use														
Catchment Number	Total Area	Agriculture	Open Space	Water	Wooded	Estate Residential	Low Residential	Medium Residential	Commercial	Institutional	ROW	Net % XImp	Net % TImp	%Routed
	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)			
TIMP		0.05	0.05	1.00	0.05	0.15	0.40	0.55	0.65	0.65	0.85			
XIMP		0.00	0.00	1.00	0.00	0.10	0.30	0.45	0.45	0.45	0.85			
P101	17.21	0.00	0.00	0.00	0.00	0.00	0.78	16.33	0.00	0.00	0.10	45	55	18
P102	4.14	0.00	0.00	0.00	0.00	0.00	0.06	4.08	0.00	0.00	0.00	45	55	18
P103	20.33	0.00	0.00	0.00	0.00	0.00	1.96	14.71	3.41	0.00	0.25	44	56	21
P104	10.13	0.00	0.16	0.00	0.07	0.00	1.37	8.47	0.00	0.00	0.07	42	52	19
P105	3.92	0.00	0.00	0.00	0.00	0.00	0.00	3.92	0.00	0.00	0.00	45	55	18
P106	14.67	0.00	0.00	0.00	0.12	0.00	0.00	14.54	0.00	0.00	0.00	45	55	18
P107	10.50	0.00	0.00	0.00	0.08	0.00	0.00	10.41	0.00	0.00	0.00	45	55	18
P108	2.68	0.00	0.04	0.00	0.02	0.00	0.00	2.60	0.00	0.00	0.02	44	54	18
P109	5.63	0.00	3.32	0.00	0.87	0.15	0.48	0.00	0.00	0.00	0.81	15	20	24
P110	3.00	0.00	0.68	0.00	1.53	0.00	0.00	0.02	0.00	0.00	0.76	22	26	15
P111	2.68	0.00	0.00	0.00	2.51	0.00	0.00	0.16	0.00	0.00	0.00	3	8	66
P112	2.18	0.00	0.00	0.00	0.00	0.00	0.00	2.18	0.00	0.00	0.00	45	55	18
P113	5.32	0.00	1.67	1.30	0.54	1.79	0.00	0.00	0.00	0.00	0.03	28	32	12
P114	5.53	0.00	0.00	0.00	0.00	0.00	0.00	5.53	0.00	0.00	0.00	45	55	18
S199	0.61	0.00	0.00	0.00	0.00	0.00	0.41	0.04	0.00	0.00	0.16	45	52	14
S200	0.40	0.00	0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.08	41	49	16
S201	0.55	0.00	0.00	0.00	0.00	0.00	0.29	0.00	0.00	0.00	0.26	56	62	9
S202	0.32	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.26	75	76	2
S204	0.65	0.00	0.00	0.00	0.00	0.00	0.42	0.00	0.00	0.00	0.23	49	55	12
S205	0.50	0.00	0.00	0.00	0.00	0.00	0.27	0.00	0.14	0.00	0.09	45	56	20
S206	1.72	0.00	0.00	0.00	0.00	0.00	1.14	0.00	0.22	0.00	0.36	43	52	18
S207	0.69	0.00	0.00	0.00	0.00	0.00	0.48	0.00	0.00	0.00	0.21	47	54	13
S208	1.00	0.00	0.00	0.00	0.00	0.00	0.85	0.00	0.00	0.00	0.14	38	46	18
S209	0.77	0.00	0.00	0.00	0.00	0.00	0.63	0.00	0.00	0.00	0.15	40	48	17
S210	0.17	0.00	0.00	0.00	0.00	0.00	0.04	0.07	0.00	0.00	0.06	56	62	10
S211	0.77	0.00	0.19	0.00	0.00	0.00	0.12	0.23	0.00	0.00	0.23	44	50	12
S212	0.48	0.00	0.00	0.00	0.00	0.00	0.36	0.00	0.00	0.00	0.13	45	52	14
S213	1.30	0.00	0.00	0.00	0.00	0.00	0.95	0.10	0.00	0.00	0.25	42	50	16
S214	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.10	62	68	8
S215	0.45	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.00	0.24	60	64	7
S216	0.43	0.00	0.17	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.01	20	28	29
S217	0.76	0.00	0.01	0.00	0.00	0.00	0.44	0.00	0.00	0.00	0.30	51	57	10
S218	0.33	0.00	0.15	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00	16	23	32
S219	0.78	0.00	0.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	5	100
S226	1.03	0.00	0.00	0.00	0.00	0.00	0.93	0.00	0.00	0.00	0.10	36	45	20
S227	0.83	0.00	0.08	0.00	0.00	0.00	0.29	0.00	0.29	0.00	0.16	43	54	20
S228	0.88	0.00	0.00	0.00	0.00	0.00	0.59	0.00	0.13	0.00	0.16	42	52	19
S230	0.32	0.00	0.00	0.00	0.00	0.00	0.19	0.00	0.00	0.00	0.13	52	58	10
S231	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.09	79	82	3
S232	1.52	0.00	0.00	0.00	0.00	0.00	1.27	0.00	0.00	0.00	0.26	39	48	17
S233	1.34	0.00	0.70	0.00	0.00	0.00	0.34	0.00	0.00	0.00	0.30	27	32	16
S234	1.16	0.00	0.00	0.00	0.00	0.00	0.84	0.00	0.00	0.00	0.32	45	53	14
S235	0.81	0.00	0.00	0.00	0.00	0.00	0.67	0.00	0.00	0.00	0.15	40	48	17
S236	0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.00	0.07	55	70	21
S237	0.91	0.00	0.01	0.00	0.00	0.00	0.59	0.00	0.00	0.00	0.32	49	55	12
S238	0.74	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.54	0.00	0.16	53	68	22
S239	0.74	0.00	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.00	0.16	42	50	16
S240	1.10	0.00	0.00	0.00	0.00	0.00	0.77	0.00	0.00	0.00	0.33	47	54	13
S241	0.47	0.00	0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.17	50	56	12
S242	1.15	0.00	0.00	0.00	0.00	0.00	0.46	0.00	0.39	0.00	0.30	49	60	18
S243	1.27	0.01	0.00	0.00	0.00	0.00	0.87	0.00	0.00	0.04	0.36	46	53	14
S244	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.00	0.00	0.16	62	68	9
S245	0.96	0.00	0.00	0.00	0.00	0.00	0.37	0.39	0.00	0.00	0.19	47	55	15
S246	0.41	0.00	0.00	0.00	0.00	0.00	0.07	0.20	0.00	0.00	0.15	57	64	10
S247	1.41	0.00	0.00	0.00	0.00	0.00	0.23	0.07	0.00	0.91	0.21	48	63	24
S248	0.78	0.00	0.00	0.00	0.00	0.00	0.61	0.00	0.00	0.00	0.17	42	50	16
S249	0.21	0.00	0.00	0.00	0.00	0.00	0.04	0.08	0.00	0.00	0.09	60	66	9
S250	1.39	0.00	0.00	0.00	0.00	0.00	1.20	0.00	0.00	0.00	0.19	37	46	19
S254	1.53	0.00	0.00	0.00	0.00	0.00	0.75	0.47	0.00	0.15	0.16	42	52	19
S255	0.45	0.00	0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.14	47	54	13
S256	1.43	0.00	0.00	0.00	0.00	0.00	0.25	0.03	0.62	0.00	0.54	58	68	15
S257	1.56	0.00	0.00	0.00	0.01	0.00	0.03	0.00	0.00	1.53	0.00	45	64	31
S258	1.08	0.00	0.00	0.00	0.01	0.00	0.06	0.66	0.00	0.00	0.35	56	63	11
S259	0.31	0.00	0.16	0.00	0.01	0.00	0.14	0.00	0.00	0.00	0.00	14	21	35
S260	1.01	0.00	0.00	0.00	0.00	0.49	0.24	0.00	0.00	0.00	0.28	35	40	12
S261	2.13	0.00	0.00	0.00	0.00	0.67	0.76	0.00	0.00	0.00	0.70	42	47	11
S262	1.07	0.00	0.00	0.00	0.00	0.00	0.68	0.00	0.00	0.00	0.39	50	57	11
S263	2.46	0.00	0.01	0.00	0.00	0.00	1.56	0.00	0.00	0.00	0.89	50	56	11
S264	3.64	0.00	3.12	0.00	0.00	0.00	0.52	0.00	0.00	0.00	0.00	4	10	57
S265	1.15	0.00	0.33	0.00	0.00	0.00	0.82	0.00	0.00	0.00	0.00	21	30	29
S266	4.92	0.00	2.67	0.00	0.00	0.00	2.25	0.00	0.00	0.00	0.00	14	21	35
S267	1.15	0.00	0.31	0.00	0.00	0.00	0.85	0.00	0.00	0.00	0.00	22	31	28
S268	1.67	0.00	0.09	0.00	0.00	0.00	1.09	0.01	0.00	0.00	0.49	45	52	13
S269	0.87	0.00	0.23	0.00	0.00	0.00	0.52	0.00	0.04	0.00	0.09	28	36	22
S270	1.44	0.00	0.00	0.00	0.00	0.00	0.93	0.00	0.00	0.00	0.52	50	56	11
S271	1.39	0.00	0.61	0.00	0.00	0.00	0.78	0.00	0.00	0.00	0.00	17	25	32
S272	1.21	0.00	0.00	0.00	0.00	0.25	0.52	0.00	0.00	0.00	0.44	46	51	10

S273	1.50	0.00	0.13	0.00	0.00	0.37	0.71	0.00	0.00	0.00	0.30	33	40	16
S278	0.63	0.00	0.11	0.00	0.00	0.00	0.51	0.00	0.00	0.00	0.02	26	35	25
S279	0.69	0.00	0.00	0.00	0.00	0.29	0.21	0.00	0.00	0.00	0.19	37	42	12
S282	0.93	0.00	0.00	0.00	0.00	0.45	0.24	0.00	0.00	0.00	0.24	34	39	13
S288	1.94	0.00	1.10	0.00	0.76	0.00	0.00	0.08	0.00	0.00	0.00	2	7	75
S289	6.94	0.00	4.67	0.00	2.28	0.00	0.00	0.00	0.00	0.00	0.00	0	5	100
S293	3.63	0.00	0.00	0.00	3.57	0.00	0.00	0.06	0.00	0.00	0.00	1	6	88
S295	1.26	0.00	0.00	0.00	0.00	0.00	0.82	0.44	0.00	0.00	0.00	35	45	22
S296	0.50	0.00	0.00	0.00	0.00	0.00	0.23	0.27	0.00	0.00	0.00	38	48	21
S297	9.52	0.00	7.37	0.01	2.14	0.00	0.00	0.00	0.00	0.00	0.00	0	5	97
Totals	199.0	0.0	28.9	1.3	14.5	4.5	39.1	86.5	6.0	2.6	15.7			

PCSWMM Input Curves

Existing Condtions - Stage-Storage Curve

Existing Stage-Storage for Existing Online Pond

Elev (m)	Depth (m)	Area (m^2)	Inc. Vol. (m^3)	Vol. (m^3)
198.00	*0.00*	12500	*0*	*0*
198.50	*0.50*	13720	6555	6555
198.75	*0.75*	15500	3653	10208
199.00	*1.00*	19850	4419	14626

Note: Stage-Areas for elevations 198.25 to 199.00 taken from DTM. Below 198.25 extrapolated Stage-Area values.

Existing Stage-Storage for Glenview SWMF

Elev (m)	Depth (m)	Area (m^2)	Inc. Vol. (m^3)	Vol. (m^3)
199.40	0.00	0.36	0	0
200.50	1.10	0.36	0	0
200.75	1.35	148	19	19
201.00	1.60	272	53	71
201.25	1.85	348	78	149
201.50	2.10	448	100	248
201.57	2.17	464	31	280

Proposed Conditions

Proposed Stage-Storage for West Upper Basin SWMF

Elev (m)	Depth (m)	Area (m^2)	Vol. (m^3)	Vol. (m^3)
198.00	0.00	7178	0	0
200.00	2.00	11245	18423	18423

Proposed Stage-Storage for Online Pond Retrofit

Elev (m)	Depth (m)	Area (m^2)	Vol. (m^3)	Vol. (m^3)
197.00	0.00	6157	0	0
197.50	0.50	8496	3663	3663
199.00	2.00	15429	17944	21607

Proposed Stage-Storage for East Basin SWMF

Elev (m)	Depth (m)	Area (m^2)	Vol. (m^3)	Vol. (m^3)
197.50	0.00	5776	0	0
199.50	2.00	9976	15752	15752

Subcatchment Runoff Results Petrolia Existing Condition										
Catchment Number	Outlet ID	Area	TIMP	IMP Area	2 - Year			100 - Year		
					Peak Flow	Cal. Runoff Coef.	Volume	Peak Flow	Cal. Runoff Coef.	Volume
		(ha)	(%)	(ha)	(m^3/s)		(10^6 Ltr)	(m^3/s)		(10^6 Ltr)
S199	OutletH	0.61	51	0.31	0.10	0.55	0.10	0.29	0.70	0.28
S200	OutletJ	0.40	44	0.18	0.05	0.50	0.06	0.16	0.67	0.18
S201	OutletH	0.55	62	0.34	0.11	0.64	0.11	0.33	0.76	0.28
S202	OutletH	0.32	76	0.24	0.09	0.76	0.08	0.23	0.84	0.18
S204	OutletJ	0.65	55	0.36	0.11	0.61	0.12	0.32	0.75	0.32
S205	OutletG	0.50	56	0.28	0.08	0.58	0.09	0.24	0.72	0.24
S206	OutletB	1.72	44	0.76	0.23	0.52	0.28	0.68	0.70	0.79
S207	OutletG	0.69	54	0.37	0.12	0.56	0.12	0.32	0.71	0.32
S208	OutletH	1.00	46	0.46	0.14	0.50	0.16	0.42	0.67	0.44
S209	OutletH	0.77	48	0.37	0.11	0.52	0.12	0.33	0.68	0.34
S210	OutletG	0.17	62	0.11	0.03	0.63	0.03	0.09	0.76	0.08
S211	OutletG	0.77	50	0.39	0.12	0.53	0.13	0.33	0.69	0.35
S212	OutletG	0.48	52	0.25	0.08	0.55	0.08	0.22	0.70	0.22
S213	OutletG	1.30	46	0.60	0.18	0.53	0.21	0.52	0.70	0.60
S214	OutletG	0.23	68	0.16	0.05	0.71	0.05	0.14	0.82	0.12
S215	OutletG	0.45	64	0.29	0.10	0.68	0.09	0.27	0.80	0.24
S216	OutletB	0.43	28	0.12	0.03	0.36	0.05	0.11	0.58	0.16
S217	OutletB	0.76	48	0.36	0.11	0.52	0.12	0.32	0.68	0.34
S218	OutletC	0.33	23	0.08	0.02	0.31	0.03	0.09	0.53	0.12
S219	OutletC	0.78	5	0.04	0.01	0.16	0.04	0.08	0.42	0.22
S220	OutletB	6.67	5	0.33	0.02	0.09	0.18	0.19	0.37	1.62
S221	OutletB	3.81	17	0.65	0.15	0.24	0.28	0.47	0.49	1.23
S222	OutletA	2.38	5	0.12	0.01	0.07	0.05	0.08	0.34	0.53
S223	OutletB	6.48	27	1.75	0.55	0.28	0.57	1.54	0.48	2.05
S226	OutletH	1.03	45	0.46	0.14	0.50	0.16	0.45	0.66	0.45
S227	OutletG	0.83	54	0.45	0.13	0.56	0.14	0.37	0.71	0.39
S228	OutletG	0.88	52	0.46	0.13	0.55	0.15	0.38	0.70	0.40
S230	OutletI	0.32	58	0.19	0.06	0.61	0.06	0.18	0.74	0.16
S231	OutletJ	0.10	81	0.08	0.03	0.81	0.03	0.07	0.89	0.06
S232	OutletI	1.52	48	0.73	0.22	0.52	0.24	0.66	0.68	0.68
S233	OutletJ	1.34	32	0.43	0.13	0.37	0.15	0.37	0.57	0.51
S234	OutletJ	1.16	53	0.61	0.19	0.56	0.20	0.54	0.70	0.54
S235	OutletJ	0.81	43	0.35	0.10	0.47	0.12	0.30	0.64	0.34
S236	OutletJ	0.26	70	0.18	0.05	0.72	0.06	0.16	0.83	0.14
S237	OutletJ	0.91	55	0.50	0.16	0.57	0.16	0.43	0.72	0.43
S238	OutletJ	0.74	68	0.50	0.14	0.71	0.16	0.41	0.82	0.40
S239	OutletJ	0.74	50	0.37	0.11	0.57	0.13	0.33	0.73	0.36
S240	OutletJ	1.10	54	0.59	0.19	0.60	0.21	0.55	0.75	0.54
S241	OutletJ	0.47	54	0.25	0.08	0.60	0.09	0.24	0.74	0.23
S242	OutletJ	1.15	60	0.69	0.21	0.65	0.23	0.61	0.78	0.59
S243	OutletJ	1.27	51	0.65	0.20	0.58	0.23	0.60	0.73	0.61
S244	OutletG	0.38	68	0.26	0.08	0.69	0.08	0.23	0.80	0.20
S245	OutletG	0.96	46	0.44	0.14	0.53	0.16	0.40	0.70	0.44
S246	OutletG	0.41	62	0.25	0.08	0.66	0.08	0.23	0.79	0.21
S247	OutletG	1.41	63	0.89	0.24	0.65	0.28	0.73	0.77	0.71
S248	OutletG	0.78	50	0.39	0.12	0.53	0.13	0.33	0.69	0.35
S249	OutletG	0.21	66	0.14	0.04	0.66	0.04	0.11	0.78	0.11
S250	OutletG	1.39	46	0.64	0.19	0.50	0.21	0.55	0.66	0.61
S252	OutletB	4.47	8	0.36	0.04	0.14	0.20	0.21	0.42	1.23
S254	OutletG	1.53	52	0.80	0.23	0.55	0.26	0.67	0.70	0.70
S255	OutletG	0.45	54	0.24	0.08	0.60	0.08	0.22	0.75	0.22

Subcatchment Runoff Results (Continued)
Petrolia Existing Condition

Catchment Number	Outlet ID	Area	TIMP	IMP Area	2 - Year			100 - Year		
					Peak Flow	Cal. Runoff Coef.	Volume	Peak Flow	Cal. Runoff Coef.	Volume
		(ha)	(%)	(ha)	(m^3/s)		(10^6 Ltr)	(m^3/s)		(10^6 Ltr)
S256	OutletH	1.43	68	0.97	0.29	0.68	0.30	0.83	0.79	0.75
S257	OutletG	1.56	64	1.00	0.29	0.66	0.32	0.97	0.77	0.80
S258	OutletF	1.08	63	0.68	0.23	0.67	0.22	0.69	0.79	0.56
S259	OutletE	0.31	14	0.04	0.01	0.30	0.03	0.06	0.55	0.11
S260	OutletB	1.01	40	0.40	0.13	0.45	0.14	0.37	0.63	0.42
S261	OutletB	2.13	47	1.00	0.33	0.51	0.34	0.92	0.67	0.94
S262	OutletD	1.07	56	0.60	0.19	0.61	0.20	0.56	0.75	0.53
S263	OutletE	2.46	55	1.35	0.44	0.61	0.47	1.29	0.76	1.23
S264	Internal	3.64	10	0.36	0.06	0.22	0.25	0.39	0.49	1.17
S265	OutletB	1.15	30	0.35	0.09	0.36	0.13	0.30	0.57	0.43
S266	Internal	4.92	21	1.03	0.25	0.31	0.47	0.96	0.55	1.78
S267	OutletB	1.15	31	0.36	0.09	0.37	0.13	0.30	0.57	0.43
S268	OutletB	1.67	51	0.85	0.27	0.58	0.30	0.80	0.73	0.81
S269	OutletB	0.87	36	0.31	0.09	0.41	0.11	0.26	0.60	0.34
S270	OutletB	1.44	56	0.81	0.26	0.60	0.27	0.74	0.74	0.70
S271	OutletE	1.39	24	0.33	0.08	0.36	0.16	0.33	0.60	0.54
S272	OutletB	1.21	51	0.62	0.20	0.54	0.20	0.57	0.69	0.55
S273	OutletC	1.50	40	0.60	0.19	0.45	0.21	0.56	0.63	0.62
S275	OutletB	3.74	17	0.64	0.15	0.22	0.25	0.45	0.47	1.16
S276	OutletB	9.38	6	0.56	0.04	0.11	0.33	0.30	0.40	2.45
S278	OutletB	0.63	35	0.22	0.06	0.41	0.08	0.20	0.60	0.25
S279	OutletB	0.69	42	0.29	0.09	0.47	0.10	0.27	0.64	0.29
S282	OutletB	0.93	39	0.36	0.12	0.44	0.13	0.33	0.62	0.38
S283	OutletB	21.23	6	1.27	0.08	0.10	0.62	0.61	0.37	5.24
S285	OutletA	2.50	5	0.13	0.01	0.07	0.05	0.13	0.31	0.50
S286	OutletA	8.60	5	0.43	0.03	0.08	0.22	0.27	0.35	2.00
S287	OutletA	10.96	5	0.55	0.03	0.06	0.21	0.32	0.32	2.30
S288	OutletA	1.94	5	0.10	0.01	0.11	0.07	0.16	0.37	0.47
S289	OutletA	6.94	5	0.35	0.04	0.11	0.24	0.49	0.37	1.71
S290	OutletB	11.25	7	0.79	0.06	0.10	0.34	0.43	0.36	2.65
S291	OutletB	8.58	8	0.69	0.09	0.15	0.41	0.49	0.43	2.42
S293	OutletA	3.63	5	0.18	0.02	0.07	0.08	0.27	0.31	0.74
S294	OutletK	3.49	22	0.77	0.23	0.24	0.26	0.69	0.46	1.05
S295	OutletF	1.26	40	0.50	0.19	0.50	0.19	0.54	0.68	0.57
S296	OutletF	0.50	48	0.24	0.09	0.56	0.09	0.26	0.72	0.24
S297	OutletA	9.52	5	0.48	0.05	0.12	0.35	0.64	0.39	2.41

Subcatchment Runoff Results Petrolia Proposed Condition										
Catchment Number	Outlet ID	Area	TIMP	IMP Area	2 - Year			100 - Year		
					Peak Flow	Cal. Runoff Coef.	Volume	Peak Flow	Cal. Runoff Coef.	Volume
		(ha)	(%)	(ha)	(m^3/s)		(10^6 Ltr)	(m^3/s)		(10^6 Ltr)
P101	OutletB	17.21	55	9.47	2.71	0.57	3.06	7.71	0.72	8.16
P102	OutletB	4.14	55	2.28	0.63	0.57	0.73	1.78	0.72	1.96
P103	OutletA	20.33	56	11.38	2.98	0.58	3.63	8.53	0.72	9.67
P104	OutletB	10.13	52	5.27	1.54	0.55	1.74	4.50	0.71	4.71
P105	OutletB	3.92	55	2.16	0.59	0.57	0.69	1.66	0.72	1.85
P106	OutletA	14.67	55	8.07	2.29	0.56	2.55	6.41	0.71	6.81
P107	OutletB	10.50	55	5.78	1.64	0.55	1.78	4.51	0.69	4.74
P108	OutletB	2.68	54	1.45	0.43	0.54	0.45	1.23	0.68	1.20
P109	OutletB	5.63	20	1.13	0.32	0.26	0.46	1.07	0.49	1.83
P110	OutletK	3.00	26	0.78	0.24	0.29	0.27	0.76	0.49	0.96
P111	OutletA	2.68	8	0.21	0.03	0.10	0.08	0.18	0.33	0.58
P112	OutletB	2.18	55	1.20	0.36	0.53	0.36	0.99	0.66	0.95
P113	OutletB	5.32	32	1.70	0.55	0.32	0.53	1.53	0.50	1.76
P114	OutletB	5.53	55	3.04	0.91	0.58	0.99	2.65	0.72	2.61
S199	OutletH	0.61	52	0.32	0.10	0.55	0.10	0.29	0.70	0.28
S200	OutletJ	0.40	49	0.20	0.06	0.54	0.07	0.18	0.70	0.18
S201	OutletH	0.55	62	0.34	0.11	0.64	0.11	0.33	0.76	0.28
S202	OutletH	0.32	76	0.24	0.09	0.76	0.08	0.23	0.84	0.18
S204	OutletJ	0.65	55	0.36	0.11	0.61	0.12	0.32	0.75	0.32
S205	OutletG	0.50	56	0.28	0.08	0.58	0.09	0.24	0.72	0.24
S206	OutletA	1.72	52	0.89	0.27	0.58	0.31	0.79	0.74	0.84
S207	OutletG	0.69	54	0.37	0.12	0.56	0.12	0.32	0.71	0.32
S208	OutletH	1.00	46	0.46	0.14	0.50	0.16	0.42	0.67	0.44
S209	OutletH	0.77	48	0.37	0.11	0.52	0.12	0.33	0.68	0.34
S210	OutletG	0.17	62	0.11	0.03	0.63	0.03	0.09	0.76	0.08
S211	OutletG	0.77	50	0.39	0.12	0.53	0.13	0.33	0.69	0.35
S212	OutletG	0.48	52	0.25	0.08	0.55	0.08	0.22	0.70	0.22
S213	OutletG	1.30	50	0.65	0.20	0.56	0.22	0.57	0.72	0.61
S214	OutletG	0.23	68	0.16	0.05	0.71	0.05	0.14	0.82	0.12
S215	OutletG	0.45	64	0.29	0.10	0.68	0.09	0.27	0.80	0.24
S216	OutletB	0.43	28	0.12	0.03	0.36	0.05	0.11	0.58	0.16
S217	OutletB	0.76	57	0.43	0.14	0.59	0.14	0.39	0.73	0.37
S218	OutletC	0.33	23	0.08	0.02	0.31	0.03	0.09	0.53	0.12
S219	OutletC	0.78	5	0.04	0.01	0.16	0.04	0.08	0.42	0.22
S226	OutletH	1.03	45	0.46	0.14	0.50	0.16	0.45	0.66	0.45
S227	OutletG	0.83	54	0.45	0.13	0.56	0.14	0.37	0.71	0.39
S228	OutletG	0.88	52	0.46	0.13	0.55	0.15	0.38	0.70	0.40
S230	OutletI	0.32	58	0.19	0.06	0.61	0.06	0.18	0.74	0.16
S231	OutletJ	0.10	82	0.08	0.03	0.82	0.03	0.07	0.89	0.06
S232	OutletI	1.52	48	0.73	0.22	0.52	0.24	0.66	0.68	0.68
S233	OutletJ	1.34	32	0.43	0.13	0.37	0.15	0.37	0.57	0.51
S234	OutletJ	1.16	53	0.61	0.19	0.56	0.20	0.54	0.70	0.54
S235	OutletJ	0.81	48	0.39	0.12	0.51	0.13	0.33	0.67	0.36
S236	OutletJ	0.26	70	0.18	0.05	0.72	0.06	0.16	0.83	0.14
S237	OutletJ	0.91	55	0.50	0.16	0.57	0.16	0.43	0.72	0.43
S238	OutletJ	0.74	68	0.50	0.14	0.71	0.16	0.41	0.82	0.40
S239	OutletJ	0.74	50	0.37	0.11	0.57	0.13	0.33	0.73	0.36
S240	OutletJ	1.10	54	0.59	0.19	0.60	0.21	0.55	0.75	0.54
S241	OutletJ	0.47	56	0.26	0.08	0.61	0.09	0.25	0.75	0.23
S242	OutletJ	1.15	60	0.69	0.21	0.65	0.23	0.61	0.78	0.59
S243	OutletJ	1.27	53	0.67	0.21	0.59	0.23	0.62	0.74	0.62

Subcatchment Runoff Results (Continued)
Petrolia Proposed Condition

Catchment Number	Outlet ID	Area	TIMP	IMP Area	2 - Year			100 - Year		
					Peak Flow	Cal. Runoff Coef.	Volume	Peak Flow	Cal. Runoff Coef.	Volume
		(ha)	(%)	(ha)	(m^3/s)		(10^6 Ltr)	(m^3/s)		(10^6 Ltr)
S244	OutletG	0.38	68	0.26	0.08	0.69	0.08	0.23	0.80	0.20
S245	OutletG	0.96	55	0.53	0.16	0.60	0.18	0.47	0.75	0.47
S246	OutletG	0.41	64	0.26	0.08	0.68	0.09	0.23	0.80	0.22
S247	OutletG	1.41	63	0.89	0.24	0.65	0.28	0.73	0.77	0.71
S248	OutletG	0.78	50	0.39	0.12	0.53	0.13	0.33	0.69	0.35
S249	OutletG	0.21	66	0.14	0.04	0.66	0.04	0.11	0.78	0.11
S250	OutletG	1.39	46	0.64	0.19	0.50	0.21	0.55	0.66	0.61
S254	OutletG	1.53	52	0.80	0.23	0.55	0.26	0.67	0.70	0.70
S255	OutletG	0.45	54	0.24	0.08	0.60	0.08	0.22	0.75	0.22
S256	OutletH	1.43	68	0.97	0.29	0.68	0.30	0.83	0.79	0.75
S257	OutletG	1.56	64	1.00	0.29	0.66	0.32	0.97	0.77	0.80
S258	OutletF	1.08	63	0.68	0.23	0.67	0.22	0.69	0.79	0.56
S259	OutletE	0.31	21	0.07	0.02	0.35	0.03	0.08	0.59	0.12
S260	OutletB	1.01	40	0.40	0.13	0.45	0.14	0.37	0.63	0.42
S261	OutletB	2.13	47	1.00	0.33	0.51	0.34	0.92	0.67	0.94
S262	OutletD	1.07	57	0.61	0.20	0.62	0.21	0.57	0.76	0.53
S263	OutletE	2.46	56	1.38	0.45	0.62	0.47	1.31	0.76	1.23
S264	Internal	3.64	10	0.36	0.06	0.22	0.25	0.39	0.49	1.17
S265	OutletB	1.15	30	0.35	0.09	0.36	0.13	0.30	0.57	0.43
S266	Internal	4.92	21	1.03	0.25	0.31	0.47	0.96	0.55	1.78
S267	OutletB	1.15	31	0.36	0.09	0.37	0.13	0.30	0.57	0.43
S268	OutletB	1.67	52	0.87	0.28	0.59	0.30	0.81	0.74	0.81
S269	OutletB	0.87	36	0.31	0.09	0.41	0.11	0.26	0.60	0.34
S270	OutletB	1.44	56	0.81	0.26	0.60	0.27	0.74	0.74	0.70
S271	OutletE	1.39	25	0.35	0.09	0.37	0.16	0.34	0.60	0.55
S272	OutletB	1.21	51	0.62	0.20	0.54	0.20	0.57	0.69	0.55
S273	OutletC	1.50	40	0.60	0.19	0.45	0.21	0.56	0.63	0.62
S278	OutletB	0.63	35	0.22	0.06	0.41	0.08	0.20	0.60	0.25
S279	OutletB	0.69	42	0.29	0.09	0.47	0.10	0.27	0.64	0.29
S282	OutletB	0.93	39	0.36	0.12	0.44	0.13	0.33	0.62	0.38
S288	OutletA	1.94	7	0.14	0.01	0.13	0.08	0.17	0.38	0.49
S289	OutletA	6.94	5	0.35	0.04	0.11	0.24	0.49	0.37	1.71
S293	OutletA	3.63	6	0.22	0.02	0.08	0.09	0.28	0.32	0.77
S295	OutletF	1.26	45	0.57	0.17	0.53	0.21	0.55	0.71	0.59
S296	OutletF	0.50	48	0.24	0.07	0.56	0.09	0.25	0.72	0.24
S297	OutletA	9.52	5	0.48	0.05	0.12	0.35	0.64	0.39	2.41

Subbasin Outlet Summary

Existing Development Conditions

Outlet	Location	Total Area (ha)	Total % IMP	Existing Condition Results			
				2-year		100-year	
				Peak Flow (m3/s)	Unit Flow (m3/s/ha)	Peak Flow (m3/s)	Unit Flow (m3/s/ha)
OutletA	Tributary of Little Bear Creek	46.5	5.0	0.09	0.002	1.35	0.029
OutletB	Greenizen Drain	91.4	15.1	0.29	0.003	2.30	0.025
OutletC	Tile Yard Road	2.6	27.4	0.19	0.074	0.34	0.130
OutletD	Garden Cresent NW	1.1	56.0	0.03	0.029	0.07	0.063
OutletE	Glenview SWMF	4.2	41.6	0.10	0.025	0.69	0.166
OutletF	Fairway Court	2.8	50.2	0.41	0.144	0.89	0.314
OutletG	First Avenue	15.4	54.5	0.59	0.038	1.39	0.090
OutletH	Petrolia Line - West	5.7	55.4	0.37	0.065	0.96	0.168
OutletI	North Street - West	1.8	49.7	0.34	0.186	0.98	0.530
OutletJ	North Street - East	11.1	51.8	0.64	0.058	0.92	0.083
OutletK	Highway 21	3.5	22.0	0.02	0.006	0.09	0.025
Internal	Golf Course Internal Ponds	8.6	16.3				
Total		**195**					

Proposed Development Conditions

Outlet	Location	Total Area (ha)	Total % IMP	Proposed Condition Results			
				2-year		100-year	
				Peak Flow (m3/s)	Unit Flow (m3/s/ha)	Peak Flow (m3/s)	Unit Flow (m3/s/ha)
OutletA	Tributary of Little Bear Creek	61.4	35.4	0.09	0.001	0.76	0.012
OutletB	Greenizen Drain	81.3	48.7	0.25	0.003	1.75	0.022
OutletC	Tile Yard Road	2.6	27.4	0.19	0.074	0.34	0.130
OutletD	Garden Cresent NW	1.1	57.0	0.03	0.029	0.09	0.088
OutletE	Glenview SWMF	4.2	43.0	0.11	0.025	0.73	0.175
OutletF	Fairway Court	2.8	52.4	0.38	0.133	0.89	0.313
OutletG	First Avenue	15.4	55.5	0.59	0.038	1.41	0.092
OutletH	Petrolia Line - West	5.7	55.5	0.37	0.065	0.96	0.168
OutletI	North Street - West	1.8	49.7	0.34	0.186	0.98	0.530
OutletJ	North Street - East	11.1	52.6	0.65	0.058	0.93	0.083
OutletK	Highway 21	3.0	26.0	0.02	0.007	0.09	0.031
Internal	Golf Course Internal Ponds	8.6	16.3				
Total		**199**					

Note:

1. Proposed conditions include diversion of 14.4 ha from Greenizen Drain to Tributary of Little Bear Creek. Overcontrol provided in proposed SWMF works to meet existing condition flows.

2. Proposed conditions include redirection of 4 ha for the Glenview Estates Phase 4/5 to retrofitted online pond, currently draining to Greenizen Drain downstream of the online pond and wetland complexes to the south.

SWMF Hydraulic Performance

Existing Development Conditions

Existing Online Pond

Storm Event	Total Precipiation (mm)	Peak Outflow			Max Active Storage	Max Water Level	Active Depth
		Outlet (m^3/s)	Overflow (m^3/s)	Total (m^3/s)	(m^3)	(m)	(m)
2-year 3 hr Chicago	31.0	0.290	-	0.290	2479	198.25	0.20
5-year 3 hr Chicago	40.3	0.491	-	0.491	5021	198.44	0.39
10-year 3 hr Chicago	46.5	0.588	-	0.588	7327	198.61	0.56
25-year 3 hr Chicago	54.4	0.637	0.674	1.311	8757	198.71	0.66
50-year 3 hr Chicago	60.2	0.657	1.189	1.846	9352	198.75	0.70
100-year 3 hr Chicago	65.8	0.672	1.626	2.298	9797	198.78	0.72

*** Assumed Pond Surface Elevation of 198.05 based on BMROSS Survey*

Proposed Development Conditions

Proposed Online Pond Retrofit

Storm Event	Total Precipiation (mm)	Peak Outflow			Max Active Storage	Max Water Level	Active Depth
		Outlet (m^3/s)	Overflow (m^3/s)	Total (m^3/s)	(m^3)	(m)	(m)
2-year 3 hr Chicago	31.0	0.250	-	0.250	5535	197.71	0.71
5-year 3 hr Chicago	40.3	0.358	-	0.358	8742	198.02	1.02
10-year 3 hr Chicago	46.5	0.669	-	0.669	10600	198.19	1.19
25-year 3 hr Chicago	54.4	1.308	-	1.308	11750	198.28	1.28
50-year 3 hr Chicago	60.2	1.596	-	1.596	12230	198.32	1.32
100-year 3 hr Chicago	65.8	1.751	-	1.751	12490	198.35	1.35

*** Assumed Pond Surface Elevation of 197 m*

Proposed West Basin SWMF

Storm Event	Total Precipiation (mm)	Peak Outflow			Max Active Storage	Max Water Level	Active Depth
		Outlet (m^3/s)	Overflow (m^3/s)	Total (m^3/s)	(m^3)	(m)	(m)
2-year 3 hr Chicago	31.0	0.342	-	0.342	6248	198.78	0.78
5-year 3 hr Chicago	40.3	0.631	-	0.631	8515	199.04	1.04
10-year 3 hr Chicago	46.5	0.926	-	0.926	9755	199.17	1.17
25-year 3 hr Chicago	54.4	1.217	-	1.217	11480	199.34	1.34
50-year 3 hr Chicago	60.2	1.300	-	1.300	13070	199.50	1.50
100-year 3 hr Chicago	65.8	1.365	-	1.365	14870	199.67	1.67

Proposed East Basin SWMF

Storm Event	Total Precipiation (mm)	Peak Outflow			Max Active Storage	Max Water Level	Active Depth
		Outlet (m^3/s)	Overflow (m^3/s)	Total (m^3/s)	(m^3)	(m)	(m)
2-year 3 hr Chicago	31.0	0.044	-	0.044	5920	198.38	0.88
5-year 3 hr Chicago	40.3	0.052	-	0.052	8456	198.70	1.20
10-year 3 hr Chicago	46.5	0.087	-	0.087	10020	198.89	1.39
25-year 3 hr Chicago	54.4	0.176	-	0.176	11720	199.08	1.58
50-year 3 hr Chicago	60.2	0.240	-	0.240	12900	199.21	1.71
100-year 3 hr Chicago	65.8	0.282	-	0.282	14090	199.33	1.83

APPENDIX E

CONSULTATION

TOWN OF PETROLIA

MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT
STORMWATER MASTER PLAN SERVICING STUDY
FOR THE PETROLIA SOUTHEAST SERVICE AREA

NOTICE OF COMMENCEMENT

THE PROJECT:

The Town of Petrolia has initiated a Municipal Class Environmental Assessment (Class EA) process to develop a Stormwater Servicing Master Plan for the southeast service area, as shown on the attached key plan. The Master Plan will inventory and evaluate existing stormwater facilities within developed portions of the service area and investigate the most cost effective and efficient manner to provide stormwater servicing, where required, within the established and future development areas.

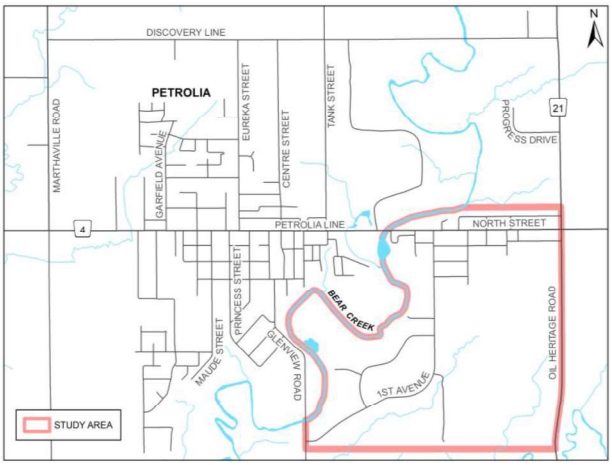
When completed, the Master Plan will recommend a stormwater servicing strategy that could be implemented in phases, within the established areas of the study area, as well as recommending best practices and strategies for addressing stormwater servicing within future development areas.

THE ENVIRONMENTAL ASSESSMENT PROCESS:

The investigations are being planned as a Master Plan project under the Municipal Class Environmental Assessment document. Master Plan projects incorporate a screening process that involves consultation with the public, government review agencies, Aboriginal Communities and affected property owners. Public input and comment is therefore invited for incorporation into this project.

PUBLIC INVOLVEMENT:

The consultation program for the Class EA Master Plan processes includes several opportunities for public involvement including a questionnaire and a public information meeting, so that local residents and property owners have direct input into the study. Details related to the public meetings will be provided at a later date. For the initial phase of the program, public input into the planning and design of this study will be received until **October 5th, 2018**. Additional opportunities for comment will be provided as the process proceeds.



Any comments collected in conjunction with the Master Plan process will be maintained on file for use during the project and may be included in project documentation. With the exception of personal information, all comments will become part of the public record.

For further information on this project, or to review the Class EA Master Plan process, please contact the project engineers: B.M. Ross and Associates, 2695 Hamilton Road, P.O. Box 400 Brights Grove, ON. Telephone (519) 908-9564, Fax (519) 524-4403. Kelly Vader, Environmental Planner; (e-mail: kvader@bmross.net).

Mike Thompson, Director of Operations
Town of Petrolia

This Notice issued September 5th, 2018

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File No. 17065

September 10, 2018

Agency
(See attached list)

RE: Town of Petrolia
Stormwater Master Plan Servicing Study
Petrolia Southeast Service Area

The Town of Petrolia has initiated a Municipal Class Environmental Assessment (Class EA) process to develop a Stormwater Servicing Master Plan for the southeast service area, as shown on the attached figure. The Master Plan will inventory and evaluate existing stormwater facilities within developed portions of the service area and investigate the most cost effective and efficient manner to provide stormwater servicing, where required, within the established and future development areas. When completed, the Master Plan will recommend a stormwater servicing strategy that could be implemented in phases, within the established areas of the study area, as well as recommending best practices and strategies for addressing stormwater servicing within future development areas.

The investigations are being planned as a Master Plan project under the Municipal Class Environmental Assessment document. Master Plan projects incorporate a screening process that involves consultation with the public, government review agencies, Aboriginal Communities and affected property owners. The Public's input and comment is therefore invited for incorporation into this project.

Your agency has been identified as possibly having an interest in the project and we are soliciting your input. Please forward any initial comments to our office by October 19, 2018. If you have any questions or require further information, please contact the undersigned at 519-524-2641 or e-mail kvader@bmross.net.

Yours very truly

B. M. ROSS AND ASSOCIATES LIMITED

Per _____
Kelly Vader, RPP, MCIP
Environmental Planner

Encl.
cc. Mike Thompson, Director of Operations

Z:\17065-Petrolia-Class_EA_Southeast_Quadrant\WP\Class EA\17065-18Sep10-Agency Let.docx

TOWN OF PETROLIA

MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT
STORMWATER MASTER PLAN SERVICING STUDY FOR THE PETROLIA SOUTHEAST SERVICE AREA

REVIEW AGENCY CIRCULATION LIST

REVIEW AGENCY	INVOLVEMENT
Ministry of Environment, Conservation and Parks (London) - EA Coordinator	Mandatory Contact
Ministry of Natural Resources and Forestry (Aylmer)	Potential Impact on Natural Features
Ministry of Tourism, Culture and Sport (Toronto)	Potential Impact to Heritage Features
Ministry of Transportation (London)	General Information
Town of Petrolia	Proponent
County of Lambton - Planning & Development Department - Public Works Department - Emergency Services Department	General Information
St. Clair Region Conservation Authority	Potential Impact on Natural Features
Township of Enniskillen	Adjacent Municipality
Department of Fisheries and Oceans (DFO)	Aquatic Species at Risk

B. M. ROSS AND ASSOCIATES LIMITED
Engineers and Planners
2695 Hamilton Road, P.O. Box 400
Brights Grove, ON N0N 1C0
p. (519) 908-9564 • f. (519) 524-4403
www.bmross.net

File No. 17065

September 10, 2018

'First Nation Community'

RE: Town of Petrolia
Class Environmental Assessment for Stormwater Master Plan Servicing Study for the Petrolia Southeast Service Area

The Town of Petrolia has initiated a Municipal Class Environmental Assessment (Class EA) process to develop a Stormwater Servicing Master Plan for the southeast service area, as shown on the attached key plan. The Master Plan will inventory and evaluate existing stormwater facilities within developed portions of the service area and investigate the most cost effective and efficient manner to provide stormwater servicing, where required, within the established and future development areas. When completed, the Master Plan will recommend a stormwater servicing strategy that could be implemented in phases, within the established areas of the study area, as well as recommending best practices and strategies for addressing stormwater servicing within future development areas.

The investigations are being planned as a Master Plan project under the Municipal Class Environmental Assessment document. Master Plan projects incorporate a screening process that involves consultation with the public, government review agencies, Aboriginal Communities and affected property owners. The public's input and comment is therefore invited for incorporation into this project. This letter is advising of the start of study investigations. A public information meeting will be held later in the process to update on study progress and to receive additional input.

Your community has been identified as possibly having an interest in this project. For your convenience, a response form is enclosed along with a self-addressed stamped envelope. Please complete and return the form by October 5, 2018. If you have any questions on this matter or require further information, please contact the undersigned at 519-524-2641 or by e-mail at kvader@bmross.net.

Yours very truly

B. M. ROSS AND ASSOCIATES LIMITED

Per _____
Kelly Vader, RPP, MCIP
Environmental Planner

KV:hv
Encl.
cc. Mike Thompson, Director of Operations

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TOWN OF PETROLIA

MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT
STORMWATER MASTER PLAN SERVICING STUDY FOR THE PETROLIA SOUTHEAST SERVICE AREA

ABORIGINAL CIRCULATION LIST: 17065

Aamjiwnaang First Nation
Chief Chris Plain
Aamjiwnaang Administration Office
978 Tashmoo Ave.
Sarnia, ON N7T 7H5

Chippewas of the Thames First Nation
Chief Myeengun Henry
320 Chippewa Road
Muncey, ON N0L 1Y0

Oneida Nation of the Thames
Chief Jessica Hill
2212 Elm Ave
Southwold, ON N0L 2G0

Munsee-Delaware Nation
Chief Roger Thomas
RR#1
Muncey, ON N0L 1Y0

Bkejwanong Territory (Walpole Island)
Chief Daniel Miskokomon
117 Tahgahoning Road, R.R. #3
Wallaceburg, ON N8A 4K9

Métis Nation of Ontario – Sent via email
RoseAnne Archibald (Ontario Regional Chief)

Chippewas of Kettle and Stony Point First Nation
Chief Jason Henry
Kettle & Stony Point Band Office
6247 Indian Lane
Kettle & Stony Point First Nation, ON N0N 1J1

Great Lakes Métis Council
Peter Coture, President
380 9th Street East
Owen Sound, ON N4K 1P1

Response Form

Project Name: Stormwater Servicing Master Plan

Project Description: Stormwater Servicing Master Plan for the Petrolia Southeast Service Area.

Project Location: Town of Petrolia, County of Lambton

(Key Plan of Project Location attached)

Please Detach and Return in Envelope Provided

Name of Aboriginal Community: _____

Please check appropriate box

☐ **Please send additional information on this project**

☐ **We would like to meet with representatives of this project.**

☐ **We have no concerns with this project and do not wish to be consulted further**

Ministry of the Environment, Conservation and Parks

733 Exeter Road
London ON N6E 1L3
Tel: 519 873-5000
Fax: 519 873-5020

Ministère de l'Environnement, de la Protection de la nature et des Parcs

733, rue Exeter
London ON N6E 1L3
Tél.: 519 873-5000
Fax: 519 873-5020

Ontario

Sept 7, 2018

Town of Petrolia

Attention: Mike Thompson, Director of Operations

Re: Class EA for the Petrolia Master Plan for Stormwater Servicing in Southeast Service Area

Dear Mike Thompson:

This letter is in response to the Notice of Commencement for the above noted project. The Ministry of the Environment, Conservation and Parks (MECP) acknowledges that the Town of Petrolia has indicated that its study is following the Municipal Class EA process for Master Plans.

Aboriginal Consultation

The Crown has a legal duty to consult Aboriginal communities when it has knowledge, real or constructive, of the existence or potential existence of an Aboriginal or treaty right and contemplates conduct that may adversely impact that right. Before the Town of Petrolia may proceed with this project, the Crown must ensure that its duty to consult has been fulfilled, where such a duty is triggered. Although the duty to consult with Aboriginal peoples is a duty of the Crown, the Crown may delegate procedural aspects of consultation to project proponents while retaining oversight of the process.

Your proposed project may have the potential to affect Aboriginal or treaty rights protected under section 35 of Canada's *Constitution Act 1982*. Where the Crown's duty to consult is triggered in relation to your proposed project**, the MECP is delegating the procedural aspects of rights-based consultation to you through this letter.** The Crown intends to rely on the delegated consultation process in discharging its duty to consult and maintains the right to participate in the consultation process as it sees fit.

Based on information you have provided to date and the Crown's preliminary assessment you are required to consult with the following communities who have been identified as potentially affected by your proposed project:

Aamjiwnaang First Nation	Aamjiwnaang First Nation 978 Tashmoo Ave. Sarnia, ON N7T 7H5 519-336-8410 Chief Chris Plain chief@aamjiwnaang.ca Other Contacts: Sharilyn Johnston, Environment Coordinator sjohnston@aamjiwnaang.ca Christine James, Environment Worker cjames@aamjiwnaang.ca (same mailing address for all)
Bkejwanong Territory (Walpole Island First Nation)	Bkejwanong Territory 117 Tahgahoning Road R.R.#3 Wallaceburg, ON N8K 4K9 519-627-1481 Chief Dan Miskokomon drskoke@wifn.org Other Contacts: Dean Jacobs, Consultation Manager Walpole Island Heritage Centre 2185 River Road R.R.#3 Wallaceburg, ON N8K 4K9 519-627-1475 dean.jacobs@wifn.org and Janet Macbeth, Project Review Coordinator janet.macbeth@wifn.org
Chippewas of Kettle and Stony Point First Nation	Chippewas of Kettle and Stony Point First Nation 6247 Indian Lane, R.R.#2 Forest, ON N0N 1J1 519-786-2125 Chief Jason Henry jason.henry@kettlepoint.org Other Contact: Valerie George Consultation Officer valerie.george@kettlepoint.org
Chippewas of the Thames First Nation	Chippewas of the Thames First Nation 320 Chippewa Rd., Muncey, ON N0L 1Y0 519-289-5555 Chief Myeengun Henry myeengun@cottfn.com Other Contacts: Kelly Riley, Acting Director - Lands & Environment kriley@cottfn.com Rochelle Smith, Consultation Coordinator rsmith@cottfn.com Consultation email: consultation@cottfn.com
Caldwell First Nation	Caldwell First Nation 14 Orange St. Leamington, ON N8H 3W3 519-322-1766 or 1-800-206-7522 Chief Mary Duckworth chief.duckworth@caldwellfirstnation.ca Executive Administrator Nikki Orosz nikki.orosz@caldwellfirstnation.ca
Oneida Nation of the Thames ONYOTA'A:KA	Oneida Nation of the Thames 2212 Elm Ave. Southwold, ON N0L 2G0 519-652-3244 Chief Jessica Hill jessica.hill@oneida.on.ca Other Contact: Political Reception: Holly Elijah holly.elijah@oneida.on.ca

The following community should be consulted on an interest basis:

Delaware Nation	Delaware Nation 14760 School House Line R.R.#3 Thamesville, ON N0P 2K0 519-692-3936 Chief Denise Stonefish denise.stonefish@delawarenation.on.ca

Steps that you may need to take in relation to Aboriginal consultation for your proposed project are outlined in the "Code of Practice for Consultation in Ontario's Environmental Assessment Process" which can be found at the following link: https://www.ontario.ca/document/consultation-ontarios-environmental-assessment-process

Additional information related to Ontario's *Environmental Assessment Act* is available online at: www.ontario.ca/environmentalassessments

You must contact the Director of Environmental Assessment and Permissions Branch (Director) under the following circumstances subsequent to initial discussions with the communities identified by MOECC:

- Aboriginal or treaty rights impacts are identified to you by the communities;
- You have reason to believe that your proposed project may adversely affect an Aboriginal or treaty right;
- Consultation has reached an impasse;
- A Part II Order request or elevation request is expected.

The Director can be notified either by email, mail or fax using the information provided below:

Email:	MOECCpermissions@ontario.ca Subject: Potential Duty to Consult
Fax:	416-314-8452
Address:	Environmental Assessment and Permissions Branch 135 St. Clair Avenue West, 1st Floor Toronto, ON, M4V 1P5

The MECP will then assess the extent of any Crown duty to consult for the circumstances and will consider whether additional steps should be taken, including what role the Town of Petrolia will be asked to play should additional steps and activities be required.

Source Water Protection

As per the recent amendments to the Municipal Engineers Association (MEA) Class Environmental Assessment parent document approved October 2015, proponents undertaking a Municipal Class EA project must identify early in the process whether a project is occurring within a source water protection vulnerable area. This must be clearly documented in a Project File report or ESR. If the project is occurring in a vulnerable area, then there may be policies in the local Source Protection Plan (SPP) that need to be addressed (requirements under the Clean Water Act). The proponent

should contact and consult with the appropriate Conservation Authority/Source Protection Authority (CA/SPA) to discuss potential considerations and policies in the SPP that apply to the project.

Please include a section in the report on Source Water Protection. Specifically, it should discuss whether or not the project is located in a vulnerable area or changes or creates new vulnerable areas, and provide applicable details about the area. If located in a vulnerable area, proponents should document whether any project activities are a prescribed drinking water threat and thus pose a risk to drinking water (this should be consulted on with the appropriate CA/SPA). Where an activity poses a risk to drinking water, the proponent must document and discuss in the Project File Report/ESR how the project adheres to or has regard to applicable policies in the local SPP. If creating or changing a vulnerable area, proponents should document whether any existing uses or activities may potentially be affected by the implementation of source protection policies. This section should then be used to inform and should be reflected in other sections of the report, such as the identification of net positive/ negative effects of alternatives, mitigation measures, evaluation of alternatives etc. As a note, even if the project activities in a vulnerable area are deemed not to be a drinking water risk, there may be other policies that apply and so consultation with the local CA/SPA is important.

Climate Change

The Municipality is strongly encouraged to include climate change in this EA. Climate change should be considered in the context of mitigation and the context of adaptation. The Ministry has recently released a guidance document to support proponents in including climate change in environmental assessments. The guide can be found online: https://www.ontario.ca/page/considering-climate-change-environmental-assessment-process. It should be noted that Climatic Features is identified in Appendix 2 of the Municipal Class EA page 2-7 (2015).

Part II Order Request Form

Please note that as of July 1, 2018, a Part II Order Request Form must be used to request a Part II Order as per O. Reg. 152/18. Accordingly, please include those details when conveying information regarding the Part II Order process such as on the Notice of Completion. The following sample text would cover this requirement in the Notice of Completion for this project:

"As of July 1, 2018, a Part II Order Request Form must be used to request a Part II Order in accordance with O. Reg. 152/18. The Part II Order Request Form is available online on the Forms Repository website (http://www.forms.ssb.gov.on.ca/) by searching "Part II Order" or "012-2206E" (the form ID number)."

Conclusion

Thank you for the opportunity to comment on this project. Please keep this office fully informed of the status of this project as it proceeds through the Class EA process. All future correspondence with respect to this project should be sent to my attention, as I am this ministry's one window contact for this project: Anneleis Eckert, Regional Environmental Planner / Regional EA Coordinator at (519) 873-5115 or by email at anneleis.eckert@ontario.ca.

If the Master Plan will be following Approach # 2, 3, or 4, a draft copy of the EA documentation sent to the appropriate MECP regional office before the Town of Petrolia issues its notice of completion of the final report would be appreciated. Please allow a minimum of 30 days for MECP's technical reviewers to provide comments on the draft documentation.

When the EA documentation is finalized, please send the Notice of Completion and final documentation to me.

Should you or any members of your project team have any questions regarding the material above, please contact me directly.

Yours truly,

Anneleis Eckert

Anneleis Eckert
Regional Environmental Planner / Regional EA Coordinator
Ministry of Environment, Conservation and Parks
733 Exeter Road
London ON, N6E 1L3
519-873-5115

Copy:
Kelly Vader, B.M. Ross
Mary Jane Corda, MECP

AAMJIWNAANG FIRST NATION

978 Tashmoo Ave.
Sarnia, Ontario N7T 7H5
Ph.: 519-336-8410
Fax: 519-336-0382

17065

September 7, 2018

Our File # 2018-0002

B.M. ROSS AND ASSOCIATES LIMITED
Engineers and Planners
62 North Street
Goderich, ON N7A 2T4

Attention: Kelly Vader, RPP, MCIP
Environmental Planner

Re: County of Lambton (Village of Warwick)
Class Environmental Assessment for the Bear Creek Bridge
File No. BR 1279

Dear Kelly Vader:

We are writing to follow-up with the information that you recently provided regarding the above noted project dated July 10, 2018. The information was recorded into our consultation log and recently discussed at the Aamjiwnaang First Nation's Environment Committee on August 28, 2018 for their review and consideration.

After review of information provided, Aamjiwnaang First Nation (AFN) has concerns with road mortalities during construction and would like to know your plans to reduce/mitigate impacts on wildlife? AFN requests that any habitat areas that have been disturbed or removed as a result of the project be restored, where possible. Any wildlife corridors that are disturbed due to the project, be restored after completion of the project. Also, AFN is interested in any archeological studies in the project area. AFN requests that we have our Archeological and Species at Risk Monitors on site during assessments studies and construction. In addition, as part of the rebuilding after improvements, AFN would like to have native plant species re-planted or planted in another significant area near the project area.

As the First Peoples of this territory, we are intimately connected to our lands, water and resources. We have an inherent and sacred responsibility to manage and protect our lands and resources. Our existing Aboriginal and treaty rights, our perspectives, interests and obligations of stewardship must inform the development of any proposed project, which may potentially impact these rights. Our First Nation must be involved in the decision-making processes at an early stage in the project and be fully informed throughout.

Attached: July 23, 1980 letter submitted to the Provincial Government by Mr. Ron Rowcliffe, Q.C. Aamjiwnaang Water Assertion Rights, as directed by Chief and Council.

AAMJIWNAANG FIRST NATION

978 Tashmoo Ave.
Sarnia, Ontario N7T 7H5
Ph.: 519-336-8410
Fax: 519-336-0382

To promote consistency and timely responses, please forward any and all relevant information pertaining to this project to:

Chief Joanne Rogers
Aamjiwnaang First Nation
978 Tashmoo Avenue
Sarnia, Ontario, N7T 7H5
Office: (519) 336-8410

Sharilyn Johnston
Environmental Coordinator
Aamjiwnaang First Nation
978 Tashmoo Avenue
Sarnia, Ontario, N7T 7H5
Office: (519) 336-8410
Email: sjohnston@aamjiwnaang.ca

Information sharing between the proponent and our community is critical to making informed decisions. However, this review process must not in any way be interpreted as satisfying the Crown's constitutional duty to consult and accommodate Aamjiwnaang First Nation. As the Supreme Court set out in *Haida Nation*, the Crown may delegate procedural elements of its duty to consult, however, "the ultimate legal responsibility for consultation and accommodation rests with the Crown and the Crown alone."

Aamjiwnaang First Nation is committed to facilitating a flexible, clear, and reasonable process for reviewing information in relation to the proposed project and will participate fully in responding to the information provided. This letter does not abrogate or derogate Aamjiwnaang First Nation's continuing ability to assert and exercise its Aboriginal Rights and Title to all parts for its Reserve and Traditional Territory.

Sincerely,

Sharilyn Johnston
Environment Coordinator
Aamjiwnaang First Nation
sjohnston@aamjiwnaang.ca

Attached: July 23, 1980 letter submitted to the Provincial Government by Mr. Ron Rowcliffe, Q.C. Aamjiwnaang Water Assertion Rights, as directed by Chief and Council.

Ministry of Natural Resources
Minister
Whitney Block
Queen's Park
Toronto Ont.
416/965-1301

October 23, 1980

Dear Chief Shawkence:

We have reviewed the paper which you presented to the Premier and Cabinet when we met with the Chiefs of Ontario on July 31, 1980, in which you stated your position that the Chippewas of Sarnia, Kettle Point and Stoney Point have an interest in part of Lake Huron.

We recognize that the area described in your paper does not appear to have been included in a treaty or similar agreement between the Crown and the Chippewa Indian people. Accordingly, there may be an unextinguished Indian interest in that area, and, as you suggest, such an interest may be related to the provisions of the Royal Proclamation of 1763. It is Ontario's position that, if there is any Indian interest in that area, it is different than the interest of Indian people in Indian Reserve land.

We will consider your paper to be a formal claim to Ontario on behalf of the Chippewas of Sarnia, Kettle Point and Stoney Point. As an initial step in addressing the claim, I have asked Mr. E.G. "Ted" Wilson to prepare a research report on the historical facts relevant to the issues raised by your claim.

We will forward copies of our correspondence and other relevant material, to the Honourable John C. Munro, Minister of Indian Affairs and Northern Development, since it is necessary for the Federal Government to be involved in any discussions and negotiations concerning this claim.

We will contact you again when our research report has been completed. In the interim, however, you should be advised that all land in or under Lake Huron is, until it is disposed of by Ontario, Crown land in Ontario and is, together with the resources in it, subject to the administration and control of the Government of Ontario.

I look forward to working with you to resolve the issues which you have brought to our attention.

Yours sincerely,

James Auld

James A.C. Auld

Chief Charles K. Shawkence
Chippewas of Kettle and Stoney Point
Kettle Point Council
53 Indian Lane
R.R. #2

Whereas by a certain provisional Agreement of April 26th, 1825 which was followed by an Indenture of July 10th, 1827, made between certain Chiefs and Principal Men of the Chippewa Nation of Indians and Our Sovereign Lord George the Fourth as represented by the Superintendent of Indian Affairs, certain lands, together with all and every of the woods and underwoods, ways, waters, watercourses, improvements, profits, commodities, hereditaments and appurtenances on the said tract of land, lying and being or thereto belonging or in anywise appertaining were surrendered.

And whereas the description of the said lands made no reference to that part of the territory extending to the International Boundary, the possession and the right of possession whereof having been enjoyed by the Chippewa Nation of Indians, which was specifically not included and which was not surrendered and yielded up.

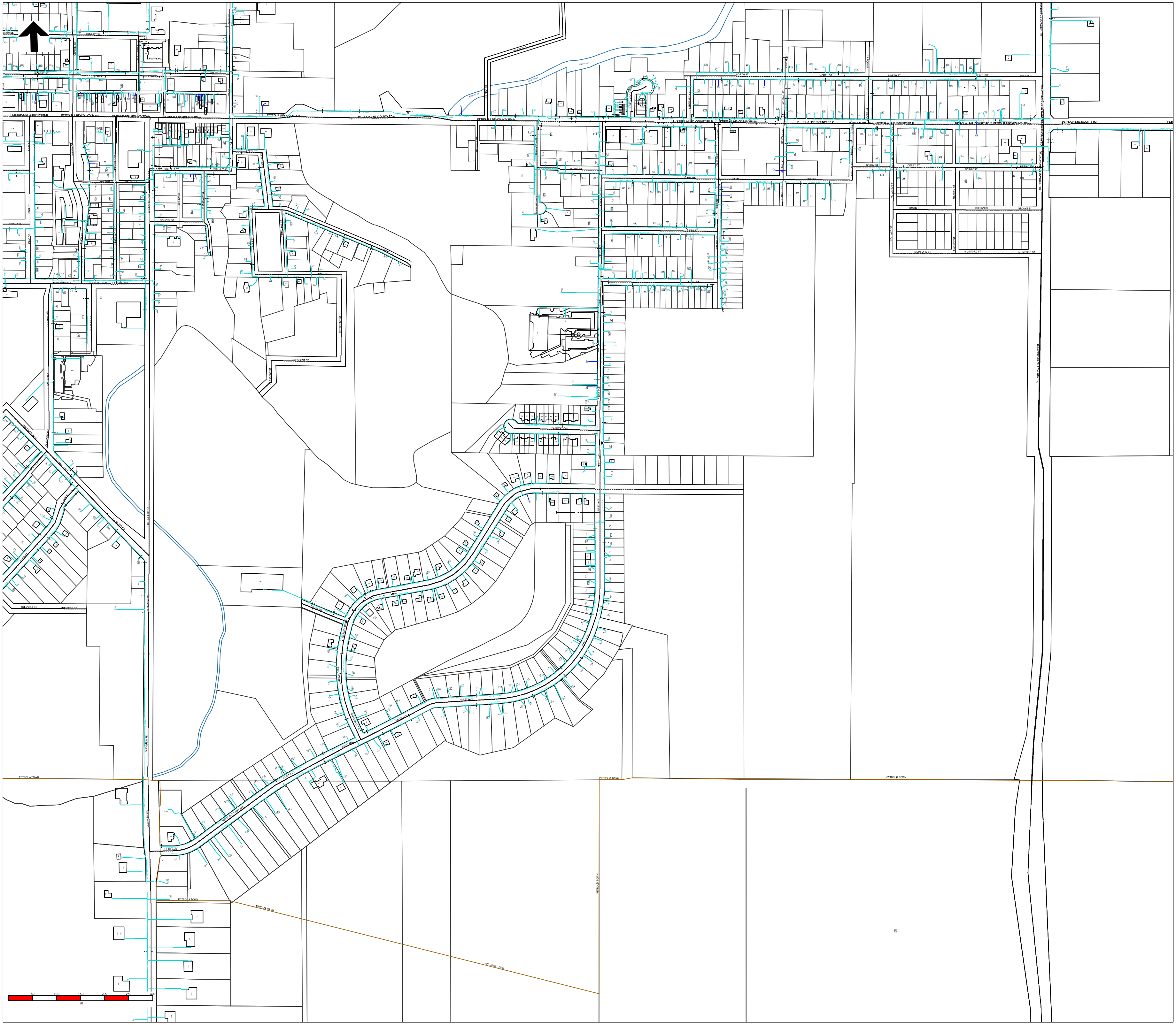
Therefore Know All Ye to whom this shall become known that that part of the territory extending from the point of intersection of the northerly limit of the lands as described in the said Indenture with the waters edge of Lake Huron, to the International Boundary and south to the point of intersection of the Southerly limit of the lands with the waters edge of the River St. Clair, to the International Boundary, and their and every of their appurtenances lying and being or thereto belonging or in anywise appertaining, are unsurrendered and the Chippewa Nation of Indians as represented by the undersigned do claim right, title and possession and the right of possession to that part of the territory and all things thereto belonging.

And further we do hereby notify all to whom this shall become known that until that part of the territory is otherwise dealt with by and with the consent and concurrence of the Chippewa Nation of Indians, each and every one who is, has or may use or enjoy any part of the territory and any of the appurtenances thereto belonging or in anywise appertaining, is trespassing, has trespassed or will commit trespass and shall be held to account, in the same manner to the same extent as provided for by the laws in effect and which may thereunto apply, including such penalties as may be imposed by Virtue of The Royal Proclamation of October 7, 1763 given at the Court of St. James by King George.

And Further we do hereby notify each and all of you who are using, have used or may use any part of the territory and any of the appurtenances thereto belonging or in anywise appertaining, to forthwith disclose your use, past, present or future and to be prepared to account to us therefor.

Dated this 23 day of July 1980.

The Chippewas of Sarnia, Kettle Point
and Stoney Point, for and on behalf of



- NOTICE -
THIS DRAWING IS FOR INFORMATION PURPOSES ONLY.
ONTARIO ONE CALL MUST BE CONTACTED FOR A NEW LINE LOCATE BEFORE EXCAVATION

1-800-400-2255

8225-2005/04

THE LOCATION OF UNION GAS FACILITIES ON THIS DRAWING IS APPROXIMATE AND IS TO BE USED FOR INFORMATION PURPOSES ONLY. UNION GAS RE- AFFIRMS THAT THIS DRAWING SHOULD NOT BE RELIED UPON TO DETERMINE THE LOCATION OF ANY OF UNION GAS' FACILITIES. EXACT LOCATES CAN BE DETERMINED BY CALLING ONTARIO ONE CALL 1-800-400-2255

SOURCE DOCUMENT INFORMATION

Qualified Individual:		Pipeline Certificate No:	
Welder / Fuser:		Ticket Number:	
In-Service Date:		G-Tech Update By: Date:	
Testing	Design Pressure:	Test Medium:	
	Time On:	Pressure:	
	Time Off:	Pressure:	

REVISIONS

Date	By	App'd	Remarks

Title : **AS - BUILT**

Description : Oil Heritage Rd, Petrolia

Project # :	CARS Ref # :	D.M.W.O. # :
District : LONDON	Municipality : Petrolia	Authorized:
Drawn By : IJELIC	Date Drawn : 2018/09/21	Corrosion:
Scale : 1:2500	GTech # : JOBNO30536	Drawing Number 1 OF 1

Ontario
Infrastructure Ontario

One Dundas Street West, Suite 2000, Toronto, ON M5G 2L5
1, rue Dundas Ouest, bureau 2000, Toronto, ON M5G 2L5

September 24, 2018

Kelly Vader
B.M. Ross and Associates
2695 Hamilton Road,
Bright Grove, ON.

Dear. Kelly Vader

RE: Municipal Class Environmental Assessment Stormwater Master Plan Servicing Study for the Petrolia Southeast Service Area.

Thanks for sending us the Notice of Commencement for **Stormwater Master Plan Servicing Study for the Petrolia Southeast Service Area**

Our records indicate that Ministry of Infrastructure (MOI) property identified by PIN N05987 might be within your project's study area. In this regard, please let us know if MOI land may be required for your project so we can advise you of our process to acquire this land. If MOI land is not required for your project, please continue to consult us as a directly affected party.

Yours Sincerely

Alex Lye
Environmental Specialist
Infrastructure Ontario
1 Dundas Street West, Suite 2000
Toronto, ON
M5G 2L5
Tel: (416) 326-0483
Email: alex.lye@infrastructureontario.ca

Kelly Vader

From: MNRF Ayl Planners (MNRF) <MNRF.Ayl.Planners@ontario.ca>
Sent: October 15, 2018 10:53 AM
To: kvader@bmross.net
Subject: MNRF Comments - Town of Petrolia – Stormwater Master Plan Servicing Study
Attachments: image002.jpg; 2018-07_SAR Screening Process_Technical Bulletin.pdf; 2018-05_SAR Reference Material Memo_AylmerDistrict.pdf; Township of Enniskillen.pdf

Ministry of Natural Resources and Forestry

615 John Street
North
Aylmer, ON N5H 2S8
Tel: 519-773-9241
Fax: 519-773-9014

Ministère des Richesses naturelles et des Forêts

615, rue John Nord
Aylmer ON N5H 2S8
Tél: 519-773-9241
Téléc: 519-773-9014

Ontario

October 15, 2018

B. M. Ross and Associates Limited
Engineers and Planners
2695 Hamilton Road, P.O. Box 400
Brights Grove, ON N0N 1C0

Subject: Town of Petrolia – Stormwater Master Plan Servicing Study

Dear Kelly Vader,

Ministry of Natural Resources and Forestry (MNRF) Aylmer District received a notice for the proposed Stormwater Master Plan Servicing Study for the Town of Petrolia on September 13, 2018. Thank for you for circulating this notice to our office, however, **please note that we have not completed a screening of natural heritage (including species at risk) or other resource values for the project at this time**. Please also note that it is your responsibility to be aware of and comply with all relevant federal or provincial legislation, municipal by-laws or other agency approvals.

This response provides information to guide you in identifying and assessing natural features and resources as required by applicable policies and legislation, and engaging with MNRF Aylmer District for advice as needed.

Natural Heritage & Endangered Species Act

- Please refer to the attached *Species at Risk Reference Guides* for a list of threatened and endangered species that may occur in your area to further inform an initial background information review for your project. Also attached is Aylmer District's *Species at Risk Reference Material Memo* intended to introduce and explain the reference guide that is attached

- Please refer to Aylmer District's *Species at Risk Screening Process Technical Bulletin* (attached) for information about the process for seeking *Endangered Species Act 2007* advice, including the information required and where to submit a request.

Petroleum Wells & Oil, Gas and Salt Resource Act

There may be petroleum wells within the proposed project area. Please consult the Ontario Oil, Gas and Salt Resources Library website (www.ogsrlibrary.com) for the best known data on any wells recorded by MNRF. Please reference the 'Definitions and Terminology Guide' listed in the publications on the Library website in order to better understand the well information available. Any oil and gas wells in your project area are regulated by the *Oil, Gas and Salt Resource Act*, and the supporting regulations and operating standards. If any unanticipated wells are encountered during development of the project, or if the proponent has questions regarding petroleum operations, the proponent should contact the Petroleum Operations Section at 519-873-4634.

Public Lands Act & Lakes and Rivers Improvement Act

Some Municipal projects may be subject to the provisions of the *Public Lands Act* or *Lakes and Rivers Improvement Act*. Please review the information on MNRF's web pages provided below regarding when an approval is required or not. Please note that many of the authorizations issued under the *Lakes and Rivers Improvement Act* are administered by the local Conservation Authority.

- For more information about the *Public Lands Act*: https://www.ontario.ca/page/crown-land-work-permits
- For more information about the *Lakes and Rivers Improvement Act*: https://www.ontario.ca/document/lakes-and-rivers-improvement-act-administrative-guide

After reviewing the information provided, if you have not identified any of MNRF's interests stated above, there is no need to circulate any subsequent notices to our office. If you have any questions or concerns, please feel free to contact me.

Sincerely,

_____

Karina Cerniavskaja
District Planner
Ministry of Natural Resources and Forestry, Aylmer District
615 John St. N. Aylmer, ON, N5H 2S8
Phone: (519) 773-4757
E-mail: MNRF.Ayl.Planners@ontario.ca

Ministry of Natural Resources and Forestry

615 John Street North
Aylmer, ON N5H 2S8
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Ontario

May 2018

Re: Aylmer District Species at Risk Reference Material for Species and Habitat Information

The Ministry of Natural Resources and Forestry (**MNRF**) has created reference material for species at risk (**SAR**) specific to each municipality in Aylmer District. This document is intended to introduce and explain the reference material that is attached.

Intended use of the reference material

- The reference material is targeted towards landowners, municipalities, consultants, and developers in Aylmer District.
- The material is meant to provide awareness of endangered and threatened SAR that have potential to occur in a specific municipality, along with brief descriptions of typical habitat and general survey recommendations for each SAR species.
- It is MNRF's expectation that consultants and their proponents will refer to the reference material prior to completing SAR field assessments, since it outlines MNRF-approved survey protocols that should be followed in order to work towards MNRF Aylmer District's expectations for ensuring due diligence under the *Endangered Species Act, 2007* (**ESA**).
- The material is not meant to replace species and/or habitat surveys conducted by a qualified biologist, but help scope the field assessments.
- If you are intending to conduct a project that has known occurrences of SAR or a high likelihood of SAR in the area, MNRF (ESA.Aylmer@ontario.ca) should be contacted early in the process; see our attached SAR Screening Process Technical Bulletin outlining how to submit a screening request.
- During the SAR screening process, MNRF can provide site-specific information regarding:
  - likelihood of SAR species and/or habitat occurring;
  - whether a qualified professional should be retained for field assessments;
  - SAR survey methodologies to demonstrate due diligence under the ESA; and,
  - options to avoid contravening the ESA or ways to acquire approval, if required.

General information and disclaimers

- The Species at Risk in Ontario (**SARO**) List is prescribed by Ontario Regulation 230/08 issued under the ESA. The ESA provides protection for endangered and threatened species listed on the SARO List, and their habitats. The ESA is a law of General Application that is binding on everyone (e.g. landowners, corporations, municipal and provincial governments) in the province of Ontario and applies to both private and public lands.
- Please note that the province has not been comprehensively surveyed and MNRF data relies on observers to report sightings. As such, the absence of a species from the municipal list does not guarantee the absence of SAR species or habitat in the specific municipality.

- It is important to note that the reference material may be updated annually but MNRF's guidance on SAR occurrences and field assessments can change throughout the year as policies, regulations, survey protocols, SAR data, and other SAR documents are finalized.

Species and habitat information

The Committee on the Status of Species at Risk in Ontario (COSSARO) meets regularly to evaluate species for listing and/or re-evaluate species already listed. As a result, species designations may change that could in turn change the level of protection they receive under the ESA. Additionally, habitat protection provisions for a species may change over time.

- Detailed information on all species on the SARO List can be found on the MNRF website
- Ontario Regulation (O. Reg.) 242/08 should be consulted for a complete and current list of SAR habitat regulations.
- MNRF (ESA.Aylmer@ontario.ca) should be contacted for guidance on identifying habitat for species that do not have habitat regulations, general habitat descriptions, or recovery strategies available.
    - Aylmer District recommends consulting federal recovery strategies if provincial ones are not available (http://www.registrelep-sararegistry.gc.ca/sar/recovery/recovery_e.cfm)

Conducting adequate surveys

- SAR surveys must be undertaken by a qualified professional who has experience with the target species and/or habitat.
- MNRF approvals or authorizations (e.g. permit under clause 17(2)(b) of the ESA or registry under O. Reg. 242/08, authorization under the *Fish and Wildlife Conservation Act*, and an approved animal care protocol) may be required to conduct SAR surveys.
- MNRF has finalized survey protocols for some SAR species, which are specified in the reference material, and these protocols can be obtained from Aylmer District upon request.
- It is strongly recommended that Aylmer District be consulted prior to conducting species surveys to confirm if surveys are necessary to determine if a project may contravene the ESA, and that surveys are conducted using appropriate methods and effort.

Additional information sources

The reference material was populated using Natural Heritage Information Centre (NHIC) data and additional information available to MNRF Aylmer District. There are additional sources of SAR information, including for species of special concern and provincially rare species that both receive consideration under the Provincial Policy Statement (2014), such as:

- Your local Conservation Authority
- Land Information Ontario
- Ontario Make a Natural Heritage Map tool
- Fisheries and Oceans Canada
- Breeding Birds of Ontario
- eBird
- Ontario Reptile and Amphibian Atlas

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Technical Bulletin: Aylmer District Species at Risk Screening Process

This technical bulletin outlines the process for engaging the Ministry of Natural Resources and Forestry (**MNRF**) Aylmer District Office regarding the *Endangered Species Act, 2007* (**ESA**).

The ESA provides protection for species listed as Endangered or Threatened on the Species at Risk in Ontario List. Individuals receive protection under Section 9 and their habitat is protected under Section 10. The ESA is a law of general application that is binding on everyone in the province of Ontario, and applies to both private and public lands. MNRF Aylmer District provides review of a project's compliance under the ESA by responding to species at risk (**SAR**) information requests (Stage 1) and project screening requests (Stage 2) only when both of the following conditions are met:

1. The request comes directly from the property owner or their delegate (e.g. consultants) on their behalf; and,
2. A specific project/activity is proposed by the property owner.

MNRF Aylmer District Contact Information

All ESA-related requests must be submitted to MNRF Aylmer District via our ESA inbox at ESA.Aylmer@ontario.ca

> ***NOTE:*** *MNRF response time is between 10 and 12 weeks after receipt of all required information, due to the high volume of requests received.*

Stage 1: Information Request

To ensure due diligence under the ESA, MNRF encourages property owners and/or their delegates proposing to conduct site alteration (such as construction, vegetation/debris removal, site grading, etc.) to request SAR information from Aylmer District prior to beginning site alteration and/or conducting SAR surveys. For MNRF to respond to an information request, the following information is required:

- Proponent information (name, mailing address, and email address);
- Property location and mapping (municipal address and/or lot and concession);
- Digital photos of the property, including the vegetation on-site, if available;
- General description of all proposed activities and extent of development footprint (e.g. residential, driveway, vegetation clearing). Maps / site layout drawings are beneficial;
- Current state of vegetation, property maintenance/management (e.g. frequency of mowing), and recent property landscape history / changes (i.e. for the last five years);
- Timing and duration of proposed activities;
- Copies of past correspondence with MNRF about the property, if applicable; and,
- Status of municipal planning or Environmental Assessment process, if any.

Once the above information has been provided, MNRF will review available SAR data to determine if SAR species and/or their habitat(s) are known or likely to occur on or in the general area of the property. MNRF's response will be one of the following:

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1. There is a **low** likelihood for SAR species and/or habitat to occur and/or be impacted
   - Further project screening / comment from MNRF will not be needed unless recommendations to avoid impacts cannot be followed or significant changes to the project are made (e.g. natural vegetation proposed to be removed).

2. SAR species and/or habitat are **known** to occur on or near the property, or there is a **high** likelihood for SAR species and/or habitat to occur
   - MNRF may recommend that field assessments by a qualified biologist are needed to determine whether the proposed project may contravene the ESA.
     - It is expected that the retained qualified biologist will use the information provided by MNRF to scope and design the field assessments, including identifying appropriate species-specific survey methodologies and timing.
     - MNRF can provide guidance on field assessments (i.e. protocols or proposed work plans). Some field assessment methodologies may require MNRF authorizations under the ESA and the *Fish and Wildlife Conservation Act*.
   - After field assessments have been completed, proceed to Stage 2.

   NOTE: *MNRF strongly recommends that no on-site activity (i.e. site alteration, vegetation/debris removal, etc.) occur until Stage 2 is complete, in order for proponents to demonstrate due diligence and remain in compliance with the ESA. Failure to comply with this recommendation could result in a contravention of the ESA and possible compliance / enforcement action.*

Stage 2: Project Screening / IGF Review

Following MNRF's recommendations, a qualified biologist should complete appropriate field assessments and submit the results in an Information Gathering Form (**IGF**) to initiate a project screening request.

Link to IGF:
http://www.forms.ssb.gov.on.ca/mbs/ssb/forms/ssbforms.nsf/MinistryResults?Openform&SRT=T&MAX=5&ENV=WWE&STR=1&TAB=PROFILE&MIN=018&BRN=21&PRG=31

MNRF will review the IGF to determine whether the project is likely to contravene the ESA (Section 9 and/or Section 10). MNRF's response will be one of the following:

1. Contravention under the ESA is **not likely** to occur:
   - A response will be provided, which could include recommendations necessary to avoid impacts to SAR; or,

2. Contravention under the ESA is **likely** to occur:
   - MNRF will recommend options for seeking approval under the ESA, such as applying for a permit or assessing eligibility for alternative regulatory processes. Please be advised that applying for a permit does not guarantee approval and processes can take several months before a permit may be issued.

Township of Enniskillen

Municipal Species at Risk Reference Guide

Birds

Acadian Flycatcher — **Endangered** — Species Protection ☑ Regulated Habitat Protection ☐ General Habitat Protection ☑

Habitat Information
Occupies a broad spectrum of deciduous and mixed woodlands of variable size across its breeding range. Refer to the Provincial Recovery Strategy (2016).
https://www.ontario.ca/page/acadian-flycatcher

Timing Windows
Migratory bird that may be present in Ontario from April through September.

Survey Protocol
Follow Breeding Bird Survey Protocol as applicable, conducting three rounds of surveys during the breeding window.
http://www.ec.gc.ca/reom-mbs/default.asp?

Bank Swallow — **Threatened** — Species Protection ☑ Regulated Habitat Protection ☐ General Habitat Protection ☑

Habitat Information
Bank swallows nest in burrows in natural and human-made settings where there are exposed and inclined areas of erodable substrate like silt or sand, such as banks of rivers and lakes, roadsides, aggregate pits, and stock-piled materials. Refer to the Provincial Recovery Strategy (2016) and contact ESA.Aylmer@Ontario.ca for the General Habitat Description (not yet available online).
https://www.ontario.ca/page/bank-swallow

Timing Windows
Migratory bird most commonly seen in Ontario from April through September.

Survey Protocol
Survey for burrows in potential habitat features and identify habitat according to the species general habitat description. Follow Breeding Bird Survey Protocol to assess habitat occupancy, conducting three rounds of surveys during the breeding window.
http://www.ec.gc.ca/reom-mbs/default.asp?

Barn Owl — **Endangered** — Species Protection ☑ Regulated Habitat Protection ☑ General Habitat Protection ☐

Habitat Information
Barn Owls are known to nest in both natural structures (e.g. hollows in trees or banks) and human-made structures (e.g. nest boxes, barns and other shelters with access). Refer to the Provincial Recovery Strategy (2010) and Ontario Regulation 242/08.
https://www.ontario.ca/page/barn-owl

Timing Windows
May be present year-round. Egg dates recorded in Ontario have occurred from March through October.

Survey Protocol
No standardized species protocol available; contact ESA.Aylmer@Ontario.ca to request specific advice on conducting adequate surveys for your project.

Barn Swallow — **Threatened** — Species Protection ☑ Regulated Habitat Protection ☐ General Habitat Protection ☑

Habitat Information	Timing Windows	Survey Protocol
Barn Swallow nests in Ontario are commonly situated inside or outside of buildings and other man-made shelters, under bridges and piers and in road culverts. Refer to the Provincial Recovery Strategy (2014) and the General Habitat Description. https://www.ontario.ca/page/barn-swallow	Migratory bird most commonly seen in Ontario from April through September.	Survey structures for the presence of nest cups. Identify habitat according to the species general habitat description. http://www.ec.gc.ca/reom-mbs/default.asp?

Bobolink	**Threatened**	Species Protection ☑	Regulated Habitat Protection ☐	General Habitat Protection ☑

Habitat Information	Timing Windows	Survey Protocol
Nests in grassland-like habitats typically greater than 2 hectares, such as hayfield, pasture, alfalfa, winter wheat, old/overgrown fields, prairie, savannah, and meadow or meadow marsh. Refer to the Provincial Recovery Strategy (for Bobolink and Eastern Meadowlark; 2013). https://www.ontario.ca/page/bobolink	Migratory bird most commonly seen in Ontario from May to September.	Contact ESA.Aylmer@ontario.ca to obtain a copy of the MNRF draft Bobolink breeding survey protocol (2011).

Cerulean Warbler	**Threatened**	Species Protection ☑	Regulated Habitat Protection ☐	General Habitat Protection ☑

Habitat Information	Timing Windows	Survey Protocol
Typically occur in mature deciduous woodlands. Has been found breeding in tracts as small as 10 hectares in Ontario. Refer to COSEWIC Assessment and Status Report (2010). https://www.ontario.ca/page/cerulean-warbler	Migratory bird most commonly seen in Ontario from May to August.	Follow Breeding Bird Survey Protocol as applicable, conducting three rounds of surveys during the breeding window. http://www.ec.gc.ca/reom-mbs/default.asp?

Chimney Swift	**Threatened**	Species Protection ☑	Regulated Habitat Protection ☐	General Habitat Protection ☑

Habitat Information	Timing Windows	Survey Protocol
They typically nest and roost in chimneys and other man-made structures. Can also nest in hollow trees or tree cavities. Refer to COSEWIC Assessment and Status Report (2007) and the General Habitat Description. https://www.ontario.ca/page/chimney-swift	Migratory bird most commonly seen in Ontario from mid-April to mid-October.	Follow the Ontario Swift Watch Protocol by Bird Studies Canada (2015). Identify habitat according to the general habitat description. http://www.bsc-eoc.org/volunteer/ai/resour

Eastern Meadowlark	**Threatened**	Species Protection ☑	Regulated Habitat Protection ☐	General Habitat Protection ☑

Habitat Information

Breed primarily in grassland-like habitats, such as pastures and hayfields (including alfalfa), meadow and meadow marsh, old/overgrown fields, prairie, savannah, weedy borders of croplands, roadsides, orchards, gold courses, and other open areas, typically greater than 3 hectares. Refer to the Provincial Recovery Strategy (for Bobolink and Eastern Meadowlark; 2013).

https://www.ontario.ca/page/eastern-meadowlark

Timing Windows

Migratory bird most commonly seen in Ontario from March through October.

Survey Protocol

Contact ESA.Aylmer@ontario.ca to obtain a copy of the MNRF draft Eastern Meadowlark breeding survey protocol (2013) .

Least Bittern **Threatened** Species Protection ☑ Regulated Habitat Protection ☐ General Habitat Protection ☑

Habitat Information

Found in marshes, often where vegetation cover is interspersed with areas of open water. They can be found in smaller isolated marshes though most known occurrences are in larger wetlands. Refer to the Provincial Recovery Strategy (2016).

https://www.ontario.ca/page/least-bittern

Timing Windows

Migratory bird most commonly seen in Ontario from May through September.

Survey Protocol

Follow the National Least Bittern Survey Protocol, CWS Technical Report Series no. 519 (2011). Contact ESA.Aylmer@ontario.ca for more information if needed.

Prothonotary Warbler **Endangered** Species Protection ☑ Regulated Habitat Protection ☐ General Habitat Protection ☑

Habitat Information

Key features are presence of water near wooded area with suitable cavity nest sites or nest boxes. Nests usually occur near large bodies of standing or slow-moving water, such as seasonally flooded forest, swamps, rivers, streams, ponds, or lakes. Refer to the Provincial Recovery Strategy (2012).

https://www.ontario.ca/page/prothonotary-warbler

Timing Windows

Migratory bird most commonly seen in Ontario from May through August.

Survey Protocol

Follow Breeding Bird Survey Protocol as applicable, conducting three rounds of surveys during the breeding window.

http://www.ec.gc.ca/reom-mbs/default.asp?

Yellow-breasted Chat **Endangered** Species Protection ☑ Regulated Habitat Protection ☐ General Habitat Protection ☑

Habitat Information

A wide variety of early-successional habitats are used (i.e., dense, low deciduous or coniferous vegetation), including early shrubby regrowth on abandoned agricultural fields, power-line corridors, clear-cuts, fencerows, forest edges and openings, and areas near streams, ponds and swamps. Refer to the COSEWIC Assessment and Status report (virens subspecies; 2012).

https://www.ontario.ca/page/yellow-breasted-chat

Timing Windows

Migratory bird most commonly seen in Ontario from May through August.

Survey Protocol

Follow Breeding Bird Survey Protocol as applicable, conducting three rounds of surveys during the breeding window.

http://www.ec.gc.ca/reom-mbs/default.asp?

Fish and Mussel SAR

Fish and Mussel SAR	**Threatened and Endangered**	Species Protection ☑	Regulated Habitat Protection ☑	General Habitat Protection ☑

Habitat Information	Timing Windows	Survey Protocol
Consult DFO mapping (http://www.dfo-mpo.gc.ca/species-especes/fpp-ppp/index-eng.htm) to determine if species at risk and/or their habitat may be in or near the proposed project area, and contact ESA.Aylmer@ontario.ca (and/or DFO) for site-specific information or advice as applicable.		

https://www.ontario.ca/environment-and-energy/species-risk-ontario-list

http://www.dfo-mpo.gc.ca/species-especes

Herbaceous

American Ginseng	**Endangered**	Species Protection ☑	Regulated Habitat Protection ☐	General Habitat Protection ☑

Habitat Information	Timing Windows	Survey Protocol
American Ginseng typically grows in rich, moist, but well-drained, and relatively mature, deciduous woods dominated by Sugar Maple, White Ash and American Basswood. It usually grows in deep, nutrient rich soil over limestone or marble bedrock. Refer to the general habitat description (2013) and the federal recovery strategy (2015).	American Ginseng plants are typically found from May to late September. Refer to protocol for details.	Draft Site Occupancy Survey Protocol for American Ginseng in Ontario (2013) - contact MNRF Aylmer District for more information.

https://www.ontario.ca/page/american-ginseng

Goldenseal	**Threatened**	Species Protection ☑	Regulated Habitat Protection ☐	General Habitat Protection ☑

Habitat Information	Timing Windows	Survey Protocol
Grows in rich, moist semi-open to closed areas of deciduous forests. Found at periodically flooded upland sites and in moist lowlands near floodplains. Associated with Red Oak, Sugar Maple, Hawthorns, Shagbark Hickory, Ironwood and Basswood. Typically grows in disturbed areas where trees have fallen, or next to recreational paths or woodland edges. Prefers sandy loam, loam soils or clay soils depending on whether it is growing in an upland or lowland area. Refer to the provincial recovery strategy (2016).	Flowers April - May; fruit ripens July-August.	No standardized species protocol available; contact ESA.Aylmer@Ontario.ca to request specific advice on conducting adequate surveys for your project.

https://www.ontario.ca/page/goldenseal

Lizard

Common Five-lined Skink (Carolinian population)	**Endangered**	Species Protection ☑	Regulated Habitat Protection ☑	General Habitat Protection ☐

Habitat Information	Timing Windows	Survey Protocol
Common Five-lined Skinks habitat includes sand dunes, savannah, forest clearings and edges. They over-winter in crevices among rocks or buried in the soil. Refer to the provincial recovery strategy (2010), Ontario Regulation 242/08, and the habitat protection summary (2012). https://www.ontario.ca/page/common-five-lined-skink	Active from April to early October: Courtship and mating in May, nest site selection in June, Egg-laying and brooding young in July.	No standardized species protocol available; contact ESA.Aylmer@Ontario.ca to request specific advice on conducting adequate surveys for your project.

Mammals

Eastern Small-footed Myotis	**Endangered**	Species Protection ☑	Regulated Habitat Protection ☐	General Habitat Protection ☑

Habitat Information	Timing Windows	Survey Protocol
Will roost in a variety of habitats changing day to day, including in trees or under tree bark, under rocks or in rock outcrops, in buildings, under bridges, etc. Over-winter in caves and abandoned mines. https://www.ontario.ca/page/eastern-small-footed-bat	Typically over-winter from about October to April.	No standardized species protocol available; contact ESA.Aylmer@Ontario.ca to request specific advice on conducting adequate surveys for your project.

Little Brown Myotis (formerly little brown bat)	**Endangered**	Species Protection ☑	Regulated Habitat Protection ☐	General Habitat Protection ☑

Habitat Information	Timing Windows	Survey Protocol
Roost habitat may include human structures such as houses, bridges, and barns, or natural features such as rock crevices and forests. May over-winter in buildings, caves, or mines. Refer to the draft federal recovery strategy (2015). https://www.ontario.ca/page/little-brown-bat	They feed at night and are most active in the two or three hours after sunset. Typically over-winter from about October to April.	No standardized species protocol available; contact ESA.Aylmer@Ontario.ca to request specific advice on conducting adequate surveys for your project.

Northern Myotis (formerly Northern Long-eared Bat)	**Endangered**	Species Protection ☑	Regulated Habitat Protection ☐	General Habitat Protection ☑

Habitat Information	Timing Windows	Survey Protocol
Roosts in tree cavities, under tree bark, in natural and artificial crevices such as rock outcrops and roof shingles. Over-winters in caves and mines. Refer to the draft federal recovery strategy (2015). https://www.ontario.ca/page/northern-long-eared-bat	Typically over-winter from about October to April.	No standardized species protocol available; contact ESA.Aylmer@Ontario.ca to request specific advice on conducting adequate surveys for your project.

Tri-colored Bat	**Endangered**	Species Protection ☑	Regulated Habitat Protection ☐	General Habitat Protection ☑

Habitat Information
Roosts in forests, and maternity colonies may be located in anthropogenic features such as barns and houses. Over-winters in caves and mines. Refer to the draft federal recovery strategy (2015).

https://www.ontario.ca/page/tri-colored-bat

Timing Windows
Typically over-winter from about October to April.

Survey Protocol
No standardized species protocol available; contact ESA.Aylmer@Ontario.ca to request specific advice on conducting adequate surveys for your project.

Trees

American Chestnut **Endangered** Species Protection ☑ Regulated Habitat Protection ☐ General Habitat Protection ☑

Habitat Information
In Ontario, it is only found in the Carolinian Zone between Lake Erie and Lake Huron. American Chestnut grows alongside Red Oak, Black Cherry, Sugar Maple, American Beech and other deciduous tree species. Refer to the provincial recovery strategy (2012).

https://www.ontario.ca/page/american-chestnut-species-risk

Timing Windows
Trees typically flower in late May to early July. Nuts mature by mid-October.

Survey Protocol
No standardized species protocol available; contact ESA.Aylmer@Ontario.ca to request specific advice on conducting adequate surveys for your project.

Blue Ash **Threatened** Species Protection ☑ Regulated Habitat Protection ☐ General Habitat Protection ☑

Habitat Information
Blue Ash grows in floodplains, river valleys, alvar and limestone, and beaches. Refer to the draft federal management plan (2016).

https://www.ontario.ca/page/blue-ash-species-risk

Timing Windows
Flowering occurs in April and May, prior to leaf-out. Seed crops are produced every 3-4 years in late fall.

Survey Protocol
No standardized species protocol available; contact ESA.Aylmer@Ontario.ca to request specific advice on conducting adequate surveys for your project.

Butternut **Endangered** Species Protection ☑ Regulated Habitat Protection ☐ General Habitat Protection ☑

Habitat Information
Butternut usually grows alone or in small groups in forests and woodlands. It prefers moist, well-drained soil and is also found on well-drained gravel sites. This species does not do well in the shade, and often grows in sunny openings and near forest edges. Refer to the provincial recovery strategy (2013).

https://www.ontario.ca/page/butternut-species-risk

Timing Windows
Flowers from April to June. Fruits reach maturity during the month of September or October in the year of pollination and usually remain on the tree until after leaf fall.

Survey Protocol
A certified butternut health assessor must assess Butternut trees. Contact ESA.Aylmer@Ontario.ca for more information.

Eastern Flowering Dogwood **Endangered** Species Protection ☑ Regulated Habitat Protection ☑ General Habitat Protection ☐

Habitat Information

Grows in deciduous or mixed forests, open woodlands, forest edges, floodplains, slopes, bluffs, ravines, roadsides, hedgerows, and along drains. Refer to the provincial recovery strategy (2010) and Ontario Regulation 242/08.

https://www.ontario.ca/page/eastern-flowering-dogwood

Timing Windows

Flowering occurs from mid-May to early June, as the leaves begin to develop. The fruits mature in August and September.

Survey Protocol

No standardized species protocol available; contact ESA.Aylmer@Ontario.ca to request specific advice on conducting adequate surveys for your project.

Kentucky Coffee-tree **Threatened** Species Protection ☑ Regulated Habitat Protection ☐ General Habitat Protection ☑

Habitat Information

Generally grows in woodlands, floodplains, forest and wetland edges, hedgerows, roadsides and urban areas. Refer to the federal recovery strategy (2014).

https://www.ontario.ca/page/kentucky-coffee-tree-species-risk

Timing Windows

Flowers appear in May and June. Fertilized flowers form seed pods which remain on the tree through the winter.

Survey Protocol

No standardized species protocol available; contact ESA.Aylmer@Ontario.ca to request specific advice on conducting adequate surveys for your project.

Turtles

Blanding's Turtle **Threatened** Species Protection ☑ Regulated Habitat Protection ☐ General Habitat Protection ☑

Habitat Information

Blanding's Turtle lives in shallow water, usually in large wetlands and shallow lakes with lots of water plants. May travel long distances from nearest waterbody, usually while searching for mates or traveling to nesting or overwintering sites. Hibernate in the mud at the bottom of permanent water bodies from late October until the end of April. Refer to the general habitat description (2013) and the draft federal recovery strategy (2016).

https://www.ontario.ca/page/blandings-turtle

Timing Windows

Mating prior to and right after overwintering, typically in April to early May, and from the end of August to end of October. Eggs are laid in from late May to early July, with hatchlings emerging in throughout September and October. Overwinter from October to April.

Survey Protocol

Survey Protocol for Blanding's Turtle (Emydoidea blandingii) in Ontario (August 2015) - contact MNRF Aylmer District for more information.

Spotted Turtle **Endangered** Species Protection ☑ Regulated Habitat Protection ☐ General Habitat Protection ☑

Habitat Information	Timing Windows	Survey Protocol
Semi-aquatic preferring ponds, marshes, bogs and even ditches with slow-moving, unpolluted water and abundant supply of aquatic vegetation. Other aquatic habitat can include vernal pools, seeps, sloughs, creeks, stormwater ponds, sheltered edges of bays, channels and drainage ditches. Strong preference for marsh meadows as well. Nests will be found in well-drained, sunny locations that are bare or have sparse vegetation. Hibernates in wetlands or seasonally wet areas associated with structures including overhanging banks, hummocks, tree roots, or aquatic animal burrows. Refer to the draft federal recovery strategy (2016) for more information.	Overwinters in underwater hibernacula for 7 to 8 months of the year, from mid-September/October to mid-late April. Basks in April. Mates begins in early spring as soon as ice/snow melt and can occur from late May through to early July.	Survey Protocol for Spotted Turtle (Clemmys guttata) in Ontario (August 2015) - contact MNRF Aylmer District for more information.

https://www.ontario.ca/page/spotted-turtle

ONTARIO MINISTRY of NATURAL RESOURCES and FORESTRY | AYLMER DISTRICT OFFICE
615 John Street N. Aylmer ON, N5H 2S8 esa.aylmer@ontario.ca

This report was produced May, 2018

Please refer to the associated Municipal Species at Risk Reference Material Memo for instructions on how to use this guide.

The Committee on the Status of Species at Risk in Ontario (COSSARO) meets regularly to evaluate new species for listing and/or re-evaluate species already on the SARO List. As a result, species designations may change, which could in turn change the protection they receive under the ESA and whether proposed projects may have adverse effects on SAR. Habitat protection provisions for a species may also change if a species-specific habitat regulation comes into effect, or as new general habitat guidance is developed based on the best available information. Additionally, the province has not been comprehensively surveyed and MNRF data relies on observers to report sightings. As such, the absence of an occurrence does not indicate the absence of SAR species or habitat, and new occurrence information may affect whether a proposed project may contravene the ESA.

Ministry of Tourism, Culture and Sport

Heritage Program Unit
Programs and Services Branch
401 Bay Street, Suite 1700
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Tel: 416 314 7643

Ministère du Tourisme, de la Culture et du Sport

Unité des programmes patrimoine
Direction des programmes et des services
401, rue Bay, Bureau 1700
Toronto ON M7A 0A7
Tél: 416 314 7643

16 October 2018 EMAIL ONLY

Kelly Vader
Environmental Planner
BM Ross and Associates Limited
2695 Hamilton Road
P.O. Box 400
Brights Grove, ON N0N 1C0
kvader@bmross.net

MTCS File	**:**	**0009672**
Proponent	**:**	**Town of Petrolia**
Subject	**:**	**Notice of Commencement under the Municipal Class EA Process**
Project	**:**	**Stormwater Servicing Master Plan for the Petrolia Southeast Servicing Study**
Location	**:**	**Southeast Neighbourhood, Town of Petrolia**

Dear Ms. Vader:

Thank you for providing the Ministry of Tourism, Culture and Sport (MTCS) with the Notice of Commencement for the above-referenced project. MTCS's interest in this Environmental Assessment (EA) project relates to its mandate of conserving Ontario's cultural heritage, which includes:

- Archaeological resources, including land and marine;
- Built heritage resources, including bridges and monuments; and,
- Cultural heritage landscapes.

Under the EA process, the proponent is required to determine a project's potential impact on cultural heritage resources. The recommendations below are for a Municipal Class EA project, as described in the notice of study commencement. If any municipal bridges may be impacted by this project, we can provide additional screening documentation as formulated by the Municipal Engineers Association in consultation with MTCS.

Realizing that this is in part a Master Plan, developing or reviewing inventories of known and potential cultural heritage resources within the study area can identify specific resources that may play a significant role in guiding the evaluation of alternatives for subsequent project-driven EAs.

Project Summary
The Town of Petrolia is undertaking a Municipal Class Environmental Assessment to inventory and evaluate existing stormwater facilities so as to create a best practices and strategies for providing stormwater servicing within future development areas. The study area is generally bounded by Oil Heritage Road, Third Street/ Bear Creek and the southern boundary of Concession 10, from Glenview Road to First Avenue.

Identifying Cultural Heritage Resources
While some cultural heritage resources may have already been formally identified, others may be identified through screening and evaluation. Indigenous communities may have knowledge that can contribute to the identification of cultural heritage resources, and we suggest that any engagement with Indigenous communities includes a discussion about known or potential cultural heritage resources that are of value to these communities. Municipal Heritage Committees, historical societies and other local heritage organizations may also have knowledge that contributes to the identification of cultural heritage resources.

Archaeological Resources
This EA project may impact archaeological resources and should be screened using the MTCS *Criteria for Evaluating Archaeological Potential* and *Criteria for Evaluating Marine Archaeological Potential* to determine if an archaeological assessment is needed. MTCS archaeological sites data are available at *archaeology@ontario.ca*. If the EA project area exhibits archaeological potential, then an archaeological assessment (AA) should be undertaken by an archaeologist licenced under the *OHA*, who is responsible for submitting the report directly to MTCS for review.

Built Heritage and Cultural Heritage Landscapes
The MTCS *Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes* should be completed to help determine whether this EA project may impact cultural heritage resources. The Clerk for the Town of Petrolia can provide information on property registered or designated under the *Ontario Heritage Act*. Municipal Heritage Planners can also provide information that will assist in completing the checklist.

If potential or known heritage resources exist, MTCS recommends that a Heritage Impact Assessment (HIA), prepared by a qualified consultant, should be completed to assess potential project impacts. Our Ministry's *Info Sheet #5: Heritage Impact Assessments and Conservation Plans* outlines the scope of HIAs. Please send the HIA to MTCS and the Town of Petrolia for review, and make it available to local organizations or individuals who have expressed interest in review.

Environmental Assessment Reporting
All technical cultural heritage studies and their recommendations are to be addressed and incorporated into EA projects. Please advise MTCS whether any technical heritage studies will be completed for this EA project, and provide them to MTCS before issuing a Notice of Completion or commencing any work on the site. If screening has identified no known or potential cultural heritage resources, or no impacts to these resources, please include the completed checklists and supporting documentation in the EA report or file.

Thank you for consulting MTCS on this project and please continue to do so throughout the EA process. If you have any questions or require clarification, do not hesitate to contact me.

Sincerely,

Katherine Kirzati
Heritage Planner
katherine.kirzati@ontario.ca

TOWN OF PETROLIA

NOTICE OF PUBLIC INFORMATION CENTRE

STORMWATER DRAINAGE MASTER PLAN FOR THE SOUTHEAST DEVELOPMENT AREA

PUBLIC INFORMATION CENTRE

The Town of Petrolia is preparing a Stormwater Drainage Master Plan for the southeast development area of Petrolia to address drainage issues within developed areas of the community as well as future development lands. Master Plan investigations completed to date have evaluated the condition of existing stormwater drainage infrastructure within the study area and identified a strategy for dealing with stormwater servicing within future development areas.

A Public information session is planned to present details of the Master Plan recommendations to study area residents in order to obtain their feedback before finalizing the Master Plan process. Representatives of the Town of Petrolia and the Project Engineers will be in attendance.

PUBLIC MEETING

DATE:	**Wednesday July 10, 2019**
LOCATION:	**Petrolia Council Chambers** **411 Greenfield Street, Petrolia**
TIME:	**5:00 pm**

Town of PETROLIA
you'll be surprised!

BMROSS
engineering better communities

File: 17065

TOWN OF PETROLIA
STORMWATER DRAINAGE MASTER PLAN
SOUTHEAST DEVELOPMENT AREA

PUBLIC INFORMATION MEETING

July 10, 2019

COMMENTS/QUESTIONS

Name: _____

Address: _____

_____

_____

_____

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PLEASE HAND IN, MAIL, OR FAX TO:

B. M. ROSS AND ASSOCIATES LIMITED
Engineers and Planners
2695 Hamilton Road, Box 400
Brights Grove, Ontario
N0N 1C0

Phone: (519) 908-9564 Fax: (519) 524-4403
Email: kvader@bmross.net
Attention: Kelly Vader, Environmental Planner

Comments and Information collected by B.M. Ross & Associates Limited on behalf of the Town of Petrolia will assist in coordinating public consultation for the project. Comments and opinions will be kept on file but will not be included in project documentation made available for public review. Under the Freedom of Information and Protection of Privacy Act, R.S.O. 1990, personal information provided to BMROSS will remain confidential unless prior consent is obtained.

MINUTES
Public Information Meeting - Master Drainage Plan
July 10, 2019 Council Chambers, Victoria Hall 5:00 PM

COUNCIL PRESENT:	Councillor - Joel Field Councillor - Ross O'Hara Councillor - Marty Souch Councillor - Don Welten
COUNCIL ABSENT:	Mayor - Brad Loosley Councillor - Wade Deighton Councillor - Grant Purdy
STAFF PRESENT:	Rick Charlebois, Chief Administrative Officer/Treasurer Mandi Pearson, Clerk/Operations Clerk Mike Thompson, Director of Operations
STAFF ABSENT:	Jay Arns, Fire Chief, Director of Protective Services Laurissa Ellsworth, Director of Marketing, Arts & Communications Dave Menzies, Director Facilities & Community Services
MEDIA PRESENT:	The Independent

Page

1 CALL TO ORDER

- Councillor Field called the meeting to order at 5:00 PM, and acted as Chair.

2 ROLL CALL

- Mandi Pearson, Clerk/Operations Clerk completed roll call.

3 DECLARATION OF PECUNIARY INTEREST

4 PURPOSE OF MEETING

Councillor Field noted that the Town of Petrolia is preparing a Stormwater Drainage Master Plan for the southeast development area of Petrolia to address drainage issues within developed areas of the community as well as future development lands. This meeting is a public information session to present the details of the Master Plan recommendations to study area residents in order to obtain their feedback before finalizing the Master Plan process. Representatives of the Town of Petrolia and the Project Engineers are in attendance tonight.

There will be no decisions made tonight, at a future date items will come forward to Council during a regular council meeting at a future date.

5 PRESENTATIONS

a) Ms. Kelly Vader & Mr. Dale Erb 4 - 44

- BM Ross Engineering

2019 BM Ross - Master Draignage Plan Presentation

6 OPPORTUNITY FOR PUBLIC INPUT

a) Name: Shawn Ritchie
Address: Third Street
Comment:
1. will this stop the Ball Diamond at Kerr Park from flooding?
2. I have had to install 3 sump pumps to address water.

b) Name: Alison Mavis
Address: Fourth Street
Comment: time lines for future development.

Councillor Field noted that those are developers timelines, and the moment there are several ideas being presented by the development community.

c) Name: Barry Young
Address: Garden Crescent
Comment: for past 15 years have had concerns with drainage.

d) Name: Pat Davis
Address: Garden Crescent
Comment: the outlet into Bear Creek, does the work on the pond assist other areas.

Mr. Erb: it is future development lands that will receive the most benefit from the pond.

e) Name: Neil Armstrong
Address: Garden Crescent
Comment: presented photo of the front yard from last weeks storm and the ponding in the yard from last Thursday.

f) Name: Jim Gould
Address: First Ave
Comment: P7, outlet G on my property opens up to a ditch with major erosions, will this be addressed.

Mr. Erb: yes, this will be part of the master plan.

g) Name: Jane Renier
Address: First Ave
Comment: would like to have clarification of where property drains to.

Ms. Vader confirmed, into the Grenezin Drain.

h) Name: Dave Currie

Address: First Ave
Comment: level of pond will drop 3 feet, large population of painted and snapper turtles are a concern for their habitat.

i) Name: Tim West
Address: First Ave
Comment: was the drive for this developer based?

Mr. Erb: this was governed by Petrolia is recognition that development was coming, and wanted assurance of a plan that would service the whole area properly.

j) Name: Mike Hart
Address: fourth Street
Comment: understand that the whole area has drainage issues, it would be nice to see the existing concerns addressed

k) Name: Larry Lewis
Address: Garden Crescent
Comment: concern with the existing system not being addressed before development as a priority.

l) Name: Bonnie Elliott
Address: Sixth Street
Comment: who do I speak to about the rear yard drainage, I have a concern with.

Councillor Field noted, that rear yard drainage is at the property owners responsibility, we will identify an outlet at the road, where a rear yard catch basin could be installed by the homeowner.

7 ADJOURNMENT

- Meeting officially closed at 6:12 PM

_____

Joel Field
Acting Mayor

_____

Mandi Pearson
Clerk/Operations Clerk

TOWN OF PETROLIA

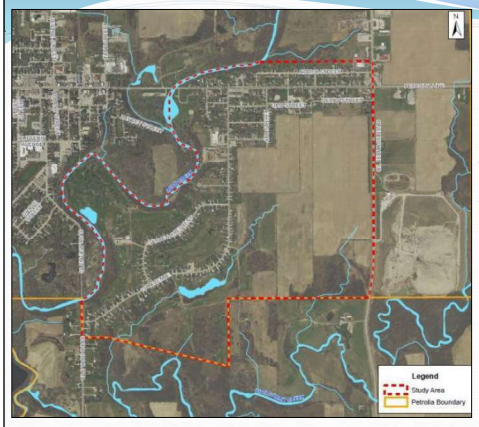
Stormwater Drainage Master Plan

Southeast Development Area

Public Information Meeting
July 10, 2019

Agenda

- Introduction
- Project Scope
- Master Plan Process
- Investigations
- Stormwater Management Model and Results
- Problem Areas
- Report Recommendations
- Next Steps



Project Study Area

- Southeast Development Area
- Mix of existing and vacant future development lands

Master Plan Study Scope

- Examine existing stormwater drainage facilities in the study area and complete inventories of structures
- Develop recommendations for improvements within existing developed areas and future development lands (Areas Designated in the Official Plan)
- Identify general areas of concern which need to be addressed – **Not Individual Lot Grading Problems**
- Consult with Local Residents and Review Agencies
- Develop a List of Priority Upgrades to Include in Capital Works Plan
- Prepare a report documenting the Master Plan process and study recommendations

Features of a Master Plan

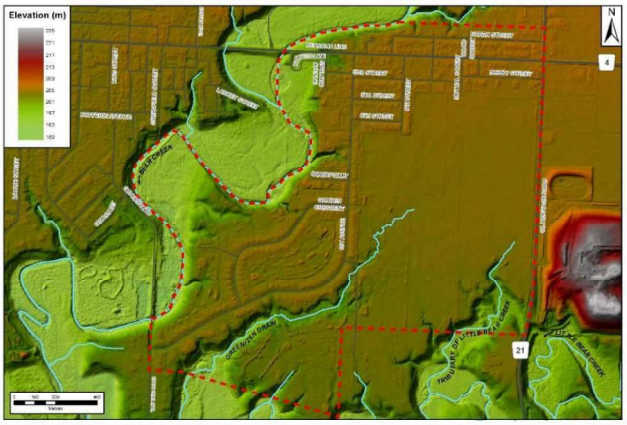
- Takes a System Wide Approach to Planning which relates Infrastructure either Geographically or by Function
- Recommends projects to be implemented over an extended period of time
- Addresses at minimum the First Two Phases of the Municipal Class EA and can also cover other phases
- Can be completed to Address Schedule B Activities
- Recommends an Infrastructure Master Plan which can be Implemented through the completion of separate individual projects

INVESTIGATIONS

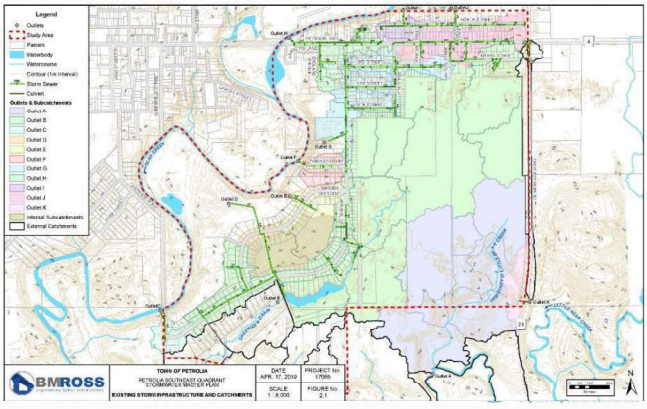
Inventory of Existing Facilities

- Photo Documentation of Study Area
- Collection and review of existing infrastructure details from Town and recent developments
- Infrastructure survey to confirm details of existing facilities
  - Pipe Inverts and size
  - Pipe gradients and current condition
  - Location and condition of outlets
- Review of digital elevation information and drainage reports to determine drainage catchments

Topography



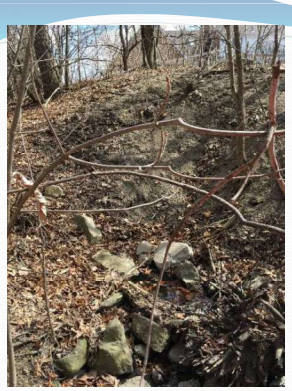
Drainage Catchments



Existing Outlets

Outlet from MH 150

Outlet from CB 28

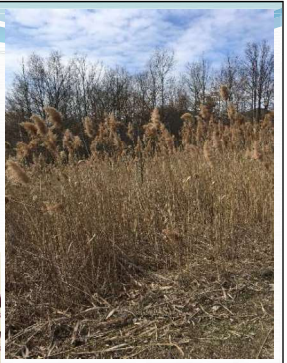


Outlet from CB 50

Existing Outlets

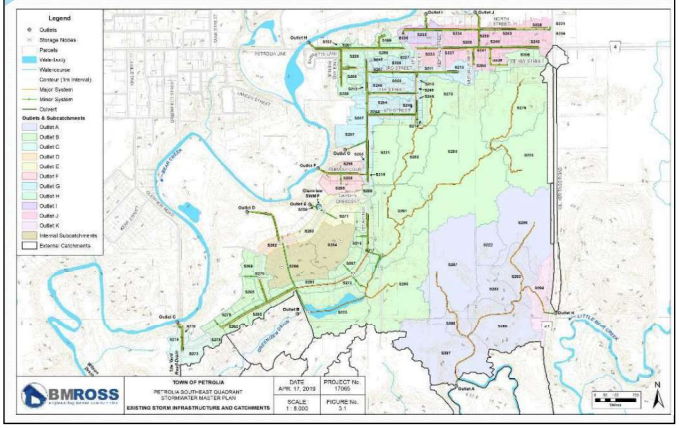
Pond

Pond Structure



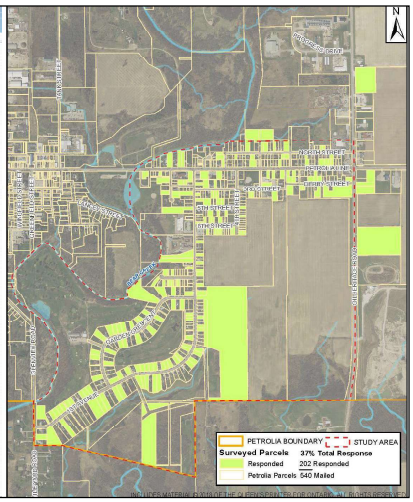
Berm

Existing storm infrastructure and Catchments

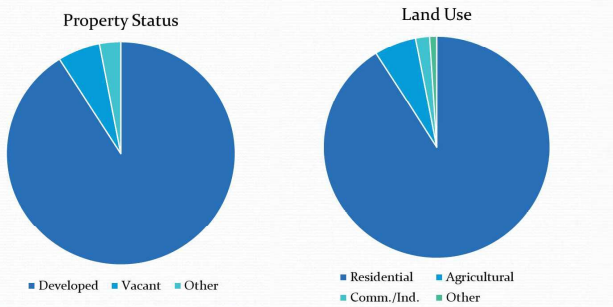


Survey Responses

- 540 Mailed Out
- 202 Questionnaires Returned
- Approximately 37%



Questionnaire Results



- 202 Questionnaires Returned
- Approximately 37%

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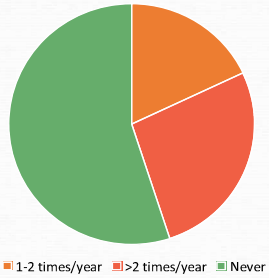
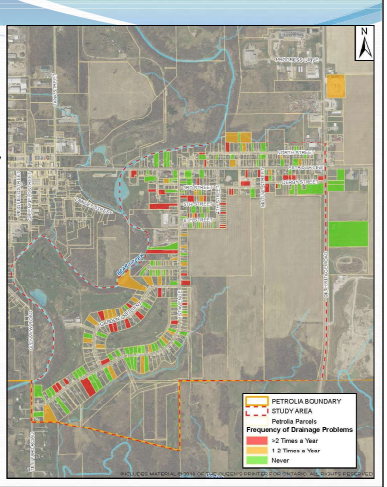
Questionnaire Results

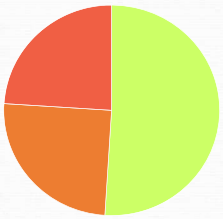
Drainage problems on Property

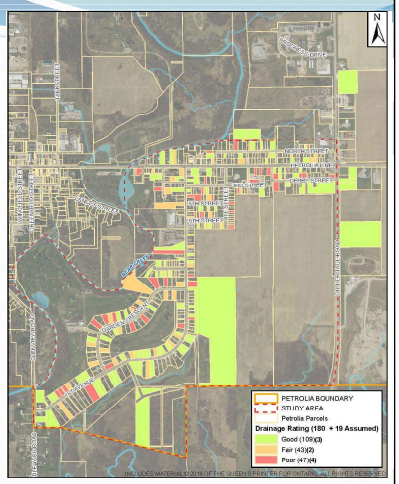




Questionnaire Results

Lot Drainage





SWM Model

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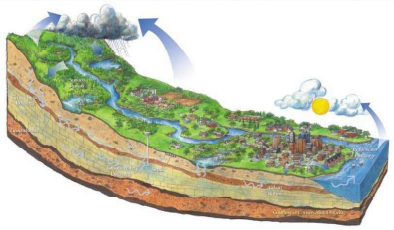
What is Stormwater Management?

- Replicating a Natural System – hydrologic cycle
- Water Quality and Water Quantity
- Major and Minor Systems
- Lot level controls vs End of Pipe



SWM Model Setup and Results

- The hydrological and hydraulic model PCSWMM™ was used to evaluate storm runoff for the modelled area of the community.
- Creates a dynamic GIS-based model that allows for dual drainage system design, wherein surface flows routed overland (major runoff) are simultaneously modelled with underground flow components (minor system: ditches, culverts and/or storm sewers).
- Flows generated from catchments areas are sent to a road node. Flows are allowed to enter the storm sewer system based on the inlet capacity of catch basins along the road. Flows from the sewer are also allowed to surcharge to the surface if capacity is exceeded.
- The interconnection between the minor and major system provides a detailed assessment of both systems, capacity restrictions and ponding depths.

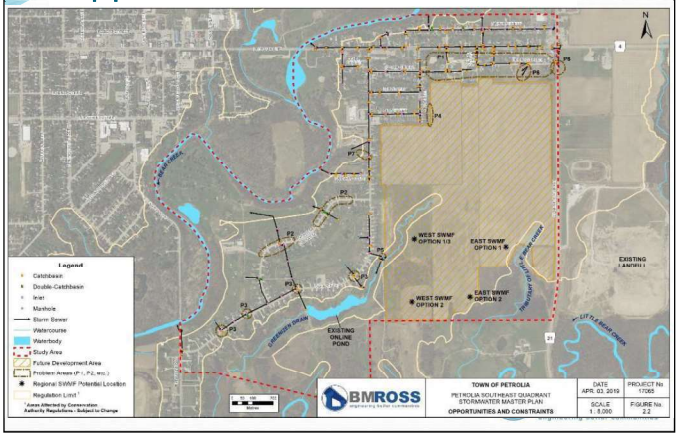
PROBLEM AREAS

Problem Areas

Photo sent in by resident

- Water Ponding on Roads
- Undersized storm sewers - surcharging
- No curb and gutters in some areas
- Inlets blocked/not maintained
- Drainage from fields entering rear yards

Opportunities and Constraints



Opportunities and Constraints

P1 – Lack of consistent stormwater infrastructure mainly on Derby, Holland, Mutual, Kentail and Third St. (east of Fourth)

- Rural cross-section with ad-hoc drainage infrastructure, CB's in need of maintenance

P2 - Lack of storm conveyance infrastructure along Garden Cr.

- Low road gradient and significant CB spacing (>110m max. recommended spacing) leads to nuisance water ponding on road, also identified through the public survey.

P3 - Surface ponding along First Avenue at low points.

- Insufficient storm sewer capacity to convey flows.

Opportunities and Constraints cont'd

P4 – Drainage from agricultural lands ponds on private property along Fourth Avenue and First Avenue.

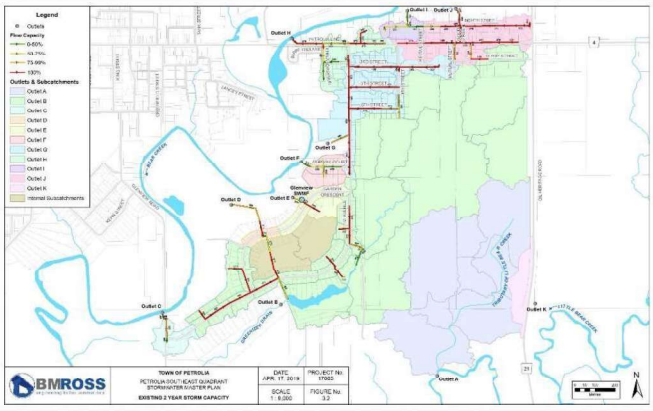
P5 - Maintenance required on Inlet grate south of First Ave. - Filter cloth requires removal on bolted inlet grate south of First Ave.

P6 - Locations with stormwater discharge to old municipal drains (Greenizen Drain and County Road Drain).

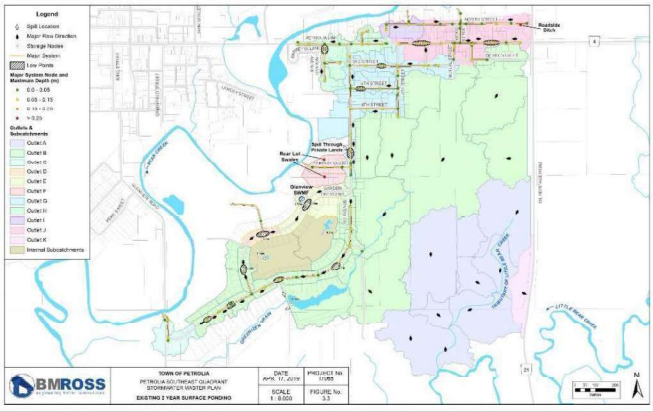
P7 - Location with major flow spill to private lands. Major flows spill from road allowance towards outlet G.

P8 - Existing online pond on the Greenizen Drain has limited freeboard. Model results indicate spills across the berm will occur for 25 year storm event and above.

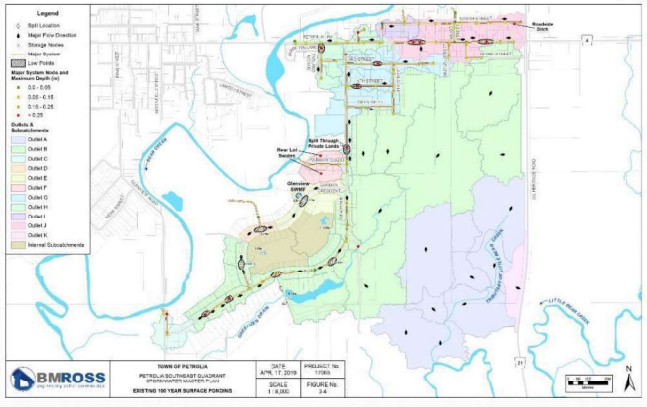
Existing 2 Year Storm Capacity



Existing 2 Year Surface Ponding



Existing 100 Year Surface Ponding



Master Plan Alternatives

- Existing Stormwater Infrastructure
  - Alternative 1 – Replace undersized sewers and upgrade outlets
  - Alternative 2 – Implement upgrades in conjunction with other infrastructure renewal activities (road reconstruction)
  - Alternative 3 – Do Nothing
- Future Development Lands
  - Alternative 1 – Coordinate stormwater planning for all future development lands
  - Alternative 2 – Address stormwater planning for each parcel as development proceeds
  - Alternative 3 – Do Nothing

REPORT Recommendations

Recommendations: Existing Storm Infrastructure

- **Select Alternative 2** – Implement upgrades in conjunction with other infrastructure renewal activities (road reconstruction), as the preferred alternative to address deficiencies present in the existing stormwater collection system
- Implementation Details
  - Develop a phasing plan for existing developed areas that will target deficiencies in conjunction with other priority infrastructure needs such as roads/sewers/watermains
  - Upgrade outlets to ensure sufficient capacity and easements
  - Develop a maintenance program for existing catch basins, inlets, etc.
  - Incorporate water quality measures where possible

Recommendations: Future Development Areas

- **Select Alternative 1** – Coordinate stormwater planning for all future development lands, as the preferred approach to address SWM needs within future development lands.
- Implementation Details
  - Confirm primary sub-basins serving future development lands
  - Establish locations and details for regional detention facilities to service each sub-basin
  - Advise development community of plan for SWM in future development lands
  - Consult with SCRCA to ensure they are supportive of approach

Future Development Land Concept

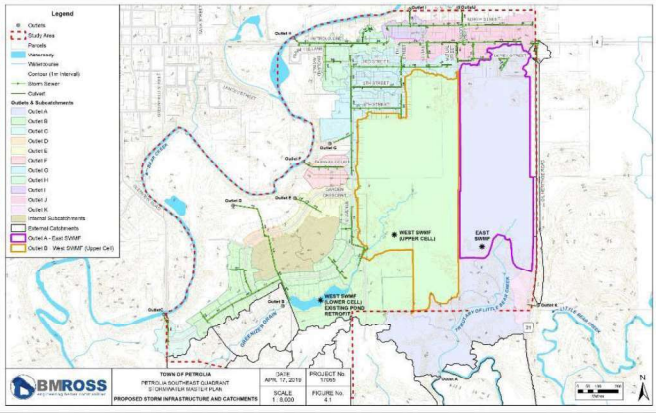
Two primary sub-basins: West Basin & East Basin

- All drainage associated with each sub-basin would be directed to a regional facility located at the downstream end
- East Basin
  - Discharge to tributary of Little Bear Creek system
  - Facility would need to be constructed when developments are proposed for East Basin
- West Basin
  - Discharge to Greenizen Drain and then Bear Creek System
  - Three options considered for SWM detention in west basin
  - Development applications being reviewed

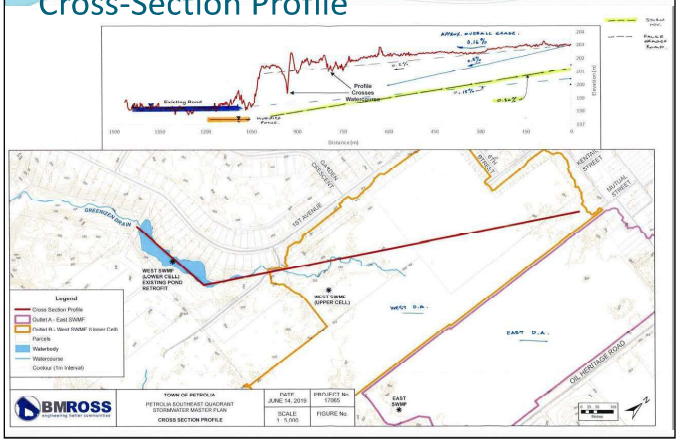
West Basin Options

- Option 1 involves the construction of a SWMF adjacent to open channel section of the Greenizen Drain, providing water quantity, water quality and erosion control for upstream future development areas discharging to the Greenizen Drain (Outlet B).
- Option 2 involves the construction of a SWMF immediately east of the existing online pond, providing water quantity, water quality and erosion control for upstream future development areas discharging to the Greenizen Drain (Outlet B).
- Option 3 involves retrofitting the existing online pond into a Lower SWMF cell and constructing an Upper SWMF cell adjacent to the open channel section of the Greenizen Drain. The Upper and Lower SWMF cells would operate as a joint facility for water quantity control. Water quality for upstream future development areas would be provided by the Upper Cell.

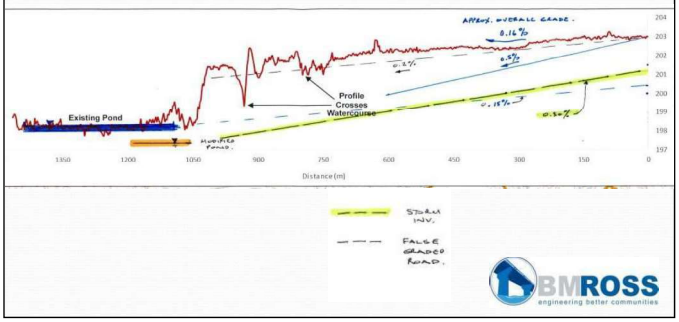
Future Development Lands



Cross-Section Profile



Cross-Section Profile



Recommendation: West Basin SWM

Select Option 3 – This option would mitigate significant design and servicing constraints presented by constructing a separate SWMF upstream of the online pond, as identified for Option 1 and 2 above.

- Retrofit existing online pond by dropping the permanent pool elevation by 1m to increase overall active storage volume provided. New outlet would be constructed to limit peak flows to existing levels. With the proposed retrofits, overflows of the existing berm embankment would also be eliminated, with a minimum 0.25 m freeboard provided for the 100 year event. This would improve existing safety concerns on the overtopping of the existing berm.
- Proposed Upper Cell would provide water quality & partial water quantity control for the upstream future development. By lowering the permanent pool of existing online pond and providing adequate grade between the two cells, servicing of upstream lands would be significantly improved. The resulting available grade to service the northwest or northeast limit of future development area is 0.40% to 0.25%, respectively. It is therefore advantageous to divert the northeast area to the East SWMF.
- As part of the retrofit, grading may be required along existing banks. Phragmites (an invasive plant species) is present along a significant portion of the existing pond banks. Mitigation measures may include the removal of invasive plant species with native vegation. Pond ownership to be transferred to the Town.

Next Steps

- Present Results to Public
- Seek input from SCRCA on report recommendations.
- Collect input from meetings and discuss with Staff
- Finalize Report
- Council Adoption of Master Plan
- Incorporation of Master Plan recommendations into Asset Management Plan priorities
- Make Final Report Available to Public

Project Completion

Public Meetings	August 2019
Completion of Draft Report	October 2019
Council Adoption	Fall 2019
Notice of Study Completion	November 2019
Project Implementation	2020 Budget Process

Questions?

June 8, 2021

Ms. Kelly Vader, MCIP, RPP
BM Ross
kvader@bmross.net

RE: Town of Petrolia Storm Drainage Master Plan

Dear Kelly,

Please be advised that this matter was heard by Council at its Regular Council meeting held on May 25, 2021, and in this regard Council enacted the following resolution.

MOVED: Wade Deighton SECONDED: Grant Purdy

THAT the Council of the Town of Petrolia endorse the report and recommendations of BM Ross in relation to the Stormwater Drainage Master Plan, Southeast Development Area as presented this evening;
AND THAT staff be directed to continue with BM Ross for the implementation of these recommendations, reporting back to Council when able.

CARRIED

Thank you for your presentation.

Yours truly,

Original Signed

Mandi Pearson
Clerk/Operations Clerk

TOWN OF PETROLIA

MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT STORMWATER MASTER PLAN SERVICING STUDY FOR THE PETROLIA SOUTHEAST SERVICE AREA

NOTICE OF COMPLETION

THE PROJECT:

The Town of Petrolia initiated a Stormwater Servicing Master Plan for the southeast service area of Petrolia in August 2018. The Master Plan was undertaken in order to inventory and evaluate existing stormwater facilities within developed areas of the community and to investigate the most cost effective and efficient manner to provide stormwater servicing within future development areas. The Master Plan process has now been completed. A preferred servicing strategy has been identified, which will be implemented in phases, within established areas. The plan has also identified a strategy to address stormwater servicing within future development lands.

THE ENVIRONMENTAL ASSESSMENT PROCESS:

The Stormwater Servicing Master Plan was conducted in accordance with the requirements of the Municipal Class Environmental Assessment (Class EA) which is an approved process under the Environmental Assessment Act. Master Plan projects incorporate Phases 1 & 2 of the Class EA process and also include consultation with the general public, government review agencies, Indigenous communities and affected property owners. While the Master Plan addresses the need and justification for the proposed stormwater servicing facilities at a broad level, more detailed Class EA studies may be required prior to the construction of some components of the plan. The information below outlines the status of various works included as a component of the Master Plan, as well as their status in regards to the Class EA Master Plan process.

TYPE OF PROJECT:	STATUS:
▪ Storm drainage construction or repair within limits of existing road allowances	Schedule A+ - Pre-Approved
▪ Road reconstruction, including storm drainage upgrades, within existing road allowances	Schedule A+ - Pre-Approved
▪ Construction of new stormwater management ponds and outlets	Reviewed in conjunction with Planning Act review process – Schedule A – Pre-Approved
▪ Construction of new stormwater drainage outlets	Schedule B – Additional Class EA Review Needed unless reviewed as part of Planning Act process
▪ Upgrades to existing Golf Course Pond	Schedule A+ - Pre-Approved

The Master Plan has been completed and, by this Notice, is being placed on the public record for review. A Master Plan Report will be available for review on the Petrolia website at www.town.petrolia.on.ca. Please provide written comments on the Stormwater Servicing Master Plan to the Study Engineers by **September 24, 2021**. Subject to comments received as a result of this Notice, the Master Plan will be formally adopted and Petrolia staff will move forward with implementation. For further information on this project, or to review the Class EA Master Plan process, please contact the study engineers: B.M. Ross and Associates: 2695 Hamilton Road, P.O. Box 400 Brights Grove, N7A 2T4. Telephone: (519) (519) 908-9564. Attn: Kelly Vader, Environmental Planner (e-mail: kvader@bmross.net).

Mike Thompson, Director of Operations
Town of Petrolia

This Notice issued August 25, 2021