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WALDEMAR COMMUNITY

Township of Amaranth

Wastewater Treatment and Effluent Disposal Class Environmental Assessment

Class EA Phases 1 and 2 Report

prepared by:

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prepared for

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2 Project Objectives

2.1 Problem/Opportunity Statement

This Class EA is being conducted to identify the preferred solution and design concept for wastewater treatment and effluent disposal for the proposed SPL residential development in Waldemar.

The objective of the Class EA is to find the preferred solution to the following Problem/Opportunity Statement:

A cost-effective and environmentally acceptable means of providing wastewater treatment and effluent disposal must be determined to provide servicing for the proposed Waldemar residential development in the Township of Amaranth. The wastewater treatment and effluent disposal system must have sufficient capacity to service the proposed 35 ha development and to potentially service existing homes and other proposed developments in the community, comply with MOECC requirements, meet environmental protection objectives, and be cost-effective to operate and maintain.

2.2 Study Area

For the purpose of this Class EA, the Study Area consists of the Waldemar development lands and surrounding area, as shown on Figure 1 overleaf.

1 Introduction

Sarah Properties Ltd. (SPL) has submitted a combined application for Official Plan Amendment, Zoning By-Law Amendment, and Plan of Subdivision for a proposed residential development in the Community of Waldemar in the Township of Amaranth (Township). SPL is proposing a 334-unit residential subdivision on 35 ha of land in the western portion of Waldemar, northeast of the intersection of County Road 109 and the Amaranth-East Luther Townline. The development will be on the west side of the Grand River, and immediately to the west of an existing residential area. These lands are designated Community Residential in the Township of Amaranth Official Plan.

The preferred wastewater servicing approach for the development will be resolved following a municipal Class Environmental Assessment (Class EA) study, undertaken by SPL. Phases 1 and 2 of the Schedule C Class EA is the subject of this report. Water servicing will be resolved separately in discussion with the Township of Amaranth.

Figure 1: Waldemar Wastewater Servicing Class EA Study Area

3 Project Approach

3.1 Class EA Process

All municipal infrastructure projects in Ontario are subject to the *Ontario Environmental Assessment Act* (EA Act). This project is following the Class EA planning process for a Schedule C undertaking described in the Municipal Engineers Association Municipal Class Environmental Assessment document (October 200, as amended in 2007, 2011 & 2015).

The Municipal Class EA is a planning and design process to identify, compare and evaluate alternative solutions to a problem. It applies to all municipal road, water and wastewater projects, and significant private projects. It considers all aspects of the environment: natural, social, cultural and economic, and involves consultation with the public, affected parties and review agencies throughout the process. A Schedule C project has the potential for significant environmental effects and must proceed through all four phases outlined in the Class EA document.

Although this project is undertaken by a private proponent, it is subject to a municipal Class EA because the preferred servicing solution may be a Schedule C undertaking that will service a residential development within the municipality (O. Reg. 345/93).

The Class EA study for this project is proceeding through the following four phases, as appropriate for a Schedule C undertaking:

- Phase 1: Identify the problem or opportunity.
- Phase 2: Identify and evaluate alternative solutions, then select the preferred solution.
- Phase 3: Identify and evaluate alternative design concepts for the preferred solution, then select the preferred design.
- Phase 4: Prepare an Environmental Study Report (ESR) and review period.

Following the satisfactory completion of the Class EA, detailed design can proceed and a submission can be made to the Ministry of the Environment and Climate Change (MOECC) for approval under the *Ontario Water Resources Act*.

A more extensive environmental review of the project can be requested by individuals or groups if significant concerns cannot be resolved through the Class EA process. Concerns should be raised first with the proponent, and if they cannot be addressed satisfactorily, a request can be submitted to the Minister of the Environment and Climate Change to require the proponent to comply with Part II of the EA Act before proceeding with the project.

3.2 Integration of the Class EA and Planning Act Consultation

As the proponent (SPL) has submitted an application to the Township of Amaranth for an Official Plan Amendment to service the development lands with a communal wastewater system (as required by section 4.2.4 d) of the Official Plan), and as a Schedule C Class EA is required for a new wastewater treatment plant, the planning processes under the *Planning Act* and the EA Act have been integrated to streamline consultation efforts and schedules. This integrated approach is outlined in section A.2.9 of the MEA Class EA document.

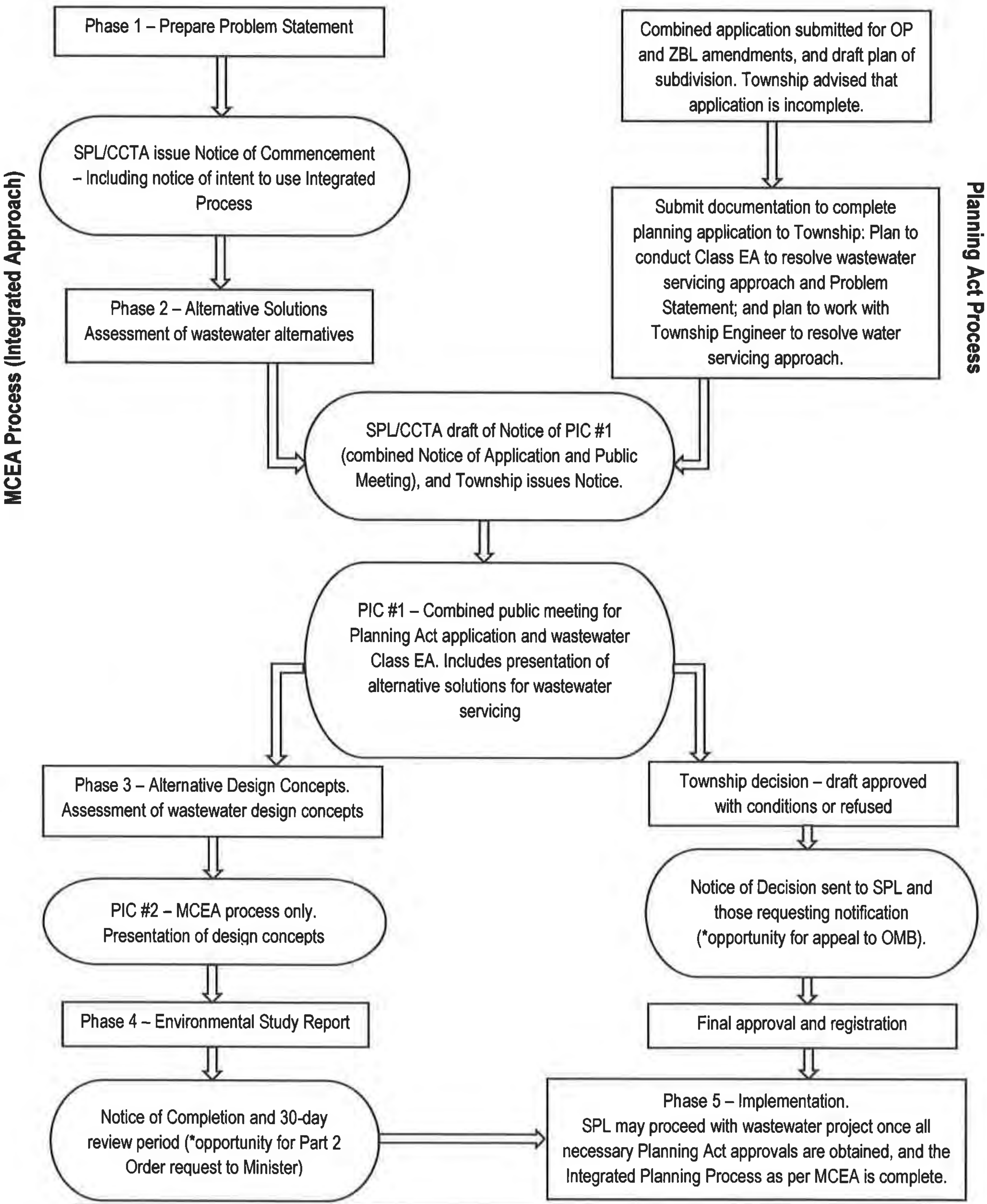
The integrated approach for the Waldemar project is presented in Figure 2 overleaf. The Class EA study includes combined *Planning Act*/Class EA notices and one combined public consultation meeting for the presentation of the proposed development plan and of the alternative wastewater solutions.

Following conclusion of Phase 2 of the Class EA and concurrence by the Township of the preferred wastewater servicing solution, the Class EA will proceed to Phase 3 to consider alternative design concepts and then to Phase 4 to complete the Environmental Study Report (ESR). Implementation of the preferred wastewater design will proceed only once all necessary *Planning Act* approvals are obtained, and the Class EA requirements have been met.

3.3 Consultation Program

Review agency and public involvement is an integral part of the development and evaluation of the alternatives during the Class EA study. The Waldemar residents, property owners, relevant government agencies, the County and adjacent municipalities were invited to provide input to the Class EA study. The public and agency consultation and the input received to date are documented in this report.

Figure 2: Class EA/Planning Integrated Approach



4 Existing Environmental Conditions

The existing environmental conditions in the Study Area are described below, for the assessment of the alternative solutions.

4.1 Socio-Economic Environment

The Community of Waldemar is one of three designated settlement areas in the Township of Amaranth, Dufferin County. It is located at the 10th Line, north of Highway 109. The Grand River runs through the community. The Town of Grand Valley is 5 km to the west; the Town of Orangeville is approximately 15 km to the east.

Waldemar is predominantly residential and has an estimated population of 525. There are approximately 55 homes on the west side of the Grand River. The most recent homes on the west side were built in the 1970s as the Acchione subdivision, and are two-storey detached dwellings. On the east side of the river, there are approximately 120 homes, most of which are in Waldemar Heights and were built in the 1990s. They are one and two storey detached dwellings. There are plans for further residential developments on the east side of the river, including the 73-lot Centurian Homes subdivision, which was approved by the Township in 2011.

The community is surrounded by rural areas, some of which are in active agricultural use.

A recreational trail, the Upper Grand Trailway, runs to the north of the community on a former railway line. The trailhead is located on the 10th Line, next to the intersection with Henry Street.

Land to the northwest of the community is designated for aggregate extraction, however there is no active pit or quarry.

The SPL development lands are presently vacant and used for agricultural purposes or fallow. They are surrounded by agricultural lands to the south and west, the Upper Grand Trailway to the north and existing residential properties to the east.

4.2 Natural Environment

4.2.1 Drainage

The Community of Waldemar and the proposed SPL development are located within the Grand River watershed. The proposed development's eastern boundary is approximately 200 m west of the Grand River. The SPL development lands contain no permanent creeks, streams or water bodies.

The lands' topography ranges from generally flat to gently rolling topography. Drainage is naturally directed north east towards the Grand River. Drainage from the central portion of the site, through a seasonal drainage swale, converges towards a catchbasin on James Street. Storm drainage in the existing residential subdivision consists of a combination of storm sewers and ditches that ultimately discharge to the Grand River via an existing 1200 mm storm sewer outfall at Henry Street. The north portion of the SPL lands drain towards an existing ditch in the abandoned railway corridor that ultimately discharges to the 1200 mm storm sewer outfall to the Grand River at Henry Street.

4.2.2 Soils and Groundwater

The soils in the SPL development lands are a glacial till (Tavistock Till) comprised of silt and clayey silts with some sand and gravel layers in the northern portion of the property. The till is underlain by limestone at varying depths. A geotechnical investigation, including 23 boreholes and 10 test pits, was completed (Terraprobe, April 2015). It is attached in Appendix A.

On the SPL lands, the upper groundwater table is found in the till at shallow depths and is seasonally variable. The clayey silt till found throughout the property forms a significant confining layer, due to its thickness and clay content, above the bedrock aquifer. The bedrock aquifer is in the Guelph and Amabel Formations and is used as a water supply throughout the area. Locally, groundwater in the shallow and deeper aquifers flows toward the Grand River, from west to east across the site. The bedrock aquifer has good water quality: nitrate and chloride levels have been found to be very low in the nearby municipal wells; however the groundwater has elevated hardness, sulphate and iron levels in some areas. A hydrogeological and water supply assessment was completed by Chung and Vander Doelen Engineering Ltd. (June 2016). It is attached in Appendix A.

4.2.3 Environmental Features

There are no biological features of provincial interest, and no significant cold water streams, spawning or nursery areas within the site and in the Study Area, with the exception of the Grand River.

The Grand River flood plain is a significant environmental feature. Its western edge lies approximately 200 m to the east at the southeastern tip of the SPL development lands.

An assimilative capacity study of the Grand River (XCG Consultants Inc., March 2016, attached in Appendix A) examined the water quality of the river in the vicinity of Waldemar. The study found that ambient phosphorus concentrations (75th percentile of 0.031 mg/L) are marginally higher than the Provincial Water Quality Objective (PWQO), and therefore the Grand River can be considered a Policy 2 receiver for phosphorus (should not be degraded further). Ambient pH for the Grand River was found to be slightly alkaline with pH levels higher than the PWQO in the summer months. Total suspended solids were found to be elevated in the spring and summer months. Ambient concentrations of unionized ammonia, dissolved oxygen, and *E.coli* were all found to be within the PWQO. Nitrate concentrations were well below the Canadian Water Quality Guideline.

The low flows in the Grand River were also reviewed by XCG. The flows in the Grand River in Waldemar are regulated; they are governed by the outflow from an upstream reservoir, which is managed by the Grand River Conservation Authority (GRCA). With the GRCA, the low flow was agreed to be 0.4 m^3/s, as documented in the Grand River Watershed Water Management Plan (2014).

The SPL development site is generally cleared, vacant agricultural land with a few internal trees: various maple and spruce species, and white elm (Tree Inventory and Preservation Plan, Beacon Environmental, February 2015, attached in Appendix A). No provincially endangered tree species were identified on the site. Many of the trees growing along the property boundary have been identified to be preserved. Internal trees that are dead or in poor health could be removed.

4.2.4 Heritage Features

There are no heritage buildings or structures or cultural heritage landscapes on the SPL development lands.

A Stage 2-3 archaeological assessment of the SPL property was conducted (Archaeological Assessments Ltd., December 2014); it is attached in Appendix A. One site of archaeological importance was found where a late 19th century Euro-Canadian homestead was previously located. The site is in the east half of Lot 3, Concession 10, which is in the northern portion of the SPL property. The site is not considered to have cultural value and will not require Stage 4 mitigation. No further archaeological assessment of the property is required.

4.3 Existing Water Systems

Approximately 125 of the 175 existing residential lots in Waldemar are serviced by the municipal groundwater system. About 50 homes in the community, mostly on the west side of the river, have individual wells, 40 of which are drilled into the bedrock, the remainder are shallow wells.

The municipal water system is supplied by three wells (two production wells and one standby well) located in the Waldemar Heights subdivision on the east side of the Grand River. A treated water reservoir, chlorination system and associated pumping system are located on Station Street just east of the river, and distribute treated water to the community via a system of watermains.

The water demands of the proposed SPL development are expected to exceed the existing municipal water system's capacity. Servicing of the proposed SPL development could be achieved by expanding the existing municipal groundwater system, or by establishing a separate groundwater supply system. Based on a desktop assessment (Chung & Vander Doelen Engineering Ltd., June 2016, in Appendix A), one or two high yielding wells could be drilled into the regional aquifer to supplement the existing groundwater supply.

4.4 Existing Sewage Systems

All existing homes in Waldemar use private septic systems for sewage treatment and disposal.

5 Servicing Requirements

The proposed 334 single detached homes are planned to be constructed in three phases. Assuming an average household occupancy of 3 persons per unit, the ultimate population of this subdivision is estimated at 1,002 persons.

Table 1 presents the projected sewage flows from the proposed SPL development and from the existing homes, if these are eventually serviced, that will require treatment and disposal. The calculated sewage flows are based on an average domestic per capita flow rate of 360 L/cap/day with a peaking factor determined using the Harmon Formula, and on an inflow/infiltration contribution of 90 L/cap/day with a peaking factor of 2.5.

Table 1: Projected Sewage Flows from Waldemar

	Number of Homes	Population	Average Day Flow (m^3/d)	Peak Flow (L/s)
SPL development	334	1,002	451	18.5
Existing homes	175	525	236	10.0
Total Proposed and Existing	**509**	**1,527**	**687**	**28.5**

6 Wastewater Servicing Solutions

6.1 Description of Alternative Solutions

The following alternative solutions were considered. Descriptions of each alternative are presented below.

1. Do Nothing
2. Individual septic systems
3. Communal wastewater treatment plant with discharge to the Grand River
4. Communal wastewater treatment plant with discharge to a large subsurface disposal system
5. Connection to an expanded Grand Valley Wastewater Treatment Plant in the Town of Grand Valley

6.1.1 Alternative 1: Do Nothing

This alternative is included for comparison purposes only. The "Do Nothing" alternative does not meet the project requirements in that it does not provide wastewater treatment and disposal capacity for the proposed development.

6.1.2 Alternative 2: Individual Septic Systems

This alternative consists of servicing each new lot in the SPL development lands with an individual septic tank and tile bed.

The SPL development lands are intended to be on communal or full municipal services, as prescribed in the Township of Amaranth Official Plan (2004), Municipal Water and Sewage Servicing Section 4.2.4 b) i. and ii. However, developments may be serviced by individual on-site systems where the use of communal systems is not feasible (Section 4.2.4 b) iii). Accordingly, the option of sewage servicing with individual septic systems was considered in this Class EA in the event that a communal wastewater treatment and disposal system is not feasible.

It is noted that servicing by individual septic systems would be inconsistent with the 2014 Provincial Policy Statement (PPS) of the Ontario Ministry of Municipal Affairs and Housing (MMAH). Sections 1.6.6.2 to 1.6.6.4 of the PPS set the preferred hierarchy of servicing in settlement areas: municipal sewage services are the preferred form, followed by private communal sewage servicing if municipal servicing is not provided. Individual on-site sewage systems may only be used in settlement areas for infilling and minor rounding out of existing development. The development of the SPL lands is a new development and a significant addition to the existing residential community. Further, as per section 1.6.6.5 of the PPS, partial services (individual on-site sewage where municipal water is provided) is not permitted for new development. Connection of the SPL lands to the existing municipal water supply system is being considered by the Township to provide safe drinking water to its residents.

If the SPL lands were developed with individual septic systems at each home, the total number of lots must be restricted such that the tile beds do not impair the quality of the groundwater for downstream users. This reasonable use policy, established by the Ontario Ministry of the Environment and Climate Change, requires that the development not increase the concentration of nitrates above 10 mg/L, which is the drinking water standard for nitrate.

The maximum number of residential properties with individual septic systems that could be accommodated on the SPL lands is 26 lots, calculated using the following assumptions:

- Background nitrate: 3 mg/L (from Terraprobe 2014 test pit results (range of 0.1 mg/L to 3.4 mg/L))
- Tile bed effluent nitrate: 40 mg/L
- Wastewater flow per tile bed: 1,080 L/day (3 ppu x 360 L/c/day)
- Incident recharge: 125 mm/year (based on the existing silty clay soils)
- Total development area: 35 ha.

6.1.3 Alternative 3: Communal Wastewater Treatment Plant with Discharge to the Grand River

This alternative consists of constructing an internal sanitary sewer system and sewage lift stations as required, a communal tertiary wastewater treatment plant (WWTP), and a treated effluent discharge outfall to the Grand River.

The WWTP would be designed to service the entire SPL development lands and could be expanded to also service existing homes and other proposed developments in the community, if so desired by the Township.

This servicing alternative could accommodate the full development proposal, which would consist of 334 single family homes on large lots, of built form and scale consistent with the other subdivisions in Waldemar, and with appropriate setbacks to minimize impacts on existing homes and the aesthetic character of the community.

A communal wastewater treatment system is consistent with the intent of the Township Official Plan and with the policies of the 2014 Provincial Policy Statement, for servicing in settlement areas.

The new WWTP would need to be a tertiary treatment facility, capable of achieving very stringent effluent quality criteria in order to ensure the Provincial Water Quality Objectives (PWQO) are maintained in the Grand River in Waldemar. The required effluent quality criteria have been developed following an assimilative capacity study (XCG, March 2016, in Appendix A), which has been reviewed and discussed with the MOECC and the GRCA. The assimilative capacity study confirmed the required treated effluent quality criteria are achievable with available treatment technology. The criteria are summarized in Table 2 overleaf.

The main water quality parameter of concern in the Grand River is Total Phosphorus. Based on ambient water quality data collected at local monitoring stations, Total Phosphorus concentrations in the river are slightly higher than the PWQO, and as such the Grand River in the vicinity of Waldemar is considered a Policy 2 receiver for Total Phosphorus. The MOECC therefore requires that the WWTP's effluent quality maintains or improves phosphorus levels in the river. The stringent phosphorus limit will require tertiary level of treatment, which will also ensure that all other parameters, such as suspended solids, BOD_5, and ammonia, are removed to a very high degree. A mixing zone analysis demonstrated that completely mixed conditions would be achieved within approximately 250 m downstream of the outfall.

Table 2: Communal WWTP Effluent Quality Criteria for Discharge to Grand River

Effluent Parameter	Effluent Limit (Average Concentration)	Effluent Objective (Average Concentration)
$CBOD_5$ (mg/L)	10	8
Total Suspended Solids (mg/L)	10	8
Total Phosphorus (mg/L)	0.1	0.08
Total Ammonia Nitrogen (mg/L)		
Winter (Dec. to Feb.)	3.8	3.0
Spring (March to May)	3.3	2.5
Summer (June to Sept.)	1.8	1.0
Fall (Oct. to Nov.)	2.4	1.6
E. Coli (counts per 100 mL)	200	100

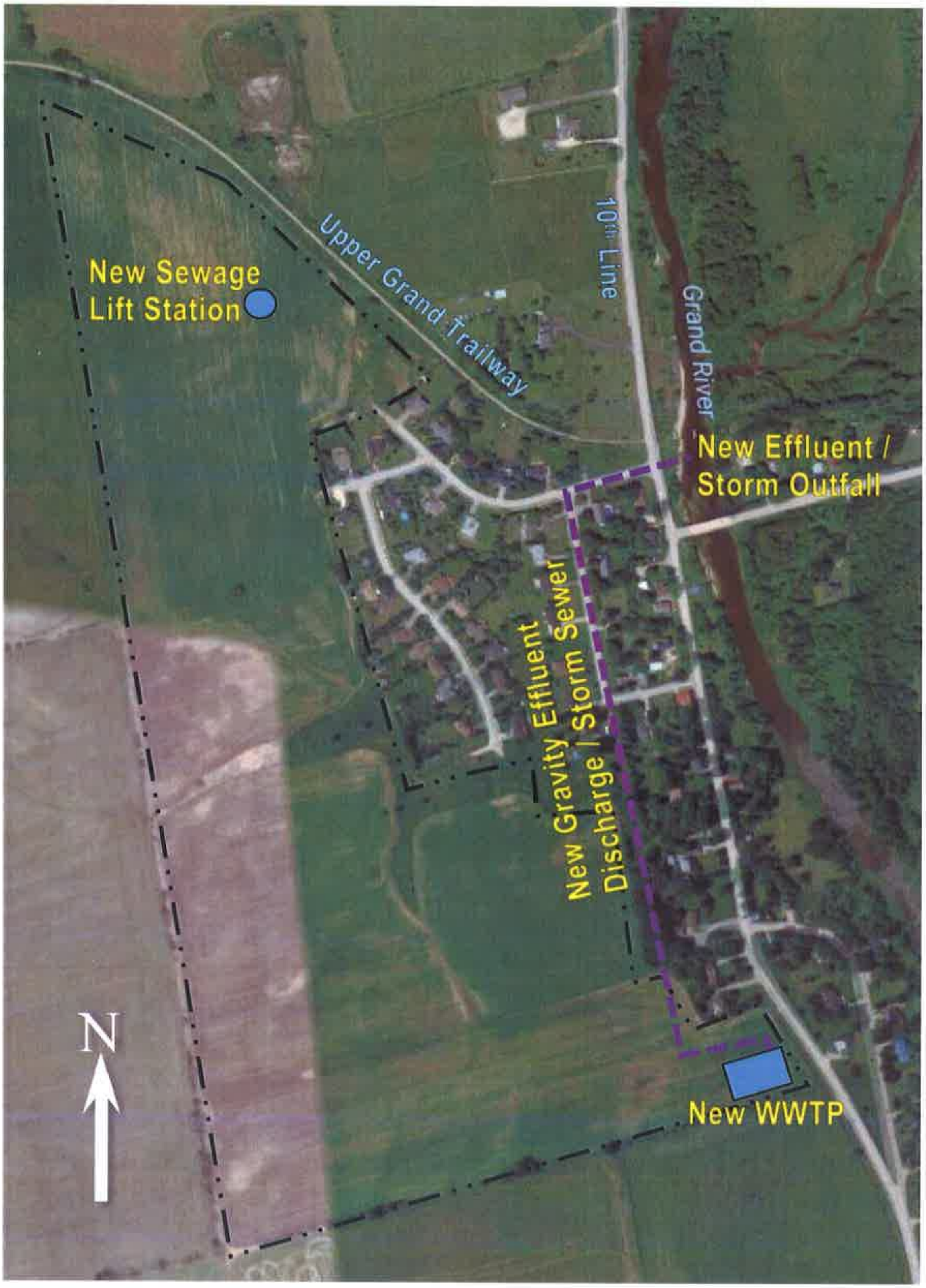
The communal WWTP would be located in the southeast corner of the site. Due to site topography, the site would be split into north and south drainage areas, with the north catchment area draining to a sewage lift station and the south catchment area draining to the WWTP. The sewage lift station would be located approximately 100 m from the existing Henry Street cul-de-sac, and would pump via forcemain into the gravity sewer system flowing south to the WWTP. This alternative is presented in Figure 3.

In summary, the infrastructure required for this alternative solution would include:

- Sanitary sewer system and one sewage lift station within the SPL development lands;
- Mechanical wastewater treatment plant with tertiary treatment for phosphorus removal, located at the south east corner of the SPL lands;
- Effluent discharge to a new trunk storm sewer on Main Street that will discharge to a new outfall to the Grand River at Henry Street.

The new communal WWTP would be operated by certified operators, in accordance with provincial regulations. The WWTP and sewage lift station would be either owned by a condominium corporation or by the Township, following discussions between SPL and the Township. If the facilities are privately owned, the Environmental Compliance Approval (ECA) from the MOECC for the sewage works will include a requirement that the Township enter into a responsibility agreement with the condominium corporation or that financial assurances be maintained by the owner to ensure funds are available for the maintenance of the facility.

Figure 3: Alternative Solution 3 – WWTP with Discharge to Grand River



6.1.4 Alternative 4: Communal Wastewater Treatment Plant and Large Subsurface Disposal System

This alternative solution consists of the construction of an internal sanitary sewer system, a sewage pumping station, and a communal WWTP that would discharge its treated effluent to a large communal subsurface disposal system.

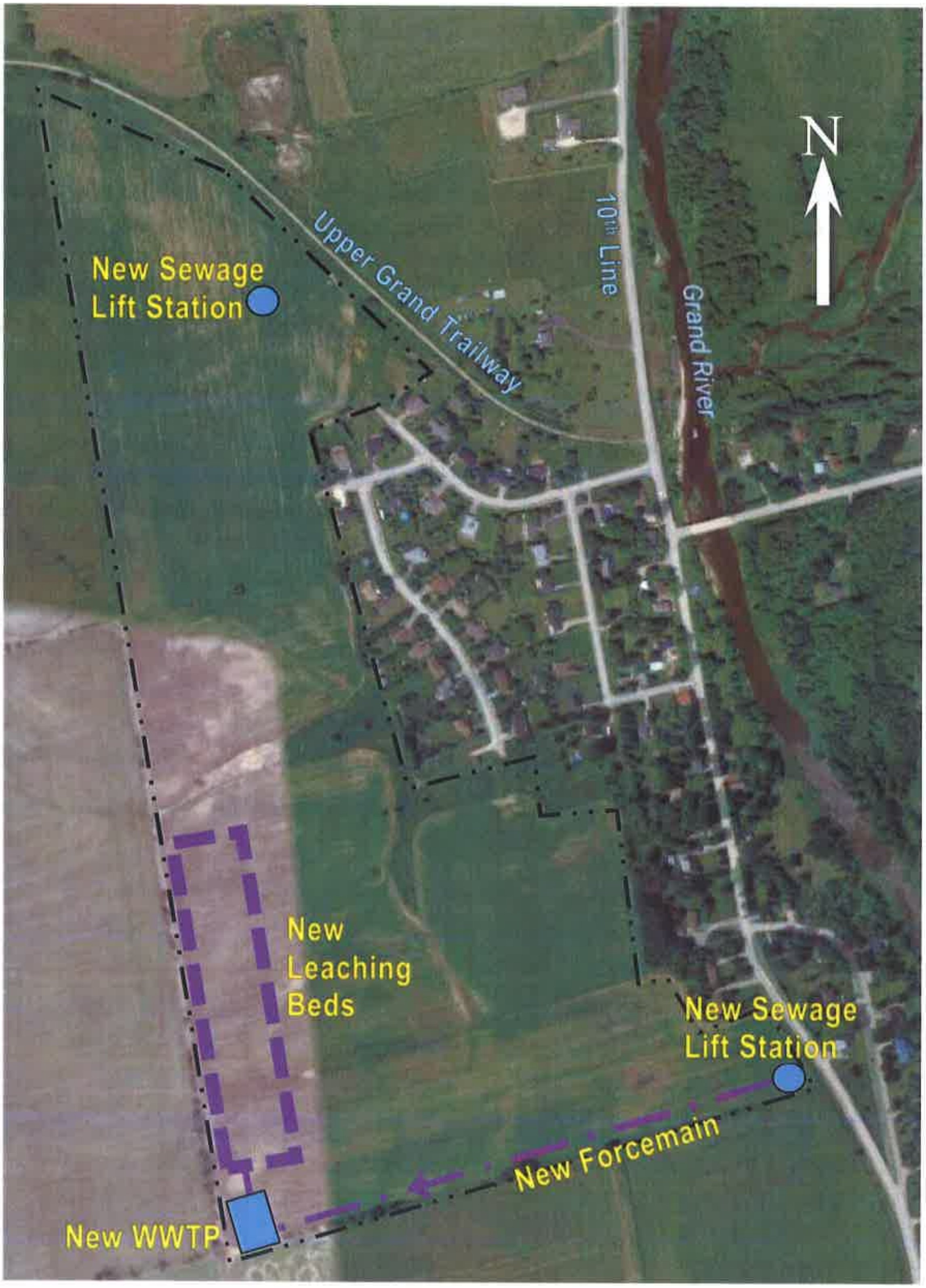
The WWTP and the subsurface disposal system would be located at the southwest corner of the SPL lands, as shown on Figure 4, as distant as possible from existing wells used for drinking water purposes. The north catchment area would drain to a sewage lift station in the northern portion of the site, and the south catchment area would drain to the WWTP. The sewage lift station would discharge via forcemain into the gravity system flowing south to the WWTP. The WWTP would need to be a tertiary treatment facility designed to reduce nitrate levels in the effluent. The leaching beds would cover an area of approximately 5 ha, sized with a loading rate of 12 $L/m^2/day$ based on the native soil characteristics.

A calculation based on the MOECC Reasonable Use Concept of the MOE 2008 Design Guidelines for Sewage Works, which applies .to large subsurface disposal systems, indicates that to service 334 residential units, the WWTP would need to achieve an effluent nitrate level of about 3 mg/L, in order to ensure the nitrate concentration in the groundwater at the east property line would not exceed 2.5 mg/L. This effluent quality is beyond the capability of available treatment technology. Therefore, this alternative is not technically feasible for 334 lots. Using a technically feasible effluent limit of 7 mg/l nitrate, a maximum of 50 units could be serviced using a communal leaching bed on the property.

The infrastructure required for this alternative solution would include:

- Sanitary sewage collection system and two sewage lift stations within the SPL development lands;
- Mechanical wastewater treatment plant with tertiary treatment for nitrate removal, located at the south west corner of the SPL lands;
- Effluent dosing system and leaching beds covering an area of approximately 5 ha.

Figure 4: Alternative Solution 4 – WWTP with Discharge to Subsurface System



6.1.5 Alternative 5: Connection to Expanded Grand Valley Wastewater Pollution Control Plant

This alternative solution consists of connecting to the closest available WWTP, the Grand Valley Wastewater Pollution Control Plant (WPCP) in the Town of Grand Valley.

The Grand Valley WPCP services the Town of Grand Valley. It is an extended aeration treatment plant with tertiary filtration and disinfection that discharges to the Grand River upstream of Waldemar. As of 2014, the WPCP was operating at 60% - 65% of its design capacity of 1,244 m^3/day. Flows from committed development activity in the Town of Grand Valley are projected to exceed the capacity of the WPCP within the next 10 years. The Town is considering a WPCP expansion to approximately 2,900 m^3/day to accommodate its current demand for wastewater treatment capacity allocations (Grand Valley Master Servicing Plan Update, R.J. Burnside, 2014) but has not defined a timeline for this work. The Town will need to complete a stream assimilative capacity study to determine the required effluent criteria for discharge to the Grand River, and a Class EA study prior to design.

In order to accommodate additional flows from the proposed SPL development lands in Waldemar, the Grand Valley WPCP expansion capacity would need to be increased by 541 m^3/day. A further, or larger, expansion would be required to service existing homes currently on septic systems. Such an increase in flow would require more stringent effluent discharge criteria that may be beyond the current limits of treatment technology.

For this alternative, wastewater from Waldemar would be pumped via a 3.4 km long forcemain, potentially located on Main Street and within the abandoned railway corridor, which runs from the north end of Waldemar to the east side of Grand Valley where the WPCP is located on Industrial Road. Alternative 5 is presented in Figure 5.

The infrastructure required for this alternative solution would include:

- Sanitary sewer system and two sewage lift station within the SPL development lands;
- Forcemain from Waldemar to the Grand Valley WPCP (3.4 km);
- Expansion of the Grand Valley WPCP.

Figure 5: Alternative Solution 5 – Connection to Expanded Grand River WPCP

6.2 Assessment of Alternative Solutions

A detailed comparative evaluation of the wastewater alternatives was completed in order to identify a preliminary preferred solution, prior to obtaining input from the public, agencies and interested parties. This assessment matrix compared the alternatives on the basis of evaluation criteria that are described in the following section.

6.2.1 Evaluation Criteria

Evaluation criteria were developed to reflect the entire range of potential impacts of the alternative solutions. They are described below.

Objectives

- Capacity to Service Proposed Development. The alternative should have the capability to treat and dispose of the wastewater flows from the entire proposed development (334 lots), and meet the intent of the Township Official Plan and Provincial Policy Statement.
- Impact on Timing of the Development. This criterion considers the potential impact of the alternative on the schedule to construction of the development.

Environmental and Heritage Considerations

- Groundwater Quality. This criterion considers the potential impacts of wastewater or effluent disposal on the groundwater quality at the downstream limit of the SPL property.
- Surface Water Quality. This criterion considers the potential impacts of the effluent disposal on the water quality of the Grand River.
- Vegetation. This criterion compares the potential impacts of constructing the wastewater infrastructure on the existing vegetation.
- Wildlife and Wildlife Habitat. This criterion compares the potential impacts of constructing the wastewater infrastructure on any significant wildlife in the study area.
- Archaeological or Heritage Resources. This criterion compares the potential impacts of constructing the wastewater infrastructure on archaeological artifacts, built heritage resources or cultural heritage landscapes.

Socio-Economic Considerations

- Drinking Water Supplies. This criterion compares the potential impact of the wastewater or effluent disposal on the water quality and quantity of the groundwater wells used for drinking water in Waldemar.

- Existing Residential. This criterion compares the impact of the wastewater infrastructure on the existing homes, particularly the opportunity to replace aging septic systems. It also considers the potential impact of the number of new homes associated with each servicing alternative.

- Temporary Construction Impacts. This criterion addresses the temporary impacts of construction of the wastewater works, including traffic disruption, noise and inconvenience, as well as impact on the recreation trail.

- Aesthetic Impacts: Visual, Noise, Odour. This criterion addresses the potential visual impacts, as well as the potential for noise and odour, from the proposed wastewater facilities.

Technical Considerations

- Technical Feasibility / Ease of Implementation. This criterion addresses any major technical constraints to implementation, as well as relative difficulty in construction. Overall, the degree of difficulty was considered to increase with the amount of infrastructure that needs to be constructed.

- Flexibility / Ease of Expansion. This criterion considers the feasibility of each alternative to be expanded to provide wastewater servicing for the existing residents of Waldemar and future developments.

- Operations and Maintenance Requirements. This criterion reflects the relative level of effort for a Township operator to monitor the system and keep the proposed infrastructure and equipment in good operating condition.

- Approval Requirements. This criterion compares the extent of effort required to obtain the required approvals before the project can be implemented.

- Agreements. This criterion refers to the need for a Municipal Responsibility Agreement or an inter-municipal agreement for the implementation of the project.

Financial Considerations

- Estimated Project Costs per Lot. This criterion compares the estimated project costs on a per developed lot basis. Costs are incurred by the developer not by the existing residents.

- Land Requirements. This criterion considers the land area that the wastewater infrastructure will require on the development property.

6.2.2 Preliminary Assessment

The comparative assessment matrix is shown overleaf as Table 3. It presents, for all criteria described above, the rationales for the preliminary evaluation and the description of potential impacts. The impacts were qualitatively ranked from very negative to very positive.

In summary, the main advantages and disadvantages of each alternative solution are as follows:

<u>Alternative 1.</u> Do Nothing, or maintaining the status quo, results in no development. Although there are no potential impacts on the natural and social environments, there are also no potential benefits or opportunities to replace existing septic systems with a connection to a sewer system and more advanced wastewater treatment and disposal system.

<u>Alternative 2.</u> Wastewater servicing by individual septic systems would only permit the development of less than 30 lots on the SPL property in order to protect the groundwater quality in private shallow well supplies. This servicing approach would be inconsistent with the intent of the Official Plan and the policies of the Provincial Policy Statement. It would not provide any future sanitary servicing opportunities for the community. Overtime, the quality of the groundwater at existing shallow wells used for drinking may be impaired due to neglected septic systems.

<u>Alternative 3.</u> A communal tertiary WWTP with an effluent discharge to the Grand River is a technically feasible alternative to service the proposed 334 residential lots. An assimilative capacity study, reviewed by the MOECC and GRCA, indicates a highly treated effluent can be discharged in the Grand River and maintain the Provincial Water Quality Objectives for surface waters. There are no environmental constraints to the WWTP site in the southeast corner of the SPL property, and aesthetic impacts can be mitigated. The WWTP could be expanded to service existing and future homes in Waldemar. A disadvantage is the cost for the operation and maintenance of the WWTP and lift station; however these costs would be paid by the system users only. This alternative has the lowest per unit cost.

<u>Alternative 4.</u> A communal tertiary WWTP discharging effluent to a large subsurface disposal bed located in the southwest corner of the SPL property is a technically feasible alternative, however the number of lots that could be developed is limited to approximately 50 lots in order to prevent contamination of the downstream groundwater quality. The WWTP could not be expanded to service existing homes due to the effluent disposal limitation. As per Alternative 3, there would be operation and maintenance costs to the benefitting users for the WWTP and the large leaching beds. This alternative has the highest per unit cost.

<u>Alternative 5.</u> Connecting to the Grand Valley WPCP is not a feasible alternative at this time as there is no available excess capacity. This alternative is only feasible if the Grand Valley facility is expanded and additional capacity is provided for the Waldemar flows. An agreement between the Town of Grand Valley and the Township would need to be reached. Further, the Town's timing for this WPCP expansion is undetermined, but will be at least five years due to required studies. The estimated project costs for this alternative are the highest due to the wastewater forcemain from Waldemar to Grand Valley and the share of upfront costs in a tertiary treatment plant expansion, as well as ongoing costs to the benefitting users for O&M at the WPCP and at the sewage pumping station. This alternative would cause the most disruption during construction of the forcemain through Waldemar.

Based on the above preliminary assessment, and prior to receiving public and agency comments, the preliminary preferred solution is to service the SPL lands with a communal WWTP with discharge of the treated effluent to the Grand River.

Table 3: Assessment of Alternative Solutions

🟥	🟧	🟦	🟨	🟩
Worst	Poor/Minor Negative	No Potential Impact	Good/Positive	Best

Evaluation Criteria	Description	1	2	3	4	5
		Do Nothing	*Individual Septic Systems*	*Communal WWTP with Surface Discharge*	*Communal WWTP with Subsurface Discharge*	*Connection to Expanded Grand Valley WPCP*
Meets Objectives	**Capacity to Service Proposed Development**	Does not meet project objectives. Lands cannot be developed without wastewater disposal solution. No homes can be built. 🟥	Does not meet project objectives, nor conform to the intent of OP and PPS. Only approx. 26 lots can be developed to limit nitrate impact on groundwater. 🟥	Can meet project objectives. 334 lots could be developed. Grand River has adequate assimilative capacity. 🟩	Limited potential to meet project objectives. Only approx. 50 lots can be developed to limit nitrate impact on groundwater. 🟧	Can't meet project objectives now as excess capacity is not currently available. Only feasible if Grand Valley expands WPCP in future. 🟧
	Impact on Timing of Development	Development is delayed indefinitely. 🟥	Lots could be developed immediately. 🟩	Lots could be developed immediately. 🟩	Lots could be developed immediately. 🟩	Development delayed until expansion of Grand Valley WPCP (not planned yet). 🟥
Environmental and Heritage Impacts	**Groundwater Quality**	No potential impact on groundwater quality. 🟦	Potential for shallow groundwater nitrate levels to reach 10 mg/L at east property line. 🟥	No potential impact on groundwater quality. 🟦	Potential for shallow groundwater nitrate levels to reach 2.5 mg/L at east property line. 🟧	No potential impact on groundwater quality. 🟦
	Surface Water Quality	No potential impact on surface water quality. 🟦	Low potential impact on water quality of the Grand River. Tile beds would not be adjacent to any surface water. 🟦	Tertiary wastewater treatment required to maintain PWQO in Grand River. 🟧	Low potential impact on water quality of the Grand River. Leaching beds would not be adjacent to any surface water. 🟦	Tertiary wastewater treatment required to maintain PWQO in Grand River. 🟧
	Vegetation	No potential impact on existing vegetation. 🟦	Removal of some existing vegetation for individual tile beds. 🟧	Removal of some existing vegetation for WWTP. WWTP would be located in un-treed area. 🟧	Removal of some trees for WWTP and leaching beds. 🟥	Removal of some existing vegetation for sewage lift stations. 🟧
	Wildlife and Wildlife Habitat	No potential impact on wildlife and wildlife habitat. 🟦	No significant wildlife or wildlife habitat have been identified on SPL site. 🟦	No significant wildlife or wildlife habitat have been identified on SPL site. 🟦	No significant wildlife or wildlife habitat have been identified on SPL site. 🟦	No significant wildlife or wildlife habitat have been identified on SPL site. 🟦
	Archaeological or Heritage Resources	No potential archaeological or heritage impacts. 🟦	No significant archaeological or heritage features have been identified on SPL site. 🟦	No significant archaeological or heritage features have been identified on SPL site. 🟦	No significant archaeological or heritage features have been identified on SPL site. 🟦	No significant archaeological or heritage features have been identified on SPL site. 🟦
Socio-Economic Impacts	**Drinking Water Supplies - Quality and Quantity**	No potential impact on existing drinking water supplies. 🟦	Potential to increase nitrate and bacteria levels in shallow wells used for drinking water. No potential impact on capacity of existing drinking water supplies. 🟥	No potential impact on water quality or quantity of existing private and municipal drinking water supplies. 🟦	Low potential to increase nitrate and bacteria levels in shallow wells used for drinking water, due to high treatment level and location of leaching beds far from existing wells. No potential impact on capacity of existing drinking water supplies. 🟧	No potential impact on water quality or quantity of existing private and municipal drinking water supplies. 🟦
	Existing Residential	No opportunity to replace aging septic systems. 🟧	No opportunity to replace aging septic systems. 🟧	Opportunity to replace aging septic systems and connect to new communal system if municipal sewers are installed. 🟩	No opportunity to replace aging septic systems. 🟧	Opportunity to replace aging septic systems and connect to new communal system if municipal sewers are installed and WPCP capacity is available. 🟨

Evaluation Criteria	Description	1	2	3	4	5
		Do Nothing	*Individual Septic Systems*	*Communal WWTP with Surface Discharge*	*Communal WWTP with Subsurface Discharge*	*Connection to Expanded Grand Valley WPCP*
	Temporary during Construction	No potential temporary construction impacts. 🟦	No potential temporary construction impacts. 🟦	Minor impacts in Waldemar during construction of on-site WWTP and lift station, and effluent pipe. 🟧	Minor impacts in Waldemar during construction of on-site WWTP, lift station and leaching beds. 🟧	More impacts in Waldemar during construction of lift stations and forcemain. Disruption of Upper Grand Trailway for forcemain construction. 🟥
	Aesthetics: Noise, Visual, Odour	No potential noise, visual or odour impacts. 🟦	No potential noise or visual impacts. No odours expected when systems function properly. 🟦	Typically low and intermittent noise from WWTP and lift station. Minor visual impact of WWTP and lift station buildings. Minor potential for odours at lift station and at WWTP if treatment process is disrupted. Can be mitigated. 🟧	Typically low and intermittent noise from WWTP and lift station. Minor visual impact of new WWTP and lift station buildings. Minor potential for odours at lift station and at WWTP if treatment process is disrupted. Can be mitigated. 🟧	Typically low and intermittent noise from lift stations. Minor visual impact and potential for odours at new lift stations. Potential for odours at Grand Valley WPCP in early phases of development due to long residence time in forcemain. Can be mitigated. 🟧
Technical Considerations	**Technical Feasibility / Ease of Implementation**	No implementation required. 🟦	No technical constraints. 🟦	More complex to implement due to infrastructure required (sewers, lift station, WWTP and outfall). 🟧	More complex to implement due to infrastructure required (sewers, lift station, WWTP, leaching beds). 🟧	Most difficult to implement due to need for coordination with Grand Valley and infrastructure required (sewers, lift stations, forcemain and expansion of WPCP). 🟥
	Flexibility / Ease of Expansion	No ability to expand. 🟥	Does not provide any future benefit for servicing existing homes or other new development. 🟥	WWTP could be designed with ability for future expansion for existing homes or other new development. 🟩	Does not provide any future benefit for servicing existing homes or other new development. 🟥	Potential for expansion to increase serviced area if Grand River WPCP capacity is available. 🟩
	Operations and Maintenance Requirements	No operation and maintenance requirements. 🟦	Septic tank pump-out every 3-5 years. No O&M responsibilities for the Township. 🟦	Ongoing O & M for the WWTP and lift station. 🟥	Ongoing O & M for the WWTP, leaching beds and lift station. 🟥	Ongoing O&M for the sewage pumping stations. 🟧
	Approval Requirements	No approvals required. 🟦	Homeowners responsible for obtaining approvals under OBC. 🟦	MOECC Environmental Compliance Approval required for wastewater works. 🟧	MOECC Environmental Compliance Approval required for wastewater works. 🟧	MOECC Environmental Compliance Approval required for lift stations and forcemains. 🟧
	Agreements	No requirement for any agreements. 🟦	No requirement for any agreements. 🟦	A Municipal Responsibility Agreement may be required by MOECC if the Township does not assume the wastewater treatment facility. No requirement for inter-municipal agreement. 🟧	A Municipal Responsibility Agreement may be required by MOECC if the Township does not assume the wastewater treatment facility. No requirement for inter-municipal agreement. 🟧	An inter-municipal agreement needs to be developed with the Town of Grand Valley. 🟧
Financial Impacts	**Estimated Project Costs per Lot**	No project costs. 🟦	Estimated cost per new lot: $26,000. 🟧	Estimated project cost: $3.4 M. Estimated costs per new lot: $10,000. 🟩	Estimated project cost: $3.9 M Estimated cost per new lot: $77,000. 🟥	Estimated project cost, incl. share of WPCP: $6.6 M Estimated cost per new lot: $20,000 🟧
	Land Required for New Infrastructure	No land requirements. 🟦	Each lot must be larger to accommodate a tile bed. 🟦	Land required for lift station and WWTP (small footprint), within the SPL site. 🟧	More land required for lift station, WWTP (small footprint), and leaching beds, within the SPL site. 🟥	Land required for lift stations only. 🟧

7 Public, Agency and Township Consultation

7.1 Notice of Study Commencement

A Notice of Study Commencement and Public Information Open House was issued on November 28, 2016. Copies of the Notice were mailed directly to all residential addresses within approximately 120 m of the proposed development as well as to relevant provincial and federal agencies, the GRCA, the Township of Amaranth, the Town of Grand Valley and the Town of Orangeville, the County of Dufferin, nearby indigenous groups, school boards and utilities. The Notice of Study Commencement is included in Appendix B.

7.2 Phase 1 Public Information Open House

A Public Information Open House was held on January 11, 2017 in the Township of Amaranth Recreation Hall. The purpose of the meeting was to provide an early opportunity to view the preliminary development plans and the list of wastewater servicing alternatives under consideration, and to provide input to the Class EA study.

In attendance were approximately 120 people, including: Township Councillors, Township staff, and the Township's engineering consultant. The Open House consisted of a question and answer session followed by informal time for attendees to view the displays and discuss the project with the study team members. Copies of the displays are provided in Appendix B. The following is a summary of questions and comments fielded by the study team during the Open House:

- Does the Grand River have capacity to receive effluent during the summer months when flow is very low?

- Will a new WWTP meet the new federal wastewater regulations?

- Concerns over who will pay for operation of new wastewater and water facilities. Will Township have to hire new staff to run these facilities?

- Concern about maintaining a buffer zone between a WWTP and sewage lift station and residents; concerns about noise and smell.

- Which existing homes and additional developments will also be served by a new WWTP? Will homes all the way to Hwy 109 be serviced?

- Concern about residents being forced to connect to a new wastewater system at their own cost.

- Concerns about impacts to existing private wells if a new municipal well is constructed in Waldemar.

- Questions about the Class EA process.

- Concern about management of biosolids from a membrane bioreactor plant.
- Questions about timing of the statutory public meeting and timing of the development.
- Comment regarding the absence of 3-phase power in Waldemar, request that this be extended to new and existing water and wastewater facilities.
- Preference for a lower density development.
- Some residents would like to see some community amenity with the development.
- Concerns about the impact of a WWTP discharge on the Grand River water quality.
- Some residents are aware their septic systems are nearing the end of their life so would be interested in connecting.

Table 4 overleaf summarizes the comments received and responses following the issuing of the Notice of Study Commencement and the first PIC.

7.3 Phase 2 Public Information Centre

A second PIC was held on June 7, 2017 in the Township of Amaranth Recreation Hall.to present the alternative solutions and their preliminary assessment. The PIC was also the statutory public meeting for the planning application for the development.

The PIC sign-in sheet was signed by 49 attendees. A presentation by the study team was followed by a question and answer period. The display boards are attached in Appendix C. Concerns expressed by the attendees are summarized below:

- Potential for failure of a wastewater treatment plant and discharge of wastewater to the river.
- Costs to existing residents.
- Operation, maintenance and monitoring of the wastewater treatment system.
- Assimilative capacity of the Grand River at low flows.

Appendix C includes the minutes of the meeting prepared by the Township of Amaranth.

Table 5 overleaf presents a summary of comments received prior to, during and following the PIC. Comments were received from the Township of Amaranth on July 14, 2017. A detailed response letter was submitted on November 28, 2017 that included a revised table summarizing the assessment of alternative solutions.

Table 4: Summary of Comments Received during Phase 1

Date	From	Via	Comments	Response
Notice of Study Commencement & PIC on January 11, 2017				
Dec. 8, 2016	Ann McCallum Highlands Youth for Christ	Email	Why is her home address identified as the property subject to study on the original notice?	Email response. Property address error corrected.
Dec. 9, 2016	Maxime Picard Huron Wendat Nation	Email	Requested mapping to show the study area; asked about archaeological assessment.	Email response: figure of study area, and sent Stage 2-3 archaeological assessment report.
Dec. 14, 2016	Nathan Garland Resource Planner GRCA	Letter	Requested further participation in the study, consultation on weighting, ranking and creation of list of alternatives, and copy of the assimilative capacity study of the Grand River. Comments regarding delay of a decision on the planning applications until the EA has been finalized.	Email response: confirm we will consult with GRCA on alternatives in Phase 2, and provide copy of the XCG assimilative capacity study; provided schematic of integrated Class EA / planning application approach; explained delaying decision on planning application until preferred design selected and ESR completed is not necessary.
Dec. 19, 2016	Katherine McLaughlin Thomasfield Homes Ltd.	Email	Requested to be added to mailing list.	
Jan. 5, 2017	Dan Minkin Heritage Planner Ministry of Tourism, Culture and Sport	Letter	Comment on MTCS's mandate to conserve cultural heritage, including archaeological, built heritage, and cultural heritage landscape resources. Information on how the study should determine potential impacts on these resources.	Email response: Stage 2-3 archaeological assessment has been completed, no built heritage resources are present, and consultation with indigenous groups is underway; any potentially significant cultural heritage landscapes will be identified.
Jan. 10, 2017	Barb Slattery EA/Planning Coordinator MOECC West Central Region	Letter	Requested involvement in study with regard to determination of effluent quality to protect the Grand River, and if the wastewater system will be assumed by the Township or operated under a MRA. Requested copy of the Notice of Completion and ESR when project is complete.	Email response and sent assimilative capacity study report.

Table 5: Summary of Comments Received during Phase 2

Date	From	Via	Comments	Response
Notice of Statutory Meeting and PIC on June 7, 2017				
May 9, 2017	Tracey Atkinson Town of Grand Valley	Email	Town's interest in any servicing or development in proximity to the Grand River. Requested to be kept informed.	None
May 19, 2017	George Govier Historic Saugeen Metis	Email	The project location is beyond the geographic area of Historic Saugeen Metis traditional territory.	None
May 17, 2017	Maxime Picard Huron Wendat Nation	Email	Requested archaeological assessment report.	Archaeological report was resent.
May 23, 2017	Stephen Albanese IBI Group	Email	Advised they are the planners for Centurion Homes Ltd. Requested to be added to the mailing list.	None
June 2, 2017	Chief Rodney Noganosh Chippewas of Rama First Nation	Email	Notice was shared with Council and has been forwarded to Ms. McKenzie for review.	None
June 6, 2017	Tammy Nguyen Ventawood Management Inc.	Phone & Email	Requested to be added to mailing list.	None
June 6, 2017	Cindy and Steve Chen Residents	Email	Wants refund of cost of water system. Concerns about potential wastewater system costs and benefits to residents. Concerns with underground streams.	None
June 7, 2017	Peter Turell Resident	Comment Sheet	Concern with high maintenance of MBR, possibility of STP failure, and river assimilative capacity. Statement that septic systems could contaminate groundwater contradicts statement that soils are clay. Option 1 or 2 preferred.	None
June 7, 2017	David Moritz Resident	Comment Sheet	Statement that septic systems could contaminate groundwater contradicts statement that soils are clay. Will the operator of the STP be qualified?	None
June 7, 2017	Trish Hamilton Resident	Comment Sheet	Supports Official Plan. Option 1 or 2 preferred.	None
June 7, 2017	Mary Eberhardt Resident	Comment Sheet	Concern with smell from STP, impacts on fish in the river, flooding, insurance rates. Hamlet should stay a hamlet, not become "little Brampton'.	None

Date	From	Via	Comments	Response
June 7, 2017	Robert and Linda Berry Residents	Comment Sheet	Concern with drinking water levels, pollution to river, too low water levels in Grand River for discharge of effluent, and smell. Option 1 or 2 preferred. GRCA should be at next meeting	None
June 13, 2017	Donald and Roseanne Garon, Residents	Email	Concern with impact on low water pressure, land tax, and traffic. Prefer a small town.	None
June 14, 2017	Andrew Aloe Resident	Email	Concern with his well potentially going dry. What happens to existing houses with septic systems?	Email response: No expected impact on groundwater; homeowners will not have to connect to a wastewater system but opportunity may be available in the future.
June 23, 2017	Fawn Sault Mississauga of the New Credit First Nation	Email	Low level of concern. Requested copies of environmental and archaeological reports. Requested to be notified of any changes in the project.	Email response and archaeological report sent.
June 28, 2017	Nathan Garland Resource Planner GRCA	Letter and phone conv.	Requested additional information be provided to justify evaluation of alternatives. Recommend decision on planning application be deferred until EA has been reviewed and approved. Concern that assessment did not address potential risk of STP failure, and statements made implied studies had been completed.	Email and phone conversation: assessment is preliminary until all comments received. Assessment and evaluation matrix will be revised with his comments. All studies and reports will be included in ESR.
June 29, 2017	Glen Sterret Town of Grand Valley	Letter	Primary concern that decisions made in Waldemar regarding wastewater disposal don't negatively impact the future expansion of the Grand Valley STP. Requested copy of stream assimilative capacity study when completed. Questioned on how cost estimates were derived.	None
June 28, 2017	Dan Minkin Ministry of Tourism, Culture and Sport	Email	Question re P.I.F number for the archaeological assessment report and result of screening for heritage resources.	Email response: P.I.F. number provided and screening found alternatives had no potential impacts on heritage resources.
July 5, 2017	Chief Rodney Noganosh Chippewas of Rama First Nation	Email	Notice was shared with Council and has been forwarded to Ms. McKenzie for review.	None

8 Preferred Wastewater Solution

The conclusion of the technical evaluation of the alternative solutions is that the preferred alternative is to service the SPL residential development with a communal wastewater treatment plant with an effluent discharge to the Grand River. The main reasons for this conclusion are:

- An assimilative capacity reviewed by the MOECC indicates that the proposed effluent quality limits and mixing zones are acceptable. Therefore, subject to MOECC approval of the proposed effluent quality criteria, wastewater treatment facility and outfall, the Grand River can be considered an acceptable receiver of a tertiary-treated WWTP effluent if the river water quality can be maintained above all provincial surface water quality objectives under the worse stream flow conditions.
- It requires, and therefore provides, the highest level of wastewater treatment, and thus excellent protection of the natural environment.
- It provides an opportunity for the future connection of existing properties if the need arises.
- Residents' concerns with the potential risk of failure of a WWTP can be addressed with redundancy in the design and equipment, and will be explained further in Phase 3 of the Class EA.
- It is the only solution that meets the project objective and enables the full proposed development.

It is acknowledged that the comments received verbally and in writing on the wastewater alternative solutions indicate the residents of Waldemar have concerns with the proposed density of the residential development and with the potential for a wastewater system failure that could affect the quality of the Grand River. Addressing the concerns associated with the wastewater solution will be the focus of Phase 3 of the Class EA, in selecting and developing alternate design concepts for the wastewater treatment facility to ensure system reliability and redundancy, and in providing additional information and clarification.

9 Next Steps

Following concurrence of the preferred wastewater solution for the servicing of the SPL development with the Township, the next steps will consist of completing the Class EA Phase 3 (assessment of alternative design concepts for the wastewater treatment facility and outfall) and Class EA Phase 4 (Environmental Study Report and conceptual design), including public and review agency consultation.

Following the Class EA study, the MOECC will be consulted until written concurrence is obtained on the effluent quality limits. Design of the wastewater facilities and application for an MOECC Environmental Compliance Approval will follow.

Jason Covey

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STroxler

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APPENDIX A:
BACKGROUND STUDIES

A1:

GEOTECHNICAL STUDY

Terraprobe
Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL SUBDIVISION
WALDEMAR DEVELOPMENT
TOWNSHIP OF AMARANTH, ONTARIO

Prepared for: Sarah Properties Ltd. Developments
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Woodstock, Ontario
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Attention: Mr. Walter Broos

File No. 11-14-4090
April 15, 2015

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APPENDIX

1. INTRODUCTION

Terraprobe Inc. was retained by Sarah Properties Ltd. Developments to conduct a geotechnical investigation for a property located in the Township of Amaranth, Ontario. The property is currently undeveloped vacant fallow agricultural fields. It is understood that the property would be developed as a residential subdivision comprising single family lots serviced by a municipal water system, a communal sewer system and internal local paved roads.

This report encompasses the geotechnical investigation of the subject site to assess its geotechnical suitability and provides geotechnical engineering recommendations for the intended development. The field investigation consisted of advancing a total of eighteen (18) boreholes and ten (10) test pits. The borehole investigation was conducted to determine the prevailing subsurface soil and ground water conditions. This information is used to provide geotechnical engineering recommendations for the design of proposed house foundations, basement drainage, earthworks, pipe bedding, earth pressure design parameters and pavement structure. In addition, comments are also included on pertinent construction aspects including excavation, backfill, ground water control and installation of underground utilities.

Terraprobe has also conducted Hydrogeologic Study and a Phase One Environmental Site Assessment for the site. The findings of these investigations are reported under separate covers.

2. SITE AND PROJECT DESCRIPTION

The property is located on the west side of the Village of Waldemar and to the north of Highway 9 between 10th Line and Amaranth East Luther Townline. The property is generally bounded by undeveloped rural lands except to the east where it abuts existing estate residential development. The general location of the subject property is presented on Figure 1.

The property is irregular in shape covering an area of about 35 hectares. The property currently consists of open agricultural fields with relatively flat to gently rolling topography. It is proposed to develop the property as a residential subdivision comprising approximately 334 single family residential lots. The development would include municipal paved roadways and be serviced with a municipal water system and a communal sewage system.

3. FIELD PROCEDURE

The field investigation was conducted on March 10 and April 9 to 15, 2014, and consisted of drilling and sampling a total of eighteen (18) boreholes extending to depths ranging from about 4.6 to 12.3 m of below existing ground surface. The field works also included five (5) shallow boreholes for Hydrogeologic Study and ten (10) test pits for sanitary tile bed area. The information of shallow boreholes and test pits are reported and included in the Hydrogeological Investigation report under a separate cover. The boreholes were staked out in the field by Terraprobe Inc. The approximate locations of boreholes are shown on the enclosed Borehole Location Plan (Figure 2).

The ground surface elevations at the borehole locations were obtained from the contour drawing (BASE TOPO - MOD) provided by the client and are assumed to be referenced to the Geodetic Datum. The elevations noted on the borehole logs are approximate, and provided only for the purpose of relating borehole soil stratigraphy, and should not be used or relied on for other purposes.

The borings were drilled by a specialist drilling contractor using a track-mounted drill rig power auger. The borings were advanced using continuous flight solid stem augers, and were sampled at 0.75 m (up to 3.0 m depth) and 1.5 m (below 3.0 m depth) intervals with a conventional 50 mm diameter split barrel samplers when the Standard Penetration Test (SPT) was carried out (ASTM D1586). The field work (drilling, sampling and testing) was observed and recorded by a member of our field engineering staff, who logged the borings and examined the samples as they were obtained.

All samples obtained during the investigation were sealed into clean plastic jars, and transported to our geotechnical testing laboratory for detailed inspection and testing. All borehole samples were examined (tactile) in detail by a geotechnical engineer, and classified according to visual and index properties. Laboratory testing consisted of water content determination on all samples; and a Sieve and Hydrometer analysis on seven (7) selected native soil samples (Borehole 1, Samples 2 and 9; Borehole 6, Sample 3; Borehole 16, Sample 5; Borehole 17, Samples 3 and 6; and Borehole 18, Sample 5). The measured natural water contents of individual samples and the results of the Sieve and Hydrometer analysis tests are plotted on the enclosed borehole logs at respective sampling depths. The results of laboratory tests (Sieve and Hydrometer analysis tests) are also summarized in Section 4.4 of this report, and appended.

Water levels were monitored in open boreholes upon completion of drilling. Monitoring wells comprising 50 mm diameter PVC tubing were installed in all boreholes to facilitate ground water level monitoring. The PVC tubing was fitted with a bentonite clay seal as shown on the accompanying borehole logs. Water levels in the monitoring wells were measured on June 5 and July 3, 2014, respectively (about two and three months following the installation). The results of ground water level monitoring are presented in Section 4.5 of this report.

4. SUBSURFACE CONDITIONS

The results of the individual boreholes are summarized below and recorded on the accompanying Borehole Logs. This summary is intended to correlate this data to assist in the interpretation of the subsurface conditions at the site. Please refer to enclosed borehole logs for detailed stratigraphic results.

It should be noted that the soil conditions are confirmed at the borehole locations only and may vary between and beyond the boreholes. The stratigraphic boundaries as shown on the logs are based on a non-continuous sampling. These boundaries represent an inferred transition between the various strata, rather than a precise plane of geologic change.

In summary, the boreholes encountered a topsoil layer at the ground surface underlain by a zone of weathered/disturbed soils which was in turn underlain by undisturbed native soil deposits extending to the full depth of investigation at all borehole locations.

4.1 Topsoil

A topsoil layer was encountered in all boreholes at the ground surface varying in thickness from about 150 mm (Boreholes, 5, 11, 17 and 18) to 500 mm (Boreholes 3, 4, 7, 8 and 14). The topsoil was dark brown to black in colour and predominately consisted of silt matrix.

It should be noted that the site was ploughed and the upper (surficial zone) of the soil was noted to be mixed/disturbed. Therefore, the topsoil thicknesses noted on the borehole logs are approximate, estimated from the boreholes. The above data is not sufficient for estimating topsoil quantities and/or associated costs. A shallow test pit investigation should be carried out to measure accurate topsoil thickness across the site for topsoil quantity estimation, if required.

4.2 Weathered/Disturbed Soil Zone

A zone of weathered/disturbed soil was encountered beneath the surficial topsoil layer in all boreholes. The weathered/disturbed soil extended to depths varying from about 0.5 m (Boreholes 6 and 16) to as much as 3.0 m (Borehole 3) below grade. The composition of weathered/disturbed soils was generally similar to that of the underlying undisturbed native soils, and included a trace amount of organics/topsoil.

The Standard Penetration Test results ('N' Values) obtained from weathered/disturbed materials generally varied from 4 to 24 blows per 300 mm of penetration, indicating a loose to compact relative density (cohesionless soils) and soft to very stiff consistency (cohesive soils). Some of the high 'N' Values obtained from the weathered/disturbed soil may likely be due to partially frozen ground condition and may not necessarily represent the state of compactness of the materials tested.

The measured moisture contents of the weathered/disturbed soil sample typically ranged between 15 to 39 percent by mass, indicating a typically moist to very moist to locally wet condition.

4.3 Native Soils

Undisturbed native soil deposit was encountered in all boreholes beneath the zone of weathered/disturbed materials and extended to the full depths of investigation varying from 4.6 to 12.3 m below grade. The composition of native soil deposits is relatively consistent across the site, generally consisting of clayey silt to sandy silt and sand and silt tills.

It must be noted that the undisturbed native soil deposit is likely to contain larger size particles (cobbles and boulders) that are not specifically identified in the boreholes. The size and distribution of such obstructions cannot be predicted with borings, because the borehole sampler size is insufficient to secure representative samples for the particles of this size.

4.3.1 Clayey Silt Till

Undisturbed native clayey silt till deposit was encountered at all boreholes with exceptions of Boreholes 6, 12 and 14 beneath the weathered/disturbed soil zone. The glacial till predominately consisted of clayey silt matrix with varying amounts of sand (trace sand to sandy) and trace to some gravel. The clayey silt till soils extended to the depths of about 1.5 m (Borehole 16) to 9.1 m (Borehole 3) below grade.

The Standard Penetration Test results ('N' Values) obtained from the clayey silt till soils generally varied from 10 to 94 blows per 300 mm of penetration and to 50 blows per 50 to 150 mm of penetration, indicating a stiff to hard (typically very stiff to hard) consistency. The measured moisture contents of the clayey silt till soil samples generally ranged from 8 to 30 percent by mass, indicating a typically moist condition.

4.3.2 Sandy Silt to Sand and Silt Till

Undisturbed native sandy silt to sand and silt till deposit was encountered in Boreholes 1, 3, 6 and 11 to 17 beneath gravel and sand, clayey silt till and weathered/disturbed soil zone at depths varying from about 0.6 m (Borehole 12) to 10.7 m (Borehole 1) below grade. The glacial till deposit included trace to some clay and gravel. This deposit extended to the full depth of the investigation varying from about 4.6 m (Borehole 6) to 12.3 m (Borehole 3) below grade.

The Standard Penetration Test results ('N Values) obtained from the cohesionless till deposit generally varied from 15 to 85 blows per 300 mm of penetration and 50 blow per 0 to 150 mm penetration, indicating a compact to very dense relative density (predominately very dense). The measured moisture contents of these soil samples typically ranged from 3 to 19 percent by mass, indicating a damp to moist condition.

4.3.3 Sand/Sand and Gravel

A layer of sand/sand and gravel was encountered beneath embedded within the glacial till deposit at depths of about 7.6 m and 2.7 m below grade in Boreholes 1 and 7 respectively, and extended to depths of about 4.6 m (Borehole 7) and 10.7 m (Borehole 1) below grade.

The Standard Penetration Test results ('N' Values) obtained from these soils were 29 and 68 blows per 300 mm of penetration, indicating a compact to very dense relative density. The measured moisture contents of these soil samples ranged from 10 to 17 percent by mass, indicating a typically wet condition.

4.4 Geotechnical Laboratory Test Results

The geotechnical laboratory testing consisted of water content determination for all samples, while a Sieve and Hydrometer analysis test was conducted on selected soil samples. The measured natural water contents of individual samples and the results of the Sieve and Hydrometer analysis tests are plotted on the enclosed borehole logs at respective sampling depths. The results (graphs) of the Sieve and Hydrometer (grain size) analysis are appended and a summary of these results is presented below:

Borehole No. Sample No.	Sampling Depth below Grade	Percentage				Description (MIT System)
		Gravel	Sand	Silt	Clay	
Borehole 1 Sample 2	0.8 m	0	9	54	37	CLAYEY SILT, trace sand
Borehole 1 Sample 9	9.1 m	47	42	11		GRAVEL AND SAND, some silt
Borehole 6 Sample 3	1.5 m	10	41	40	9	SAND AND SILT, some gravel, trace clay
Borehole 16 Sample 5	3.0 m	14	38	37	11	SAND AND SILT, some gravel, some clay
Borehole 17 Sample 3	1.5 m	3	26	47	24	CLAYEY SILT, sandy, trace gravel
Borehole 17 Sample 6	4.6 m	11	37	37	15	SAND AND SILT, some clay, some gravel
Borehole 18 Sample 5	3.0 m	3	26	49	22	CLAYEY SILT, sandy, trace gravel

4.5 Ground Water

Observations pertaining to the depth of water level and caving were made in the open boreholes immediately after completion of drilling, and are noted on the enclosed borehole logs. Monitoring wells were installed in all boreholes to facilitate ground water level monitoring. The ground water level measurements in the monitoring wells were taken on June 5 and July 3, 2014, (about two and three months following the installation) and are noted on the enclosed borehole logs. A summary of measured ground water level is provided below:

Borehole No.	Depth of Boring	Depth to Cave	Water Level Depth/Elevation at Time of Drilling	Water Level Depth/Elevation in Monitoring Well June 5, 2014	Water Level Depth/Elevation in Monitoring Well July 3, 2014
1	12.2 m BG	Open	3.0 m BG/471.2 m	-0.9 m BG/475.1 m	1.3 m BG/472.9 m
2	6.6 m BG	Open	4.6 m BG/466.2 m	1.5 m BG/469.3 m	3.4 m BG/467.5 m
3	12.3 m BG	Open	Dry	5.4 m BG/ 464.7 m	8.2 m BG/ 461.9 m
4	6.6 m BG	Open	Dry	4.3 m BG/ 466.1 m	4.9 m BG/ 465.5 m
5	6.2 m BG	Open	Dry	5.8 m BG/ 462.7 m	6.0 m BG/ 462.5 m
6	4.6 m BG	Open	Dry	1.1 m BG/ 465.6 m	1.9 m BG/ 464.8 m
7	6.6 m BG	Open	3.7 m BG/ 469.1 m	1.5 m BG/ 471.3 m	1.8 m BG/ 471.0 m
8	6.6 m BG	Open	Dry	1.6 m BG/ 467.4 m	2.2 m BG/ 466.8 m
9	5.0 m BG	Open	Dry	1.1 m BG/ 464.9 m	1.5 m BG/ 464.5 m
10	5.0 m BG	Open	Dry	2.2 m BG/ 467.5 m	2.6 m BG/ 467.0 m
11	12.2 m BG	Open	Dry	5.3 m BG/ 463.0 m	5.6 m BG/ 462.7 m
12	4.6 m BG	Open	3.7 m BG/ 462.5 m	1.9 m BG/ 464.3 m	2.5 m BG/ 463.7 m
13	4.7 m BG	Open	4.0 m BG/ 458.8 m	2.8 m BG/ 460.0 m	3.3 m BG/ 459.5 m
14	5.5 m BG	Open	4.6 m BG/ 458.6 m	1.7 m BG/ 461.5 m	2.3 m BG/ 460.9 m
15	12.2 m BG	Open	9.1 m BG/ 461.3 m	6.2 m BG/ 464.2 m	7.1 m BG/ 463.3 m
16	5.0 m BG	Open	4.3 m BG/ 461.2 m	1.5 m BG/ 464.0 m	2.2 m BG/ 463.3 m
17	4.8 m BG	Open	Dry	1.7 m BG/ 466.1 m	2.2 m BG/ 465.6 m
18	5.0 m BG	Open	Dry	1.7 m BG/ 461.8 m	2.1 m BG/ 461.4 m

BG = Below Grade

It should be noted that the ground water levels indicated above may fluctuate seasonally depending on the amount of precipitation and surface runoff. Wet soils may be encountered up to about 0.6 m above measured water level due to capillary rise in fine cohesionless silt/sand soils.

5. DISCUSSION AND RECOMMENDATIONS

The following discussion and recommendations are based on the factual data obtained from this investigation and are intended for use of the owner and the design engineer. Contractors bidding or providing services on this project should review the factual data and determine their own conclusions regarding construction methods and scheduling.

This report is provided on the basis of these terms of reference and on the assumption that the design features relevant to the geotechnical analyses will be in accordance with applicable codes, standards and guidelines of geotechnical engineering practice. The pertinent sections of Ontario Building Code may require additional considerations beyond the recommendations provided in this report, and must be followed. If there are any changes to the site development features or any additional information relevant to the interpretations made of the subsurface information with respect to the geotechnical analyses or other recommendations, then Terraprobe should be retained to review the implications of these changes with respect to the contents of this report.

5.1 Foundations

The boreholes encountered a topsoil layer at the ground surface generally underlain by a weathered/disturbed soil zone extending to depths varying from about 0.5 to 3.0 m below grade, which was in turn underlain by undisturbed native soil deposit extending to the full depth of investigation.

The existing topsoil and weathered/disturbed soils are unsuitable for the support of proposed house foundations. All foundations must be supported on the underlying competent undisturbed native soils or on engineered fill, if applicable.

It is understood that the proposed houses would be supported on conventional spread footing foundations. The following subsections provide geotechnical design recommendations for the house foundations.

5.1.1 Spread Foundations on Native Soils

The undisturbed native soils are considered suitable to support the proposed house foundations. The development details (including site grading plan) were not available at the time of preparation of this report. However, it is understood that the proposed houses would likely include a basement. A nominal net geotechnical reaction of 150 kPa (Serviceability Limit States, SLS) and factored geotechnical resistance of

225 kPa (Ultimate Limit States, ULS) may be used for preliminary design of conventional spread footing foundations (for vertical and concentric loads) supported on the underlying competent undisturbed native till soils of very stiff to hard consistency or compact to very dense relative density.

It should be noted that the foundations at Borehole 3 will have to be extended deeper (about 3.3 m below existing grade) to support them on underlying competent glacial till soil. We understand that the proposed houses will have a basement, and therefore based on the final site grading details, the design foundation elevations may already have to be designed deeper at the levels of underlying competent undisturbed native till soils. Regardless, the final site grading and house foundation elevations should be reviewed by Terraprobe to assess the design founding levels and corresponding soil bearing pressures available at the design foundation depths.

All foundations must be designed to bear at least a minimum of 0.3 m into the competent undisturbed native soil stratum. The minimum width of continuous strip footing should be 500 mm, and the minimum size of isolated footings should be 900 mm x 900 mm, in conjunction with the above bearing pressure. Footing width for houses and small building are stipulated in Division 2, Part 9 of Ontario Building Code (2006) and must be followed regardless of the foundation recommendation provided in this report.

5.1.2 Foundations on Engineered Fill

The design grading may require ambient site grades to be raised in some areas. If site grades are required to be raised, consideration should be given to construction of engineered fill which may also support house foundations at normal depths, if needed. The engineered fill refers to earth fill designed and constructed under full-time inspection and testing supervision of a geotechnical engineer to support the house foundations without excessive settlement.

Prior to the placement of the engineered fill, it is recommended that the topsoil and/or weathered and disturbed native soils be stripped from beneath and beyond the proposed house footprints (minimum of 2 m beyond), and that the subgrade be proof-rolled. Any soft or wet areas which deflect excessively during the proof roll, should be sub-excavated and replaced with suitably compacted clean earth fill placed in maximum 150 mm thick lifts. It should be noted that localized subgrade stabilization measures may be required, based on the proof-roll assessment. The selection and sorting of the existing weathered/disturbed soils present on the site should be conducted under the supervision of a geotechnical engineer. These materials may be utilized as engineered fill, provided these soils are not too wet to achieve specified compaction, and do not contain excessive organic inclusion. The moisture content of the engineered fill material must be within 2 percent of its optimum moisture content.

The engineered fill should consist of clean earth fill or imported granular materials (OPSS 1010), and should be placed in lifts of 150 mm thicknesses or less, and compacted to a minimum of 98 percent Standard Proctor Maximum Dry Density (SPMDD). The engineered fill should extend for a distance of at least 2 m beyond the house footprint as measured at the founding level, and should extend downwards from this point at a 1 to 1 (horizontal to vertical) slope, to the approved subgrade. In addition, the engineered fill should extend at least 0.6 m above the proposed foundation elevation. This is to ensure that the foundations are placed on the engineered fill both in plan and elevation.

The placement and inspection of the engineered fill must be conducted under the full time supervision of a qualified geotechnical engineer. Provided the engineered fill is placed and compacted as indicated above, a maximum net allowable geotechnical reaction of up to 150 kPa (Serviceability Limit States, S.L.S.) and 225 kPa (factored geotechnical resistance at Ultimate Limit States, U.L.S.) may be utilized for the design of conventional spread footing foundations supported on engineered fill. Site grading plan should be reviewed by Terraprobe to better assess the suitability and requirements for engineered fill.

In case of footings supported on engineered fill, the minimum width for the conventional spread strip footing must be 600 mm, and the minimum size of the individual column footing must be 1000 mm x 1000 mm, regardless of loading considerations.

It should be noted that for houses placed on engineered fill, nominal reinforcing steel is recommended in the foundation walls. The reinforcing steel should consist of two (2) continuous 15 M bars at the top of the foundation wall and two (2) continuous 15 M bars at the bottom (Figure 3). A draft copy of "Engineered Fill Earthworks Specifications" is append for reference.

5.1.3 Placement of Footings

All exterior foundations and foundations in unheated areas must be provided with a minimum soil cover of 1.2 m or equivalent insulation for frost protection. All footings must be designed and constructed to bear at least 0.3 m into the undisturbed native soil/engineered fill stratum.

It is recommended that all excavated footing bases must be evaluated by a qualified geotechnical engineer to ensure that the founding soils exposed at the excavation base are consistent with the design bearing pressure intended by the geotechnical engineer.

Prior to pouring concrete for the footings, the footing subgrade should be cleaned of all deleterious materials such as topsoil, fill, softened, disturbed or caved materials, as well as any standing water. If construction proceeds during freezing weather conditions, adequate temporary frost protection for the footing bases and concrete must be provided.

Native soils and engineered fill materials tend to weather rapidly and deteriorate on exposure to the atmosphere and surface water. Hence, foundation bases which remain open for an extended period of time should be protected by a skim coat of lean concrete.

It should be noted that wet/dilatant soils may be encountered at the design foundation elevation at some borehole locations. Foundation subgrade comprising wet/dilatant soil will become weak and unstable due to disturbance, and will loose its integrity to support foundation. Consideration should be given to minimize disturbance to the foundation subgrade in these areas and the subgrade may need to be protected by a skim coat of lean concrete. For foundation excavations extending below the ground water level, it will be necessary to lower and maintain the ground water level below the excavation base. Further comments on the ground water control are presented in Section 5.5 of this report.

5.2 Basement Floor Slab

Concrete floor slab should be placed on at least 150 mm of granular base (OPSS 1010 Granular "A" or 19 mm crusher run limestone or OPSS 1004 19 mm Clear Stone) compacted to a minimum of 98 percent SPMDD or vibrated into a dense state in case of a clearstone material. The subgrade should be assessed and approved by a geotechnical engineer prior to the placement of granular base. Any incompetent, soft and wet subgrade areas identified must be subexcavated and backfilled with suitable compacted clean earth fill or imported granular materials. The granular base should be placed either on undisturbed native subgrade or clean earth fill compacted to at least 98 percent SPMDD.

5.3 Earth Pressure Design Parameters

Walls or bracings subject to unbalanced earth pressures must be designed to resist a pressure that can be calculated based on the following equation:

$$P = K\,[\gamma\,(h-h_w) + \gamma' h_w + q] + \gamma_w h_w$$

where:
P = the horizontal pressure at depth h (kPa)
K = the earth pressure coefficient
h_w = the depth below the ground water level (m)
γ = the bulk unit weight of soil (kN/m^3)
γ_w = the bulk unit weight of water (9.8 kN/m^3)
γ' = the submerged unit weight of the exterior soil, ($\gamma_{sat} - \gamma_w$)
q = the complete surcharge loading (kPa)

Where the wall backfill can be drained effectively to eliminate hydrostatic pressures on the wall, this equation can be simplified to:

$$\mathbf{P = \quad K[\gamma h + q]}$$

This equation assumes that free-draining granular backfill is used and positive drainage is provided to ensure that there is no hydrostatic pressure acting in conjunction with the earth pressure.

Resistance to sliding of retaining structures is developed by friction between the base of the footing and the soil. This friction **(R)** depends on the normal load on the soil contact (**N**) and the frictional resistance of the soil (**tan** ϕ) expressed as **R = N tan** ϕ. The factored geotechnical resistance at ULS is **0.8 R**.

Passive earth pressure resistance is generally not considered as a resisting force against sliding for conventional retaining structure design because a structure must deflect significantly to develop the full passive resistance.

The average values for use in the design of structures subject to unbalanced earth pressures at this site are tabulated as follow:

Parameter	Definition	Units
ϕ	angle of internal friction	degrees
γ	bulk unit weight of soil	kN/ m^3
K_a	active earth pressure coefficient (Rankin)	dimensionless
K_o	at-rest earth pressure coefficient (Rankin)	dimensionless
K_p	passive earth pressure coefficient (Rankin)	dimensionless

Stratum/Parameter	ϕ	γ	K_a	K_o	K_p
Weathered/Disturbed Soil	30	19.5	0.33	0.50	3.00
Clayey Silt Till	30	21.5	0.33	0.50	3.00
Sandy Silt to Sand and Silt Till Sand and Gravel/Sand	32	21.5	0.31	0.47	3.25

The values of the earth pressure coefficients noted above are for the horizontal ground surface/backfill. The earth pressure coefficients for inclined ground surface/backfill behind the retaining structure will vary based on the inclination of the retained ground surface.

5.4 Basement Drainage

As noted before, all boreholes remained open and water levels upon completion of drilling ranged from 3.0 to 9.1 m (or dry) below grade. Water levels measured in the monitoring wells on June 5 and July 3, 2014 indicated that the water levels generally varied from 1.1 to 8.2 m below grade. Therefore, varying amounts of ground water seepage may be encountered in the excavation in some areas (depending upon the depth of excavation) .

To assist in maintaining basements dry from seepage, it is recommended that exterior grades around the house be sloped away at a 2 percent gradient or more, for a distance of at least 1.2 m. As well, perimeter foundation drains should be provided, consisting of perforated pipe with filter fabric (minimum 100 mm diameter) surrounded by a granular filter (minimum 150 mm thick), and freely outletting. The granular filter should consist of OPSS 1004 19 mm Clear Stone (Figure 4 Basement Drainage Detail).

The basement wall (for basements) must be provided with damp-proofing provisions in conformance to the Section 9.13.2 of the Ontario Building Code. The basement wall backfill for a minimum lateral distance of 0.6 m out from the wall should consist of free-draining granular material (OPSS 1010 Granular 'B'), or provided with a suitable alternative drainage cellular media. The perimeter drain installation and outlet provisions must conform to the plumbing code requirements.

A provision of a sub-floor drainage system installed beneath the basement floor slab is recommended in addition to the above recommended perimeter drainage. The sub-floor drainage system should consist of perforated pipes located at a maximum spacing of 5.0 m centre to centre (Figure 4 Basement Drainage Detail and Figure 5 Basement Subdrain Detail). The perimeter foundations and sub-floor drains may be outlet to a suitable discharge point under gravity flow, or connected to a sump located in the lowest level of the basement and the water be pumped to a suitable discharge point. The perimeter and sub-drain installation and outlet should conform to the applicable (plumbing) code requirements.

The size of the sump should be adequate to accommodate the water seepage. The sub-floor drainage system should be designed to prevent the possibility of back-flow. A duplex pumping arrangement (main pump with a provision of a backup pump) on emergency backup power is recommended. The pumps should have sufficient capacity to accommodate a maximum peak flow of water of about 6 to 8 gallons per minute. This flow is not anticipated to be a sustained flow, but could be achieved under certain peak flow conditions.

5.5 Excavations and Ground Water Control

The borehole data indicate that topsoil, weathered/disturbed and undisturbed native soils would be encountered in the excavations. Excavations must be carried out in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects. These regulations designate four broad classifications of soils to stipulate appropriate measures for excavation safety.

TYPE 1 SOIL

a. is hard, very dense and only able to be penetrated with difficulty by a small sharp object;
b. has a low natural moisture content and a high degree of internal strength;
c. has no signs of water seepage; and
d. can be excavated only by mechanical equipment.

TYPE 2 SOIL

a. is very stiff, dense and can be penetrated with moderate difficulty by a small sharp object;
b. has a low to medium natural moisture content and a medium degree of internal strength; and
c. has a damp appearance after it is excavated.

TYPE 3 SOIL

a. is stiff to firm and compact to loose in consistency or is previously-excavated soil;
b. exhibits signs of surface cracking;
c. exhibits signs of water seepage;
d. if it is dry, may run easily into a well-defined conical pile; and
e. has a low degree of internal strength

TYPE 4 SOIL

a. is soft to very soft and very loose in consistency, very sensitive and upon disturbance is significantly reduced in natural strength;
b. runs easily or flows, unless it is completely supported before excavating procedures;
c. has almost no internal strength;
d. is wet or muddy; and
e. exerts substantial fluid pressure on its supporting system.

The weathered/disturbed native soils encountered in the boreholes are classified as Type 3 Soil above and Type 4 Soil below the prevailing groundwater level, while undisturbed native soils are classified as Type 1 to Type 3 soil based on soil's consistency or relative density and ground water level under these regulation.

Where workmen must enter excavations advanced deeper than 1.2 m, the trench walls should be suitably sloped and/or braced in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects. The regulation stipulates steepest slopes of excavation by soil type as follows:

Soil Type	Base of Slope	Steepest Slope Inclination
1	within 1.2 metres of bottom of trench	1 horizontal to 1 vertical
2	within 1.2 metres of bottom of trench	1 horizontal to 1 vertical
3	from bottom of trench	1 horizontal to 1 vertical
4	from bottom of trench	3 horizontal to 1 vertical

Minimum support system requirements for steeper excavations are stipulated in the Occupational Health and Safety Act and Regulations for Construction Projects, and include provisions for timbering, shoring and moveable trench boxes.

It should be noted that the glacial till deposit may contain larger particles (cobbles and boulders) that are not specifically identified in the borehole logs. The size and distribution of such obstructions cannot be predicted with borings, because the borehole sampler size is insufficient to secure representative samples of the particles of this size. Provision should be made in excavation contracts to allocate risks associated with time spent and equipment utilized to remove or penetrate such obstructions when encountered.

Ground water levels upon completion of drilling ranged from 3.0 to 9.1 m below grade, while some boreholes remained dry. The ground water levels measured in the monitoring wells June 5 and July 3, 2014 indicated that the water level generally ranged from 1.1 to 8.2 m below grade. It must be noted that the ground water levels noted in the boreholes may fluctuate seasonally and wet soil may be found as much as 600 mm above the measured ground water levels where there is capillary rise in fine, cohesionless silt/sand soils.

Based on the borehole information, it is understood that there may be some ground water seepage in the excavation in some areas (depending upon the depth of excavation). This seepage will likely emanate from very moist to wet cohesionless sand and gravel/sand/silt lenses encountered within the glacial till deposit. The perched groundwater seepage emanating from above the static ground water table should diminish slowly and can be controlled by continuous pumping from filtered sumps at the base of the excavation. The amount of water seepage is expected to increase with the depth of excavation. For excavations extending into the underlying very moist and wet sand/silt/sand and gravel zones, and/or below the prevailing ground water level, it will be necessary to lower the ground water level and maintain it below the excavation base (at least 1.0 m) prior to and during the subsurface construction. Without positive ground water control and lowering the prevailing ground water level, the subgrade in wet permeable soil zones will become weak and lose its integrity to support. Consideration should be given to install a skim coat of lean concrete (mud-slab) to preserve the subgrade integrity, and to provide a working platform.

It should be noted that excavations carried through and below the water bearing cohesionless soil deposit (silt, sand, gravel) will experience loosening and sloughing of the base and sides, unless the ground water level is lowered first. Consideration should be given to conduct test pit excavation to further assess the ground water influx, excavation stability and to provide updated ground water control recommendations once the site servicing and other developments details are finalized. Dewatering of more than 50,000 litres/day would require a permit from the Ministry of Environment.

5.6 Backfill

The existing topsoil and weathered/disturbed soils containing excessive amounts of organics should not be reused as backfill in settlement sensitive areas (beneath the floor slabs, trench backfill and pavement areas). However, these materials may be stockpiled and reused for landscaping purposes. The weathered/disturbed materials with only trace amounts of organic inclusion may be utilized as backfill. The selection and sorting of weathered/disturbed materials should be conducted under the supervision of a geotechnical engineer.

The approved weathered/disturbed and native soils are considered suitable for backfill provided these soils are within 3 percent of the optimum moisture content. It should be noted that there will likely be wet zones within the subsurface soils which could be too wet to compact. Any soil material with 3 percent or higher in-situ moisture content than its optimum moisture content, could be put aside to dry or be tilled to reduce the moisture content so that it can be effectively compacted. Alternatively, materials of higher moisture content could be wasted and be replaced with imported material which can be readily compacted. The site soils would be best compacted with a heavy sheepsfoot type roller.

In settlement sensitive areas (beneath the floor slabs, trench backfill and pavement areas), the backfill should consist of approved clean earth and should be placed in lifts of 150 mm thicknesses or less, and heavily compacted to a minimum of 95 percent SPMDD at a water content close to optimum. The soils encountered on the site will be best compacted with a heavy sheepsfoot type roller.

It should be noted that the site soils are generally not free draining, and will be difficult to handle and compact should they become wetter as a result of inclement weather or seepage. Hence, it can be expected that earthworks will be difficult during the wet periods (i.e., spring and fall) of the year and may result in increased earthwork costs.

5.7 Pipe Bedding

The design details and invert elevations of the underground utilities were not available at the time of preparation of this report. The site stratigraphy predominantly consists of an upper weathered/disturbed soil zone underlain by undisturbed native soil deposit extending to the full depths of investigation. The undisturbed native materials and approved compacted earth fill will be suitable for support of buried services on a conventional well graded granular base material. It is recommended that the utility subgrade be inspected by a geotechnical engineer or its representative during construction. The utility subgrade may require stabilization as deemed necessary based on the subgrade assessment, particularly if it consists of weathered/disturbed soils and/or wet dilatant materials. When the disturbance of the trench base has occurred, such as due to ground water seepage, or construction traffic, the disturbed soils should be subexcavated and replaced with suitably compacted granular fill.

Granular bedding material should consist of a well graded, free draining soil, such as OPSS 1010 Granular "A" or 19 mm crusher-run limestone or as approved by the Town/County. A clear stone type bedding may also be considered if approved by the regulatory agencies. The bedding material should be placed in maximum 150 mm thick lifts and compacted to a minimum of 95 percent SPMDD or vibrated/tamped to a dense state in case of a clear stone material.

The clear stone bedding on cohesionless soil (silt/sand/sand and gravel) subgrade may be considered but only in conjunction with a suitable geotextile filter (Terrafix 270 R or equivalent); otherwise without proper filtering, there may be entry of fines from the surrounding soils into the bedding. This loss of ground could result in loss of support to the pipes and in possible future settlements.

5.8 Pavement Design

The proposed development would include construction of paved internal local roads.

The boreholes encountered a surficial layer of topsoil underlain by a zone of weathered/disturbed materials below grade. The weathered/disturbed materials were underlain by undisturbed native soil deposit which extended to the full depths of investigation.

Although the final design grades were not available at the time of preparation of this report, however, based on the existing site conditions and currently available information, it is understood that both cut and fill may be required for site grading, therefore, the pavement subgrade may consist of undisturbed native soil and compacted earth fill. The pavement subgrade should be proof-rolled with a heavy rubber tire vehicle (such as a grader) and any loose, soft, wet or unstable areas should be sub-excavated, and backfilled with clean earth fill material placed in 150 mm thick lifts and compacted to a minimum of 98 percent SPMDD. Local subexcavation in some areas may be required due to incompetent subgrade conditions (loose/soft, wet and/or excessive topsoil/organic presence) as identified during proof roll.

The existing weathered/disturbed soils encountered on the site may be utilized for subgrade preparation provided they do not contain excessive amounts of organics and deleterious materials, as well as their in-situ moisture content is within 3 percent of the optimum moisture content. The selection and sorting of the weathered/disturbed soils for reuse should be conducted under the supervision of a geotechnical engineer. Pavement subgrade (consisting of fill material) should be compacted to a minimum of 95 percent SPMDD, while the upper zone (within 1.2 m of the design subgrade) should be compacted to a minimum of 98 percent SPMDD.

The following pavement thicknesses for the internal local roadways are recommended. These pavement component design thicknesses should be compared with the Township Standards which should be followed if the Township Standards are higher or more stringent than the pavement design noted below.

Pavement Layers	Minimum Component Thickness	Compaction Requirements
Hot Mix Asphalt Surface Course, OPSS 1150 HL 3	40 mm	as per OPSS 310
Hot Mix Asphalt Binder Course, OPSS 1150 HL 8	60 mm	
Base Course, OPSS 1010 Granular A	150 mm	a minimum of 100 percent Standard Proctor Maximum Dry Density (ASTM D698)
Subbase Course, OPSS 1010 Granular B Type I	350 mm	

The granular materials should be placed in lifts 150 mm thick or less, and compacted to a minimum of 100 percent SPMDD for granular base and subbase. Hot mix asphalt mixes should be produced and placed in accordance with OPSS 310, OPSS 1150 and pertinent Town specifications. The granular base and subbase materials and their placement should conform to OPSS 501, OPSS MUNI 1010 and pertinent Town specifications. Performance graded asphalt cement PG 58-28, conforming to OPSS MUNI 1101 requirements, is recommended for the HMA binder and surface courses.

The need for adequate subgrade drainage cannot be over-emphasized. The subgrade must be free of depressions and sloped (a minimum grade of 3 percent) to provide effective drainage toward subgrade drains. Grading adjacent to the pavement areas should be designed to ensure that water is not allowed to pond adjacent to the outside edges of the pavement. Continuous pavement subdrains should be provided along both sides of the roadway and drained into respective catchbasins to facilitate drainage of the subgrade and granular materials. The subdrain invert should be maintained at least 0.3 m below subgrade level (Figure 6 Pavement Drainage Alternatives). Alternatively, side drainage ditches should be provided if a rural road cross-section is to be employed.

The above pavement design thicknesses are considered adequate for the design traffic. However, if the pavement construction occurs in wet, winter or inclement weather; it may be necessary to provide additional subgrade support for heavy construction traffic by increasing the thickness of the granular subbase, base or both. Traffic areas for construction equipment may experience unstable subgrade conditions. These areas may be stabilized utilizing additional thickness of granular materials.

The long-term performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures must be maintained to ensure that uniform subgrade moisture and density conditions are achieved as much as possible when fill is placed, and the natural subgrade is not disturbed or weakened after it is exposed.

It should be noted that in addition to the adherence to the above pavement design recommendations, a close control on the pavement construction process will also be required in order to obtain desired pavement life. Therefore, it is recommended that regular inspection and testing should be conducted during pavement construction to confirm material quality, thickness, and to ensure adequate compaction.

6. LIMITATIONS AND RISK

It must be recognized that there are special risks whenever engineering or related disciplines are applied to identify subsurface conditions. A comprehensive sampling and testing programme implemented in accordance with the most stringent level of care may fail to detect certain conditions. Terraprobe has assumed for the purposes of providing advice, that the conditions that exist between sampling points are similar to those found at the sample locations. The conditions that Terraprobe has interpreted to exist between sampling points can differ from those that actually exist.

It must also be recognized that the passage of time, natural occurrences, and direct or indirect human intervention at or near the site have the potential to alter subsurface conditions.

The discussion and recommendations are based on the factual data obtained from the investigation and are intended for use by the owner and its retained designers in the design phase of the project. Since the project is still in the design stage, all aspects of the project relative to the subsurface conditions cannot be anticipated. Terraprobe should review the design drawings and specifications prior to the construction of this work. If there are changes to the project scope and development features, the interpretations made of the subsurface information, the geotechnical design parameters and comments relating to constructibility issues and quality control may not be relevant to the revised project in part or complete. Terraprobe should be retained to review the implications of these changes with respect to the contents of this report.

The investigation at this site was conceived and executed to provide information for project design. It may not be possible to drill a sufficient number of boreholes or samples and report them in a way that would provide all the subsurface information that could have an effect on construction costs, techniques, equipment, and scheduling. Contractors bidding on or undertaking work on this project should therefore, in this light, be directed to decide on their own investigations, as well as their own interpretations of the factual investigation results. They should be cognizant of the risks implicit in subsurface investigation activities so that they may draw their own conclusions as to how the subsurface conditions may affect them.

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It is recognized that the regulatory agencies in their capacities as the planning and building authorities under Provincial statues, will make use of and rely upon this report, cognizant of the limitations thereof, both expressed and implied.

We trust the foregoing information is sufficient for your present requirements. If you have any questions, or if we can be of further assistance, please do not hesitate to contact us.

Yours truly,

Terraprobe Inc.

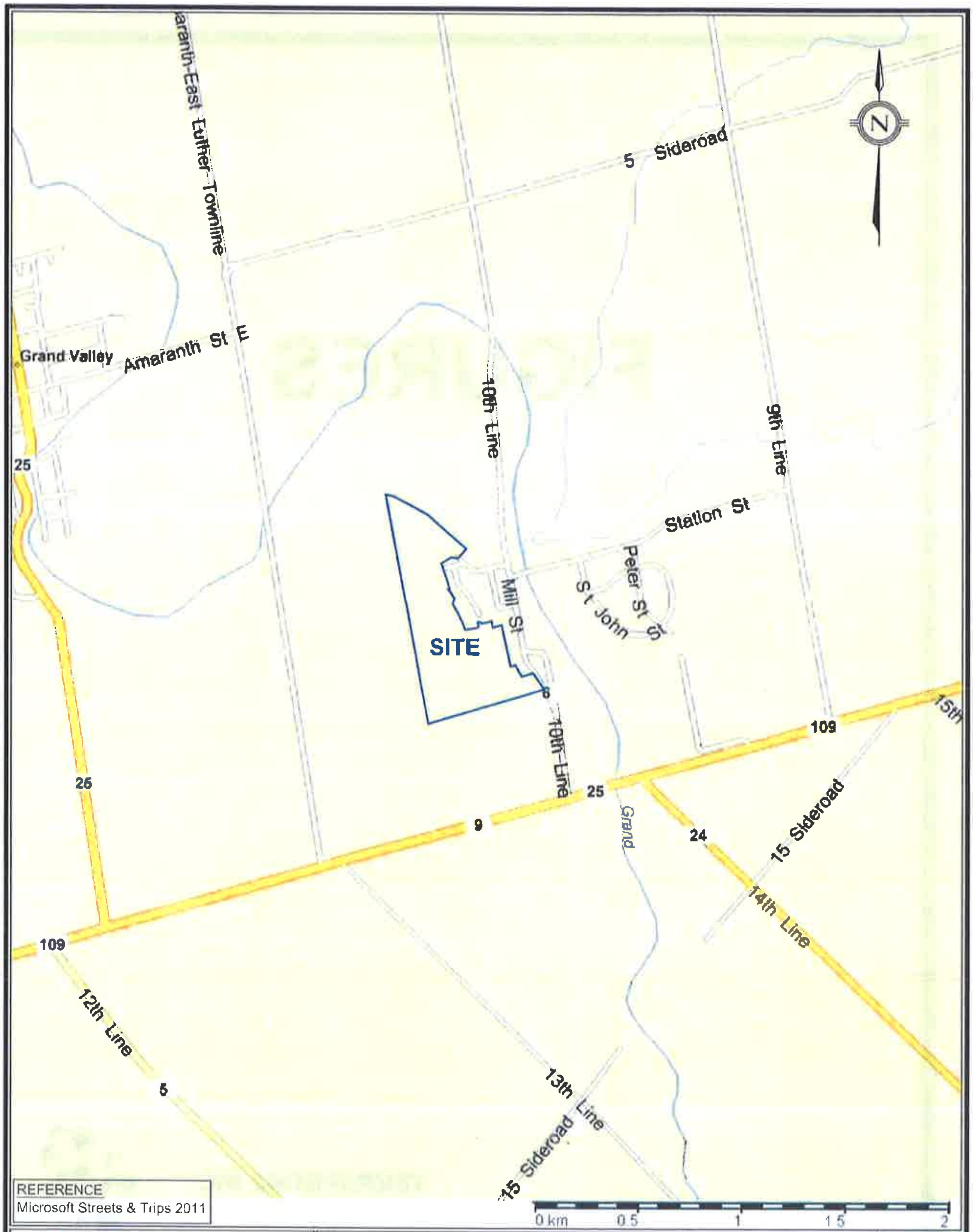
L. ZHANG
100108686
2015-04-15

Seth Zhang, P. Eng.
Geotechnical Engineer

B. Singh, M.A.Sc. P. Eng.
Principal

FIGURES

TERRAPROBE INC.



REFERENCE
Microsoft Streets & Trips 2011

Terraprobe

11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title:

SITE LOCATION PLAN

File No.

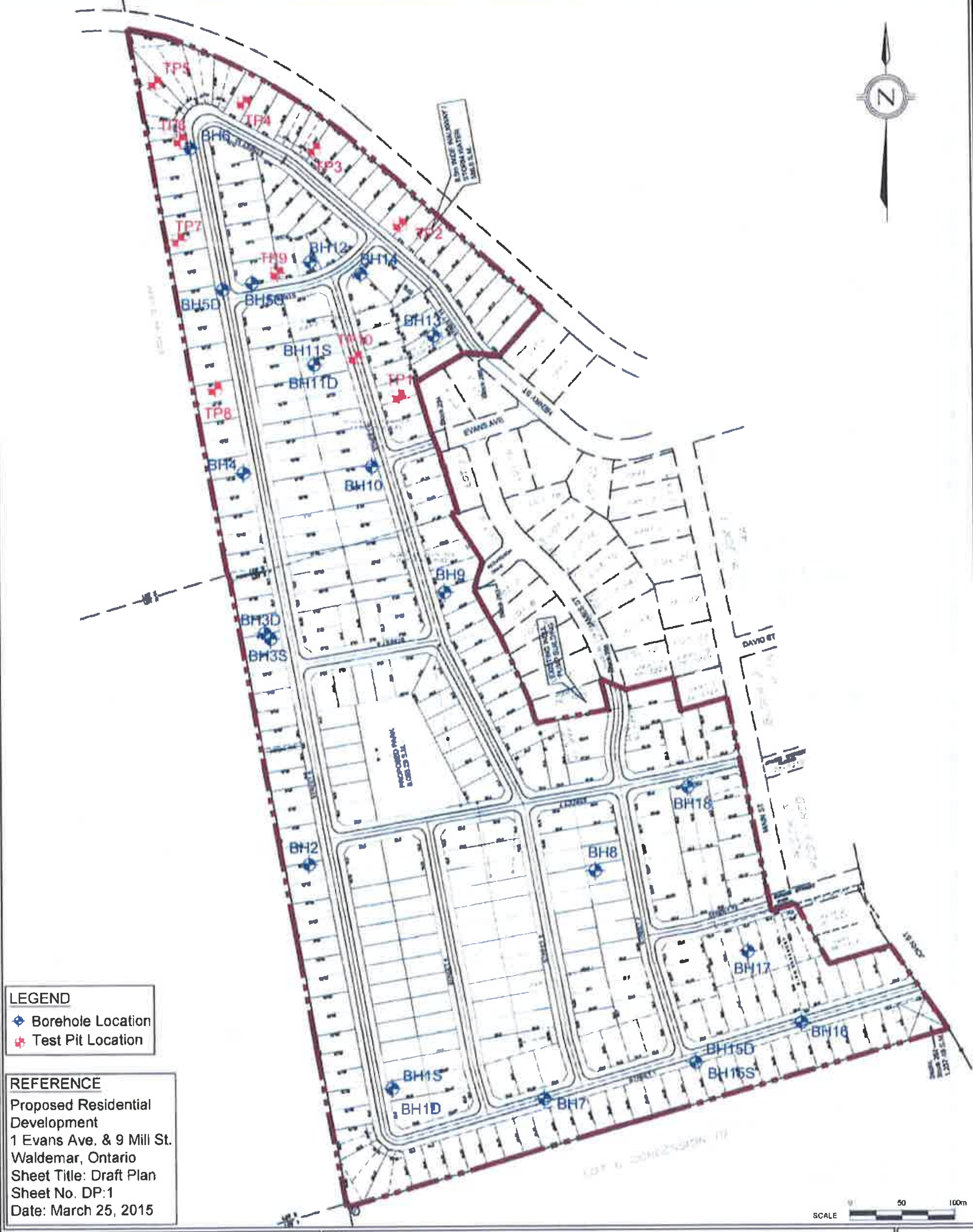
11-14-4090

FIGURE:

1

\\PDC\Server\1-Project Files\11-Geo\2014\11-14-4090\A Dwgs Logs\AutoCAD\11-14-4090 Figure 1 & 2----dwg Kamal

Z:\1-Project Files\11-Geo\2014\11-14-4090 Waldemar\A Dwgs, Logs\AutoCAD\11-14-4090 Figure 1 & 2----_UPDATED_2 dwg, sandys



LEGEND

- ⯁ Borehole Location
- ✚ Test Pit Location

REFERENCE

Proposed Residential Development
1 Evans Ave. & 9 Mill St.
Waldemar, Ontario
Sheet Title: Draft Plan
Sheet No. DP:1
Date: March 25, 2015

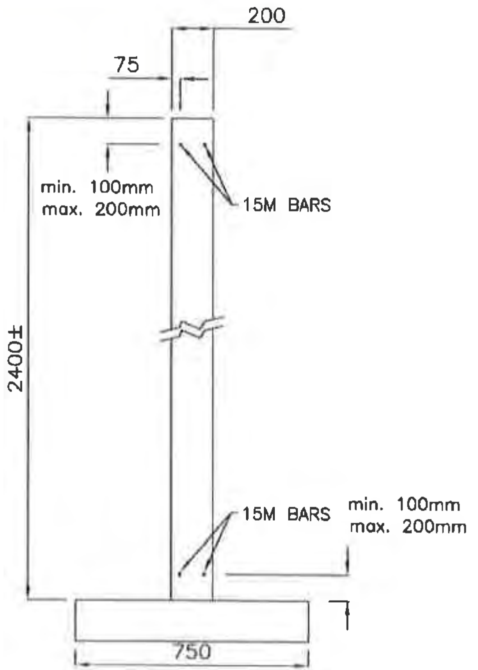
Terraprobe
11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title:

BOREHOLE LOCATION PLAN

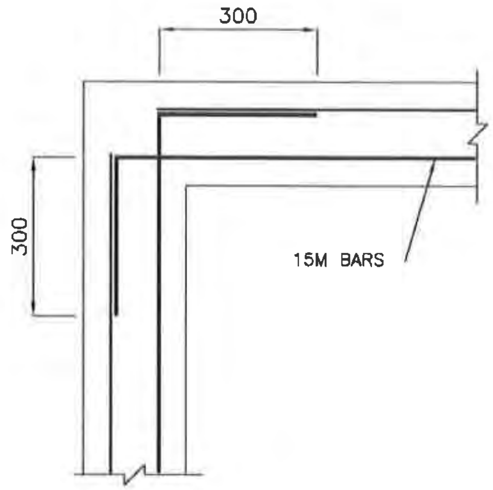
File No. 11-14-4090

FIGURE : 2



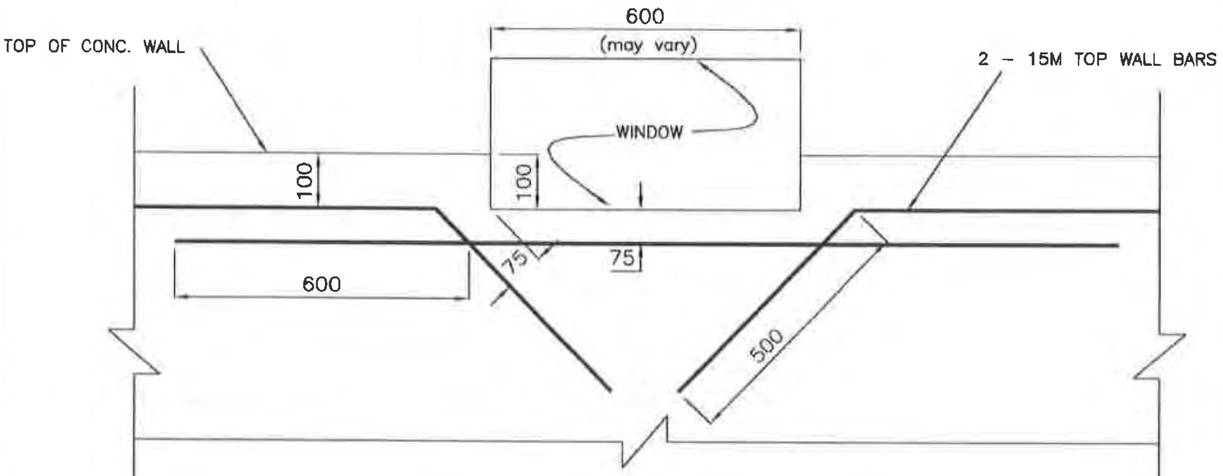
TYPICAL REINFORCED WALL

NOT TO SCALE



TYPICAL SPLICING AT CORNERS

NOT TO SCALE



TYPICAL WINDOW REINFORCING

NOT TO SCALE

NOTES:

1. Reinforcing steel C.S.A. G30.18–09 Grade 400
2. Concrete min. 28 day strength 20MPa (3000psi)
3. Base of all footing excavations to be inspected and approved prior to placing formwork.
4. All dimensions are in mm.

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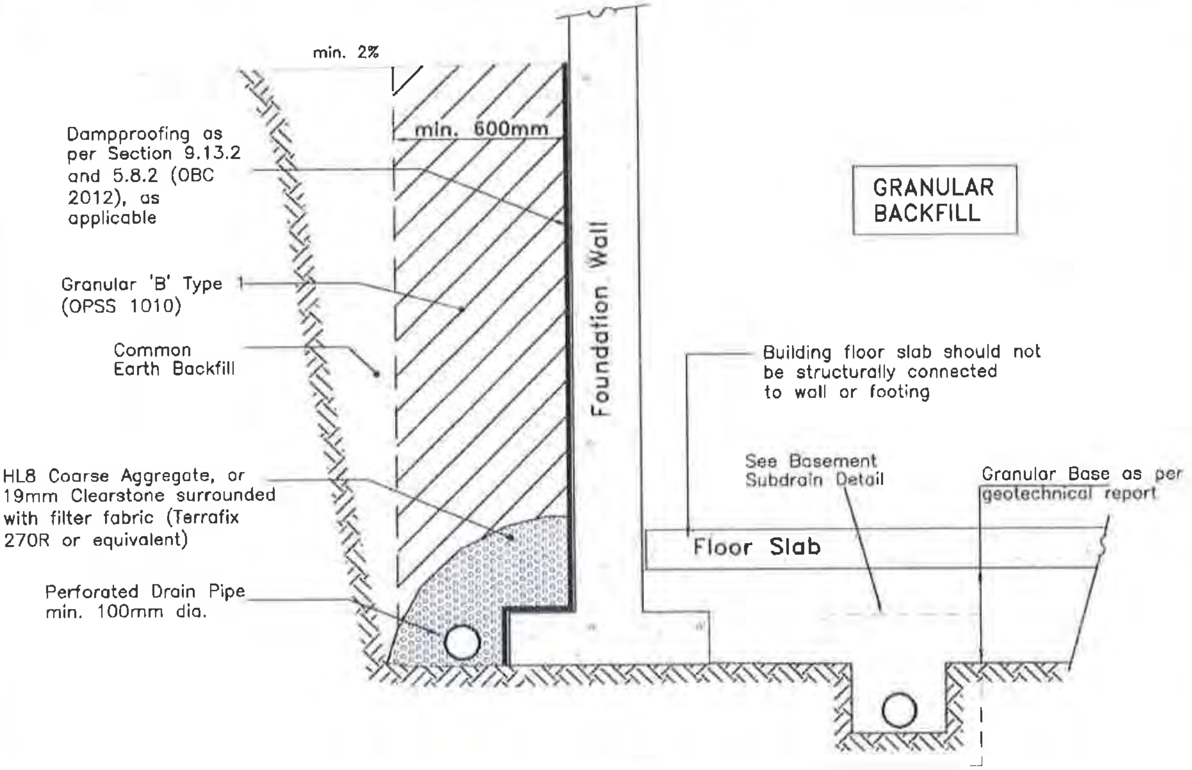
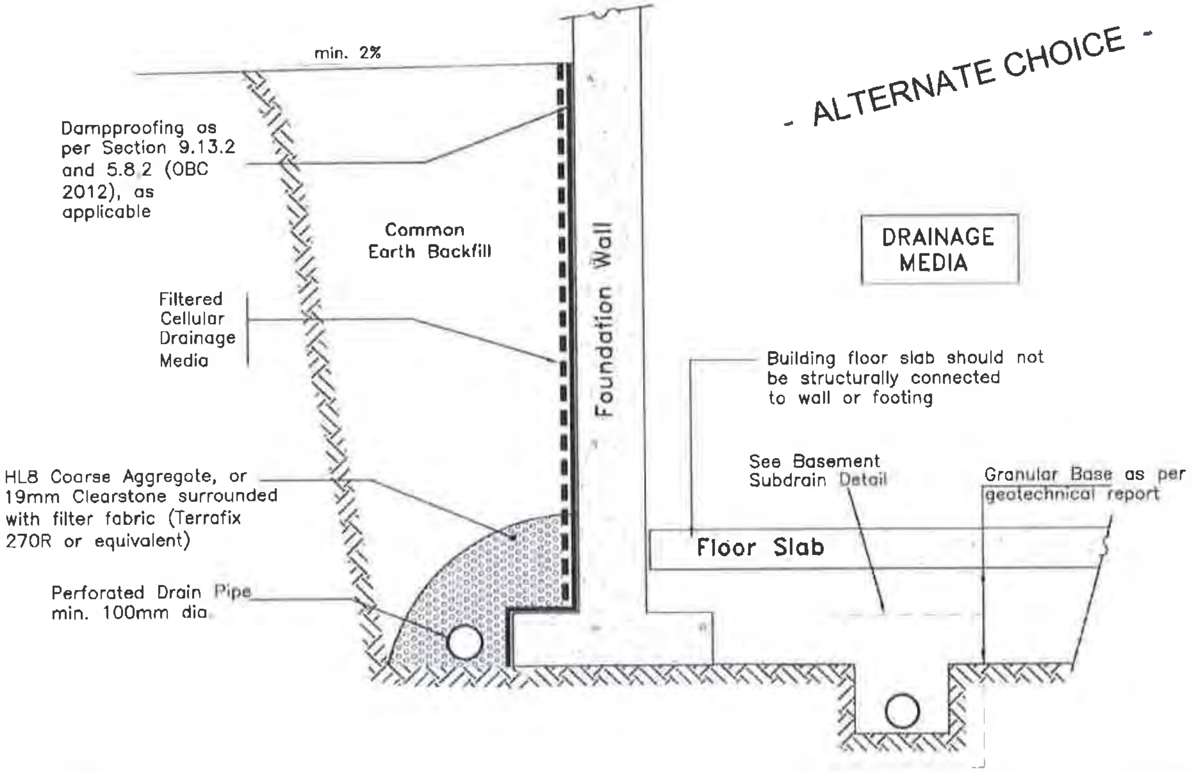
11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title: TYPICAL REINFORCED WALL DETAILS FOR HOUSES ON ENGINEERED FILL

File No. 11-14-4090

FIGURE: 3





Schematic Only
Not to Scale

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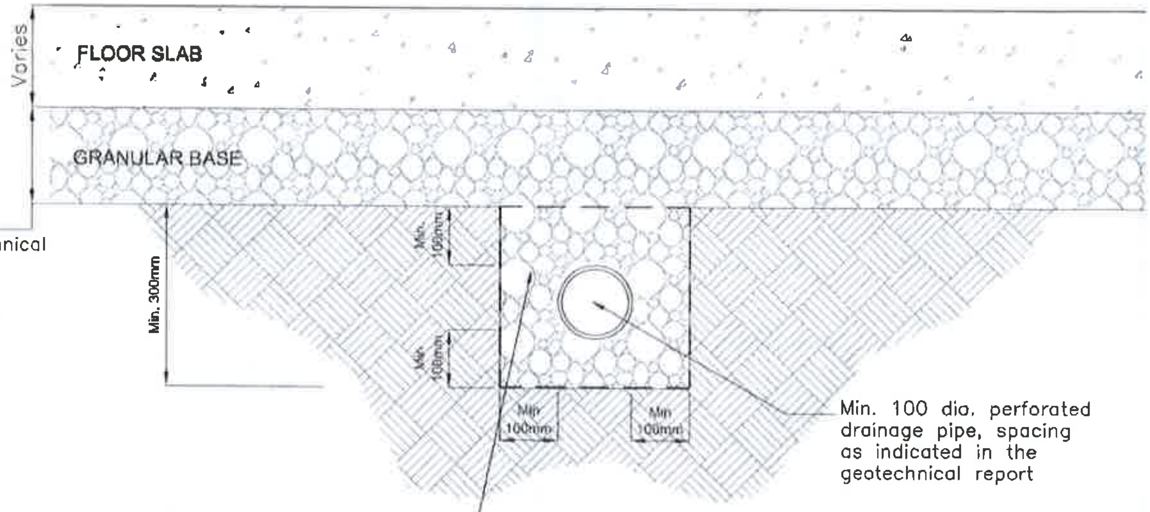
11 Indell Lane, Brampton, Ontario. L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title: BASEMENT DRAINAGE DETAIL

File No. 11-14-4090

FIGURE : 4



As per
geotechnical
report

Min. 100 dia. perforated
drainage pipe, spacing
as indicated in the
geotechnical report

HL8 coarse aggregate, or
19mm clearstone
surrounded with filter
fabric (Terrafix 270R or
equivalent)

Schematic Only
Not to Scale

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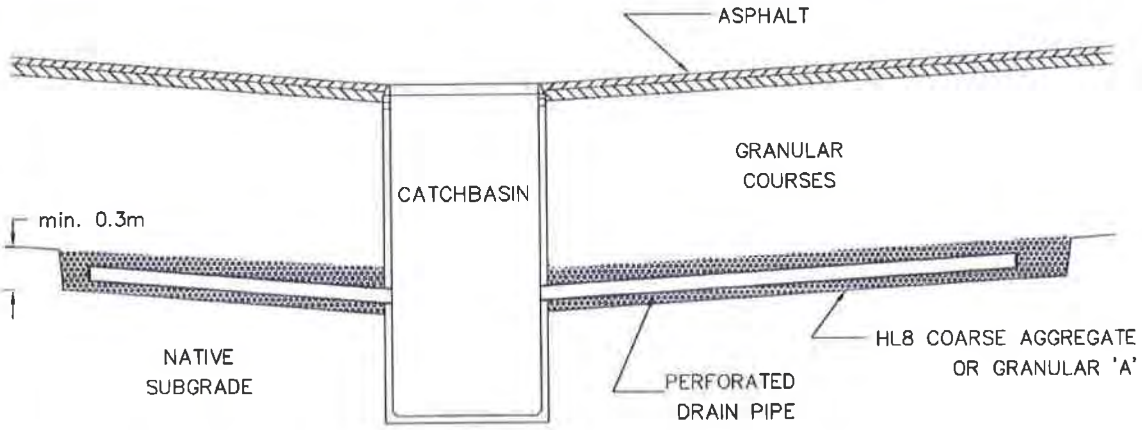
11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

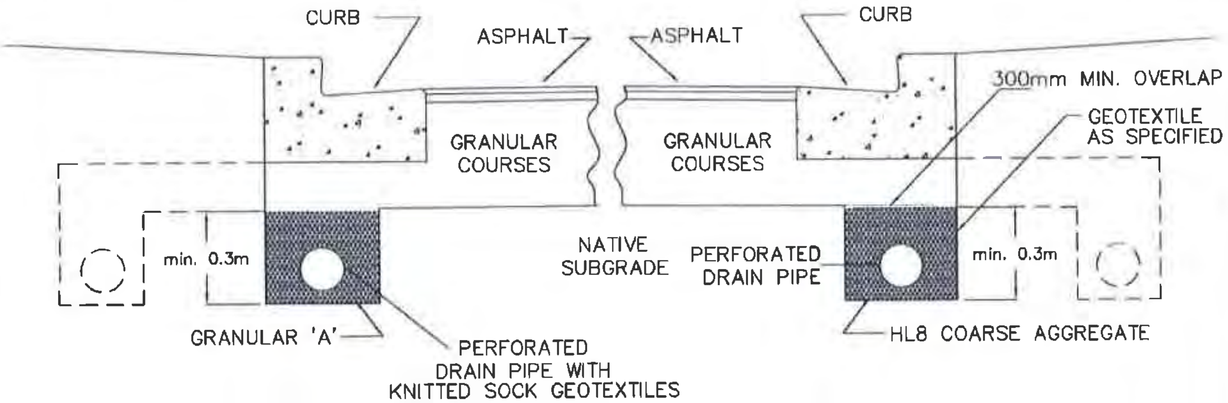
Title: BASEMENT FLOOR SUBDRAIN DETAIL

File No. 11-14-4090

Figure: 5



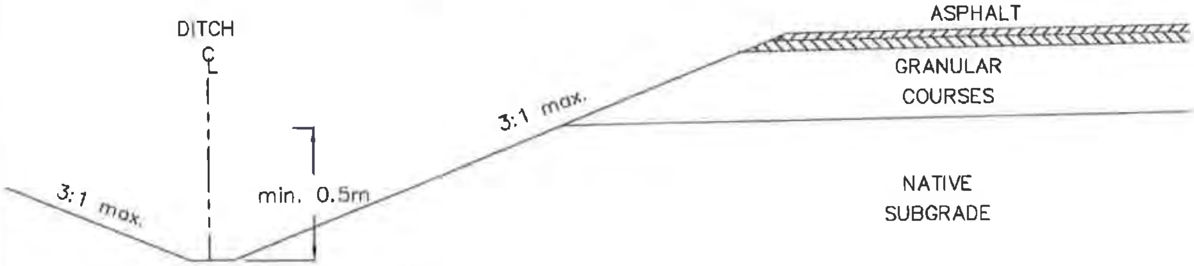
Longitudinal Subdrain Connection to Catchbasin



Unwrapped Trench

Wrapped Trench

Urban Cross Sections



Rural Cross Section

Terraprobe
11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title:
PAVEMENT DRAINAGE ALTERNATIVES

File No.
11-14-4090

FIGURE :
6

BOREHOLE LOGS

TERRAPROBE INC.

Terraprobe

ABBREVIATIONS AND TERMINOLOGY

SAMPLING METHODS

AS	auger sample
CORE	cored sample
DP	direct push
FV	field vane
GS	grab sample
SS	split spoon
ST	shelby tube
WS	wash sample

PENETRATION RESISTANCE

Standard Penetration Test (SPT) resistance ('N' values) is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a standard 50 mm (2 in.) diameter split spoon sampler for a distance of 0.3 m (12 in.).

Dynamic Cone Test (DCT) resistance is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a conical steel point of 50 mm (2 in.) diameter and with 60° sides on 'A' size drill rods for a distance of 0 3 m (12 in.) "

COHESIONLESS SOILS

Compactness	'N' value
very loose	< 4
loose	4 – 10
compact	10 – 30
dense	30 – 50
very dense	> 50

COHESIVE SOILS

Consistency	'N' value	Undrained Shear Strength (kPa)
very soft	< 2	< 12
soft	2 – 4	12 – 25
firm	4 – 8	25 – 50
stiff	8 – 15	50 – 100
very stiff	15 – 30	100 – 200
hard	> 30	> 200

COMPOSITION

Term (e.g)	% by weight
trace silt	< 10
some silt	10 – 20
silty	20 – 35
sand *and* silt	> 35

TESTS AND SYMBOLS

MH	mechanical sieve and hydrometer analysis
w, w_c	water content
w_L, LL	liquid limit
w_P, PL	plastic limit
I_P, PI	plasticity index
k	coefficient of permeability
γ	soil unit weight, bulk
G_s	specific gravity
φ'	internal friction angle
c'	effective cohesion
c_u	undrained shear strength

▽	Unstabilized water level
▼	1st water level measurement
▼	2nd water level measurement
▼	Most recent water level measurement
3,0 +	Undrained shear strength from field vane (with sensitivity)
C_c	compression index
c_v	coefficient of consolidation
m_v	coefficient of compressibility
e	void ratio

FIELD MOISTURE DESCRIPTIONS

Damp	refers to a soil sample that does not exhibit any observable pore water from field/hand inspection.
Moist	refers to a soil sample that exhibits evidence of existing pore water (e.g. sample feels cool, cohesive soil is at or close to plastic limit) but does not have visible pore water
Wet	refers to a soil sample that has visible pore water

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LOG OF BOREHOLE 1

Client	: Sarah Properties Ltd Developments	Project No. :	11-14-4090
Project	: Waldemar Development	Date started :	April 9, 2014
Location	: Township of Amaranth, Ontario	Sheet No. :	1 of 2

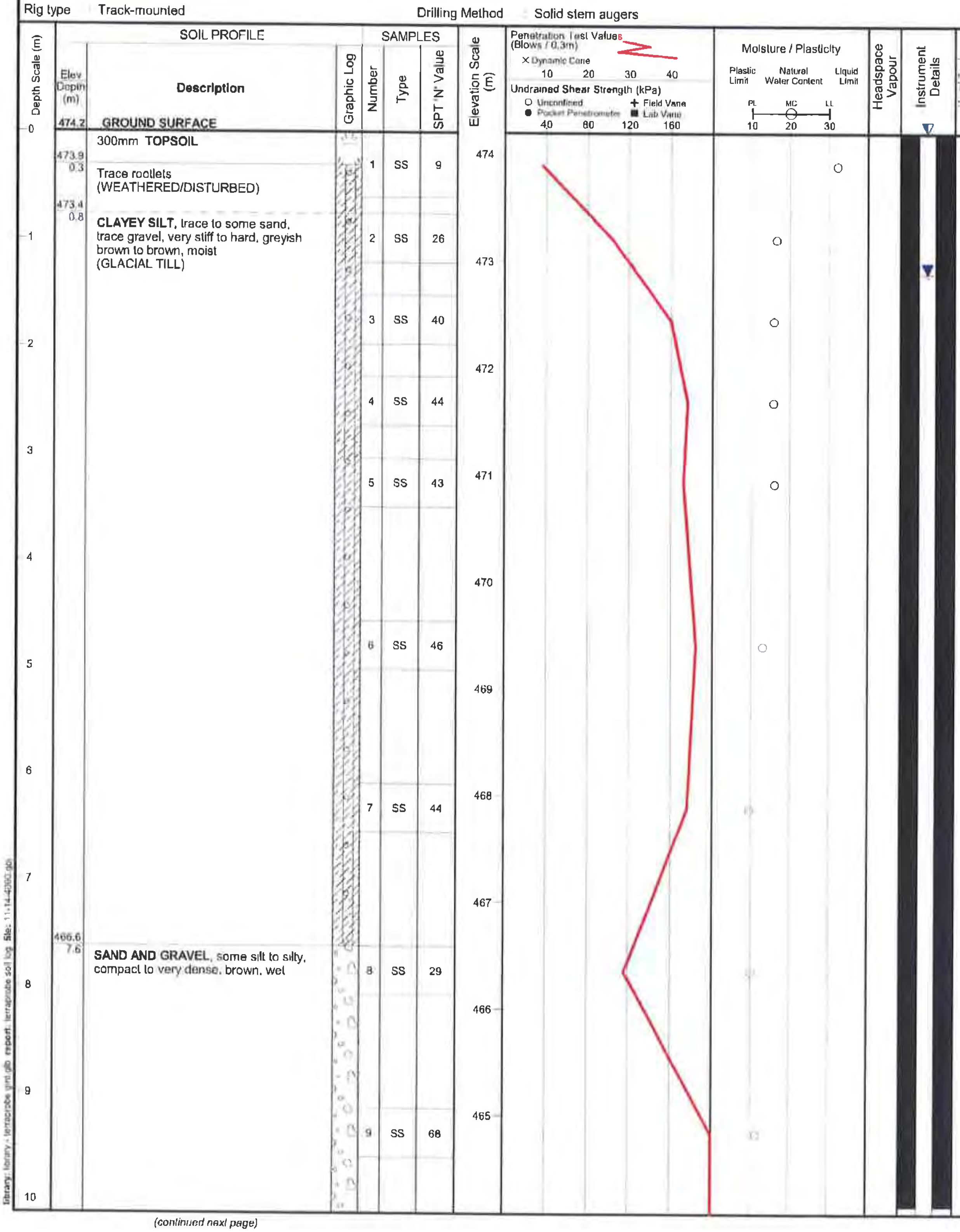
Position	E: 557124, N: 4859399 (UTM 17T)	Elevation Datum	: Geodetic
Rig type	Track-mounted	Drilling Method	: Solid stem augers

SOIL PROFILE

Elev Depth (m)	Description
474.2	GROUND SURFACE
	300mm **TOPSOIL**
473.9 0.3	Trace rootlets (WEATHERED/DISTURBED)
473.4 0.8	**CLAYEY SILT**, trace to some sand, trace gravel, very stiff to hard, greyish brown to brown, moist (GLACIAL TILL)
466.6 7.6	**SAND AND GRAVEL**, some silt to silty, compact to very dense, brown, wet

SAMPLES

Number	Type	SPT 'N' Value	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
			Artesian cond tons encountered
1	SS	9	
2	SS	26	0 9 54 37
3	SS	40	
4	SS	44	
5	SS	43	
6	SS	46	
7	SS	44	
8	SS	29	
9	SS	68	47 42 *(11)*



(continued next page)

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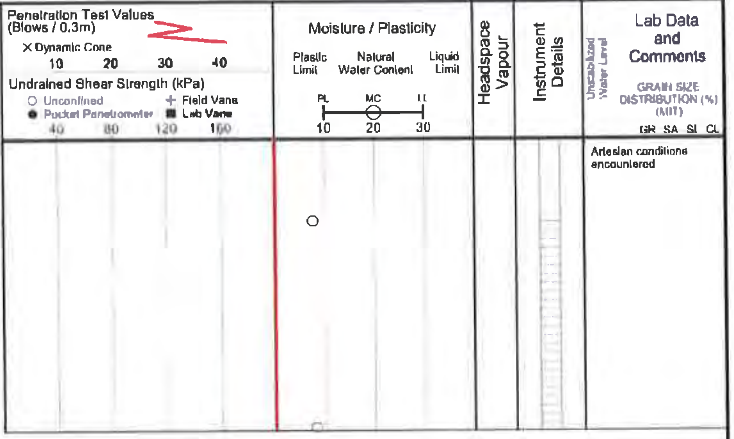
LOG OF BOREHOLE 1

Client	: Sarah Properties Ltd Developments		Project No.:	11-14-4090
Project	: Waldemar Development		Date started :	April 9, 2014
Location	: Township of Amaranth, Ontario		Sheet No. :	2 of 2

Position	E: 557124, N: 4859399 (UTM 17T)	Elevation Datum	: Geodetic
Rig type	: Track-mounted	Drilling Method	Solid stem augers

Depth Scale (m)	SOIL PROFILE Elev Depth (m)	Description *(continued)*	SAMPLES Number	Type	SPT 'N' Value	Elevation Scale (m)
		SAND AND GRAVEL, some silt to silty, compact to very dense, brown, wet *(continued)*				464
	463.5 10.7	**SANDY SILT**, trace to some clay, trace gravel, very dense, brown, moist (GLACIAL TILL)	10	SS	50 / 100mm	
11						463
12	462.0 12.2		11	SS	50 / 50mm	462



END OF BOREHOLE

Unstabilized water level measured at 3.0 m below ground surface; borehole was open upon completion of drilling.

50 mm monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Jun 5, 2014	-0.9	475.1
Jul 3, 2014	1.3	472.9

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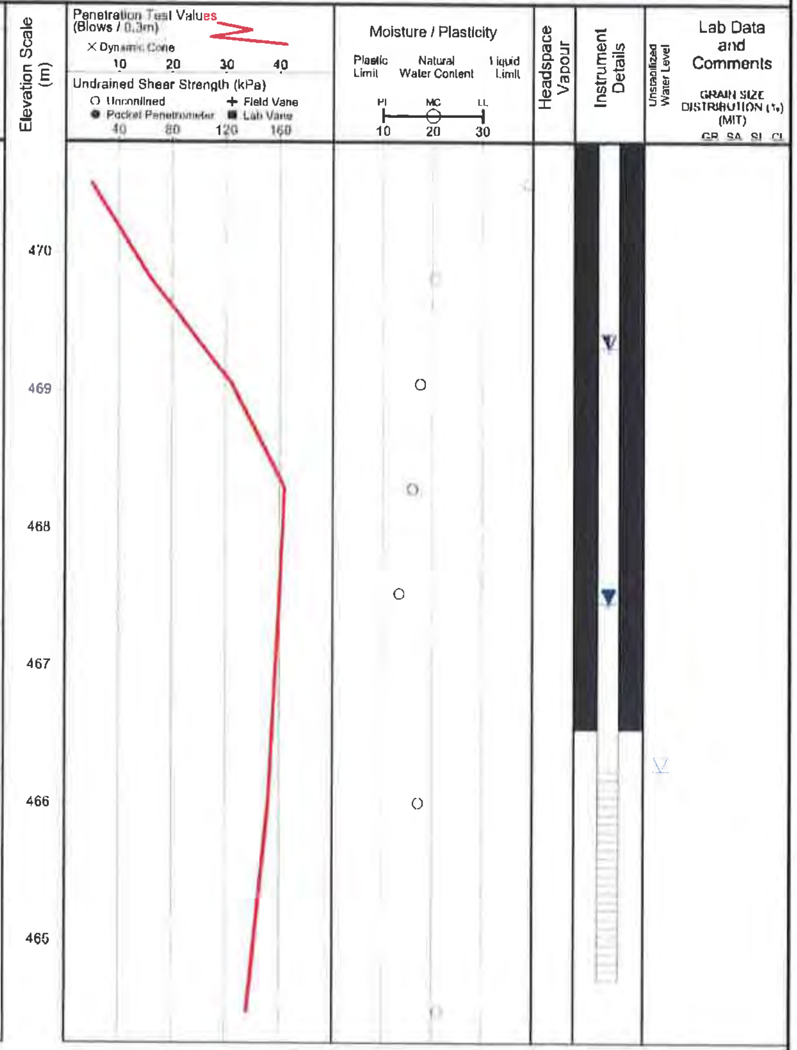
LOG OF BOREHOLE 2

Client : Sarah Properties Ltd Developments
Project : Waldemar Development
Location : Township of Amaranth, Ontario

Project No.: 11-14-4090
Date started : April 9, 2014
Sheet No. : 1 of 1

Position : E: 557049, N: 4859627 (UTM 17T)
Rig type : Track-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	Graphic Log	SAMPLES Number	Type	SPT 'N' Value
0	470.8	GROUND SURFACE				
		300mm **TOPSOIL**				
	470.5 0.3	Trace rootlets (WEATHERED/DISTURBED)		1	SS	5
1	470.0 0.8	**CLAYEY SILT**, trace to some sand, trace gravel, very stiff to hard, greyish brown to brown, moist to wet (GLACIAL TILL)		2	SS	16
				3	SS	31
2						
				4	SS	41
3						
				5	SS	40
4						
				6	SS	38
5						
6						
				7	SS	34
	464.2 6.6					



END OF BOREHOLE

Unstabilized water level measured at 4.6 m below ground surface; borehole was open upon completion of drilling.

50 mm monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Jun 5, 2014	1.5	469.3
Jul 3, 2014	3.4	467.5

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LOG OF BOREHOLE 3

Client : Sarah Properties Ltd Developments
Project : Waldemar Development
Location : Township of Amaranth, Ontario

Project No.: 11-14-4090
Date started : March 10, 2014
Sheet No. : 1 of 2

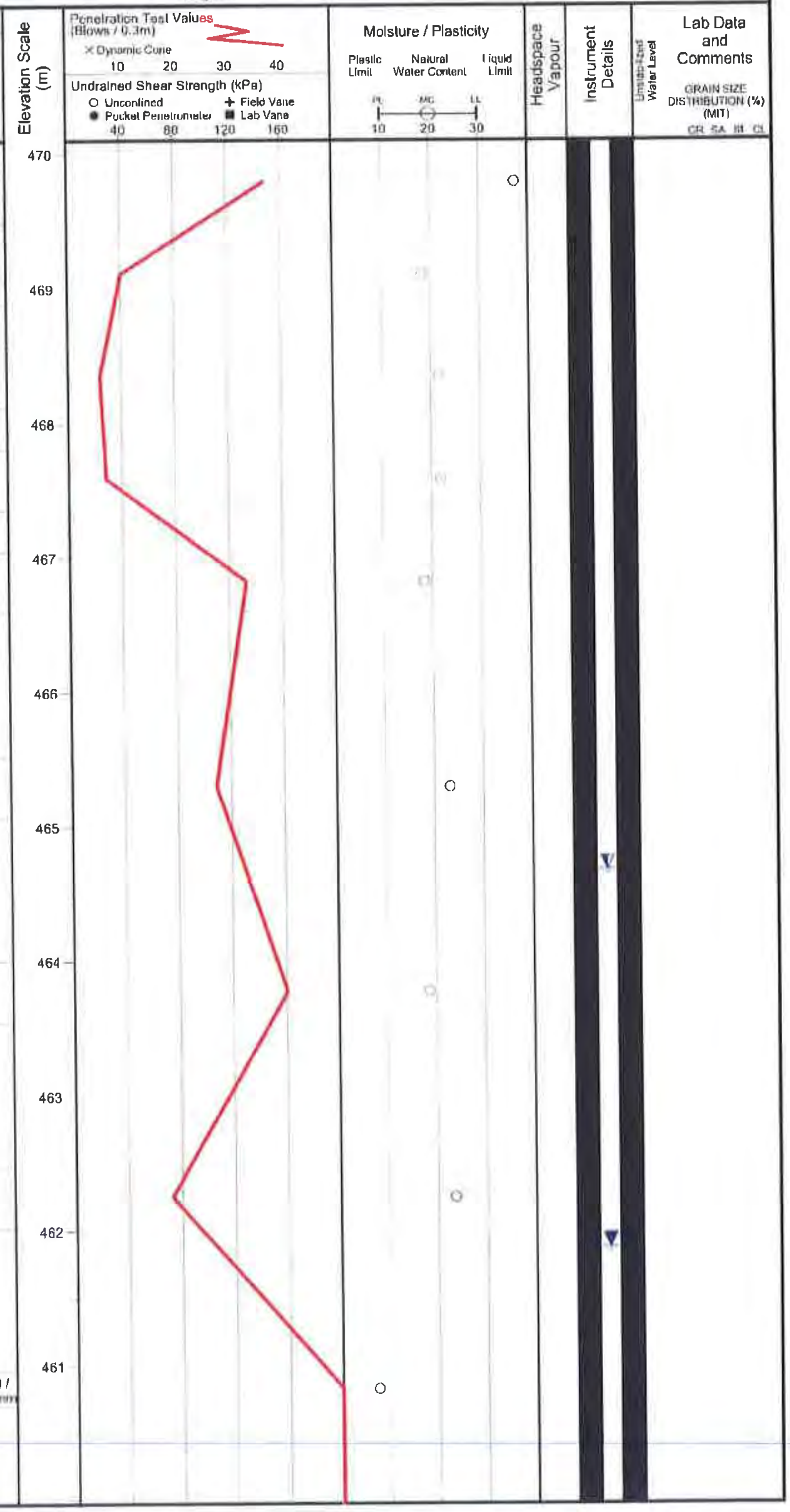
Position : E: 557013, N: 4859848 (UTM 17T)
Rig type : Track-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

SOIL PROFILE

Depth Scale (m)	Elev Depth (m)	Description
0	470.1	GROUND SURFACE
0		500mm **TOPSOIL**
	469.6 0.5	**FILL**, clayey silt, some sand to sandy, trace gravel, trace organics, firm to stiff, brown, moist (disturbed/reworked)
3	467.1 3.0	**CLAYEY SILT**, trace to some sand, trace gravel, very stiff to hard, greyish brown to brown, moist (GLACIAL TILL)
9	461.0 9.1	**SANDY SILT**, trace to some clay, trace gravel, very dense, brown, damp to moist (GLACIAL TILL)

SAMPLES

Number	Type	SPT 'N' Value
1	SS	37
2	SS	10
3	SS	6
4	SS	7
5	SS	33
6	SS	27
7	SS	40
8	SS	18
9	SS	100 / 150mm



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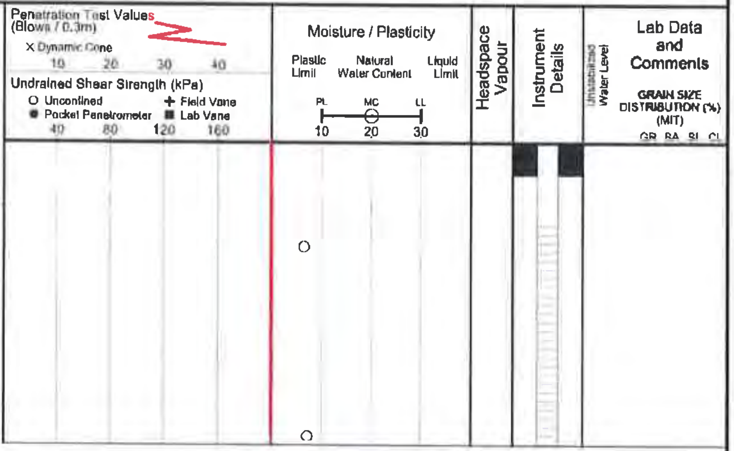
LOG OF BOREHOLE 3

Client	: Sarah Properties Ltd Developments	Project No.:	11-14-4090
Project	: Waldemar Development	Date started :	March 10, 2014
Location	: Township of Amaranth, Ontario	Sheet No. :	2 of 2

Position	E: 557013, N: 4859848 (UTM 17T)	Elevation Datum	: Geodetic
Rig type	Track-mounted	Drilling Method	: Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	Graphic Log	SAMPLES Number	Type	SPT 'N' Value	Elevation Scale (m)
		(continued)					
		SANDY SILT, trace to some clay, trace gravel, very dense, brown, damp to moist (GLACIAL TILL) *(continued)*					
11				10	SS	92 / 275mm	
							459
12							
							458
	457.8 12.3			11	SS	50 / 125mm	



END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

50 mm monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Jun 5, 2014	5.4	464.7
Jul 3, 2014	8.2	461.9

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LOG OF BOREHOLE 4

Client : Sarah Properties Ltd Developments
Project : Waldemar Development
Location : Township of Amaranth, Ontario

Project No.: 11-14-4090
Date started : March 10, 2014
Sheet No. : 1 of 1

Position E: 556988, N: 4860008 (UTM 17T)
Elevation Datum Geodetic
Rig type Track-mounted
Drilling Method Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	SAMPLES Number	Type	SPT 'N' Value	Elevation Scale (m)
0	470.4	GROUND SURFACE				
		500mm **TOPSOIL**	1	SS	86	470
	469.9 0.5	Trace organics				
	469.6 0.8	(WEATHERED/DISTURBED)				
1		**CLAYEY SILT**, trace to some sand, trace gravel, very stiff to hard, greyish brown to brown, moist (GLACIAL TILL)	2	SS	25	
						469
			3	SS	32	
2						
			4	SS	53	468
3						
			5	SS	44	467
4						
						466
5			6	SS	48	
						465
6						
			7	SS	32	464
	463.8 6.6					

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

50 mm monitoring well installed

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Jun 5, 2014	4.3	466.1
Jul 3, 2014	4.9	465.5

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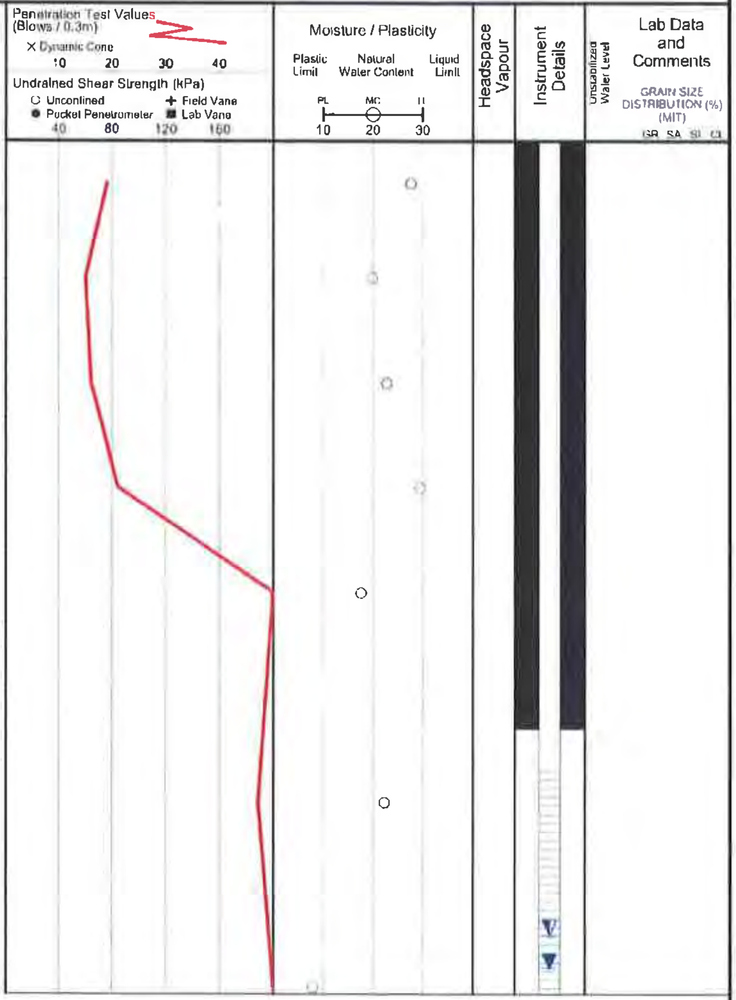
LOG OF BOREHOLE 5

Client : Sarah Properties Ltd Developments
Project : Waldemar Development
Location : Township of Amaranth, Ontario

Project No.: 11-14-4090
Date started : April 11, 2014
Sheet No. : 1 of 1

Position : E: 556958, N: 4860174 (UTM 17T)
Rig type : Track-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	Graphic Log	SAMPLES Number	Type	SPT 'N' Value	Elevation Scale (m)
0	468.5	GROUND SURFACE					
	468.3 0.2	150mm **TOPSOIL**					
		Trace rootlets (WEATHERED/DISTURBED)		1	SS	19	468
	467.7 0.8	**CLAYEY SILT**, trace to some sand, trace to some gravel, very stiff to hard, brown, moist (GLACIAL TILL)					
1				2	SS	15	
							467
				3	SS	16	
2							
				4	SS	21	466
3							
				5	SS	52	
							465
4							
							464
5				6	SS	47	
							463
6							
	462.3 6.2			7	SS	50 / 100mm	



END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

50 mm monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Jun 5, 2014	5.8	462.7
Jul 3, 2014	6.0	462.5

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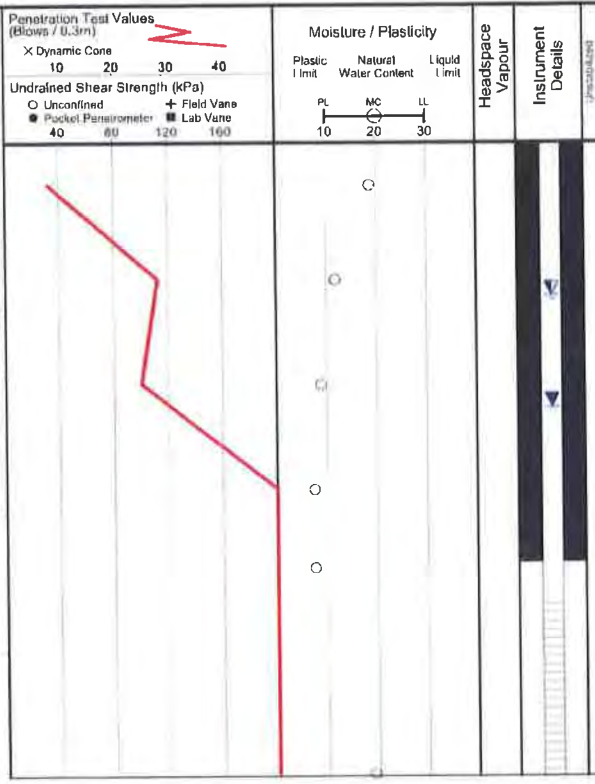
LOG OF BOREHOLE 6

Client : Sarah Properties Ltd Developments
Project : Waldemar Development
Location : Township of Amaranth, Ontario

Project No.: 11-14-4090
Date started : April 11, 2014
Sheet No. : 1 of 1

Position : E: 556934, N: 4860321 (UTM 17T)
Rig type : Track-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	SAMPLES Number	Type	SPT 'N' Value	Elevation Scale (m)	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
0	466.7	**GROUND SURFACE**					
		300mm **TOPSOIL**					
	466.4 0.3	Trace rootlets (WEATHERED/DISTURBED)	1	SS	8		
	466.2 0.5	**SANDY SILT to SILT AND SAND**, trace to some gravel, trace clay, compact to very dense, brown, damp to moist (GLACIAL TILL)				466	
1			2	SS	28		
		...sand and silt	3	SS	25	465	10 41 40 9
2							
			4	SS	78	464	
3			5	SS	50 / 75mm		
						463	
4							
	462.1 4.6		6	SS	50 / 25mm		



END OF BOREHOLE
Auger refusal

Borehole was dry and open upon completion of drilling.

50 mm monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Jun 5, 2014	1.1	465.6
Jul 3, 2014	1.9	464.8

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LOG OF BOREHOLE 7

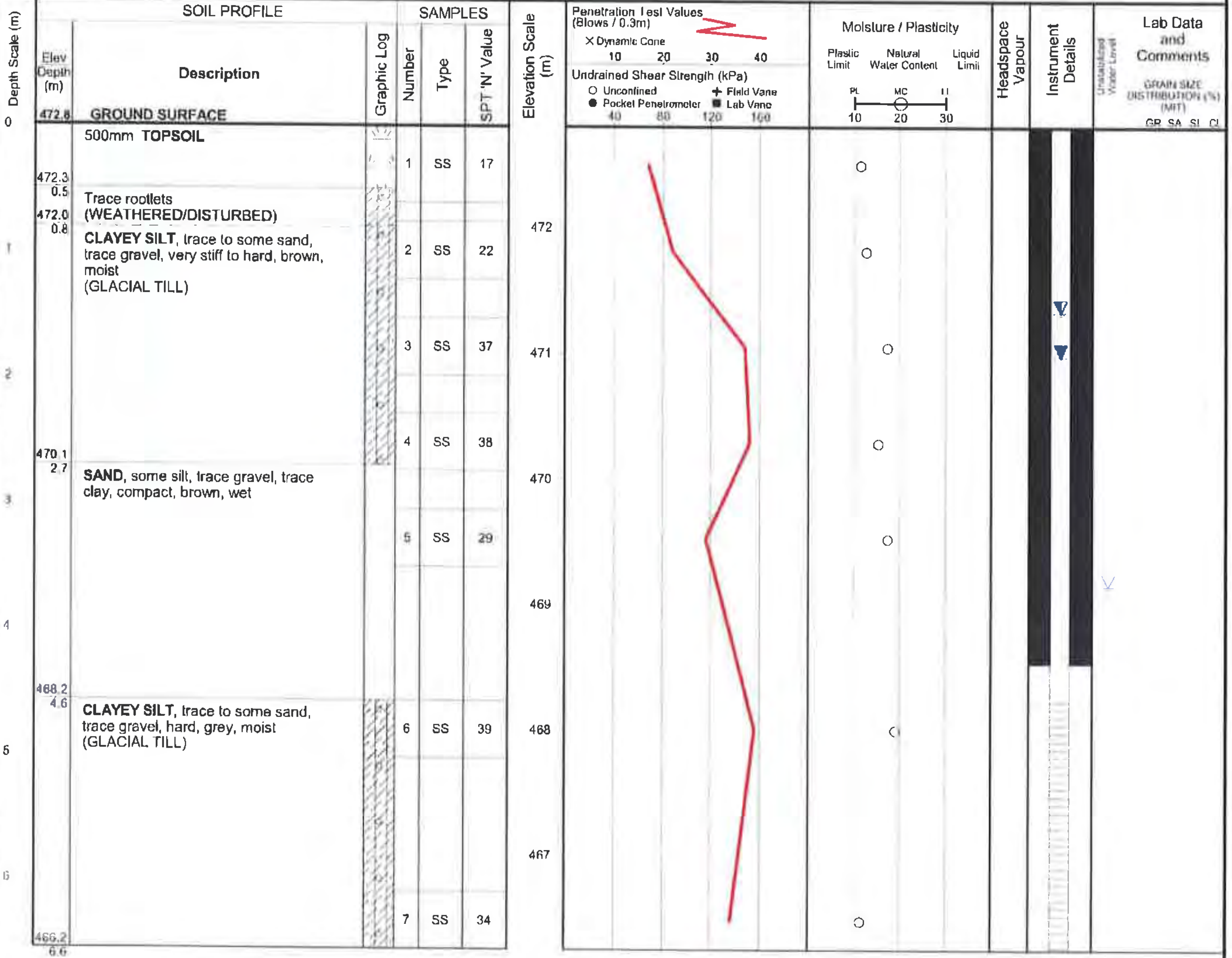
Client : Sarah Properties Ltd Developments
Project : Waldemar Development
Location : Township of Amaranth, Ontario

Project No.: 11-14-4090
Date started : April 11, 2014
Sheet No. : 1 of 1

Position : E: 557275, N: 4859408 (UTM 17T)
Rig type : Track-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

SOIL PROFILE / SAMPLES

Elev Depth (m)	Description	Number	Type	SPT 'N' Value
472.8	GROUND SURFACE			
	500mm **TOPSOIL**	1	SS	17
472.3 0.5	Trace rootlets (WEATHERED/DISTURBED)			
472.0 0.8	**CLAYEY SILT**, trace to some sand, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)	2	SS	22
		3	SS	37
		4	SS	38
470.1 2.7	**SAND**, some silt, trace gravel, trace clay, compact, brown, wet	5	SS	29
468.2 4.6	**CLAYEY SILT**, trace to some sand, trace gravel, hard, grey, moist (GLACIAL TILL)	6	SS	39
		7	SS	34
466.2 6.6	**END OF BOREHOLE**			



Unstabilized water level measured at 3.7 m below ground surface; borehole was open upon completion of drilling.

50 mm monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Jun 5, 2014	1.5	471.3
Jul 3, 2014	1.8	471.0

Terraprobe

LOG OF BOREHOLE 8

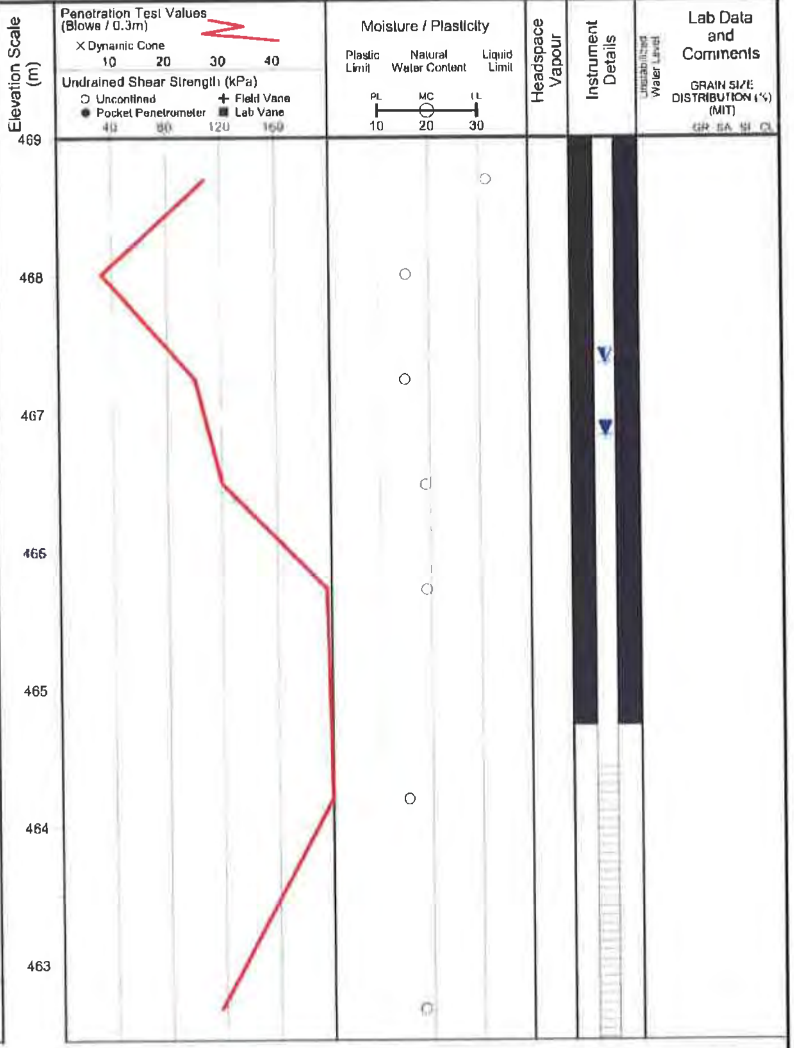
Client : Sarah Properties Ltd Developments
Project : Waldemar Development
Location : Township of Amaranth, Ontario

Project No.: 11-14-4090
Date started : April 9, 2014
Sheet No. : 1 of 1

Position E: 557321, N: 4859620 (UTM 17T)
Rig type Track-mounted

Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Depth Scale (m)	SOIL PROFILE			SAMPLES		
	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	469.0	**GROUND SURFACE**				
		500mm **TOPSOIL**		1	SS	27
	468.5 0.5	Trace rootlets (WEATHERED/DISTURBED)				
1				2	SS	8
	467.8 1.2	**CLAYEY SILT**, trace to some sand, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)		3	SS	25
2						
				4	SS	30
3				5	SS	49
4						
				6	SS	94
5						
6				7	SS	29
	462.4 6.0					



END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

50 mm monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Jun 5, 2014	1.6	467.4
Jul 3, 2014	2.2	466.8

Terraprobe

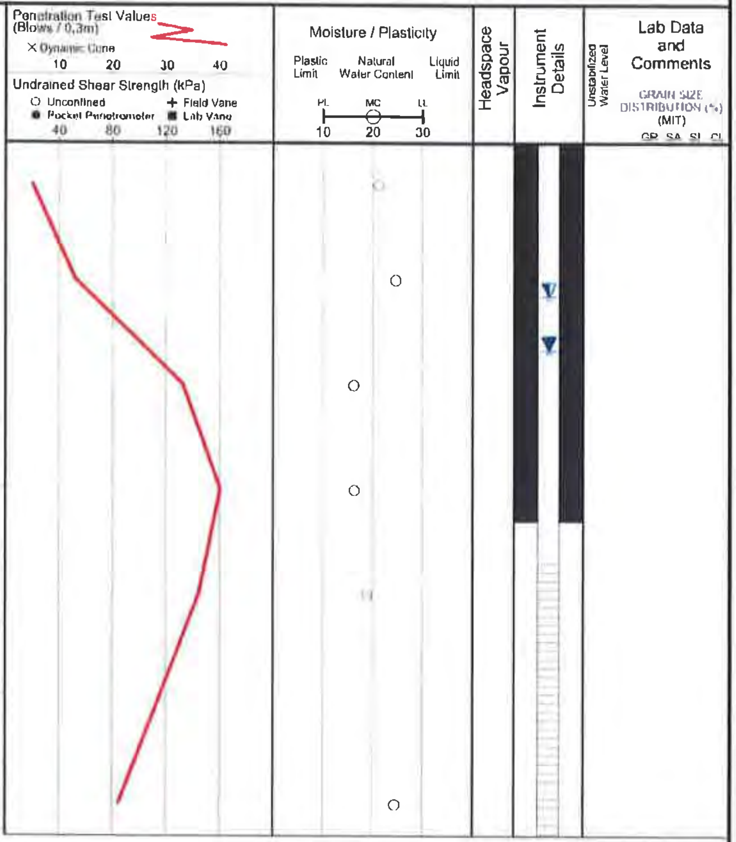
LOG OF BOREHOLE 9

Client : Sarah Properties Ltd Developments
Project : Waldemar Development
Location : Township of Amaranth, Ontario

Project No.: 11-14-4090
Date started : April 11, 2014
Sheet No. : 1 of 1

Position : E: 557171, N: 4859886 (UTM 17T)
Rig type : Track-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	SAMPLES Number	Type	SPT 'N' Value	Elevation Scale (m)
0	466.0	**GROUND SURFACE**				
		300mm **TOPSOIL**				
	465.7 0.3	Trace rootlets (WEATHERED/DISTURBED)	1	SS	5	
	465.2 0.8	**CLAYEY SILT**, trace to some sand, trace gravel, stiff to hard, greyish brown to brown, moist (GLACIAL TILL)				
1			2	SS	13	465
			3	SS	33	
2						464
			4	SS	40	
3						463
			5	SS	36	
4						462
		...wet, sand				
			6	SS	21	
5	461.0 5.0					461



END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

50 mm monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Jun 5, 2014	1.1	464.9
Jul 3, 2014	1.5	464.5

Terraprobe

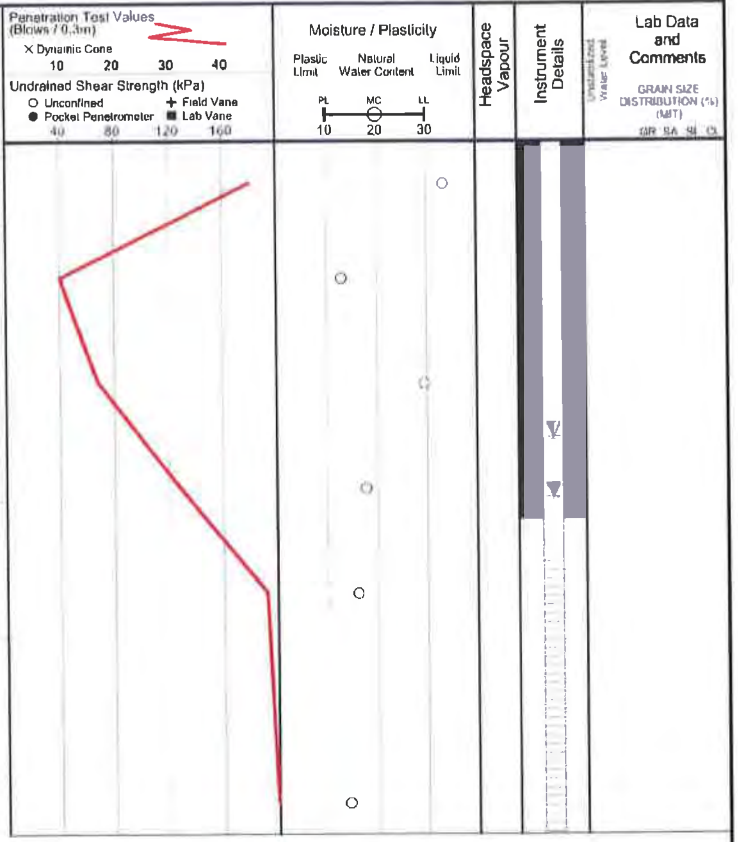
LOG OF BOREHOLE 10

Client : Sarah Properties Ltd Developments
Project : Waldemar Development
Location : Township of Amaranth, Ontario

Project No.: 11-14-4090
Date started : March 10, 2014
Sheet No. : 1 of 1

Position : E: 557109, N: 4860013 (UTM 17T)
Rig type : Track-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	SAMPLES Number	Type	SPT 'N' Value	Elevation Scale (m)
0	469.6	GROUND SURFACE				
		300mm **TOPSOIL**				
	469.3 0.3	Trace rootlets (WEATHERED/DISTURBED)	1	SS	45	469
1	468.8 0.8	**CLAYEY SILT**, trace to some sand, trace gravel, stiff to hard, greyish brown to brown, moist (GLACIAL TILL)	2	SS	10	
			3	SS	17	468
2			4	SS	32	467
3			5	SS	48	466
4						465
			6	SS	54	
5	464.6 5.0					



END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

50 mm monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Jun 5, 2014	2.2	467.5
Jul 3, 2014	2.6	467.0

Terraprobe

LOG OF BOREHOLE 11

Client : Sarah Properties Ltd Developments
Project : Waldemar Development
Location : Township of Amaranth, Ontario

Project No.: 11-14-4090
Date started : April 15, 2014
Sheet No. : 1 of 2

Position : E: 557053, N 4860109 (UTM 17T)
Rig type : CME 55, track-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	SAMPLES Number	SAMPLES Type	SAMPLES SPT 'N' Value	Elevation Scale (m)
0	468.3	**GROUND SURFACE**				
	468.1 0.2	150mm **TOPSOIL**				
		Trace rootlets (WEATHERED/DISTURBED)	1	SS	6	468
	467.7 0.6	**CLAYEY SILT**, trace to some sand, trace gravel, very stiff to hard, brown (GLACIAL TILL)				
1			2	SS	18	
						467
			3	SS	23	
2						
						466
			4	SS	67	
3						
			5	SS	44	465
4						
						464
5			6	SS	50	
						463
6	462.2 6.1	**SANDY SILT to SAND AND SILT**, trace to some gravel, trace clay, very dense, brown, damp to wet (GLACIAL TILL)	7	SS	50 / 100mm	462
7						461
8			8	SS	50 / 100mm	
						460
9			9	SS	50 / 125mm	459
10						

(continued next page)

library: library - terraprobe gint.glb report: terraprobe soil log file: 11-14-4090.gpj

Terraprobe

LOG OF BOREHOLE 11

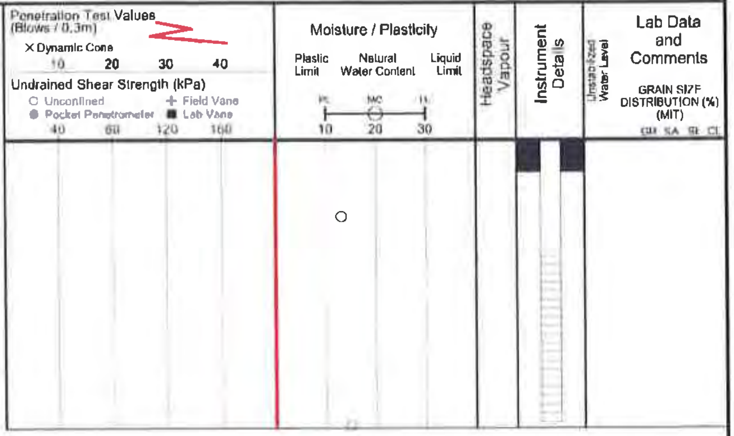
Client : Sarah Properties Ltd Developments
Project : Waldemar Development
Location : Township of Amaranth, Ontario

Project No.: 11-14-4090
Date started : April 15, 2014
Sheet No. : 2 of 2

Position E: 557053, N: 4860109 (UTM 17T)
Rig type CME 55, track-mounted

Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description *(continued)*	SAMPLES Number	Type	SPT 'N' Value	Elevation Scale (m)
		SANDY SILT to SAND AND SILT, trace to some gravel, trace clay, very dense, brown, damp to wet (GLACIAL TILL) *(continued)*				458
			10	SS	50 / 25mm	
11						
						457
12						
	456.1 12.2		11	SS	50 / 25mm	



END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

50 mm monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Jun 5, 2014	5.3	463.0
Jul 3, 2014	5.6	462.7

library: library - terraprobe gint.glb report: terraprobe soil log file: 11-14-4090.gpj

Terraprobe

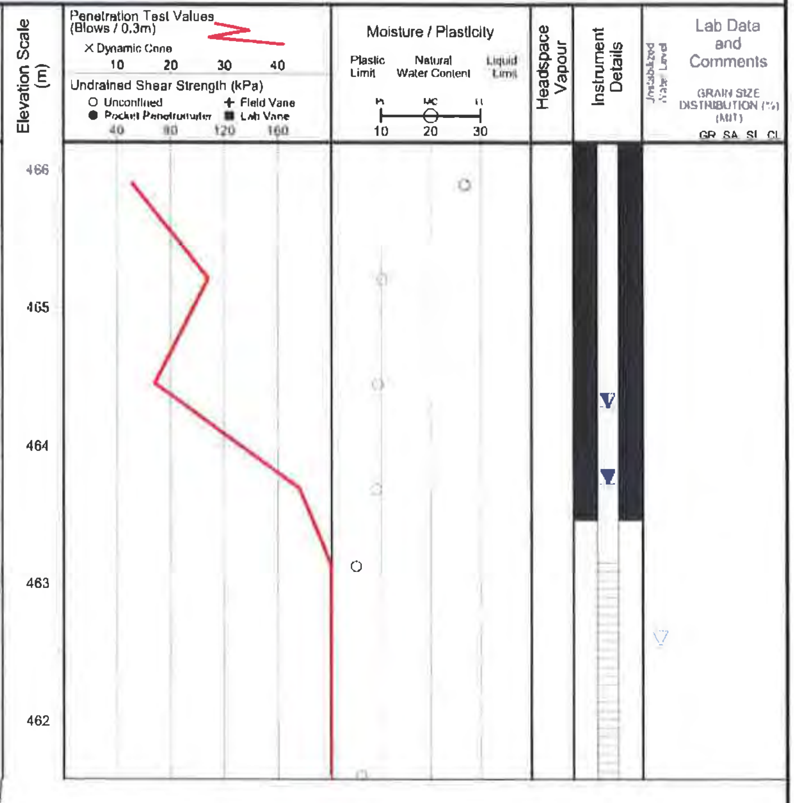
LOG OF BOREHOLE 12

Client : Sarah Properties Ltd Developments
Project : Waldemar Development
Location : Township of Amaranth, Ontario

Project No.: 11-14-4090
Date started : April 14, 2014
Sheet No. : 1 of 1

Position : E: 557046, N: 4860208 (UTM 17T)
Rig type : Track-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	SAMPLES Number	Type	SPT 'N' Value
	466.2	GROUND SURFACE			
0		300mm **TOPSOIL**			
	465.9 0.3	Trace rootlets (WEATHERED/DISTURBED)	1	SS	13
	465.6 0.6	**SANDY SILT to SAND AND SILT**, trace to some gravel, trace clay, compact to very dense, brown, moist (GLACIAL TILL)			
1			2	SS	27
2			3	SS	17
			4	SS	44
3			5	SS	50 / 50mm
4					
	461.6 4.6		6	SS	50 / 50mm



END OF BOREHOLE

Unstabilized water level measured at 3.7 m below ground surface; borehole was open upon completion of drilling.

50 mm monitoring well installed

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Jun 5, 2014	1.9	464.3
Jul 3, 2014	2.5	463.7

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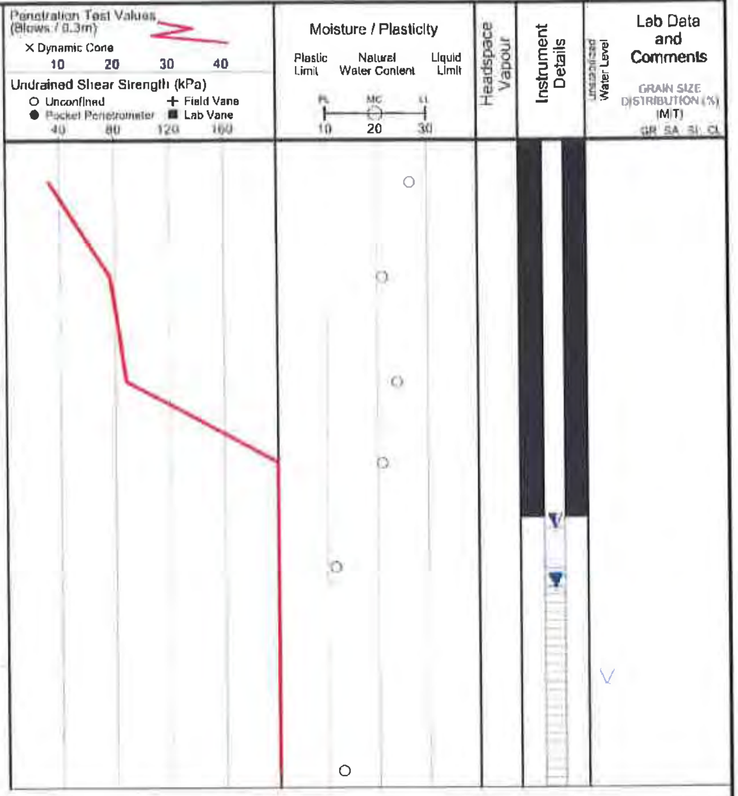
LOG OF BOREHOLE 13

Client : Sarah Properties Ltd Developments
Project : Waldemar Development
Location : Township of Amaranth, Ontario

Project No.: 11-14-4090
Date started : April 14, 2014
Sheet No. : 1 of 1

Position : E: 557165, N: 4860133 (UTM 17T)
Rig type : Track-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Depth Scale (m)	SOIL PROFILE Elev Depth (m)	Description	Graphic Log	SAMPLES Number	Type	SPT 'N' Value	Elevation Scale (m)
0	462.8	GROUND SURFACE					
		300mm **TOPSOIL**					
	462.5 0.3	Trace rootlets (WEATHERED/DISTURBED)		1	SS	8	
1	462.0 0.8	**CLAYEY SILT,** trace to some sand, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)		2	SS	19	462
2				3	SS	22	461
				4	SS	50 / 50mm	460
3	459.8 3.0	**SANDY SILT to SAND AND SILT**, trace to some gravel, trace clay, very dense, brown, damp to moist (GLACIAL TILL)		5	SS	50 / 0mm	
4							459
	458.1 4.7			6	SS	50 / 10mm	



END OF BOREHOLE

Unstabilized water level measured at 4.0 m below ground surface; borehole was open upon completion of drilling.

50 mm monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Jun 5, 2014	2.8	460.0
Jul 3, 2014	3.3	459.5

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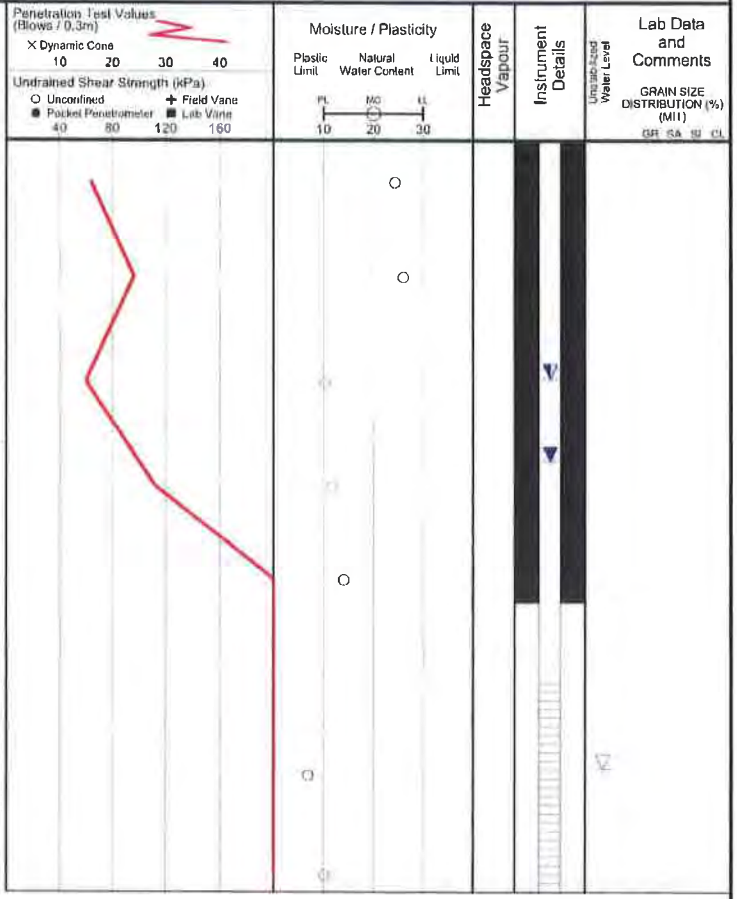
LOG OF BOREHOLE 14

Client	: Sarah Properties Ltd Developments	Project No.:	11-14-4090
Project	: Waldemar Development	Date started :	April 14, 2014
Location	: Township of Amaranth, Ontario	Sheet No. :	1 of 1

Position	: E: 557096, N: 4860199 (UTM 17T)	Elevation Datum	: Geodetic
Rig type	: Track-mounted	Drilling Method	: Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	Number	Type	SPT 'N' Value	Elevation Scale (m)
0	463.2	GROUND SURFACE				
		500mm **TOPSOIL**				463
			1	SS	16	
	462.7 0.5	Trace rootlets (WEATHERED/DISTURBED)				
1			2	SS	24	
	462.0 1.2	**SANDY SILT to SAND AND SILT**, trace to some clay, trace gravel, compact to very dense, brown, damp to moist (GLACIAL TILL)				462
			3	SS	15	
2						461
			4	SS	28	
3			5	SS	50 / 125mm	460
4						459
			6	SS	50 / 75mm	
5						458
	457.7 5.5		7	SS	50 / 10mm	



END OF BOREHOLE

Unstabilized water level measured at 4.6 m below ground surface; borehole was open upon completion of drilling.

50 mm monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Jun 5, 2014	1.7	461.5
Jul 3, 2014	2.3	460.9

Terraprobe

LOG OF BOREHOLE 15

Client : Sarah Properties Ltd Developments
Project : Waldemar Development
Location : Township of Amaranth, Ontario

Project No.: 11-14-4090
Date started : April 10, 2014
Sheet No. : 1 of 2

Position E: 557417, N: 4859437 (UTM 17T)
Rig type Track-mounted
Elevation Datum Geodetic
Drilling Method Solid stem augers

Elev Depth (m)	SOIL PROFILE Description	Number	Type	SPT 'N' Value	Elevation Scale (m)
470.4	**GROUND SURFACE**				
	300mm **TOPSOIL**				
470.1 0.3	Trace rootlets (WEATHERED/DISTURBED)	1	SS	8	470
		2	SS	9	
469.2 1.2	**CLAYEY SILT**, trace to some sand, trace gravel, stiff to hard, dark brown, moist (GLACIAL TILL)	3	SS	14	469
		4	SS	31	468
		5	SS	57	467
					466
465.8 4.6	**SANDY SILT to SAND AND SILT**, trace to some clay, trace gravel, very dense, brown, damp to moist (GLACIAL TILL)	6	SS	50 / 75mm	
					465
		7	SS	50 / 100mm	464
					463
		8	SS	50 / 50mm	
					462
		9	SS	56	461

(continued next page)

LOG OF BOREHOLE 15

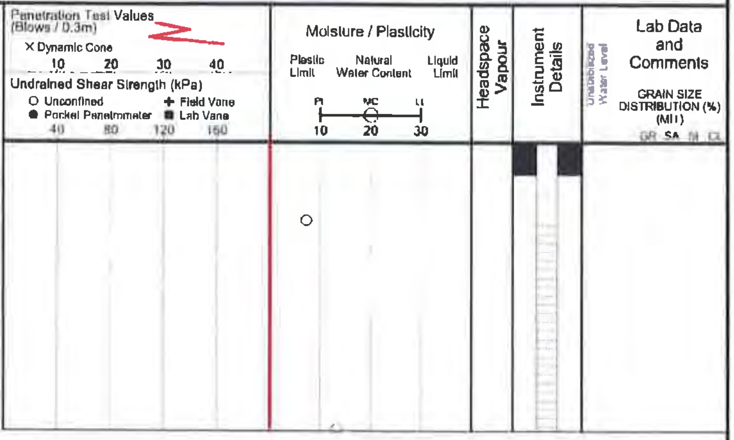
Terraprobe

Client : Sarah Properties Ltd Developments
Project : Waldemar Development
Location : Township of Amaranth, Ontario

Project No.: 11-14-4090
Date started : April 10, 2014
Sheet No. : 2 of 2

Position : E: 557417, N: 4859437 (UTM 17T)
Rig type : Track-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description *(continued)*	Graphic Log	SAMPLES Number	Type	SPT 'N' Value	Elevation Scale (m)
		SANDY SILT to SAND AND SILT, trace to some clay, trace gravel, very dense, brown, damp to moist (GLACIAL TILL) *(continued)*					460
				10	SS	50 / 50mm	
11							
							459
12	458.2 12.2			11	AS	50 / 25mm	



END OF BOREHOLE

Unstabilized water level measured at 9.1 m below ground surface; borehole was open upon completion of drilling.

50 mm monitoring well installed

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Jun 5, 2014	6.2	464.2
Jul 3, 2014	7.1	463.3

Terraprobe

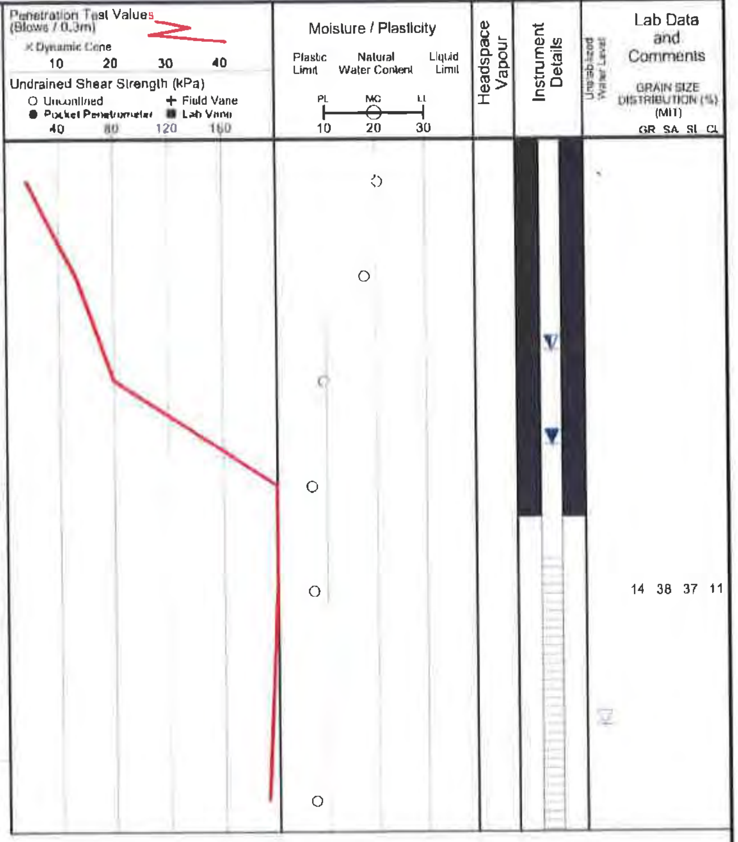
LOG OF BOREHOLE 16

Client : Sarah Properties Ltd Developments
Project : Waldemar Development
Location : Township of Amaranth, Ontario

Project No.: 11-14-4090
Date started : April 10, 2014
Sheet No. : 1 of 1

Position : E: 557522, N: 4859474 (UTM 17T)
Rig type : Track-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	Number	Type	SPT 'N' Value	Elevation Scale (m)
0	465.5	GROUND SURFACE				
		300mm **TOPSOIL**				
	465.2 0.3	Trace rootlets	1	SS	4	
	465.0 0.5	(WEATHERED/DISTURBED)				465
1		**CLAYEY SILT**, trace to some sand, trace gravel, stiff, brown, moist (GLACIAL TILL)	2	SS	13	
	464.0 1.5	**SANDY SILT to SAND AND SILT**, trace to some gravel, trace to some clay, compact to very dense, brown, moist (GLACIAL TILL)	3	SS	20	464
2			4	SS	76	463
3			5	SS	85	462
4						461
			6	SS	48	
5	460.5 5.0					



END OF BOREHOLE

Unstabilized water level measured at 4.3 m below ground surface; borehole was open upon completion of drilling.

50 mm monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Jun 5, 2014	1 5	464.0
Jul 3, 2014	2 2	463.3

Terraprobe

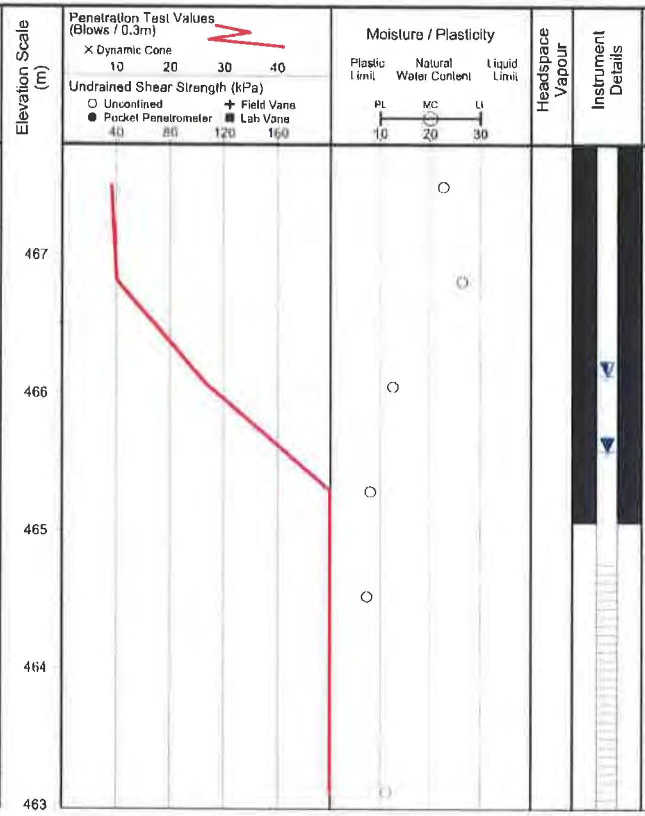
LOG OF BOREHOLE 17

Client : Sarah Properties Ltd Developments
Project : Waldemar Development
Location : Township of Amaranth, Ontario

Project No. : 11-14-4090
Date started : April 10, 2014
Sheet No. : 1 of 1

Position : E: 557469, N: 4859542 (UTM 17T)
Rig type : Track-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	Graphic Log	SAMPLES Number	Type	SPT 'N' Value
	467.8	GROUND SURFACE				
0	467.6 0.2	150mm **TOPSOIL**				
		Trace rootlets (WEATHERED/DISTURBED)		1	SS	9
1	467.0 0.8	**CLAYEY SILT**, some sand to sandy, trace gravel, stiff to very stiff, brown, moist (GLACIAL TILL)		2	SS	10
2				3	SS	27
	465.5 2.3	**SANDY SILT to SAND AND SILT**, trace to some gravel, trace to some clay, very dense, brown, moist (GLACIAL TILL)		4	SS	80
3				5	SS	75
4				6	SS	50 / 100mm
	463.0 4.8					



Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR	SA	SI	CL
3	26	47	24
11	37	37	15

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

50 mm monitoring well installed

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Jun 5, 2014	1.7	466.1
Jul 3, 2014	2.2	465.6

Terraprobe

LOG OF BOREHOLE 18

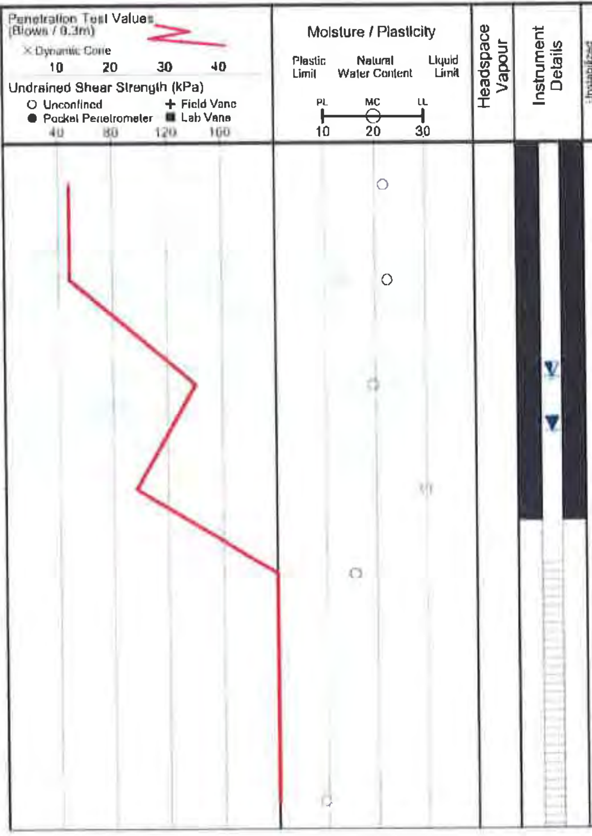
Client : Sarah Properties Ltd Developments
Project : Waldemar Development
Location : Township of Amaranth, Ontario

Project No.: 11-14-4090
Date started : April 10, 2014
Sheet No. : 1 of 1

Position : E: 557411, N: 4859702 (UTM 17T)
Rig type : Track-mounted

Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	SAMPLES Number	Type	SPT 'N' Value	Elevation Scale (m)	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
0	463.5	GROUND SURFACE					
	463.3 0.2	150mm **TOPSOIL** Trace rootlets (WEATHERED/DISTURBED)	1	SS	12	463	
1	462.7 0.8	**CLAYEY SILT**, trace gravel, trace sand to sandy, stiff to hard, brown, moist (GLACIAL TILL)	2	SS	12		
2			3	SS	35	462	
		...wet lens	4	SS	24	461	
3			5	SS	50 / 150mm		3 26 49 22
4						460	
	458.5 5.0		6	SS	83 / 250mm	459	



END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

50 mm monitoring well installed

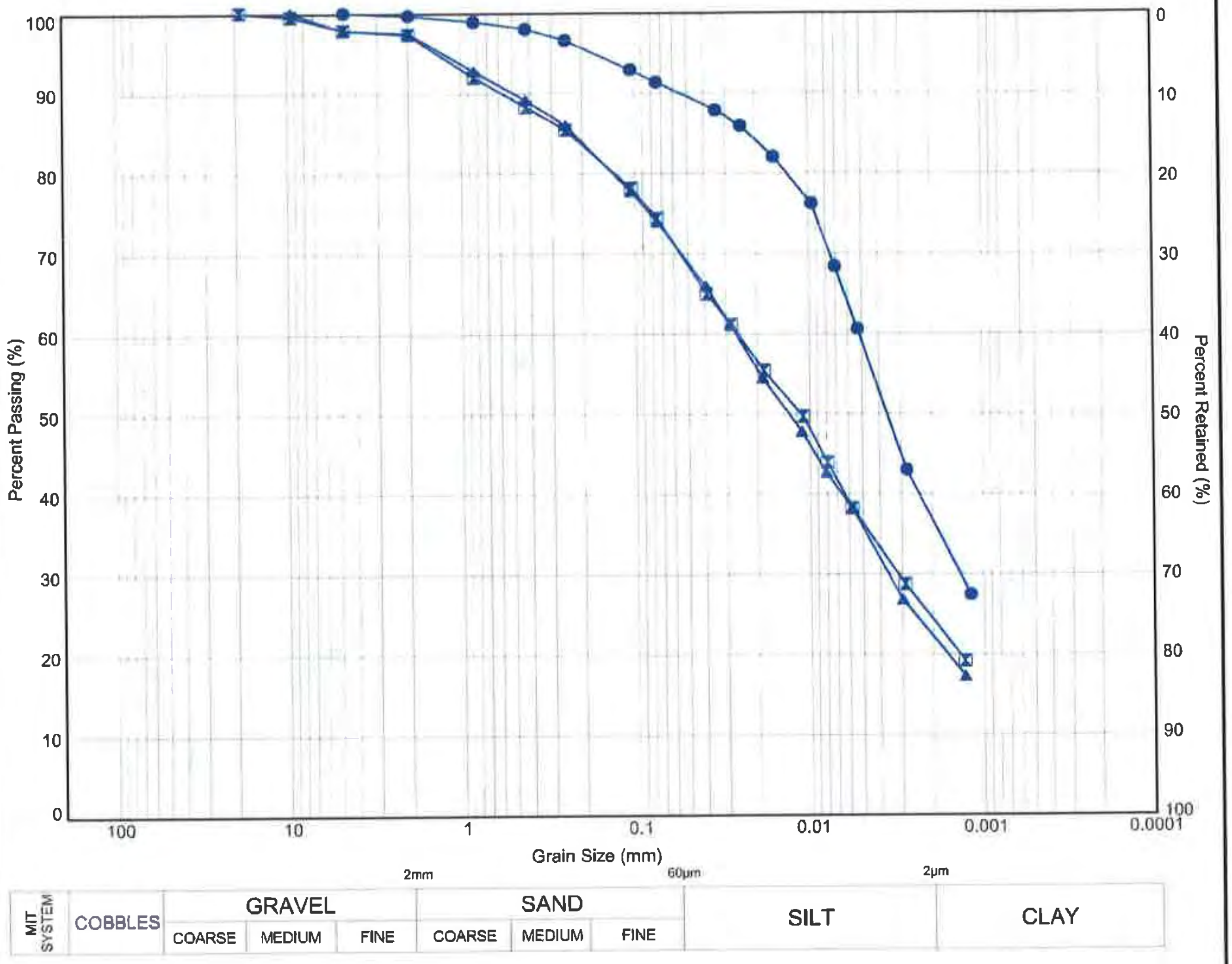
WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Jun 5, 2014	1.7	461.8
Jul 3, 2014	2 1	461.4

Library: library - terraprobe gint.glb report: terraprobe soil log file: 11-14-4090.gpj

LABORATORY TEST RESULTS

TERRAPROBE INC.



					MIT SYSTEM				
	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**1**	SS2	1.0	473.2	0	9	54	37	
☒	**17**	SS3	1.8	466.0	3	26	47	24	
▲	**18**	SS5	3.1	460.4	3	26	49	22	

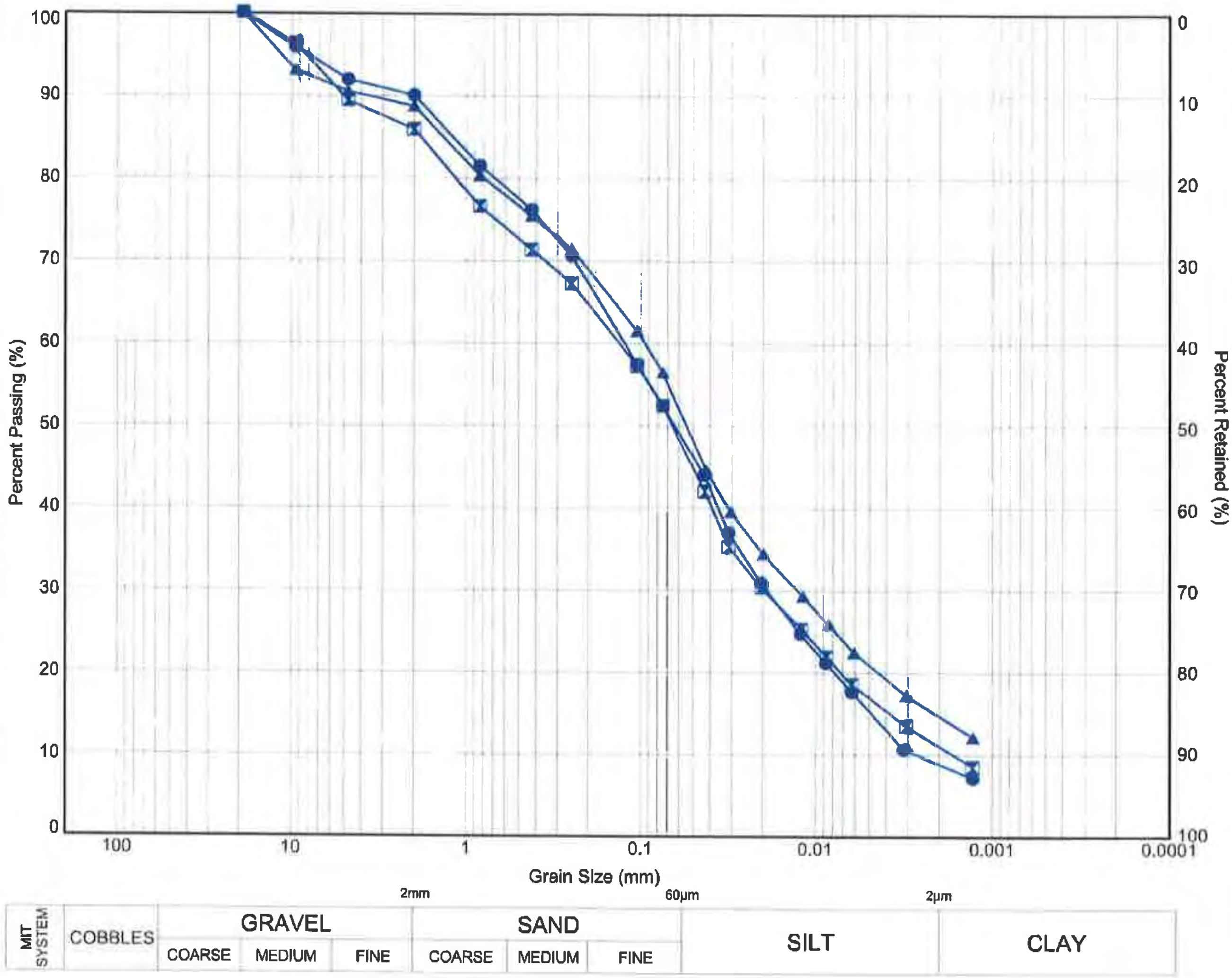
Terraprobe

11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
CLAYEY SILT, TRACE SAND TO SANDY, TRACE GRAVEL

File No.: **11-14-4090**



	Hole ID	Sample	Depth (m)	Elev. (m)	MIT SYSTEM Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	6	SS3	1.8	464.9	10	41	40	9	
☒	16	SS5	3.3	462.2	14	38	37	11	
▲	17	SS6	4.7	463.1	11	37	37	15	

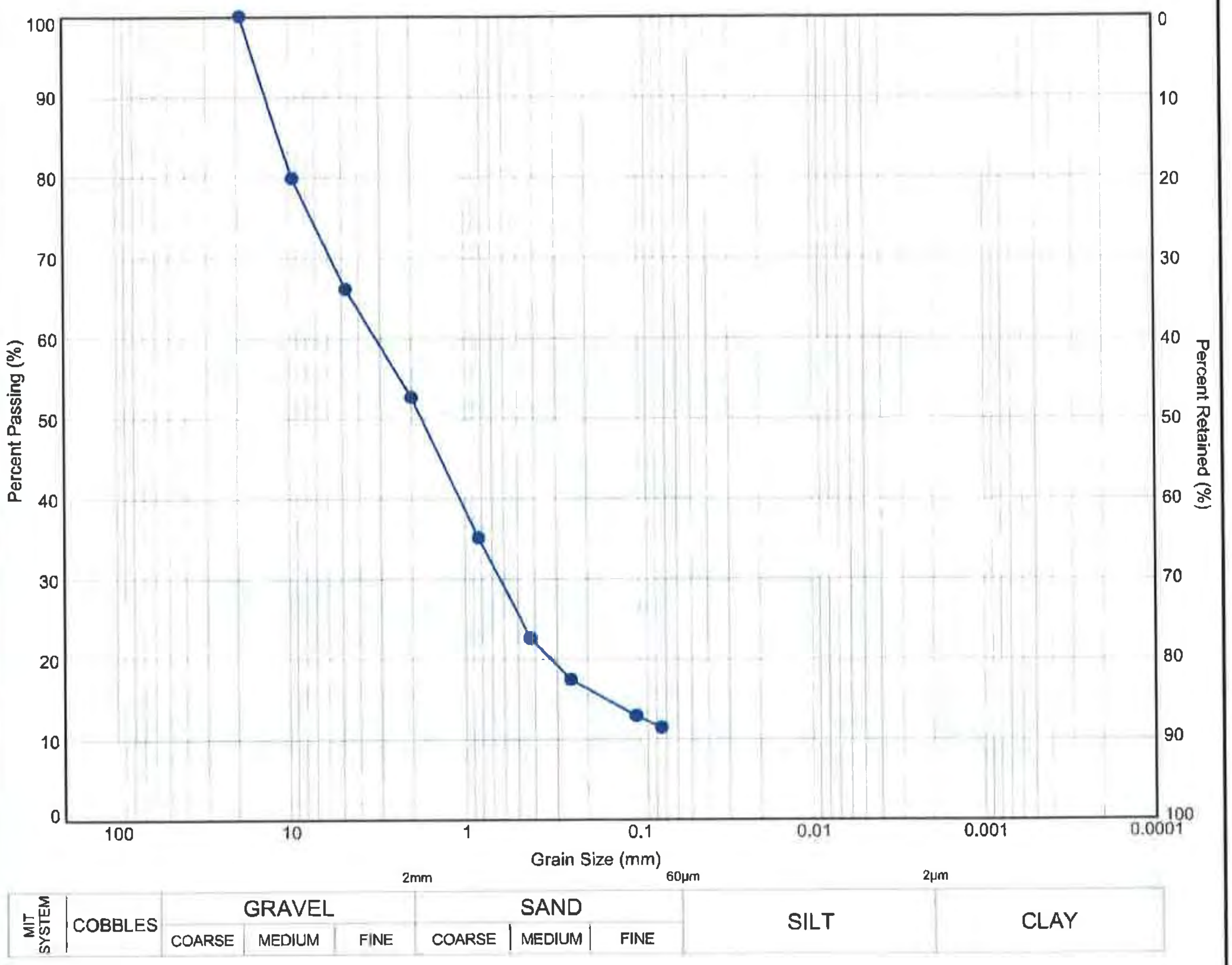
Terraprobe

11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
SAND AND SILT, TRACE TO SOME CLAY, TRACE TO SOME GRAVEL

File No.: **11-14-4090**



MIT SYSTEM

	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	1	SS9	9.4	464.8	47	42			*(11)*

Terraprobe

11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
GRAVEL AND SAND, SOME SILT

File No.: **11-14-4090**

ENGINEERED FILL EARTHWORKS SPECIFICATIONS

TERRAPROBE INC.

PART 1 GENERAL

1.01 Description

Engineered Fill refers to earth fill (earthworks) designed and constructed with engineering inspection and testing, so as to be capable of supporting structure foundations and slabs without excessive settlement. Poured concrete foundation walls must be provided with nominal reinforcing steel to provide stiffening of the foundation walls and to protect against excessive crack formation within the foundation walls.

Preparation for Engineered Fill and Engineered Fill operations must only be conducted under full time inspection and testing by the Geotechnical Engineer, in order to ensure adequate compaction and fill quality.

The work for the construction of Engineered Fill, is shown on the Design Drawings prepared by the Design Civil Engineer and as described by these specifications. The work included in this section includes the following:

a) Stripping of the existing topsoil, fill layer, and weathered/disturbed soil as needed from the ground surface below all areas to be covered with Engineered Fill,

b) Excavation of Test Holes into the subgrade to investigate the suitability of subsurface conditions for support of the Engineered Fill and determine if any prior existing fill materials are present,

c) Proof-rolling or visual inspection (as directed by the geotechnical engineer) of the subgrade below areas to be covered with Engineered Fill, to detect the presence and extent of unstable ground conditions,

d) Excavation and removal of unstable subgrade materials or other approved stabilization measures, if required prior to the placement of Engineered Fill,

e) Surveying of ground elevations prior to placing Engineered Fill,

f) Supply, placement, and compaction of approved clean earth as specified herein, with full time inspection and testing,

g) Surveying of ground elevations on completion of Engineered Fill placement,

h) Providing and maintaining survey layout of areas to receive Engineered Fill, and monitoring of ground elevations throughout the construction of Engineered Fill.

1.02 The Project Parties

A) The term Contractor shall refer to the individual or firm who will be carrying out the earthworks related to preparation and construction of Engineered Fill.

B) The term Geotechnical Engineer shall refer to the individual or firm who will be carrying out the full time inspection and testing of the earthworks related to preparation and construction of Engineered Fill.

C) The term Design Civil Engineer shall refer to the individual or firm who will be carrying out the Site Grading Design (pre-grading), the determination of Design Foundation Grades for the structures on the site, and the choice of lots and site areas to receive Engineered Fill.

PART 2 MATERIALS

2.01 Definitions

A) Topsoil Layer is the surface layer of naturally organic soil typically found at the ground surface and with thickness on the order of 25 to 250 mm thick.

B) Earth fill is soil material which has been placed by man-made effort and has not been deposited by nature over a long period of time.

C) Weathered/disturbed soil is natural or native soil that has been disrupted by weathering processes such as frost damage.

D) Subgrade soil is the "in situ" (in place) natural or native soil beneath any earth fill and/or weathered/disturbed soil and/or topsoil layer(s).

E) Engineered Fill soils must consist of clean earth materials (not excessively wet), free of organics and topsoil, free of deleterious materials such as building rubble, wood, plant materials, placed in thin lifts not exceeding 150 mm in thickness. Cohesionless soils such as sand or gravel, are the easiest to handle and compact.

F) All values stated in metric units shall be considered as accurate.

PART 3 ENGINEERED FILL DESIGN

3.01 Design Foundation Pressure

A) Engineered Fill can be expected to experience post-construction settlement on the order of 1 percent of the depth of the Engineered Fill. The time period over which most of this settlement typically occurs, depends on the composition of the Engineered Fill as follows (after initial placement);

a) Sand or gravel soil;	several days,
b) Silt soil;	several weeks,
c) Clay or clayey soil;	several months.

The placement of Engineered Fill might also result in post-construction settlement of the underlying natural soil.

The timing of foundation construction must take into account the post-construction settlement of the Engineered Fill and the foundation soil.

B) Unless otherwise stated, the Engineered Fill is to be placed over the entire lot or site area.

C) The Engineered Fill is to extend up to 1 m above the highest level of required foundation support. Typically this can be within 1 m of the design final grades. Additional common fill can be placed over the Engineered Fill to provide protection against environmental factors such as wind, frost, precipitation, and the like.

E) A geotechnical reaction at SLS of 150 kPa for 25 mm of settlement is typically recommended for the Engineered Fill, unless it consists of glaciolacustrine silt and clay in which case a lower design foundation pressure will need to be determined on a site specific basis. Foundations shall have minimum widths of 0.6 m for continuous strip footings, and minimum dimensions of 1 m for column footings.

F) At the foundation level, sufficient Engineered Fill shall be constructed to ensure that it extends at least 1.0 m laterally beyond the edge of any foundations, and that it extends outward within an area defined by a 1 to 1 line downward from the edge of any Engineered Fill.

G) Foundations placed on the Engineered Fill must be provided with nominal reinforcing steel for protection against excessive minor cracking. The reinforcing steel must consist of 2-15M bars continuous at the top of the foundation wall, and 2-15M bars continuous at the bottom of the foundation walls.

H) At the time of foundation construction, foundation excavations must be reviewed by the Geotechnical Engineer to confirm suitable bearing capacity of the Engineered Fill. The Geotechnical Engineer must inspect the foundation subgrade immediately after excavation, and must inspect the foundation subgrade immediately prior to placement of concrete for footings. The Geotechnical Engineer must also inspect the placement of reinforcing steel in the foundation walls. Written approval must be obtained from the Geotechnical Engineer prior to,

a) placement of footing concrete, and

b) placement of foundation wall concrete.

PART 4 CONSTRUCTION

4.01 Survey Layout

A) The survey layout shall be carried out and maintained throughout the construction of Engineered Fill activities. A suitable layout stake shall be placed at the corners of the start and finish of every block or work area to receive Engineered Fill.

B) At least two temporary survey elevation benchmarks shall be provided for every work area to receive Engineered Fill, to assist in monitoring the level of the Engineered Fill as it is constructed.

C) The ground elevations of the subgrade approved for receiving Engineered Fill shall be surveyed and recorded on a regular grid pattern. Engineered Fill shall not be placed on any work area without the written approval of the Geotechnical Engineer.

D) The ground elevations of the Engineered Fill on each work area shall be surveyed and recorded on a regular grid pattern at the end of each day during the placement of Engineered Fill.

E) On completion of Engineered Fill construction, the final ground elevations shall be surveyed and recorded on a regular grid pattern.

4.02 Topsoil Stripping

A) The Geotechnical Engineer must observe the stripping of topsoil from the areas proposed for Engineered Fill, from start to finish.

B) Topsoil must be stripped from the entire building site area. The Geotechnical Engineer must photograph the work areas which have had the earth fill suitably stripped.

4.03 Test Holes Into Subgrade

A) After the topsoil has been stripped, the exposed subgrade must be investigated for the presence of weak zones or deleterious material, which may be unsuitable for the support of Engineered Fill.

B) Exploratory test holes must be dug using a small backhoe, on a suitable pattern to obtain a representative indication of the entire site area.

C) The Geotechnical Engineer must observe the digging and backfilling of the test holes; must log the test hole stratigraphy; must obtain soil samples at maximum depth intervals of 0.3m; and must photograph each dug test hole.

D) If the test holes discover any old buried fill or deleterious materials, it must be excavated and removed from the lot area down to undisturbed, stable native soil.

E) All test holes must be properly backfilled and compacted in loose lifts of maximum 150 mm thickness to at least 98 percent Standard Proctor Maximum Dry Density (SPMDD), at the optimum water content plus or minus 2 percent. The Geotechnical Engineer must observe the backfilling and compaction of the test holes.

4.04 Subgrade Proof-rolling

A) Prior to placing any Engineered Fill, the exposed subgrade must be proof-rolled with a static smooth-drum roller and the Geotechnical Engineer must observe the proof-rolling.

B) Cohesive soil will be disrupted by proof-rolling. Competency must be determined by a geotechnical engineer by cutting and inspecting the soil.

C) If unstable subgrade conditions are encountered, the unstable subgrade must be sub-excavated. If wet site conditions exist during filling, stabilization with granular materials may be required.

4.05 Engineered Fill Placement

A) Engineered fill must not be placed without the approval of the Geotechnical Engineer. Prior to placing any Engineered Fill, the existing fill must be removed down to native soil subgrade, the subgrade must be investigated for old buried fill or deleterious material, the subgrade must be proof-rolled, and the subgrade elevations must be surveyed.

B) Prior to the placement of Engineered Fill, the source or borrow area for the Engineered Fill must be evaluated for its suitability. Some of the existing site fill that is removed prior to placement of Engineered Fill may be sorted and reused as Engineered Fill, but must first be approved by the Geotechnical Engineer. Samples of the proposed fill material must be obtained by the Geotechnical Engineer and tested in the geotechnical laboratory for Standard Proctor Maximum Dry Density, prior to approval of the material for use as Engineered Fill. The Engineered Fill must be free of organics and other deleterious material (wood, building debris, rubble, cobbles, boulders, and the like).

C) The Engineered Fill must be placed in maximum loose lift thicknesses of 150 mm. Each lift of Engineered Fill must be compacted with a heavy roller, to at least 98 percent Standard Proctor Maximum Dry Density (SPMDD), at the optimum water content plus or minus 2 percent.

D) Field density tests must be taken by the Geotechnical Engineer, on each lift of Engineered Fill, on each lot area. Any Engineered Fill which is tested and found to not meet the specifications, shall be either removed or, reworked and retested.

E) Engineered fill must not be placed during the period of the year when cold weather occurs, i.e., when there are freezing ambient temperatures during the daytime and overnight.

A2:

HYDROGEOLOGICAL STUDY

CHUNG & VANDER DOELEN
ENGINEERING LTD.

GROUNDWATER SUPPLY FEASIBILITY ASSESSMENT

Sarah Properties Ltd.

Waldemar Residential Development

Township of Amaranth, Ontario

SUBMITTED TO:
Sarah Properties Ltd.
2 Prince Edward Road
Woodstock, ON
N4V 1G7

ATTENTION:
Mr. Walter Broos

FILE NO.: / H16033 / June 7 2016

CHUNG & VANDER DOELEN
ENGINEERING LTD.

311 VICTORIA STREET NORTH
KITCHENER / ONTARIO / N2H 5E1
519-742-8979

June 7, 2016
FILE NO.: H16033

Mr. Walter Broos
Sarah Properties Ltd.
2 Prince Edward Road
Woodstock, ON N4V 1G7

Dear Mr. Broos:

RE: **GROUNDWATER SUPPLY FEASIBILITY ASSESSMENT**
Sarah Properties Ltd. Waldemar Residential Development
Township of Amaranth, County of Dufferin

This report presents a hydrogeological assessment of the feasibility for securing additional groundwater supply in Waldemar, Ontario to service Sarah Properties Ltd. proposed 323-lot residential development. It is intended that this report be presented to the Township of Amaranth for its consideration and input to the subsequent steps by Sarah Properties in developing additional source water.

If you have any questions or concerns regarding the report, please contact the undersigned at your convenience.

Yours truly,
CHUNG & VANDER DOELEN ENGINEERING LTD.

S. Anderson.

William (Sandy) Anderson, M.Sc., P.Eng.
Senior Hydrogeologist and Engineer

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APPENDIX A - FIGURES

APPENDIX B - FIGURES FROM BACKGROUND SOURCES

1.0 INTRODUCTION

This report presents a feasibility assessment for securing additional groundwater supply to service the Sarah Properties Ltd. (SPL) proposed 334-lot residential development located in Waldemar, Ontario. It is intended that this report be presented to the Township of Amaranth for its consideration and input prior to subsequent steps taken by SPL in developing additional source water supply.

CVD and SPL had general discussions on the matter of groundwater supply in the Waldemar area with R.J. Burnside & Associates Limited (Burnside), the engineering and hydrogeological consultant for the Township of Amaranth (Township). Burnside provided several technical reports as background information on the hydrogeological setting and the existing groundwater supplies in Waldemar and nearby Grand Valley.

The scope of this assessment includes the following:

1. Review of available background information on the hydrogeological setting and existing groundwater use, both municipal and private.
2. Characterization of the general hydrogeological setting.
3. Review the source water capabilities of the existing municipal water system serving Waldemar and assess the requirements for additional source water for the SPL development.
4. Identify the primary technical considerations for securing additional source water capability.
5. Make recommendations for the next steps in securing additional source water supply.

2.0 BACKGROUND INFORMATION

Background information sources used in completing this assessment are listed below.

- Government geological maps and reports on surficial and bedrock geology.
- Water well record database.
- Geotechnical, hydrogeological and functional servicing reports for the SPL development property.
- Well evaluation and GUDI (groundwater under direct influence of surface water) reports for the three existing municipal wells and one former municipal well in Waldemar.
- Water management study for East Luther / Grand Valley.
- Groundwater vulnerability and threats assessment reports for the Waldemar municipal wells.
- Source water protection reports / plans for the Waldemar and Grand Valley water supplies.

Section 7.0 provides a full list of the specific sources and reports. Appendix B provides several relevant figures and maps from the background sources.

The 35.02-hectare SPL development property is located on the west side of Waldemar as shown in Figure 1 (Appendix A). The Township of Amaranth Official Plan Schedule "A-1" (Appendix B, Sept 2010) indicates the SPL property is within the area identified as 'Community Residential'. Appendix B Figure 2 (Crozier, 2015) shows the Draft Plan of Subdivision for the SPL property, noting the development is an extension from the existing residential subdivision (known as the Acchione Subdivision) along Henry, James, Main and John Streets.

As shown in Figure 1 and OP Schedule A1, Waldemar is bisected by the Grand River into western and eastern portions. At present, there are about 175 residences (+/-) in the Waldemar 'Community Residential' area; roughly 55 to the west and 120 to the east. About 95 residences (+/-) on the east side (Waldemar Heights Subdivision) and 30 residences (+/-) on the west side are serviced by the Waldemar municipal water supply, which serves approximately 342 residents (Burnside, 2010) using three wells (PW1, PW2 and PW3) located in the east side residential area (Figure 1). Remaining residences in the Community Residential area (about 50 +/-) and other residences to the north and south of Waldemar use individual wells (Figure 1). All residences in the area use individual septic systems for sewage waste.

The SPL development would be fully serviced with both municipal water supply and wastewater collection and a wastewater treatment plant that would provide high level treatment prior to effluent discharge to the Grand River. The treatment plant would be located in the southeast corner of the SPL property.

3.0 SETTING

3.1 GENERAL TOPOGRAPHY AND DRAINAGE

Figure 2.1 (Appendix B - Burnside, 2010) shows the Grand River Watershed with the location of Waldemar and Amaranth Township in the northern upstream end of the watershed. The Grand River flows in a southerly direction through the middle of Waldemar at an elevation of about 448 to 446 mASL.

Not surprisingly, topography in the Waldemar area is generally sloped toward the River. On the SPL property, the topographic fall is relatively consistent; from about 476 mASL in the southwest corner, to 460 in the southeast corner, 463 mASL in the north tip, and as low as 456 along the northeast side. There are no permanent water courses on the SPL property. Topography east of the River is somewhat more complicated by a couple of creek valleys, but generally falls westerly toward the River from a similar upland area of about 475 mASL (+/-) near the eastern edge of the residential development area.

3.2 GEOLOGIC SETTING

The geologic setting in the Waldemar area is described by government maps/reports of both the Quaternary-aged surface deposits (Cowen et al., 1973) and the underlying bedrock formations (Liberty et al., 1976), as well as by water well records (MOECC database) and deeper gas well records (Beards, 1967). Burnside has summarized the setting in several reports (e.g., 2001a, 2002, 2003, 2007 and 2010).

3.2.1 Overburden Geology

Overburden thickness varies widely, as shown in Figure 4 (Appendix B - Burnside, 2007) and Figure 2 (Appendix A), and generally as follows:

- 30 to 35 m (100 to 102 feet) in the upland areas extending south and west from the southwest part of the SPL property and eastward from the east-side residential area.
- 15 to 25 m (50 to 80 feet) in the vicinity of the three existing municipal wells (PW1, PW2 and

PW3) and the former Acchione municipal well (ACC).

- Less than 5 m (15 feet) in a 50 to 200 m wide zone adjacent to the Grand River, including several stretches along the River where bedrock is exposed.

The surficial geology across the area is dominated by the silt to clayey silt Tavistock Till, mapped by Cowen et al., 1973 (Deposit 5d, Figure 4, Appendix B - Burnside, 2007). Other notable surficial deposits identified by Cowen et al. include extensive glaciofluvial outwash gravel and sandy gravel deposits within the Grand River valley and in a 1-km wide area extending east of the Grand River through most of the residential area and for several kilometers further east (Deposit 7, Figure 4, Appendix B). Notably, the mapping indicates that virtually the entire SPL property is underlain by the Tavistock Till.

The 2014-2015 subsurface investigation at the SPL property by Terraprobe included ten test pits to 3 m and twenty-three boreholes up to 12 m in depth (locations shown in Figure 2, Appendix B - Crozier, 2015). This investigation has confirmed the widespread presence of clayey silt till across the property. Only along the northeast property edge did a few shallow test pits (TP2 to TP5) indicate presence of the surficial sand/gravel Grand Valley outwash deposit on the property. The only other 'non-till' occurrences at the property were a 3.1 m thick sand and gravel layer at BH1 below the 7.6-m depth (elevation 466.6 mASL) and a 1.9 m thick sand layer at BH7 beneath the 2.7-m depth (elevation 470.1 mASL). In both of the latter occurrences, the granular layers were both over and underlain by silt till.

Borehole data from the Waldemar Heights residential area (Burnside, 2003 and MOECC well records) typically indicates a 3 to 5-m thick surficial sand and gravel layer overlying silt to clayey silt till and occasionally indicates a silt or silt till at surface. This is also consistent with Cowan's mapping.

Water wells records provide some additional information on deeper overburden deposits, although driller's descriptions are not always consistent with standard geological descriptions. Figure 2 (Appendix A) presents the total overburden thickness and the total thickness of materials with 'clay' in the description for selected well records. As shown, there is a predominance of clayey materials in the overburden, particularly at wells located in the upland areas and immediately adjacent to the SPL property.

3.2.2 Bedrock Geology

Bedrock in the area (Figure 5, Appendix B - Terraprobe, 2015) is the Middle Silurian-aged Guelph Formation tan dolostone and the underlying Amabel Formation grey dolostone (Liberty et al, 1976). Regional stratigraphic assessments (Beards, 1967 and Sanford, 1969) suggest these two formations are on the order of 85 to 105 m (280 to 340 feet) thick in the area and are underlain by the Lower Silurian-aged Clinton-Cataract Formations of interbedded shale-dolostone-sandstone.

Two of the deep municipal wells appear to have encountered the full thickness of the Guelph-Amabel dolostone (referred to by drillers as 'limestone'). At PW1, shale was encountered at 88 and 90.5 m (289 and 297 feet) below the bedrock surface and, at PW2, shale was encountered 92 m (301 feet). At Grand Valley municipal well 3 (GV3), 89.9 m (295 feet) of 'limestone' was recorded, apparently without reaching the shale.

3.3 HYDROGEOLOGIC SETTING

The hydrogeologic setting in the Waldemar area has three general components, as follows:

- A shallow water table aquifer in the surficial outwash sand/gravel deposits.
- A low-permeability clayey silt till aquitard.
- A regional aquifer in the Guelph-Amabel dolostone bedrock.

3.3.1 Water Table Aquifer

A shallow water table aquifer exists only where permeable surficial outwash granular deposits exist (e.g., immediately adjacent to the Grand River and eastward from the River through the Waldemar Heights residential area and further south and east from Waldemar Heights).

The Waldemar Heights geotechnical data indicates the water table aquifer beneath this area is no more than about 2 m thick. There may be greater saturated thicknesses in the outwash deposits south and east of Waldemar Heights or in the Grand River valley, however, there is no known data to confirm this.

In areas where the clayey silt till is found at surface (e.g., at the SPL property) no shallow aquifer exists, although the water table itself is found within the till, typically at a relatively shallow depth and seasonally variable.

Burnside (2001a) prepared a regional-scale interpretation of the water table throughout the Township (Figure 6, Appendix B). Although the elevations of the water table contours may not be precise at any particular location (given the regional scale), the pattern of the contours is considered to be a good indicator of the inferred shallow groundwater flow direction. Not surprisingly, in the Waldemar area, the inferred shallow groundwater flow mimics topography (i.e., in an easterly direction in the area west of the Grand River and in a westerly direction in the area east of the River). Across the SPL property, the shallow flow is north-easterly following topography before bending eastward toward the River. This is confirmed with water level data from the Terraprobe investigation (2015b).

3.3.2 Clayey Silt Till Aquitard

Where present, the clayey silt Tavistock Till (possibly combined with other older underlying tills) forms an aquitard, providing hydraulic separation between the water table (aquifer) and the deeper bedrock aquifer.

This aquitard is very substantial beneath the upland areas, owing to both its thickness and its clayey texture. As described in Section 3.2.1 and presented in Figure 2 (Appendix A) the majority of the +30 m of overburden in the southwest part of the SPL property, and extending to the south and west, is clayey aquitard material. Terraprobe (2015b) confirmed, through field testing of eight water table monitoring wells, that the upper portion of the aquitard across the SPL property has very low hydraulic conductivity (or permeability), in the $2x10^{-9}$ to $5x10^{-8}$ m/s range and with a mean of $1x10^{-8}$ m/s. The clayey aquitard beneath the east-side upland area, although not quite as thick near the three municipal wells (15-25 m), is expected to be similarly substantial based on the clayey texture.

Closer to the Grand River, the available well record data (Figure 2, Appendix A) indicate the aquitard conditions are more variable. The data in and south of Waldemar indicate much reduced aquitard thicknesses, typically 5 to 15 m and occasionally as much as 20 m or absent altogether. Further north along the River, the aquitard thickness ranges from 0 to 6 m. In such areas with reduced aquitard thickness there is considerably less protection afforded to the underlying bedrock aquifer.

3.3.3 Bedrock Aquifer

In the Waldemar area the bedrock aquifer is, for the most part, a 'confined' artesian aquifer; meaning that the water in the aquifer is under hydrostatic pressure, such that the 'potentiometric' water levels in the aquifer area rise to a higher elevation than the bedrock surface itself. The pressure is created by regional recharge to the bedrock aquifer and by the overlying clayey aquitard which 'confines' the aquifer by resisting the upward water pressure created by the regional recharge.

Burnside (2001a) prepared a regional-scale interpretation of the potentiometric surface of the aquifer throughout the Township (Figure 7, Appendix B). A potentiometric surface is similar to a water table contour map, but reflects the groundwater pressure from the deeper level. Although the elevations of the contours may not be precise at any particular location (given the regional scale), the pattern of the contours is considered to be a good indicator of the inferred groundwater flow direction in the bedrock aquifer. Not surprisingly, in the Waldemar area, the deep groundwater flow is toward the Grand River, which is the 'regional' discharge feature for all groundwater. Deep aquifer groundwater flow is, then, similar to flow in the shallow water table zone (i.e., in an easterly direction in the area west of the Grand River and in a westerly direction in the area east of the River).

4.0 GROUNDWATER USE

There is only one overburden well record in the Waldemar area; for a 10-foot deep well drilled in 1962 and located north of the Waldemar Heights subdivision. Notwithstanding this older well, the water table aquifer is generally not considered to be a viable aquifer for water supply due to its insufficient thickness and general lack of wells.

The Guelph and Amabel Formations, together, form a renowned regional bedrock aquifer used for water supply by many communities in the area (e.g., Guelph, Cambridge, Fergus-Elora, Grand Valley and Waldemar) and rural residences and farms.

4.1 AQUIFER GROUNDWATER QUANTITY

The quantities of groundwater available from the bedrock aquifer vary depending on location and depth within the aquifer. Where the water table aquifer or the Grand River directly overlie the bedrock, the capacity of the bedrock aquifer may be higher because of additional direct recharge, although in such instances the vulnerability to the groundwater becoming contaminated is greater.

Figure 2 (Appendix A) provides 'specific capacity' data for selected individual wells around Waldemar and the municipal wells in both Waldemar and Grand Valley. Capacities are simply the well yield divided by the total drawdown at that yield and over a particular pumping duration and are a good relative indicator of aquifer capability. For most private wells, drillers complete a one-hour capacity test (i.e., in gallons per minute per foot of drawdown or gpm/ft). The majority of private wells have one-hour capacities of 0.2 to 0.7 gpm/ft, considered to be more than adequate for individual residential wells, but not typically sufficient for a municipal well. Several of the deeper municipal wells in the area, including Waldemar Wells PW1 and PW3, the former ACC (Acchione) well and Grand Valley Wells GV2 and GV3, have higher capacities, in the 0.9 to 3.8 gpm/ft range. These higher capacities appear to correlate with the greater drilling depths of 76 to 117 m (250 to 385 feet); where the increased capacity appears to be gained by intersecting additional deeper water bearing zones. The 117-m deep Waldemar Well PW2 is the exception for deeper wells, with a more modest 0.3-gpm/ft capacity. Several relatively bedrock private wells located close to the Grand River (Figure 2, Appendix A) also have higher capacities of 1 to 5 gpm/ft; likely higher because of hydraulic connection to the shallow water sources.

The yields from well performance tests and/or the permitted pumping rates of larger production wells is another indicator of available groundwater quantity. Waldemar Wells PW1, PW2 and PW3 were tested and later permitted at rates of, respectively, 341, 273 and 318 L/min (75, 60 and 70 Imperial gpm), although PW1 and PW2 are currently operated at somewhat lower rates of 312 and 235 L/min (68.7 and 51.7 gpm) (DWCo Ltd., 2013). The former Acchione supply well and original 1981 test well were tested at rates of 227 and 273 L/min (50 and 60 Imperial gpm). In Grand Valley, municipal wells GV1 and GV2 area permitted at considerably higher rates of 1590 and 908 L/min (350 and 200 Imperial gpm) and GV1 was initially tested at a rate of 1020 L/min (225 gpm). GV3 was tested and later permitted at 454 L/min (100 Imperial gpm).

4.2 AQUIFER GROUNDWATER QUALITY

The water quality in the Guelph-Amabel aquifer is generally excellent, albeit with elevated hardness, which is common in most Southern Ontario hydrogeological settings.

2001 and 2003 water quality samples from the three existing municipal wells (Burnside, 2002, 2003) indicate very low concentrations of chloride (typically <10 mg/L) and nitrate (typically <1 mg/L), the two most common anthropogenic parameters (i.e., those introduced by man), as well as very low concentrations of iron (<0.1 mg/L), a problematic natural constituent if present at high concentrations. Other than hardness, the only natural constituent present in somewhat elevated concentrations is sulphate; at 150-270 mg/L in PW1 and lower at 75-100 mg/L in PW2 and PW3. The Ontario drinking water objective for sulphate is 500 mg/L, set for aesthetic reasons.

The former Acchione well had slightly elevated iron concentrations (approximately 0.2-0.3 mg/L, 2001) and a documented iron bacteria problem (Burnside, 2002). This well also had somewhat elevated sulphate; at about 300 mg/L in 2001.

In neighbouring Grand Valley, Burnside (2001b) indicates that the bottom 1.8 m of Municipal Well GV3 was grouted to reduce the initially elevated sulphate concentrations (580-610 mg/L) to a more acceptable concentration of about 400 mg/L. It is likely that the elevated sulphate originates from the deeper water bearing zones, which may indeed be part of the Clinton-Cataract formations given the 295-foot drilling depth. CVD has similar experience with elevated sulphate originating from the deeper water bearing zones in the Fergus-Elora area, at the bottom of Guelph-Amabel aquifer.

4.3 BEDROCK AQUIFER VULNERABILITY AND PROTECTION

Considerable effort has been made over the past approximately 15 years by municipalities in Ontario to better understand the source of groundwater that feeds its wells and the related matters of aquifer vulnerability, surface water influence and well head protection.

In Waldemar, these matters have been evaluated in detail (Burnside, 2001a, 2002, 2003, 2007 and 2010), particularly in relation to the three municipal wells (PW1, PW2 and PW3) located east of the Grand River and the former Acchione Well that had supplied some homes on the west side of the River. This work determined that the former Acchione Well was potentially influenced by shallow groundwater and/or Grand River water, while the wells on the east side of the River were determined to <u>not</u> obtain 'groundwater under the direct influence' of surface water (or GUDI). The apparent additional water contribution may well be the reason the 1987 Acchione Well and the original 1981 Acchione test well had higher well capacities compared to the existing Waldemar Heights wells (Figure 2, Appendix A). Ultimately, this work resulted in the decommissioning of the Acchione Well and the extension of municipal water from the Waldemar Heights system to the Acchione subdivision (Figure 1, Appendix A).

Figure 9 (Appendix B) presents a portion of Burnside's 2007 township-wide evaluation of bedrock aquifer vulnerability mapping, which is based on a number of hydrogeological factors including overburden texture and thickness. Not surprisingly, the upland areas underlain by clayey aquitard to both the east of the existing municipal wells and across, south and west of the SPL property have the lowest vulnerability rating, meaning these areas are the least susceptible to becoming contaminated from potential surface sources. Conversely, the areas along the Grand River valley have high to moderate vulnerability ratings, owing to the limited thickness of aquitard overlying the bedrock.

Detailed capture zone groundwater modelling was undertaken as part of the 2007 and 2010 assessments and has ultimately led to the delineation of the Waldemar Wellhead Protection Areas in the Grand River Source Water Protection Assessment Report (2012) and Plan (2015). Figure 4.6 (Appendix B) presents the resulting wellhead protection zones, extending eastward from the Waldemar wells and only a short distance westward toward the Grand River. A similar, but less extensive, capture zone / wellhead protection zone extends southwestward from Grand Valley municipal well GV3 (Figure 5.6, Appendix B).

5.0 EXISTING AND FUTURE WALDEMAR WATER SERVICING DEMANDS

5.1 EXISTING DEMANDS

The water usage from the existing Waldemar municipal system are summarized in several sources; Burnside (2010), the Grand River Source Water Protection Plan (2015), and DWCo Ltd. (2013).

Currently, the water demands for the serviced population of 342 are met by Wells PW1 and PW2, while Well PW3 is not currently being used and is considered to be a 'reserve' well (Burnside, 2010).

The MOECC permitted rates for Wells PW1, PW2 and PW3 (341, 273 and 318 L/min, respectively) equate to daily volumes of 491, 393, and 458 m³/day. Wells PW1 and PW2 had average annual water taking amounts of, respectively, 52.0 and 34.6 m³/day in 2009, and 60.0 and 54.4 m³/day in 2012. The increased usage in 2012 occurred mostly in May to July, thus appears to be related to increased outdoor uses (e.g., watering). It is notable, that the higher 2012 average volumes represent only about 12% and 14% of the volumes allowed under the MOECC permits. However, the maximum daily volumes recorded in 2012 were 352 and 234 m³/day, which represent a much greater proportion of the permitted amounts (72% and 60%).

The 2009 and 2012 total usages (86.6 and 114.4 m³/day) is equivalent to average per capita usage of 0.25 and 0.33 m³/day/person for the approximate 342 service population.

The capture zone modelling completed to establish the wellhead protection areas shown in Figure 5.6 (Appendix B) utilized long term average pumping rates of 61, 51 and 61 m³/day for the three municipal wells (for a total rate of 173 m³/day). This total exceeds the 2009 and 2012 average water takings by approximately 100% and 50%, respectively, suggesting that the existing wells have some additional capacity to meet increased average demands on the order of at least 60 m³/day without affecting the wellhead protection plan.

5.2 FUTURE DEMANDS WITH SPL DEVELOPMENT

The theoretical water demand for the 334-lot SPL development was evaluated by Crozier (2015) using the MOECC 2008 Design Manual. The average-day demand was calculated to be about 5.22 L/s (or 451 m³/day), based on Design Manual assumptions of 3 persons per household and 0.45 m³/person/day usage. It is notable that this theoretical per capita usage exceeds the actual 2009 and 2012 per capita usage by about 80% and 36%, respectively. So, for the existing Waldemar residents, the 0.45 m³/day theoretical usage is a very conservative assumption.

The maximum-day demand was calculated by Crozier to be 14.25 L/s (1240 m³/day), which is based on the Design Manual multiplier of 2.75 times the average day for populations of 500-1000. With the future population of Waldemar being in the 1000-2000 range (i.e., including the 1002 residents in the SPL development), a multiplier of 2.5 is recommended in the Manual. The maximum-day demand with this slightly lower multiplier would be 13.0 L/s (1127 m³/day).

With the same MOECC assumptions, the overall projected theoretical demands for the existing 342 residents and the 1002 prospective residents at the SPL development (i.e., 1344 total) are calculated to be 7 and 17.5 L/s (604 and 1512 m³/day) for average and maximum-day demands.

6.0 ASSESSMENT OF ADDITIONAL SOURCE WATER SUPPLY

The ability for a municipal water system to meet the required water demands is generally based on considering: a) the permitted source supply rates, b) the theoretical maximum-day demands, and c) assuming that the highest capacity source supply (or individual well) is not available for use at the time the maximum-day demand is required. This is considered a very conservative approach, especially considered the recent water usage is considerably lower than the theoretical demands. Nevertheless, for Waldemar, with removal of the permitted PW1 source (491 m³/day), the remaining existing wells PW2 (393 m³/day), and PW3 (458 m³/day) have a combined permitted source supply of 851 m³/day.

In consideration of the 851-m³/day source water supply from PW2 / PW3 and the future theoretical demand of 1512 m³/day described in Section 4.2 (i.e., including the existing residences and the SPL residences), it is projected that an additional 661 m³/day of source water supply would be necessary to service the expanded Waldemar community. This assumes using some of the existing source water 'surplus' and no other population growth or other development additions within the community that would use the surplus.

Based on the typical municipal well yields in the Waldemar area (393-491 m³/day), it is expected that two additional wells would be necessary to meet the additional 661 m³/day (equal to 7.7 L/s or 101 Imperial gpm) of source water supply. While it is possible that a single higher-yield well, such as Grand Valley Well GV3 (tested and permitted for 7.6 L/s or 100 gpm) could meet the required demands, such a well would become the highest yielding well in Waldemar and then be eliminated from the source water supply calculation for maximum-day demand. As a result, a minimum of two wells would be required regardless. However, even if typical average yields of 400 m³/day, two wells would provide some additional surplus water to handle some future growth and/or connection of some additional private residences that are currently on private wells.

6.1 OTHER CONSIDERATIONS FOR ADDITIONAL SOURCE WATER LOCATIONS

There are several other important matters that should be considered when securing additional source water supply for Waldemar. Some of these are hydrogeological in nature, while others relate to engineering or servicing. The following is a list of these key matters.

1) Minimize competition with the existing source water supplies (i.e., Wells PW1, PW2 and PW3).

2) Avoid altering existing source water wellhead protection areas, which are based on a maximum water taking from the existing source water supplies.

3) Avoid potential interference with existing private wells (i.e., maximize separation from as many private wells as possible).

4) Optimize use of the hydrogeological setting and/or other factors to maximize source water protection for the new sources (e.g., select locations with considerable aquitard protection and minimal known sources of potential contaminants in the projected area upgradient from the sources.

5) Minimize need to alter the existing infrastructure that already meets current requirements (e.g. existing watermain and storage reservoir sizes).

6) Maximize opportunities to improve existing water distribution and supply quality (e.g., remove possible watermain stagnant zones).

7) Optimize use of the existing source water supply 'surplus' to meet the SPL development water requirements, to the extent possible and safely attainable.

8) Maximize the opportunity to secure source water 'redundancy' for Waldemar (i.e., by having separate water source areas, a future problem in one source water area can be addressed with temporary increased use of the other area).

9) Recognize that drilling depth in the bedrock aquifer should be optimized to maximize source water quantity and minimize the possibility of encountering elevated sulphate.

6.2 RECOMMENDED APPROACH FOR ADDITIONAL SOURCE WATER SUPPLY

On the basis of above considerations and the required demands for the proposed SPL development, it is recommended that a test well reconnaissance investigation be conducted, specifically at two locations along the southwest side of the SPL property (See Figure 2, Appendix A).

This area would: a) maximize aquitard protection, b) maximize distance from the Grand River and potential surface water influence, c) maximize the distance from most existing private wells, d) provide a totally separate source water area that has little chance for completion with the existing source water area and provides source water redundancy, e) limits potential for existing infrastructure modifications, and f) provide opportunity to improve east-west water distribution.

Respectfully submitted,
CHUNG & VANDER DOELEN ENGINEERING LTD.

William (Sandy) Anderson, M.Sc., P.Eng.
Senior Hydrogeologist and Engineer

7.0 REFERENCES

The following documents, maps, or other publications have been used in the preparation of this report.

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- Grand River Source Protection Committee (August 16, 2012). **Assessment Report**, Grand River Source Protection Area, Chapter 6.0 (County of Dufferin).
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- Township of Amaranth (September 2010). Township of Amaranth Official Plan, Dufferin County, Schedule "A-1" Land Use & Transportation.

APPENDIX A
Figures 1 and 2

Figure 1
2015 Air Photo & Water Servicing Status

Groundwater Supply Feasibility Assessment
Sarah Properties Development, Waldemar

Drawn By: SA	Date: May 27 2016	File No.: H16033

CHUNG & VANDER DOELEN
ENGINEERING LTD
311 VICTORIA STREET NORTH

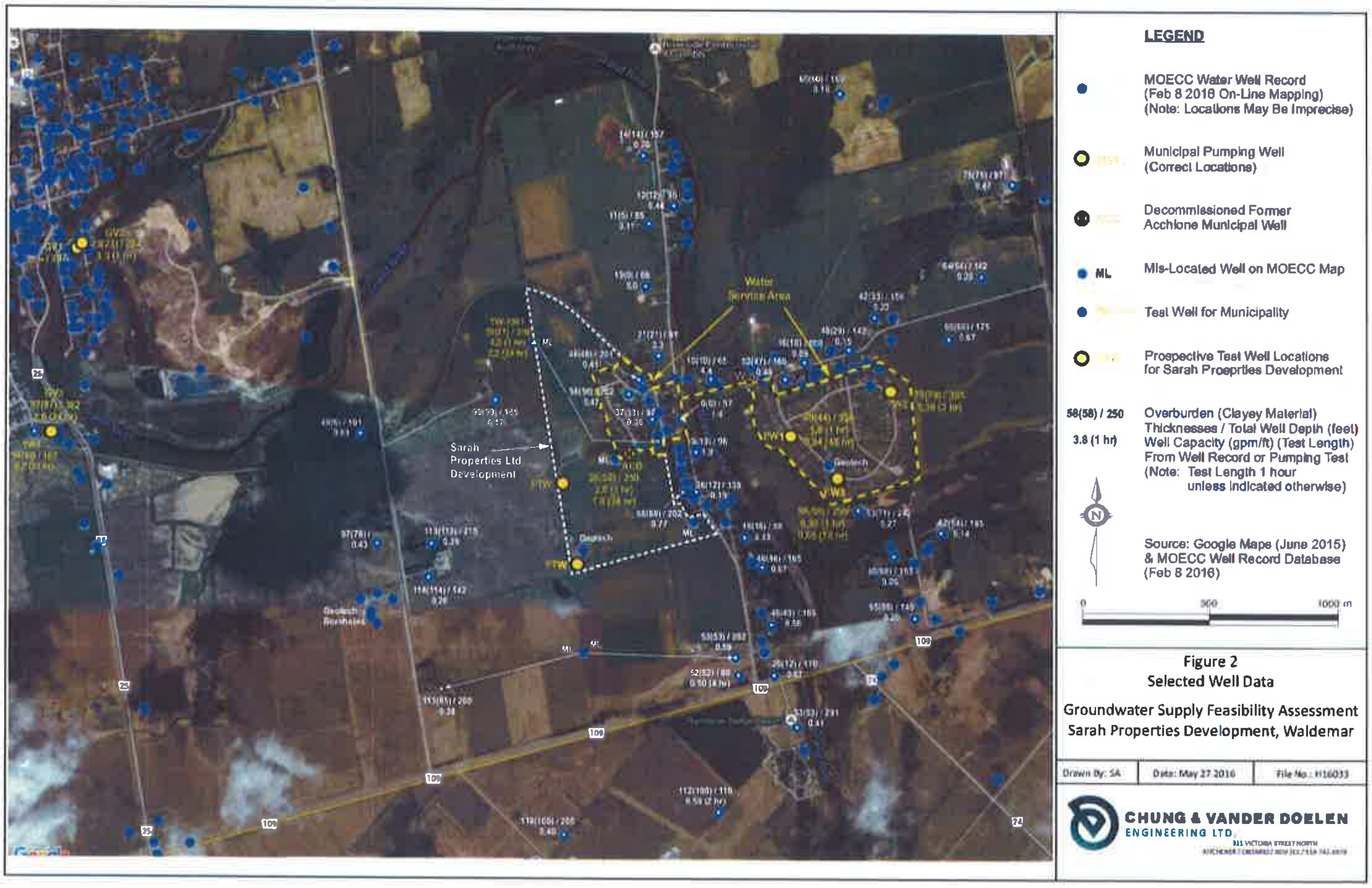


Figure 2
Selected Well Data

Groundwater Supply Feasibility Assessment
Sarah Properties Development, Waldemar

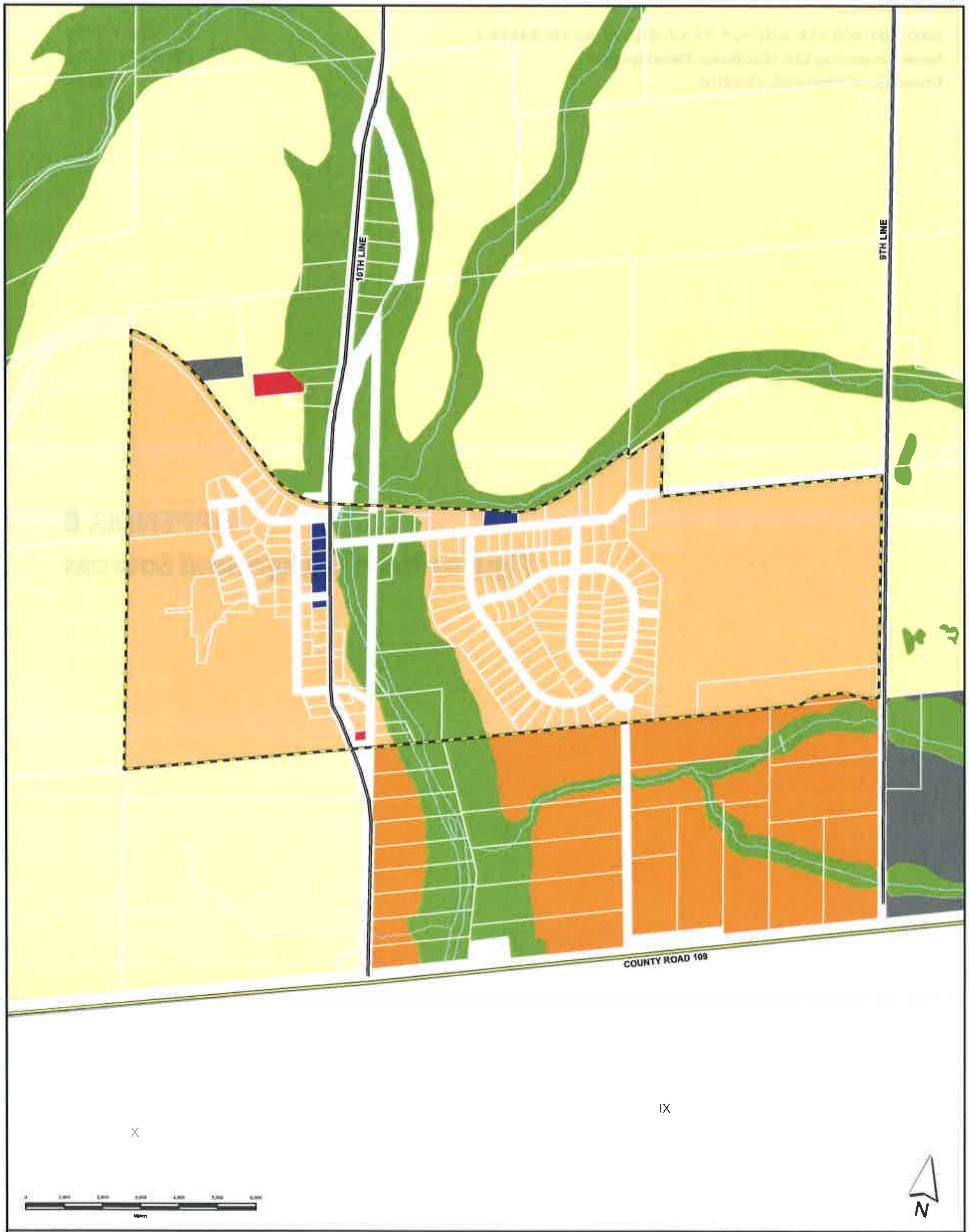
Drawn By: SA	Date: May 27 2016	File No.: H16033

CHUNG & VANDER DOELEN
ENGINEERING LTD.
311 VICTORIA STREET NORTH
KITCHENER ONTARIO

APPENDIX B
Figures from Background Sources

TOWNSHIP OF AMARANTH OFFICIAL PLAN
DUFFERIN COUNTY
SCHEDULE "A-1" LAND USE & TRANSPORTATION

TOWNSHIP OF AMARANTH



Legend

A	Agricultural	MX	Extractive Industrial	🟥	Provincial Highway
EP	Environmental Protection	RE	Open Space / Recreation	🟩	County Road
RU	Rural	CR	Community Residential	—	Municipal Road
ER	Estate Residential	I	Community Institutional	=	Parcel Boundary
EA	Employment Area	CC	Community Commercial	FWD	Former Waste Disposal Site
				WD	Waste Disposal Site

Township of Amaranth - Official Plan Consolidation
September 2010

Note: Schedule "A-1" is revised with respect to the approved Official Plan Amendments (OPA 1 - 3).

Map Projection: NAD 83, UTM Zone 17

This Map is Not A Legal Survey
The Township Cannot Be Responsible for Errors, Omissions or Other Inaccuracies

Lot Fabric Created With Data Provided By Teranet Inc
Official Plan Data updated by R J Burnside & Associates Ltd

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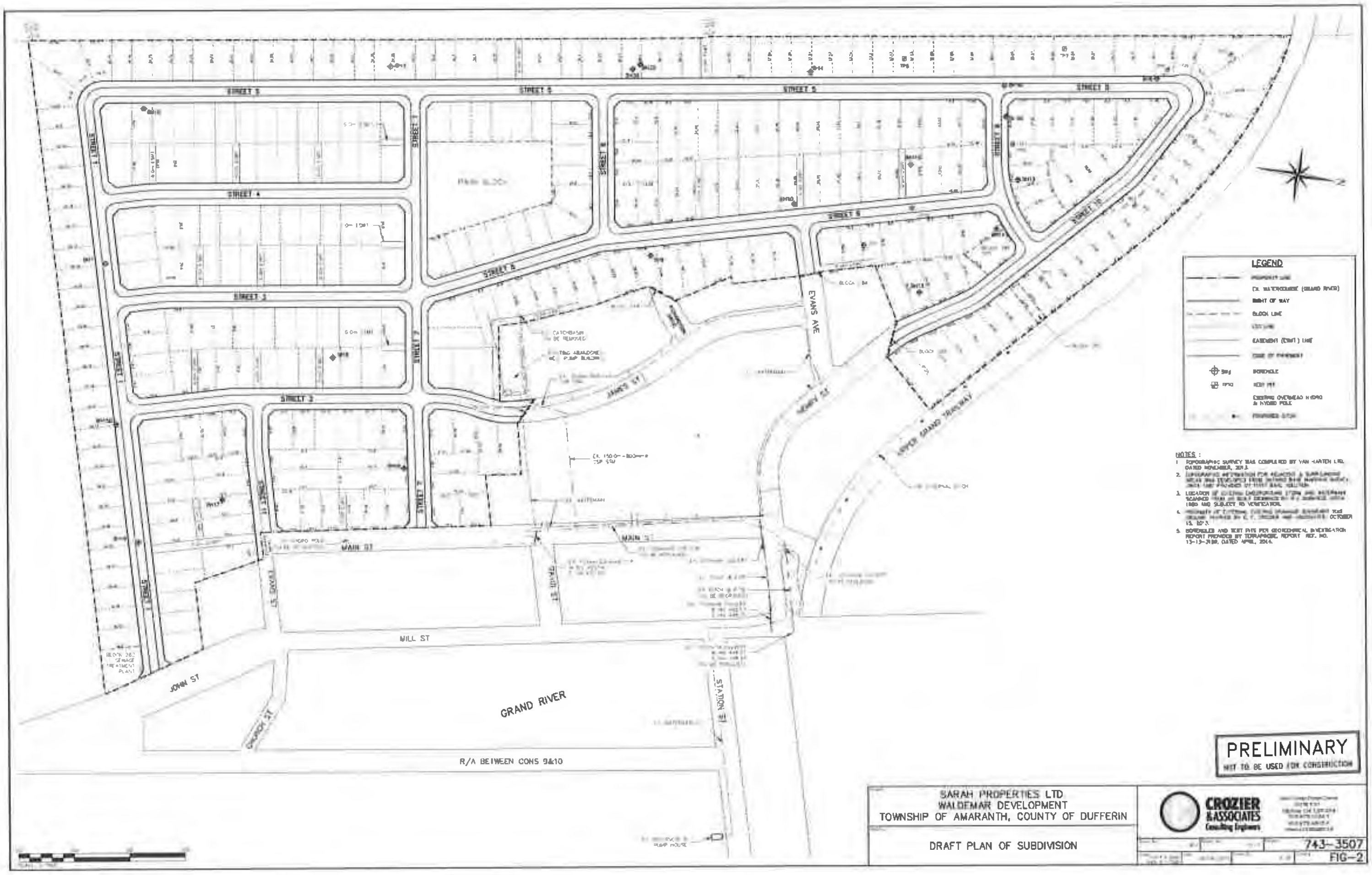
Print Date: Sept 23 2010



SARAH PROPERTIES LTD
WALDEMAR DEVELOPMENT
TOWNSHIP OF AMARANTH, COUNTY OF DUFFERIN

DRAFT PLAN OF SUBDIVISION

743-3507
FIG-2

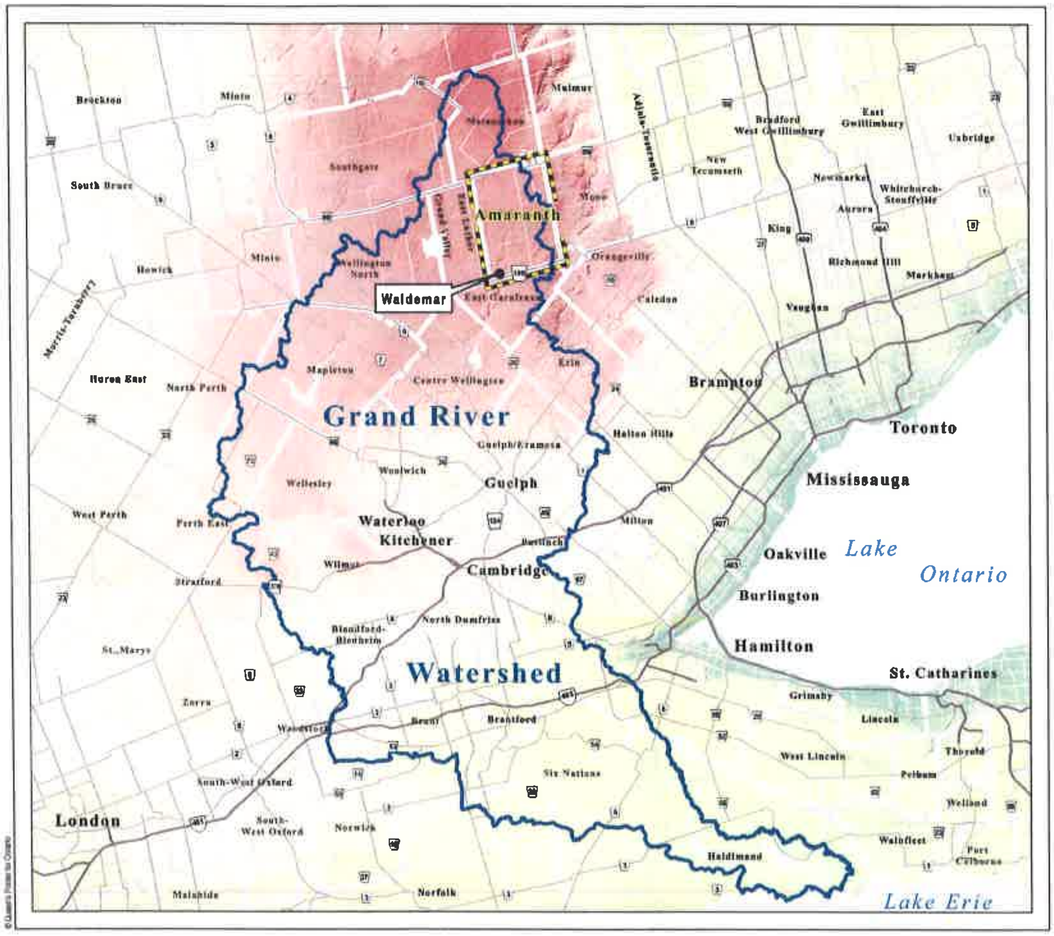


FIGURE 2.1
TOWNSHIP OF AMARANTH

VULNERABILITY ANALYSIS, ISSUES EVALUATION AND THREATS ASSESMENT

STUDY AREA WALDEMAR WATER SUPPLY SYSTEM

DATA SOURCES

1. 3. Ministry of Natural Resources © Her Majesty the Queen in Right of Ontario
2. Environmental Systems Research Institute (ESRI)
3. Grand River Conservation Authority

Scale: 1:650,000
May, 2010
Project Number: MSA10607.4
Prepared By: P. Stubbert

Projection: UTM Zone 17
Datum: NAD 83

Verified By: D. Hopkins

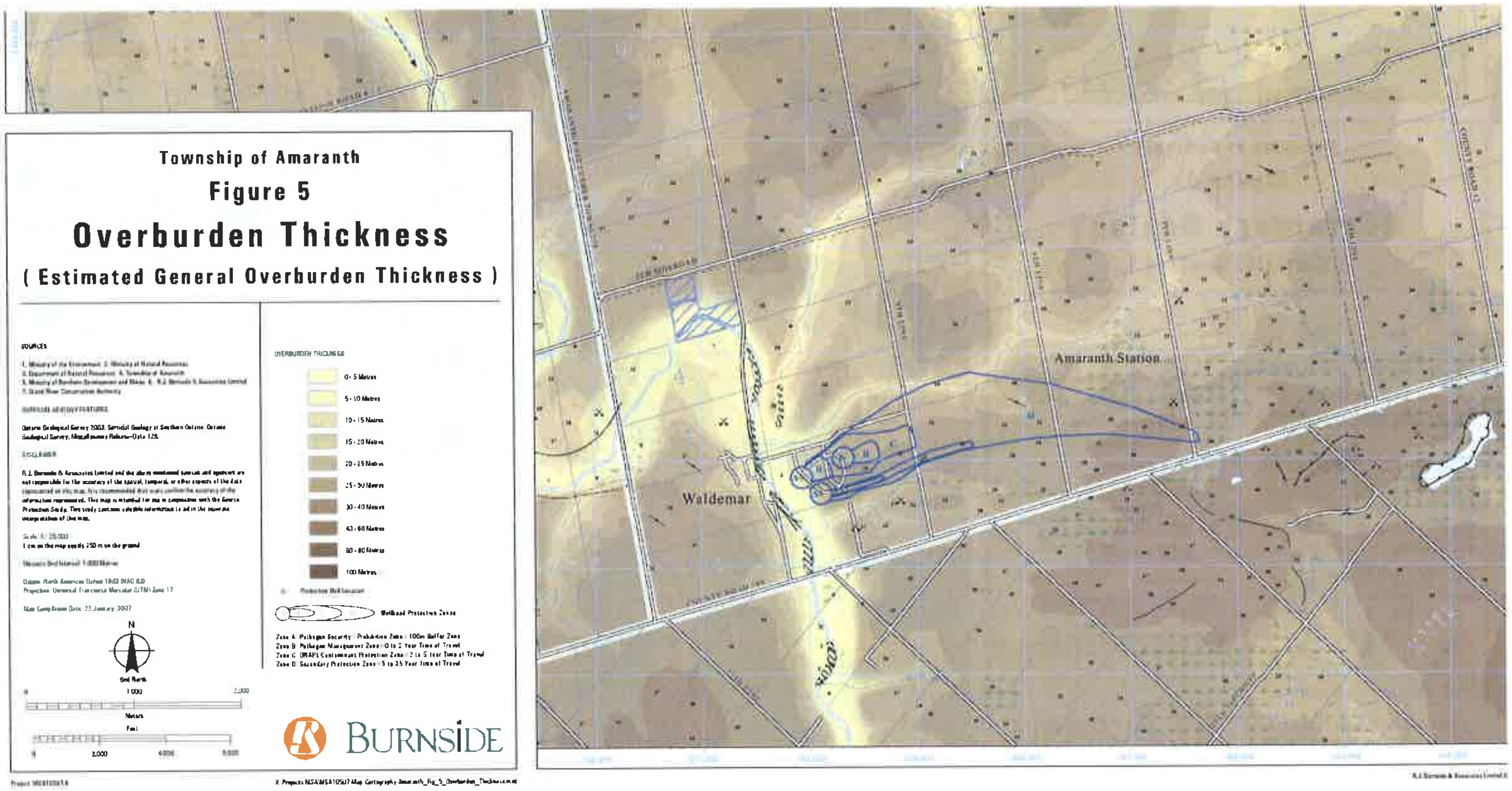
BURNSIDE

Township of Amaranth

Figure 5

Overburden Thickness

(Estimated General Overburden Thickness)



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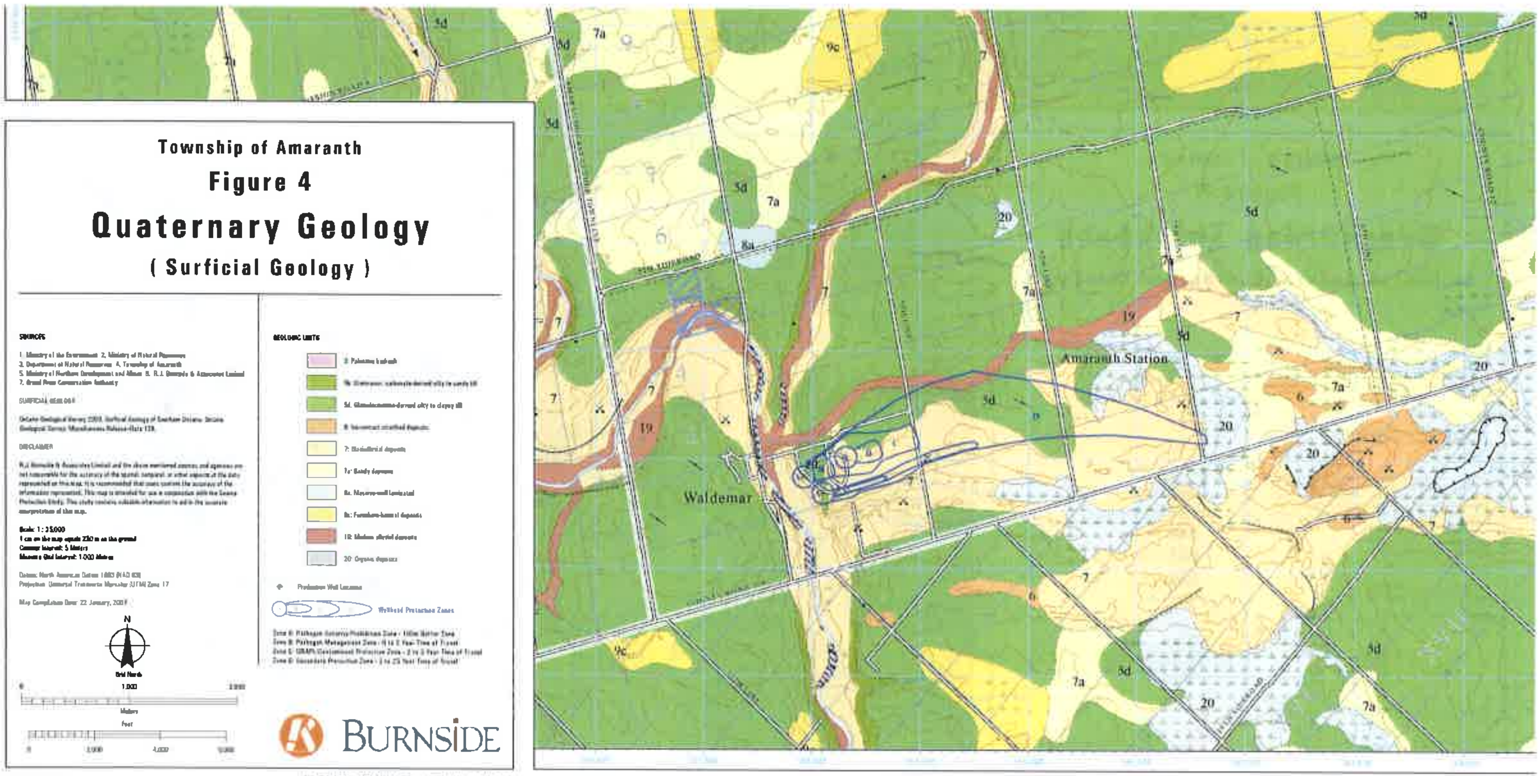


Township of Amaranth

Figure 4

Quaternary Geology

(Surficial Geology)

SOURCES

1. Ministry of the Environment 2. Ministry of Natural Resources
3. Department of Natural Resources 4. Township of Amaranth
5. Ministry of Northern Development and Mines 6. R.J. Burnside & Associates Limited
7. Grand River Conservation Authority

SURFICIAL GEOLOGY

Ontario Geological Survey 2003. Surficial Geology of Southern Ontario. Ontario Geological Survey, Miscellaneous Release-Data 128.

DISCLAIMER

R.J. Burnside & Associates Limited and the above mentioned sources and agencies are not responsible for the accuracy of the spatial, temporal, or other aspects of the data represented on this map. It is recommended that users confirm the accuracy of the information represented. This map is intended for use in conjunction with the Source Protection Study. This study contains valuable information to aid in the accurate interpretation of this map.

Scale: 1 : 25,000
1 cm on the map equals 250 m on the ground
Contour Interval: 5 Meters
Measure Grid Interval: 1,000 Meters

Datum: North American Datum 1983 (NAD 83)
Projection: Universal Transverse Mercator (UTM) Zone 17

Map Compilation Date: 22 January, 2009

GEOLOGIC UNITS

- 3: Paleozoic bedrock
- 5b: Stone-poor, carbonate-derived silty to sandy till
- 5d: Glaciolacustrine-derived silty to clayey till
- 6: Ice-contact stratified deposits
- 7: Glaciofluvial deposits
- 7a: Sandy deposits
- 8a: Massive-well laminated
- 9c: Foreshore-basinal deposits
- 19: Modern alluvial deposits
- 20: Organic deposits

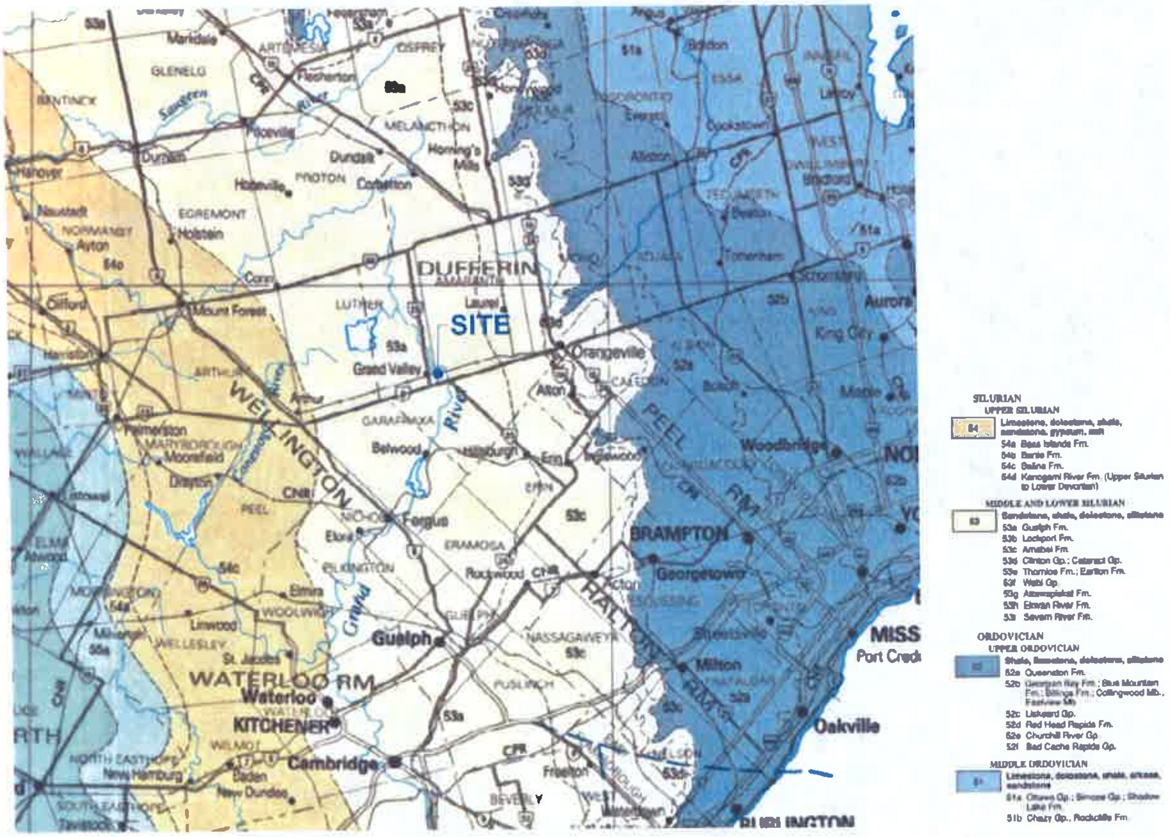
Production Well Location

Wellhead Protection Zones

Zone A: Pathogen Activity Prohibition Zone - 100m Buffer Zone
Zone B: Pathogen Management Zone - 0 to 2 Year Time of Travel
Zone C: DNAPL Contaminant Protection Zone - 2 to 5 Year Time of Travel
Zone D: Secondary Protection Zone - 5 to 25 Year Time of Travel

Project: MSA10507.4

R.J. Burnside & Associates Limited



Terraprobe Inc.

11 Indell Lane - Brampton Ontario L6T 3Y3 (905) 796-2650

KEY MAP

REFERENCE:
Ministry of Northern Development and Mines
MAP 2544
Bedrock Geology of Ontario
Southern Sheet

NOTES:

LEGEND:

PROJECT TITLE:
Hydrogeological Investigation

SITE LOCATION:
Waldemar Developments
Township of Amaranth, Ontario

FIGURE TITLE:
REGIONAL BEDROCK GEOLOGY

REV NO.: 0	FILE NO.: 13-13-3198-6
SCALE: NTS	FIGURE NO.: 5
DATE: January 2014	

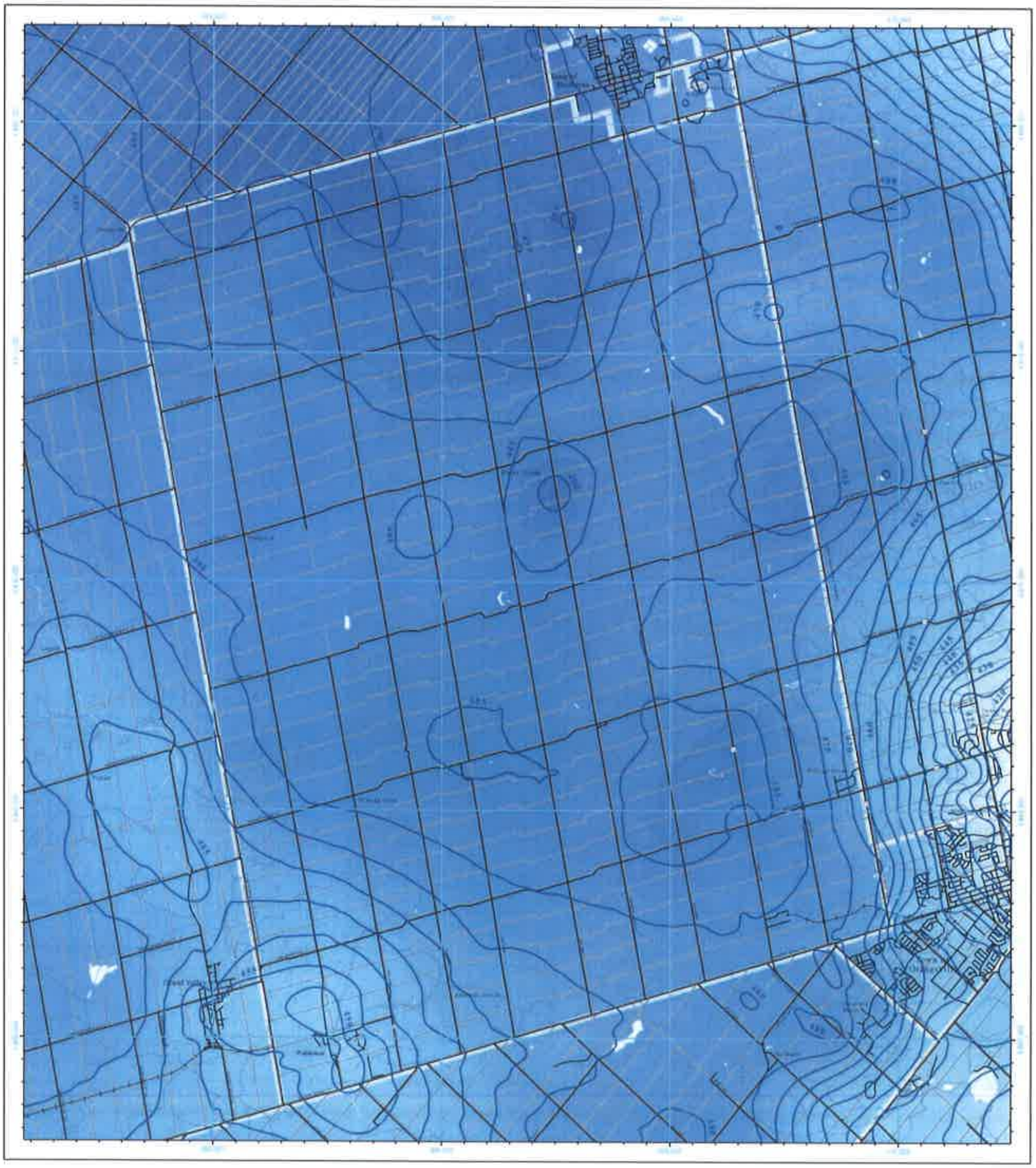


FIGURE 6

Township of Amaranth

Water Table Elevation

Scale 1:65,000
Mapping Date: 22 January, 2007

Projection: UTM Zone 17
Datum: NAD 83

Project: MSA10507.4

NOTES

1. Watertable elevation data taken from the Amaranth Groundwater Protection Study, 2002

SOURCES

1. Ministry of the Environment 2. Ministry of Natural Resources
3. Department of Natural Resources 4. Township of Amaranth
5. Ministry of Northern Development and Mines 6. R.J. Burnside & Associates Limited

DISCLAIMER

R.J. Burnside & Associates Limited and the above mentioned sources and agencies are not responsible for the accuracy of the spatial, temporal, or other aspects of the data represented on this map. It is recommended that users confirm the accuracy of the information represented. This map is intended for used in conjunction with the Source Protection Study. This study contains valuable information to aid in the accurate interpretation of this map.

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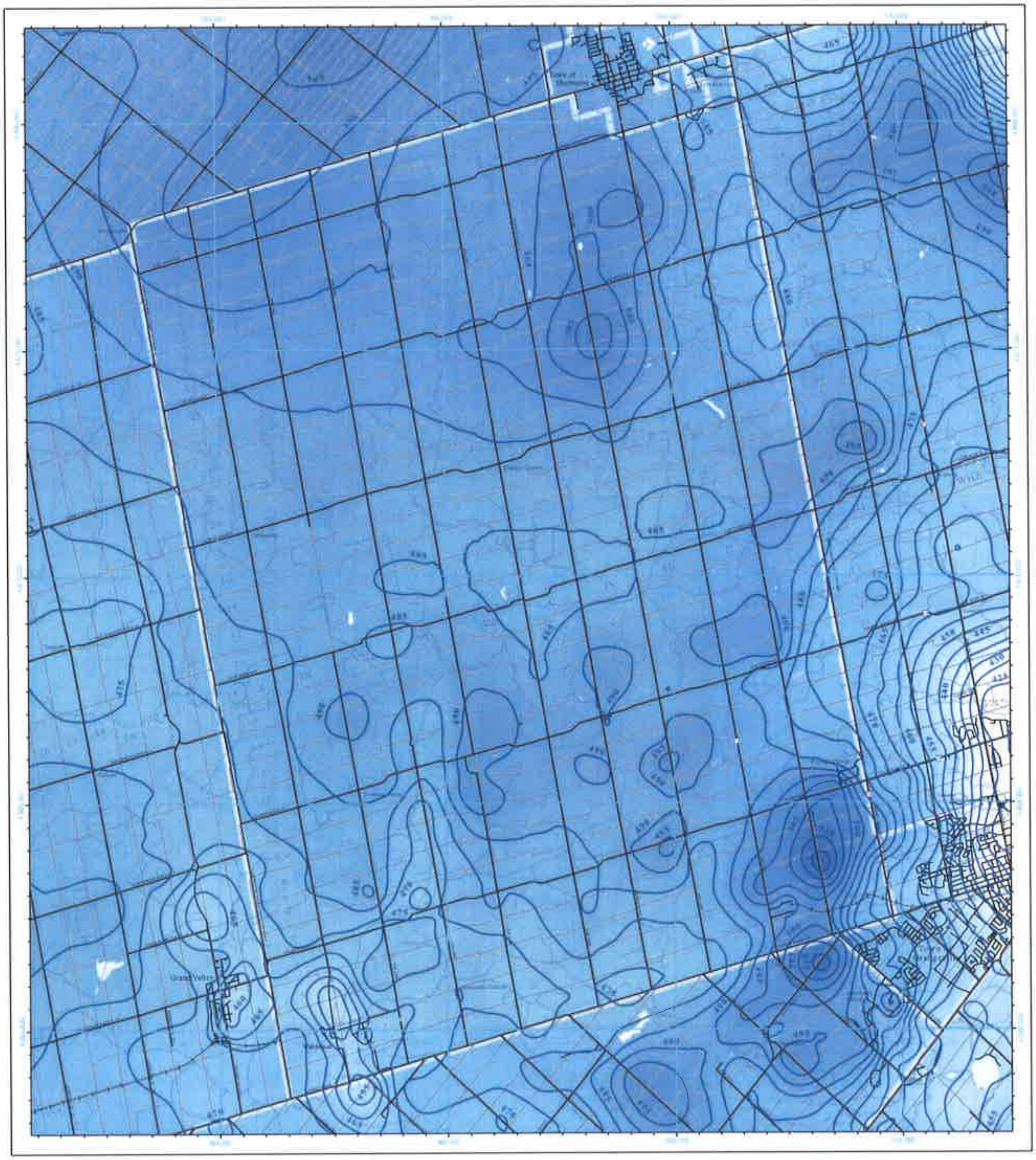
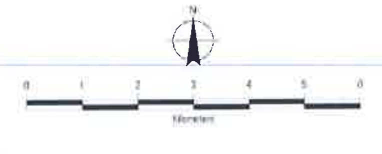


FIGURE 7

Township of Amaranth

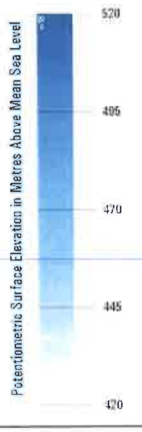
Potentiometric Surface



Scale 1:85,000
Mapping Date: 22 January, 2007

Projection: UTM Zone 17
Datum: NAD 83

Project: MSA10587.4



NOTES

1. Potentiometric Surface data taken from the Amaranth Groundwater Protection Study, 2002

SOURCES

1. Ministry of the Environment 2. Ministry of Natural Resources
3. Department of Natural Resources 4. Township of Amaranth
5. Ministry of Northern Development and Mines 6. R.J. Burnside & Associated Limited

DISCLAIMER

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BURNSIDE

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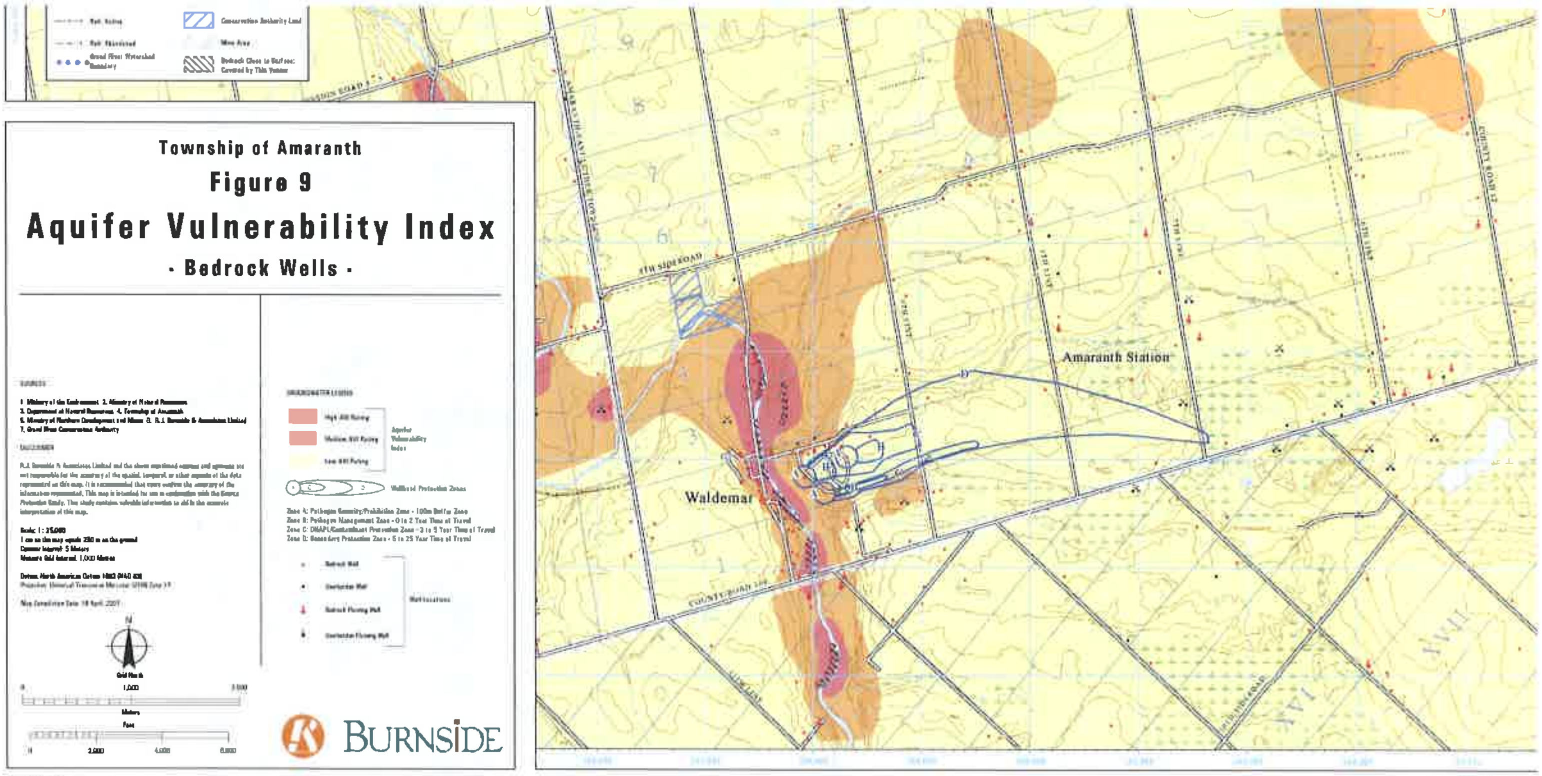

Township of Amaranth

Figure 9

Aquifer Vulnerability Index

- Bedrock Wells -

SOURCES

1. Ministry of the Environment 2. Ministry of Natural Resources
3. Department of Natural Resources 4. Township of Amaranth
5. Ministry of Northern Development and Mines 6. R.J. Burnside & Associates Limited
7. Grand River Conservation Authority

DISCLAIMER

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Scale: 1 : 25,000
1 cm on the map equals 250 m on the ground
Contour Interval: 5 Meters
Metre Grid Interval: 1,000 Metres

Datum: North American Datum 1983 (NAD 83)
Projection: Universal Transverse Mercator (UTM) Zone 17

Map Compilation Date: 18 April 2007

GROUNDWATER LEGEND

🟥	High AVI Rating	Aquifer Vulnerability Index
🟥	Medium AVI Rating	
🟨	Low AVI Rating	

Wellhead Protection Zones

Zone A: Pathogen Security/Prohibition Zone - 100m Buffer Zone
Zone B: Pathogen Management Zone - 0 to 2 Year Time of Travel
Zone C: DNAPL/Contaminant Protection Zone - 2 to 5 Year Time of Travel
Zone D: Secondary Protection Zone - 5 to 25 Year Time of Travel

×	Bedrock Well	Well Locations
•	Overburden Well	
▲	Bedrock Flowing Well	
▲	Overburden Flowing Well	

Grid North

0 1,000 2,000
Meters

Feet
0 2,000 4,000 6,000

BURNSIDE

Project: [illegible]

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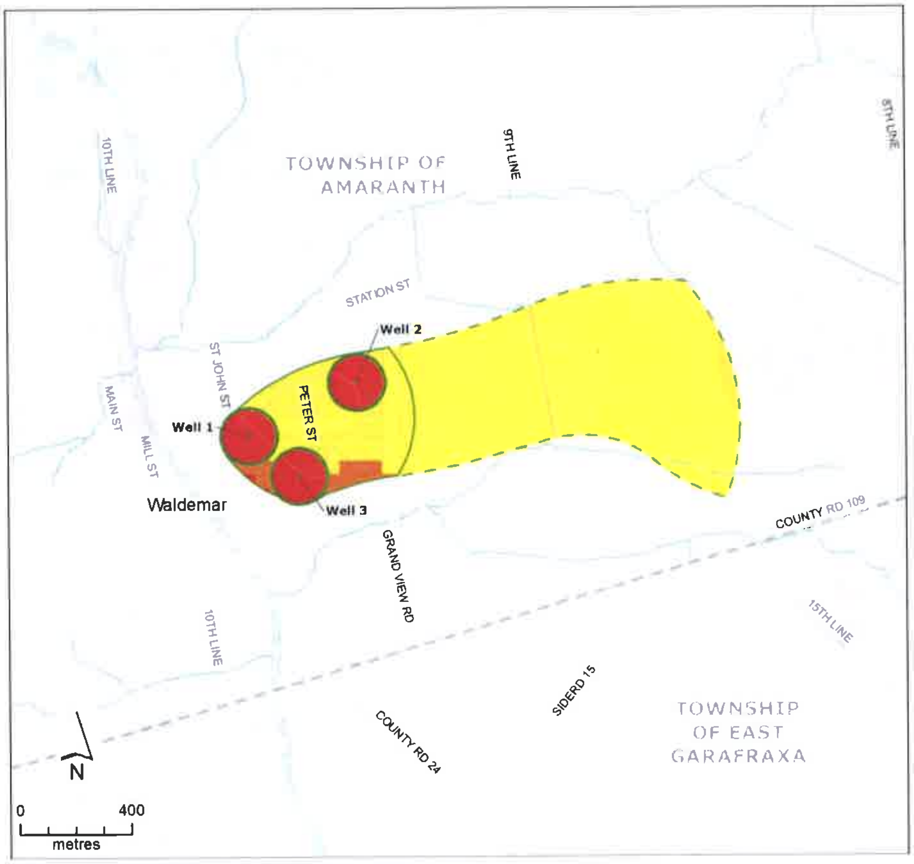
R.J. Burnside & Associates Limited [illegible]

4.6 Schedule A: Dufferin County: Township of Amaranth, Waldemar Water Supply



DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

Significant Drinking Water Threat Policy Applicability

	Significant Drinking Water Threat Policy Categories	Vulnerability Scores on Map		
		🟥	8	2,4,6
1.	Waste Disposal	🟥	🟧	
2.	Sewage Systems	🟥	🟧	
3, 4.	Agricultural Source Material	🟥		
6, 7.	Non-Agricultural Source Material*	🟥		
8, 9.	Commercial Fertilizer*	🟥		
10, 11.	Pesticide	🟥		
12, 13.	Road Salt*	🟥		
14.	Storage of Snow	🟥		
15.	Fuel	🟥		
16.	DNAPLs	🟥	🟧	🟨
17.	Organic Solvents	🟥		
18.	Aircraft De-icing	🟥		
21.	Livestock Area	🟥		
Local Threat	Oil Pipelines	🟥		

Note: This table provides a summary of the activities listed in the Clean Water Act (2006) that apply as Prescribed Drinking Water Threats (PDWT) within the Non-GUDI Wellhead Protection Zones shown on this map. For details refer to the text of the Source Protection Plan and the Ministry of the Environment Drinking Water Threats Tables.

*Application of Commercial Fertilizer, Non-Agricultural Source Material, and Road Salt may not be a significant drinking water threat in some areas due to the % managed land, livestock density, and/or % impervious surface calculations for these areas. See the text of the plan for further details.

• Well
Road
Minor River
Lake / Main River
Municipal Boundary

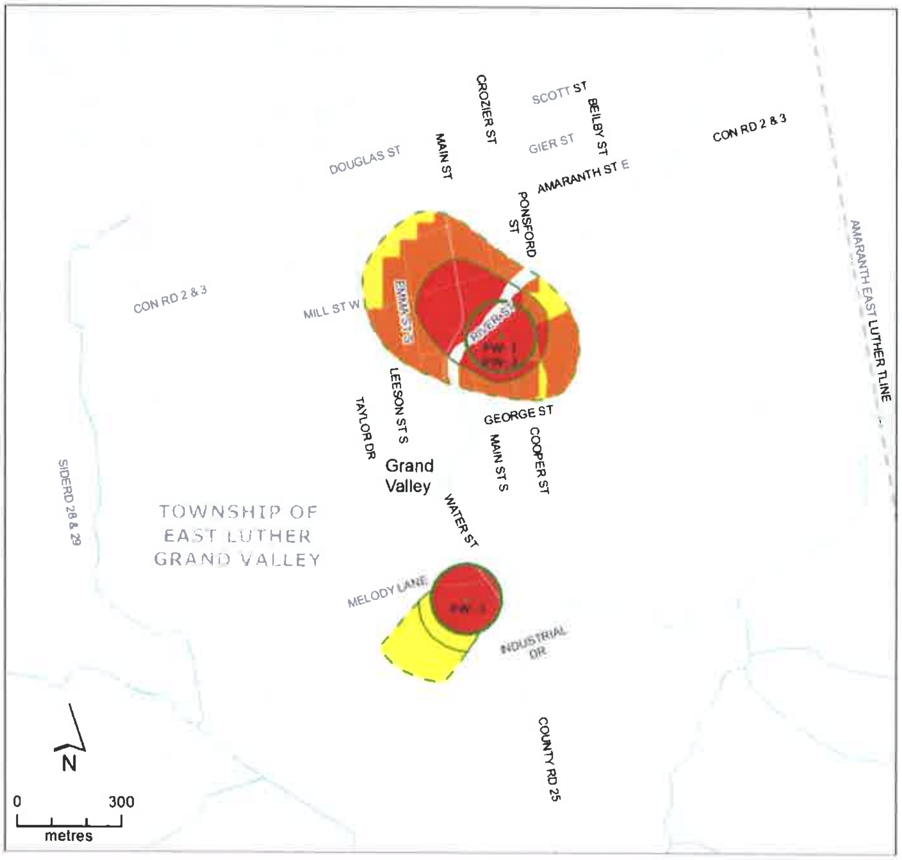
Wellhead Protection Zones:
WHPA-A
WHPA-B
WHPA-C

Ontario

Grand River Conservation Authority

1 Updated November 19, 2014
2 Larger scale mapping of some map layers, including roads and vulnerability scores, is available at www.sourcewater.ca
3 This map is for illustrative purposes only. Information contained hereon is not a substitute for professional review or a site survey and is subject to change without notice. The Grand River Conservation Authority takes no responsibility for, nor guarantees, the accuracy of the information contained on this map. Any interpretations or conclusions drawn from this map are the sole responsibility of the user.

5.6 Schedule A: Dufferin County, Townshipof Grand Valley, Grand Valley Well Supply



DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

Significant Drinking Water Threat Policy Applicability

Significant Drinking Water Threat Policy Categories		Vulnerability Scores on Map		
		🟥 10	🟧 8	🟨 2,4,6
1.	Waste Disposal	🟥	🟧	
2.	Sewage Systems	🟥	🟧	
3, 4.	Agricultural Source Material	🟥		
6, 7.	Non-Agricultural Source Material*	🟥		
8, 9.	Commercial Fertilizer*	🟥		
10, 11.	Pesticide	🟥		
12, 13.	Road Salt*	🟥		
14.	Storage of Snow	🟥		
15.	Fuel	🟥		
16.	DNAPLs	🟥	🟧	🟨
17.	Organic Solvents	🟥		
18.	Aircraft De-icing	🟥		
21.	Livestock Area	🟥		
Local Threat	Oil Pipelines	🟥		

Note: This table provides a summary of the activities listed in the Clean Water Act (2006) that apply as Prescribed Drinking Water Threats (PDWT) within the Non-GUDI Wellhead Protection Zones shown on this map. For details refer to the text of the Source Protection Plan and the Ministry of the Environment Drinking Water Threats Tables.

*Application of Commerical Fertilizer, Non-Agricultural Source Material, and Road Salt may not be a significant drinking water threat in some areas due to the % managed land, livestock density, and/or % impervious surface calculations for these areas. See the text of the plan for further details.

• Well	**Wellhead Protection Zones:**
Road	WHPA-A
Minor River	WHPA-B
Lake / Main River	WHPA-C
Municipal Boundary	

Ontario

Grand River Conservation Authority

1. Updated November 19, 2014
2. Larger scale mapping of some map layers, including roads and vulnerability scores, is available at www.sourcewater.ca
3. This map is for illustrative purposes only. Information contained hereon is not a substitute for professional review or a site survey and is subject to change without notice. The Grand River Conservation Authority takes no responsibility for, nor guarantees, the accuracy of the information contained on this map. Any interpretations or conclusions drawn from this map are the sole responsibility of the user.

A3:

STREAM ASSIMILATIVE CAPACITY STUDY

XCG
Environmental Engineers & Scientists

XCG CONSULTANTS LTD.
T 905 829 8880 F 905 829 8890 | toronto@xcg.com
2620 Bristol Circle, Suite 300, Oakville, Ontario, Canada L6H 6Z7

XCG File No.: 3-3756-01-01
March 29, 2016

ASSIMILATIVE CAPACITY STUDY OF THE GRAND RIVER IN THE VICINITY OF A PROPOSED WWTP IN WALDEMAR, ON

Prepared for:

SARAH PROPERTIES LTD.
2 Prince Edward Road
Woodstock, ON
N4V 1G7

Attention: Walter Broos

Prepared by:

XCG CONSULTANTS LTD.
2620 Bristol Circle, Suite 300
Oakville, Ontario
L6H 6Z7

TABLE OF CONTENTS

TABLE

FIGURES

APPENDICES

1. INTRODUCTION

1.1 Background

Sarah Properties Ltd. is proposing the construction of a new sewage treatment system in Waldemar with dry ditch discharge and subsequent discharge to the ultimate receiver, the Grand River. It is anticipated that the sewage treatment facility will have an average day flow (ADF) capacity between 451 m^3/d and 552 m^3/d, based on the selected design scenario, and will provide tertiary level treatment.

A critical component of this study is the completion of an assimilative capacity assessment of the receiving water body, in this case the Grand River. An assimilative capacity assessment requires that both water quality and quantity be evaluated. The intent of this technical memorandum is to present proposed effluent requirements for a new wastewater treatment plan (WWTP) in Waldemar, ON.

This technical memorandum includes an assessment of the ambient water quality and current conditions in the Grand River in the vicinity of the proposed WWTP discharge location and the development of proposed effluent objectives and limits for the new WWTP in Waldemar, ON.

1.2 Objectives

The objectives of this analysis are to:

- characterize ambient water quality parameters and to determine critical low flows as well as impacts of the upstream Grand Valley Water Pollution Control Plant (WPCP);
- conduct an assimilative capacity assessment of the receiving waters;
- conduct mixing zone analysis; and
- formulate reasonable recommendations for effluent limits for the new proposed WWTP in Waldemar, ON.

2. AMBIENT CONDITIONS

2.1 Water Quality

Representative background water quality can be defined by examining water quality in the vicinity of the Grand Valley WPCP effluent discharge. For analysis purposes, the 75th percentile threshold is applied to characterize ambient conditions, as recommended by the Ministry of the Environment and Climate Change (MOECC). The MOECC states, "Normally the 75th percentile is used to determine background quality…".[1] The receiving water quality is assigned Policy 1 if the ambient concentration is less than the Provincial Water Quality Objective (PWQO) and Policy 2 if the ambient concentration exceeds the PWQO. The implication of being a Policy 1 or Policy 2 receiver is described briefly below.

- **Policy 1:** In areas which have water quality better than the Provincial Water Quality Objectives, water quality shall be maintained at or above the Objectives.
- **Policy 2:** Water quality which presently does not meet the Provincial Water Quality Objectives shall not be degraded further and all practical measures shall be taken to upgrade the water quality to the Objectives.

Ideally, in establishing ambient water quality for a receiver, there are recent data available at a location in the vicinity of the discharge location. In the case of the Assimilative Capacity Assessment in support of the proposed WWTP in Waldemar, various data sources have been considered to establish the ambient water quality and are identified in Table 1. Figure 1 presents the water quality stations in the vicinity of the proposed discharge location and other points of interest for this study.

Data from each PWQMN station collected during the period from 1994 to 1996 was compared for each parameter of interest. A strong consistency in water quality was observed for each parameter. As such, it can be reasonably assumed that the water quality upstream and downstream of the proposed discharge location does not differ significantly. Therefore, data collected from PWQMN Station 16018406702 (downstream) will be used for the purposes of this study, as it provides current data, while PWQMN Station 16018403902 (upstream) is dated with a period of record ending in 2006.

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[1] Ministry of Environment and Energy, *Water Management: Policies, Guidelines, Provincial Water Quality Objectives*. July 1994 (MOE Blue Book).

Table 1 **Table of Data Sources for Ambient Water Quality**

Source	Distance From Proposed Discharge Location	Period of Record	Parameters of Interest
PWQMN Station 16018403902 (Upstream)	3.0 km	1972 - 2006	DO, pH, water temperature, TP, TSS, TAN, NO_3
PWQMN Station 16018406702 (Downstream)	3.6 km	1975 - 1996	DO, pH, water temperature, TP, TSS, TAN, NO_3
		2007 - 2014	DO, pH, water temperature, TP, TSS, TAN, NO_3
GRCA Data Collected at PWQMN Station 16018406702 (Downstream)	3.6 km	2004 - 2006	pH, water temperature, TP, TSS, NH_3, NO_3, *E. coli*

Figure 1 **Location Map Identifying Points of Interest**

Where possible, ambient water quality conditions for parameters of interest were characterized on a seasonal basis as follows, with seasons defined as advised by the GRCA:

- Winter: December – February
- Spring: March – May
- Summer: June – September
- Fall: October – November

2.1.1 Total Phosphorus

The MOE PWQO state that, as an interim guideline for streams and rivers, total phosphorus (TP) should not exceed 0.03 mg/L to prevent excessive plant growth. The statistical summary of the total phosphorus concentration data is shown in Table 2. Most seasons are at or above the Policy 2 threshold. For characterization, the annual value for TP of 0.031 mg/L was used to represent ambient conditions. This concentration exceeds the PWQO and therefore the receiver is MOE Policy 2 in the vicinity of the proposed WWTP with respect to TP. This means that a Policy 2 deviation will be required for the proposed WWTP.

Table 2 Summary of Grand River Total Phosphorus Near Proposed Outfall

Season	Median TP (mg/L)	75th Percentile TP (mg/L)	Number of Observations
Winter (Dec - Feb)	0.030	0.032	57
Spring (Mar - May)	0.025	0.037	115
Summer (Jun - Sep)	0.024	0.033	164
Fall (Oct - Nov)	0.014	0.020	67
Annual	**0.022**	**0.031**	**403**

2.1.2 Un-ionized Ammonia

The percentage of un-ionized ammonia in aqueous solution varies depending on the temperature and pH of the water. The 75th percentile concentrations of ammonia, pH, and temperature are summarized in Table 3, Table 4, and Table 5, respectively.

Table 3 Summary of Grand River Ammonia Data Near Outfall

Season	Median Ammonia (mg/L)	75th Percentile Ammonia (mg/L)	Number of Observations
Winter (Dec - Feb)	0.032 (1)	0.058 (1)	No Data
Spring (Mar - May)	0.032	0.058	28
Summer (Jun - Sep)	0.032	0.050	48
Fall (Oct - Nov)	0.028	0.050	20

Notes:
1. No data were available for winter. Therefore, winter ammonia concentrations assumed to be equivalent to spring (Mar - May) concentrations.

The PWQMN dataset for ammonia showed an increasing trend. To remove the trend, all data prior to 1997 was truncated, as per GRCA's comment, and the statistics shown in Table 3 were generated. As a result of truncation, no data was available for winter (Dec - Feb). Therefore it was assumed that winter concentrations would be equivalent to those observed in spring (Mar - May).

Table 4 Summary of Grand River pH Field Data Near Outfall

Season	Median pH	75th Percentile pH	Number of Observations
Winter (Dec - Feb)	7.99	8.28	25
Spring (Mar - May)	8.17	8.38	49
Summer (Jun - Sep)	8.39	8.55	87
Fall (Oct - Nov)	8.31	8.40	33

The PWQO for pH states that the pH should be maintained within the range of 6.5 and 8.5 to protect aquatic life; and both alkaline and acid water may cause irritation to anyone using the water from recreational purposes. Based on the data presented in Table 4, the Grand River is Policy 1 with respect to pH during all seasons with the exception summer (June - September). Higher pH during these months may be a result of aquatic life activity.

Table 5 Summary of Grand River Temperature Near Outfall

Season	Median Temperature (°C)	75th Percentile Temperature (°C)	Number of Observations
Winter (Dec - Feb)	0.55	1.00	48
Spring (Mar - May)	7.50	13.4	102
Summer (Jun - Sep)	20.5	23.0	158
Fall (Oct - Nov)	7.70	10.1	65

In order to determine the 75th percentile in-stream un-ionized ammonia, it is first necessary to calculate the unionized ammonia concentration for days in which synoptic measurements of ammonia, pH, and temperature are available.

As mentioned above, the ammonia data showed an increasing trend and, as such, only the data collected after 1997 was used to calculate unionized ammonia with synoptic measurements of pH and temperature. Seasonal unionized concentrations are shown in Table 6. It should be noted that no data were for available for winter. Concentrations in winter are expected to be similar to those observed in spring. Based on the data provided, the receiver is Policy 1 with respect to unionized ammonia.

Table 6 Summary of Grand River Unionized Ammonia Near Outfall

Season	Median Unionized Ammonia (mg/L)	75th Percentile Unionized Ammonia (mg/L)	Number of Observations
Winter (Dec - Feb)	0.001 (1)	0.002 (1)	No Data
Spring (Mar - May)	0.001	0.002	27
Summer (Jun - Sep)	0.003	0.006	42
Fall (Oct - Nov)	0.001	0.001	15

Notes:

1. Assumed to be equivalent to spring concentrations.

2.1.3 Dissolved Oxygen and Biological Oxygen Demand (BOD_5)

For dissolved oxygen (DO), low concentrations are indications of degraded water quality; therefore, 25th percentiles are typically used, rather than 75th percentiles, to characterize ambient conditions. The PWQO for DO ranges from 5 to 8 mg/L for a warm water fishery based on temperature; cooler temperatures have a higher PWQO than warmer temperatures.

The Grand River is Policy 1 with regard to DO for a warm water fishery, based on the PWQMN data. The monthly statistics are shown in Table 7.

Table 7 Summary of Grand River Dissolved Oxygen Near Outfall

Season	Median DO (mg/L)	25th Percentile DO (mg/L)	Number of Observations
Winter (Dec - Feb)	12.8	12.2	55
Spring (Mar - May)	12.2	11.2	98
Summer (Jun - Sep)	10.6	9.8	156
Fall (Oct - Nov)	12.4	11.5	64

The DO concentrations reported in Table 7 show that the 25th percentile concentrations and the minimum observed concentrations are higher than the PWQO for DO in all seasons. Therefore, based on the available instantaneous DO data, the Grand River in the vicinity of the proposed outfall is MOE Policy 1 with respect to DO. In spite of this, the possibility does exist that aquatic plant respiration may result in lower instantaneous DO concentrations, particularly during the late summer and early fall.

The available BOD_5 measurements from the PWQMN were quite dated (period of record 1978 - 1981), and the reported annual 75th percentile BOD_5 concentration was 1.2 mg/L. Based on the available data, a conservative estimate of ambient BOD_5 concentrations is 1.5 mg/L.

2.1.4 E.coli

The *E.coli* data from the PWQMN dataset was limited, with a total of 5 results from samples collected by the GRCA in 2005. Based on these data, the receiver appears to be Policy 1 with respect to *E.coli*, with all five samples results less than 1 cfu/100mL. Total Suspended Solids

2.1.5 TSS

There are no PWQO values for total suspended solids (TSS). Reported PWQMN TSS concentrations were available over the period 1975 to 2015, however the results from 1984 to 1986 were excluded as they were several orders of magnitude higher than concentrations reported both before and after that period. Generally, TSS concentrations are elevated in the spring and summer. A statistical summary of TSS concentrations is provided in Table 8.

Table 8 **Summary of Grand River TSS Near Outfall**

Season	Median TSS (mg/L)	75th Percentile TSS (mg/L)	Number of Observations
Winter (Dec - Feb)	3.0	5.4	28
Spring (Mar - May)	3.3	9.7	83
Summer (Jun - Sep)	4.7	8.0	123
Fall (Oct - Nov)	2.0	3.9	48
Annual	**3.6**	**8.0**	**282**

2.1.6 Nitrate

While there is no PWQO for nitrate, there is a Canadian Water Quality Guideline (CWQG) for the Protection of Aquatic Life. The CWQG is 2.93 mg/L-N. The dataset was truncated to exclude nitrate water quality data from and prior to 1996 because the analysis method for nitrogen species was changed in 1996. The 75th percentile concentration for nitrate was well below the CWQG of 2.93 mg/L-N on both a seasonal and annual basis. This indicates that the Grand River has ample assimilative capacity for nitrate at this location. A statistical summary of nitrate concentrations is provided in Table 9.

Table 9 **Summary of Grand River Nitrate Near Proposed Outfall**

Season	Mean Nitrate (mg/L-N)	75th Percentile Nitrate (mg/L-N)	Number of Observations
Winter (Dec - Feb)	No data	No data	No data
Spring (Mar - May)	1.12	1.53	28
Summer (Jun - Sep)	0.33	0.47	50
Fall (Oct - Nov)	0.58	1.23	20
Annual	**0.52**	**1.00**	**98**

2.2 Grand River Flows

Typically for assimilative capacity analyses, the 7Q20 stream flow represents an appropriate design-case estimate. At the location of the proposed sewage treatment facility discharge, low flow is governed by outflows from an upstream reservoir. It was proposed that a low flow value of 0.40 m^3/s be used in this analysis. This flow was provided by the GRCA and is documented in the Grand River Watershed Water Management Plan (2014) as the design 7Q20 equivalent flow to be used for WWTPs discharging to the regulated river system near the Leggatt stream gauge. During a conference call held on November 25, 2015, both the MOECC and GRCA agreed that a low flow value of 0.40 m^3/s should be used for the assimilative capacity assessment of the Grand River in the vicinity of the newly proposed WWTP.

3. DETERMINATION OF EFFLUENT LIMITS

3.1 Effluent cBOD$_5$

At a design flow of 552 m^3/d, a conservative estimated background BOD$_5$ concentration of 1.5 mg/L, and a cBOD5 concentration effluent limit of 10 mg/L, the ambient BOD$_5$ concentration would increase marginally by 10 percent. Given the Policy 1 status of the receiver in terms of DO, it is proposed that a cBOD5 compliance limit of 10 mg/L and design objective of 8 mg/L be used for the proposed WWTP for both design ADF scenarios (451 m^3/d and 552 m^3/d).

3.2 Effluent Total Suspended Solids

Total suspended solids concentrations are high in the receiver with a 75th percentile value of 8.0 mg/L on an annual basis. At a design flow of 552 m^3/d and a TSS concentration effluent limit of 10 mg/L, the ambient TSS concentration would increase marginally by less than 2 percent. Therefore, it is proposed that a TSS compliance limit of 10 mg/L and design objective of 8 mg/L be used for the proposed WWTP for both design ADF scenarios (451 m^3/d and 552 m^3/d).

3.3 Effluent Total Phosphorus

As indicated in Table 2, the Grand River in the vicinity of the proposed outfall is MOECC Policy 2 with respect to total phosphorus and therefore has no available capacity for TP assimilation; however, for a MOECC Policy 2 receiver, "Water quality which presently does not meet the Provincial Water Quality Objectives shall not be degraded further and all practical measures shall be taken to upgrade the water quality to the Objectives." Approval of a new point-source discharge with an effluent TP concentration in excess of the PWQO of 0.030 mg/L will require a Policy 2 deviation.

To address the Policy 2 status of the receiver, it is proposed that the new WWTP be designed to provide a level of treatment consistent with Limit of Technology (LoT) for phosphorus removal. It is therefore proposed that the new WWTP have an effluent TP limit of 0.10 mg/L and objective of 0.08 mg/L for both design ADF scenarios (451 m^3/d and 552 m^3/d). At the design 7Q20 flow of 0.40 m^3/s, and assuming the facility is operating at an ADF of 552 m^3/d and the TP limit of 0.10 mg/L, the WWTP effluent would result in an increase in the receiver TP concentration of approximately 0.0016 mg/L, or approximately a 5% increase over the annual 75th percentile background concentration of 0.031 mg/L.

3.4 Effluent Total Ammonia

For ammonia limits, it was assumed that current MOECC policy requiring a non-toxic effluent would apply. Extensive research by the US EPA and others has demonstrated that a non-toxic limit for un-ionized ammonia ranges between 0.1 and 0.5 mg/L depending on the fish species of interest. Therefore, a conservative non-toxic limit for un-ionized ammonia in the Grand Valley WPCP effluent is 0.1 mg/L-NH_3.

In the recently released federal Wastewater Systems Effluent Regulations under the Fisheries Act, effluent toxicity limits are set to 1.25 mg/L for un-ionized ammonia (at 15°C). The assumption of un-ionized toxicity at 0.1 mg/L, as discussed above, is more stringent and thus the effluent limits discussed below are more conservative than required and complies with the new federal regulation.

For the proposed effluent limits to be acceptable, the resultant unionized ammonia concentration in the effluent stream (based on the proposed effluent limit) must be less than or equal to 0.1 mg/L at end-of-pipe and the receiver unionized ammonia concentration (based on fully mixed conditions between the effluent and the receiver) must be less than or equal to the PWQO of 0.02 mg/L.

The percentage of un-ionized ammonia in aqueous solution varies depending on the temperature and pH of the water. The seasonal end-of-pipe effluent dissociation ratios were estimated based on assumed effluent quality from the new WWTP. As a conservative measure and based on experience at other similar treatment facilities in Ontario, a pH of 8.0 was used for all seasons and seasonal temperatures of 12°C, 14°C, 22°C and 18°C were used for Winter, Spring, Summer and Fall, respectively.

In order to determine the in stream un-ionized ammonia concentrations, it was necessary to calculate the seasonal 75th percentile ammonia dissociation ratios based on synoptic measurements of pH and temperature (taken at the same time). The seasons applied for the analysis align with those previously defined.

To ensure a conservative evaluation of fully mixed conditions within the receiver, the impacts of the upstream Grand Valley WPCP on receiver water quality were also considered. To accomplish this, it was assumed that the Grand Valley WPCP would be operating at its rated capacity of 1,244 m3/d and at its ECA total ammonia nitrogen (TAN) limit of: 4.0 mg/L from December 1 to March 31, 1.0 mg/L from April 1 to May 31, 0.7 mg/L from June 1 to September 30, and 1.0 mg/L from October 1 to November 30. This additional TAN loading was used to develop an adjusted background unionized ammonia concentration. Because the month of March has been included in the definition of Spring for this study, it was assumed that the Grand Valley WPCP would be discharging effluent at a TAN concentration of 4.0 mg/L for both the Winter and Spring seasons.

The dissociation ratios, proposed effluent ammonia concentrations, and resultant unionized ammonia concentrations are shown in Table 10 and Table 11 for both the end-of-pipe and fully mixed receiver conditions, respectively.

The compliance limits for TAN are recommended to be 3.8 mg/L for Winter (December to February), 3.3 mg/L for Spring (March - May), 1.8 mg/L for Summer (June - September) and 2.4 mg/L for Fall (October - November). Meeting end-of-pipe non-toxicity requirements limits the recommended TAN limits, therefore the proposed effluent TAN limits are the same for both design ADF scenarios (451 m^3/d and 552 m^3/d).

Table 10 End of Pipe Effluent Un-ionized Ammonia Data Summary

Discharge Period	Proposed TAN Limit (mg/L-N)	Estimated Dissociation Ratio (1)	Un-ionized ammonia at End-of-Pipe (mg/L-NH_3)
Winter	3.8	0.0212	0.098
Spring	3.3	0.0247	0.099
Summer	1.8	0.0438	0.096
Fall	2.4	0.0331	0.096

Notes:

1. Based on conservative estimates of plant effluent pH and seasonal temperatures, as specified in text above.

Table 11 Fully Mixed Receiver Un-ionized Ammonia Data Summary

Discharge Period	Proposed TAN Limit (mg/L-N)	Adjusted Receiver Background TAN (mg/L-N) (2)	75th Percentile Dissociation Ratio (3)	Fully Mixed Un-ionized Ammonia (mg/L-NH_3) (4)
Winter (1)	3.8	0.1945	0.0524	0.016
Spring	3.3	0.1945	0.0524	0.015
Summer	1.8	0.0726	0.1114	0.013
Fall	2.4	0.0830	0.0378	0.005

Notes:

1. Background receiver TAN concentrations and dissociation ratios were not available for the winter period. Therefore, the values from Spring were assumed for Winter conditions.
2. Adjusted receiver background TAN concentration based on the background 75th percentile TAN concentrations, the 7Q20 flow of 0.4 m3/s for all seasons, and the Grand Valley WPCP operating at its rated capacity of 1,244 m3/d and at its current TAN limits of 4.0 mg/L Winter / Spring, 0.7 mg/L Summer, and 1.0 mg/L Fall.
3. 75th percentile dissociation ratio in the receiver based on background water quality data in terms of synoptic pH and temperature data.
4. Fully mixed un-ionized ammonia concentration based on a new WWTP design ADF of 552 m^3/d.

3.5 Effluent E.coli

The receiver is MOE Policy 1 with respect to *E.coli*. A compliance limit of 200 cfu/100 mL and design objective of 100 cfu/100 mL is proposed for both design ADF scenarios (451 m^3/d and 552 m^3/d).

4. MIXING ZONE ANALYSIS

4.1 Introduction and Methodology

An analysis was conducted to define the low-flow mixing zone in the Grand River near Marsville for two proposed WPCP effluent scenarios, namely 451 m^3/d and 552 m^3/d. The general approach involved application of an analytical solution of the two-dimensional adjective dispersive transport equation (Equation [1]) for steady state conditions[2].

$$v\frac{\partial C}{\partial x} = E\left[\frac{\partial^2 C}{\partial x^2} + \frac{\partial^2 C}{\partial y^2}\right] - kC \pm S \qquad [1]$$

Where:

C = Concentration of contaminate (mg/L)
E = Dispersion coefficient (m^2/s)
v = Velocity (m/s)
k = Decay constant (s^{-1})
S = Sources and sinks (mg/L/s)

The dispersion coefficient, E, can be approximated using an empirical relationship presented below as Equation [2][3].

$$E \cong 0.6d\sqrt{gdS} = 0.6du \qquad [2]$$

Where:

d = Channel depth (m)
g = Gravitational constant (m/s^2)
S = Average channel slope (m/m)
u = Channel shear velocity (m/s)

Plume superposition was applied to address channel boundaries. Assumptions included that effluent is completely mixed vertically, average flow and average depth can be applied with Manning's equation to estimate depth for low-flow conditions, momentum of effluent can be ignored, steady-state conditions have been achieved, the channel is rectangular with a constant width of 20 m, and effluent is introduced in the center of the channel.

A summary of key parameters used in the analysis are presented in Table 12.

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[2] Fischer, H.B., List, E.J., Koh, R.Y., Imberger, J., and Brooks, N.H., "Mixing in Inland And Coastal Waters", Academic Press, New York, 1979.

[3] Ibid.

Table 12 Key Parameter Values for Mixing Zone Analysis

Parameter	Variable	Value	Units
Channel Width	w	20.0	m
Average Channel Depth - Low-Flow	d	0.30	m
WPCP Flow	Qe	451 or 552	m^3/d
River Low-Flow	Qr	0.4	m^3/s
Average Channel Slope	S	0.001	m/m
Shear velocity	u	0.054	m/s
Dispersion Coefficient	Et	0.010	m^2/s

4.2 Results

The estimated mixing zones corresponding to Scenarios 1 (451 m^3/d) and 2 (552 m^3/d) are provided as Figures A1 and A2 in Appendix A, respectively. Illustrative plume cross-sections for each scenario are provided in Figures A3 and A4 in Appendix A, respectively. For each Scenario, completely mixed conditions are achieved within approximately 250 m downstream of the source. Effluent concentrations are greater than 5% for a relatively small area (2 m in width and from 12 to 20 m in length) immediately downstream of the source for each scenario. Completely mixed concentrations for Scenario 1 and 2 are 1.3% and 1.6%, respectively.

5. SUMMARY

- It was found that the Grand River in the vicinity of the proposed outfall is MOE Policy 2 for total phosphorus, and pH in the summer season. All other parameters were MOE Policy 1 or did not have a PWQO.
- Design equivalent 7Q20 flows for all seasons in the vicinity of the proposed outfall were set to 0.4 m^3/s as per the Grand River Watershed Water Management Plan (2014).
- As a conservative approach, proposed effluent limits for the new proposed WWTP were generated based on the available assimilative capacity in the Grand River and an ADF of 552 m^3/d from a new WPCP. The proposed compliance limits and design objectives are shown in Table 13 and Table 14, respectively. Loading limits have been defined for both ADF scenarios (451 m^3/d and 552 m^3/d).
- A Policy 2 deviation with respect to phosphorus will be required for approval of this new point-source discharge. The proposed TP limit and objective are consistent with providing Limit of Technology for phosphorus removal. Mixing zones length was found to be reasonable in extent.

Proposed effluent compliance limits and objectives are presented in Table 13 and Table 14, respectively.

Table 13 Proposed Effluent Compliance Limits

Effluent Parameter	Average Concentration (mg/L)	Average Waste Loading (kg/d)	
		Design ADF of 451 m^3/d	Design ADF of 552 m^3/d
cBOD5	10.0	4.51	5.52
Total Suspended Solids	10.0	4.51	5.52
Total Phosphorus	0.10	0.045	0.055
Total Ammonia Nitrogen			
Winter (Dec - Feb)	3.8	1.7	2.1
Spring (Mar - May)	3.3	1.5	1.8
Summer (Jun - Sep)	1.8	0.8	1.0
Fall (Oct - Nov)	2.4	1.1	1.3

Notes:

E.coli less than 200 organisms per 100 mL.

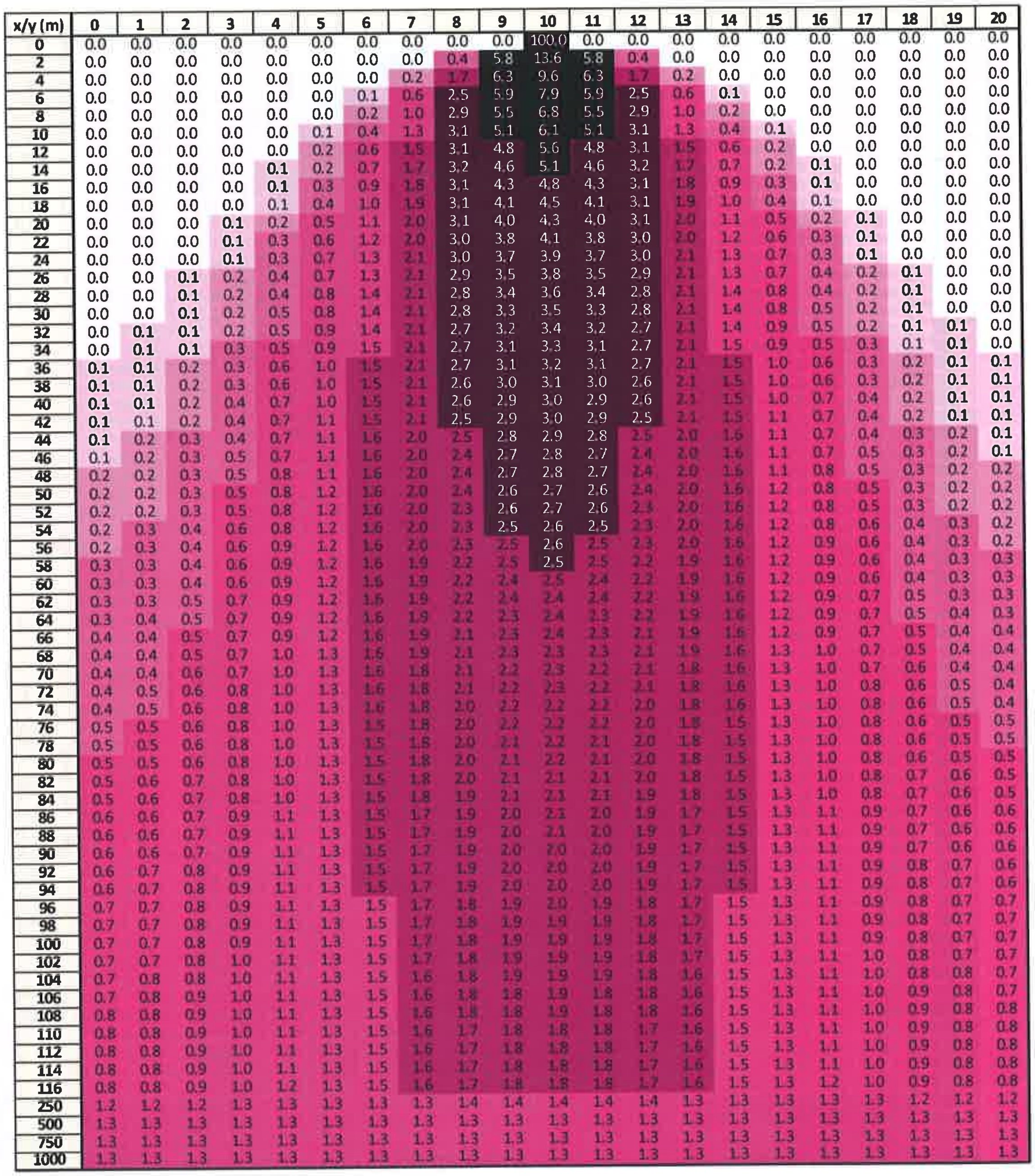
Table 14 Proposed Effluent Objectives

Effluent Parameter	Average Concentration (mg/L)
cBOD5	8.0
Total Suspended Solids	8.0
Total Phosphorus	0.08
Total Ammonia Nitrogen	
Winter (Dec - Feb)	3.0
Spring (Mar - May)	2.5
Summer (Jun - Sep)	1.0
Fall (Oct - Nov)	1.6

Notes:

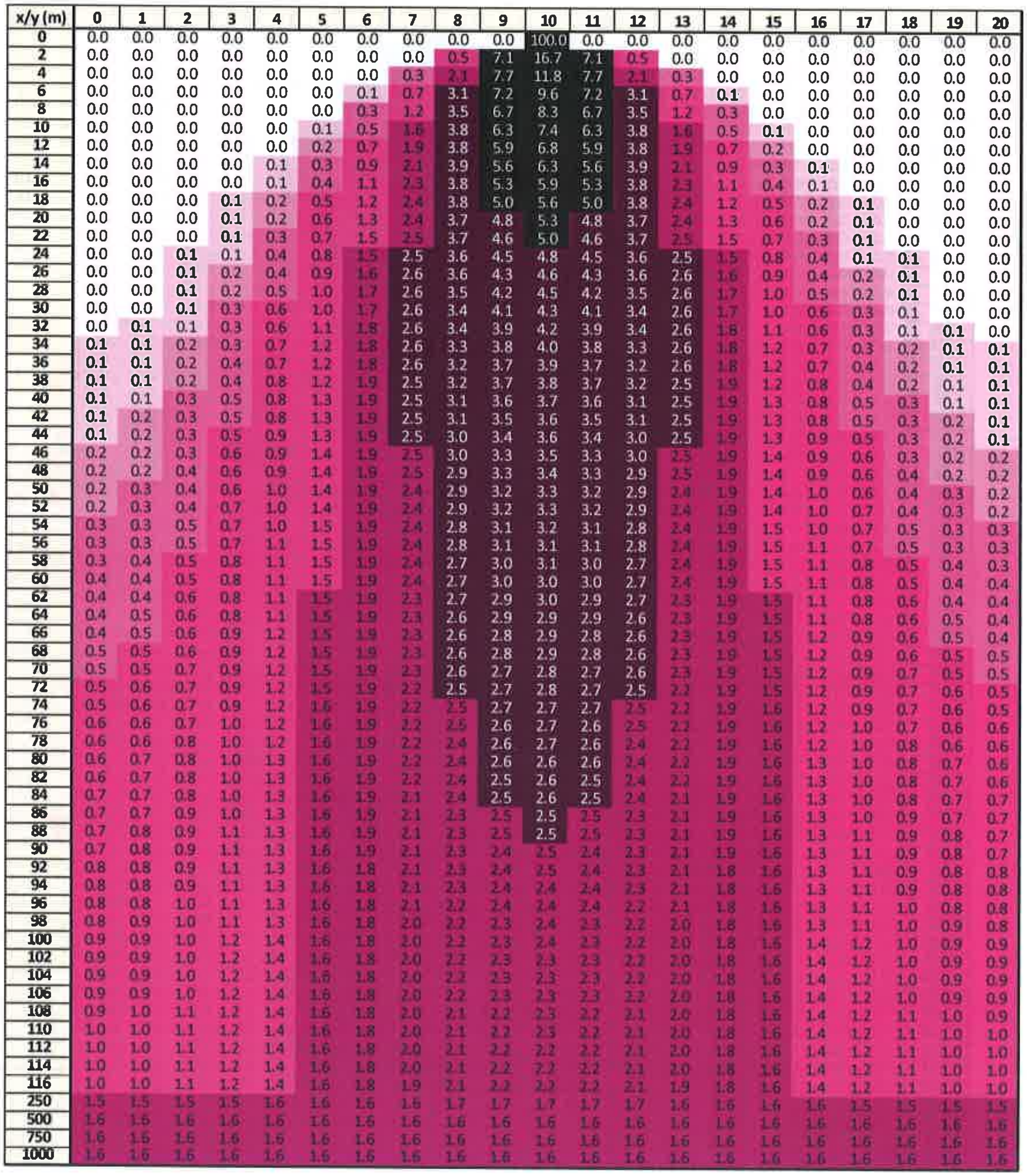
E.coli less than 100 organisms per 100 mL

APPENDIX A
MIXING ZONE ANALYSIS FIGURES



x/y (m)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	5.8	13.6	5.8	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.7	6.3	9.6	6.3	1.7	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6	2.5	5.9	7.9	5.9	2.5	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.0	2.9	5.5	6.8	5.5	2.9	1.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.1	0.4	1.3	3.1	5.1	6.1	5.1	3.1	1.3	0.4	0.1	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.2	0.6	1.5	3.1	4.8	5.6	4.8	3.1	1.5	0.6	0.2	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.1	0.2	0.7	1.7	3.2	4.6	5.1	4.6	3.2	1.7	0.7	0.2	0.1	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.1	0.3	0.9	1.8	3.1	4.3	4.8	4.3	3.1	1.8	0.9	0.3	0.1	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.1	0.4	1.0	1.9	3.1	4.1	4.5	4.1	3.1	1.9	1.0	0.4	0.1	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.1	0.2	0.5	1.1	2.0	3.1	4.0	4.3	4.0	3.1	2.0	1.1	0.5	0.2	0.1	0.0	0.0	0.0
22	0.0	0.0	0.0	0.1	0.3	0.6	1.2	2.0	3.0	3.8	4.1	3.8	3.0	2.0	1.2	0.6	0.3	0.1	0.0	0.0	0.0
24	0.0	0.0	0.0	0.1	0.3	0.7	1.3	2.1	3.0	3.7	3.9	3.7	3.0	2.1	1.3	0.7	0.3	0.1	0.0	0.0	0.0
26	0.0	0.0	0.1	0.2	0.4	0.7	1.3	2.1	2.9	3.5	3.8	3.5	2.9	2.1	1.3	0.7	0.4	0.2	0.1	0.0	0.0
28	0.0	0.0	0.1	0.2	0.4	0.8	1.4	2.1	2.8	3.4	3.6	3.4	2.8	2.1	1.4	0.8	0.4	0.2	0.1	0.0	0.0
30	0.0	0.0	0.1	0.2	0.5	0.8	1.4	2.1	2.8	3.3	3.5	3.3	2.8	2.1	1.4	0.8	0.5	0.2	0.1	0.0	0.0
32	0.0	0.1	0.1	0.2	0.5	0.9	1.4	2.1	2.7	3.2	3.4	3.2	2.7	2.1	1.4	0.9	0.5	0.2	0.1	0.1	0.0
34	0.0	0.1	0.1	0.3	0.5	0.9	1.5	2.1	2.7	3.1	3.3	3.1	2.7	2.1	1.5	0.9	0.5	0.3	0.1	0.1	0.0
36	0.1	0.1	0.2	0.3	0.6	1.0	1.5	2.1	2.7	3.1	3.2	3.1	2.7	2.1	1.5	1.0	0.6	0.3	0.2	0.1	0.1
38	0.1	0.1	0.2	0.3	0.6	1.0	1.5	2.1	2.6	3.0	3.1	3.0	2.6	2.1	1.5	1.0	0.6	0.3	0.2	0.1	0.1
40	0.1	0.1	0.2	0.4	0.7	1.0	1.5	2.1	2.6	2.9	3.0	2.9	2.6	2.1	1.5	1.0	0.7	0.4	0.2	0.1	0.1
42	0.1	0.1	0.2	0.4	0.7	1.1	1.5	2.1	2.5	2.9	3.0	2.9	2.5	2.1	1.5	1.1	0.7	0.4	0.2	0.1	0.1
44	0.1	0.2	0.3	0.4	0.7	1.1	1.6	2.0	2.5	2.8	2.9	2.8	2.5	2.0	1.6	1.1	0.7	0.4	0.3	0.2	0.1
46	0.1	0.2	0.3	0.5	0.7	1.1	1.6	2.0	2.4	2.7	2.8	2.7	2.4	2.0	1.6	1.1	0.7	0.5	0.3	0.2	0.1
48	0.2	0.2	0.3	0.5	0.8	1.1	1.6	2.0	2.4	2.7	2.8	2.7	2.4	2.0	1.6	1.1	0.8	0.5	0.3	0.2	0.2
50	0.2	0.2	0.3	0.5	0.8	1.2	1.6	2.0	2.4	2.6	2.7	2.6	2.4	2.0	1.6	1.2	0.8	0.5	0.3	0.2	0.2
52	0.2	0.2	0.3	0.5	0.8	1.2	1.6	2.0	2.3	2.6	2.7	2.6	2.3	2.0	1.6	1.2	0.8	0.5	0.3	0.2	0.2
54	0.2	0.3	0.4	0.6	0.8	1.2	1.6	2.0	2.3	2.5	2.6	2.5	2.3	2.0	1.6	1.2	0.8	0.6	0.4	0.3	0.2
56	0.2	0.3	0.4	0.6	0.9	1.2	1.6	2.0	2.3	2.5	2.6	2.5	2.3	2.0	1.6	1.2	0.9	0.6	0.4	0.3	0.2
58	0.3	0.3	0.4	0.6	0.9	1.2	1.6	1.9	2.2	2.5	2.5	2.5	2.2	1.9	1.6	1.2	0.9	0.6	0.4	0.3	0.3
60	0.3	0.3	0.4	0.6	0.9	1.2	1.6	1.9	2.2	2.4	2.5	2.4	2.2	1.9	1.6	1.2	0.9	0.6	0.4	0.3	0.3
62	0.3	0.3	0.5	0.7	0.9	1.2	1.6	1.9	2.2	2.4	2.4	2.4	2.2	1.9	1.6	1.2	0.9	0.7	0.5	0.3	0.3
64	0.3	0.4	0.5	0.7	0.9	1.2	1.6	1.9	2.2	2.3	2.4	2.3	2.2	1.9	1.6	1.2	0.9	0.7	0.5	0.4	0.3
66	0.4	0.4	0.5	0.7	0.9	1.2	1.6	1.9	2.1	2.3	2.4	2.3	2.1	1.9	1.6	1.2	0.9	0.7	0.5	0.4	0.4
68	0.4	0.4	0.5	0.7	1.0	1.3	1.6	1.9	2.1	2.3	2.3	2.3	2.1	1.9	1.6	1.3	1.0	0.7	0.5	0.4	0.4
70	0.4	0.4	0.6	0.7	1.0	1.3	1.6	1.8	2.1	2.2	2.3	2.2	2.1	1.8	1.6	1.3	1.0	0.7	0.6	0.4	0.4
72	0.4	0.5	0.6	0.8	1.0	1.3	1.6	1.8	2.1	2.2	2.3	2.2	2.1	1.8	1.6	1.3	1.0	0.8	0.6	0.5	0.4
74	0.4	0.5	0.6	0.8	1.0	1.3	1.6	1.8	2.0	2.2	2.2	2.2	2.0	1.8	1.6	1.3	1.0	0.8	0.6	0.5	0.4
76	0.5	0.5	0.6	0.8	1.0	1.3	1.5	1.8	2.0	2.2	2.2	2.2	2.0	1.8	1.5	1.3	1.0	0.8	0.6	0.5	0.5
78	0.5	0.5	0.6	0.8	1.0	1.3	1.5	1.8	2.0	2.1	2.2	2.1	2.0	1.8	1.5	1.3	1.0	0.8	0.6	0.5	0.5
80	0.5	0.5	0.6	0.8	1.0	1.3	1.5	1.8	2.0	2.1	2.2	2.1	2.0	1.8	1.5	1.3	1.0	0.8	0.6	0.5	0.5
82	0.5	0.6	0.7	0.8	1.0	1.3	1.5	1.8	2.0	2.1	2.1	2.1	2.0	1.8	1.5	1.3	1.0	0.8	0.7	0.6	0.5
84	0.5	0.6	0.7	0.8	1.0	1.3	1.5	1.8	1.9	2.1	2.1	2.1	1.9	1.8	1.5	1.3	1.0	0.8	0.7	0.6	0.5
86	0.6	0.6	0.7	0.9	1.1	1.3	1.5	1.7	1.9	2.0	2.1	2.0	1.9	1.7	1.5	1.3	1.1	0.9	0.7	0.6	0.6
88	0.6	0.6	0.7	0.9	1.1	1.3	1.5	1.7	1.9	2.0	2.1	2.0	1.9	1.7	1.5	1.3	1.1	0.9	0.7	0.6	0.6
90	0.6	0.6	0.7	0.9	1.1	1.3	1.5	1.7	1.9	2.0	2.0	2.0	1.9	1.7	1.5	1.3	1.1	0.9	0.7	0.6	0.6
92	0.6	0.7	0.8	0.9	1.1	1.3	1.5	1.7	1.9	2.0	2.0	2.0	1.9	1.7	1.5	1.3	1.1	0.9	0.8	0.7	0.6
94	0.6	0.7	0.8	0.9	1.1	1.3	1.5	1.7	1.9	2.0	2.0	2.0	1.9	1.7	1.5	1.3	1.1	0.9	0.8	0.7	0.6
96	0.7	0.7	0.8	0.9	1.1	1.3	1.5	1.7	1.8	1.9	2.0	1.9	1.8	1.7	1.5	1.3	1.1	0.9	0.8	0.7	0.7
98	0.7	0.7	0.8	0.9	1.1	1.3	1.5	1.7	1.8	1.9	1.9	1.9	1.8	1.7	1.5	1.3	1.1	0.9	0.8	0.7	0.7
100	0.7	0.7	0.8	0.9	1.1	1.3	1.5	1.7	1.8	1.9	1.9	1.9	1.8	1.7	1.5	1.3	1.1	0.9	0.8	0.7	0.7
102	0.7	0.7	0.8	1.0	1.1	1.3	1.5	1.7	1.8	1.9	1.9	1.9	1.8	1.7	1.5	1.3	1.1	1.0	0.8	0.7	0.7
104	0.7	0.8	0.8	1.0	1.1	1.3	1.5	1.6	1.8	1.9	1.9	1.9	1.8	1.6	1.5	1.3	1.1	1.0	0.8	0.8	0.7
106	0.7	0.8	0.9	1.0	1.1	1.3	1.5	1.6	1.8	1.8	1.9	1.8	1.8	1.6	1.5	1.3	1.1	1.0	0.9	0.8	0.7
108	0.8	0.8	0.9	1.0	1.1	1.3	1.5	1.6	1.8	1.8	1.9	1.8	1.8	1.6	1.5	1.3	1.1	1.0	0.9	0.8	0.8
110	0.8	0.8	0.9	1.0	1.1	1.3	1.5	1.6	1.7	1.8	1.8	1.8	1.7	1.6	1.5	1.3	1.1	1.0	0.9	0.8	0.8
112	0.8	0.8	0.9	1.0	1.1	1.3	1.5	1.6	1.7	1.8	1.8	1.8	1.7	1.6	1.5	1.3	1.1	1.0	0.9	0.8	0.8
114	0.8	0.8	0.9	1.0	1.1	1.3	1.5	1.6	1.7	1.8	1.8	1.8	1.7	1.6	1.5	1.3	1.1	1.0	0.9	0.8	0.8
116	0.8	0.8	0.9	1.0	1.2	1.3	1.5	1.6	1.7	1.8	1.8	1.8	1.7	1.6	1.5	1.3	1.2	1.0	0.9	0.8	0.8
250	1.2	1.2	1.2	1.3	1.3	1.3	1.3	1.3	1.4	1.4	1.4	1.4	1.4	1.3	1.3	1.3	1.3	1.3	1.2	1.2	1.2
500	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
750	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
1000	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3

Figure A.1 ***Concentration Plume (Effluent %) for Scenario 1 Effluent Conditions (451 m^3/d)***



x/y (m)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	7.1	16.7	7.1	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	2.1	7.7	11.8	7.7	2.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.7	3.1	7.2	9.6	7.2	3.1	0.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.2	3.5	6.7	8.3	6.7	3.5	1.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.1	0.5	1.6	3.8	6.3	7.4	6.3	3.8	1.6	0.5	0.1	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.2	0.7	1.9	3.8	5.9	6.8	5.9	3.8	1.9	0.7	0.2	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.1	0.3	0.9	2.1	3.9	5.6	6.3	5.6	3.9	2.1	0.9	0.3	0.1	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.1	0.4	1.1	2.3	3.8	5.3	5.9	5.3	3.8	2.3	1.1	0.4	0.1	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.1	0.2	0.5	1.2	2.4	3.8	5.0	5.6	5.0	3.8	2.4	1.2	0.5	0.2	0.1	0.0	0.0	0.0
20	0.0	0.0	0.0	0.1	0.2	0.6	1.3	2.4	3.7	4.8	5.3	4.8	3.7	2.4	1.3	0.6	0.2	0.1	0.0	0.0	0.0
22	0.0	0.0	0.0	0.1	0.3	0.7	1.5	2.5	3.7	4.6	5.0	4.6	3.7	2.5	1.5	0.7	0.3	0.1	0.0	0.0	0.0
24	0.0	0.0	0.1	0.1	0.4	0.8	1.5	2.5	3.6	4.5	4.8	4.5	3.6	2.5	1.5	0.8	0.4	0.1	0.1	0.0	0.0
26	0.0	0.0	0.1	0.2	0.4	0.9	1.6	2.6	3.6	4.3	4.6	4.3	3.6	2.6	1.6	0.9	0.4	0.2	0.1	0.0	0.0
28	0.0	0.0	0.1	0.2	0.5	1.0	1.7	2.6	3.5	4.2	4.5	4.2	3.5	2.6	1.7	1.0	0.5	0.2	0.1	0.0	0.0
30	0.0	0.0	0.1	0.3	0.6	1.0	1.7	2.6	3.4	4.1	4.3	4.1	3.4	2.6	1.7	1.0	0.6	0.3	0.1	0.0	0.0
32	0.0	0.1	0.1	0.3	0.6	1.1	1.8	2.6	3.4	3.9	4.2	3.9	3.4	2.6	1.8	1.1	0.6	0.3	0.1	0.1	0.0
34	0.1	0.1	0.2	0.3	0.7	1.2	1.8	2.6	3.3	3.8	4.0	3.8	3.3	2.6	1.8	1.2	0.7	0.3	0.2	0.1	0.1
36	0.1	0.1	0.2	0.4	0.7	1.2	1.8	2.6	3.2	3.7	3.9	3.7	3.2	2.6	1.8	1.2	0.7	0.4	0.2	0.1	0.1
38	0.1	0.1	0.2	0.4	0.8	1.2	1.9	2.5	3.2	3.7	3.8	3.7	3.2	2.5	1.9	1.2	0.8	0.4	0.2	0.1	0.1
40	0.1	0.1	0.3	0.5	0.8	1.3	1.9	2.5	3.1	3.6	3.7	3.6	3.1	2.5	1.9	1.3	0.8	0.5	0.3	0.1	0.1
42	0.1	0.2	0.3	0.5	0.8	1.3	1.9	2.5	3.1	3.5	3.6	3.5	3.1	2.5	1.9	1.3	0.8	0.5	0.3	0.2	0.1
44	0.1	0.2	0.3	0.5	0.9	1.3	1.9	2.5	3.0	3.4	3.6	3.4	3.0	2.5	1.9	1.3	0.9	0.5	0.3	0.2	0.1
46	0.2	0.2	0.3	0.6	0.9	1.4	1.9	2.5	3.0	3.3	3.5	3.3	3.0	2.5	1.9	1.4	0.9	0.6	0.3	0.2	0.2
48	0.2	0.2	0.4	0.6	0.9	1.4	1.9	2.5	2.9	3.3	3.4	3.3	2.9	2.5	1.9	1.4	0.9	0.6	0.4	0.2	0.2
50	0.2	0.3	0.4	0.6	1.0	1.4	1.9	2.4	2.9	3.2	3.3	3.2	2.9	2.4	1.9	1.4	1.0	0.6	0.4	0.3	0.2
52	0.2	0.3	0.4	0.7	1.0	1.4	1.9	2.4	2.9	3.2	3.3	3.2	2.9	2.4	1.9	1.4	1.0	0.7	0.4	0.3	0.2
54	0.3	0.3	0.5	0.7	1.0	1.5	1.9	2.4	2.8	3.1	3.2	3.1	2.8	2.4	1.9	1.5	1.0	0.7	0.5	0.3	0.3
56	0.3	0.3	0.5	0.7	1.1	1.5	1.9	2.4	2.8	3.1	3.1	3.1	2.8	2.4	1.9	1.5	1.1	0.7	0.5	0.3	0.3
58	0.3	0.4	0.5	0.8	1.1	1.5	1.9	2.4	2.7	3.0	3.1	3.0	2.7	2.4	1.9	1.5	1.1	0.8	0.5	0.4	0.3
60	0.4	0.4	0.5	0.8	1.1	1.5	1.9	2.4	2.7	3.0	3.0	3.0	2.7	2.4	1.9	1.5	1.1	0.8	0.5	0.4	0.4
62	0.4	0.4	0.6	0.8	1.1	1.5	1.9	2.3	2.7	2.9	3.0	2.9	2.7	2.3	1.9	1.5	1.1	0.8	0.6	0.4	0.4
64	0.4	0.5	0.6	0.8	1.1	1.5	1.9	2.3	2.6	2.9	2.9	2.9	2.6	2.3	1.9	1.5	1.1	0.8	0.6	0.5	0.4
66	0.4	0.5	0.6	0.9	1.2	1.5	1.9	2.3	2.6	2.8	2.9	2.8	2.6	2.3	1.9	1.5	1.2	0.9	0.6	0.5	0.4
68	0.5	0.5	0.6	0.9	1.2	1.5	1.9	2.3	2.6	2.8	2.9	2.8	2.6	2.3	1.9	1.5	1.2	0.9	0.6	0.5	0.5
70	0.5	0.5	0.7	0.9	1.2	1.5	1.9	2.3	2.6	2.7	2.8	2.7	2.6	2.3	1.9	1.5	1.2	0.9	0.7	0.5	0.5
72	0.5	0.6	0.7	0.9	1.2	1.5	1.9	2.2	2.5	2.7	2.8	2.7	2.5	2.2	1.9	1.5	1.2	0.9	0.7	0.6	0.5
74	0.5	0.6	0.7	0.9	1.2	1.6	1.9	2.2	2.5	2.7	2.7	2.7	2.5	2.2	1.9	1.6	1.2	0.9	0.7	0.6	0.5
76	0.6	0.6	0.7	1.0	1.2	1.6	1.9	2.2	2.5	2.6	2.7	2.6	2.5	2.2	1.9	1.6	1.2	1.0	0.7	0.6	0.6
78	0.6	0.6	0.8	1.0	1.2	1.6	1.9	2.2	2.4	2.6	2.7	2.6	2.4	2.2	1.9	1.6	1.2	1.0	0.8	0.6	0.6
80	0.6	0.7	0.8	1.0	1.3	1.6	1.9	2.2	2.4	2.6	2.6	2.6	2.4	2.2	1.9	1.6	1.3	1.0	0.8	0.7	0.6
82	0.6	0.7	0.8	1.0	1.3	1.6	1.9	2.2	2.4	2.5	2.6	2.5	2.4	2.2	1.9	1.6	1.3	1.0	0.8	0.7	0.6
84	0.7	0.7	0.8	1.0	1.3	1.6	1.9	2.1	2.4	2.5	2.6	2.5	2.4	2.1	1.9	1.6	1.3	1.0	0.8	0.7	0.7
86	0.7	0.7	0.9	1.0	1.3	1.6	1.9	2.1	2.3	2.5	2.5	2.5	2.3	2.1	1.9	1.6	1.3	1.0	0.9	0.7	0.7
88	0.7	0.8	0.9	1.1	1.3	1.6	1.9	2.1	2.3	2.5	2.5	2.5	2.3	2.1	1.9	1.6	1.3	1.1	0.9	0.8	0.7
90	0.7	0.8	0.9	1.1	1.3	1.6	1.9	2.1	2.3	2.4	2.5	2.4	2.3	2.1	1.9	1.6	1.3	1.1	0.9	0.8	0.7
92	0.8	0.8	0.9	1.1	1.3	1.6	1.8	2.1	2.3	2.4	2.5	2.4	2.3	2.1	1.8	1.6	1.3	1.1	0.9	0.8	0.8
94	0.8	0.8	0.9	1.1	1.3	1.6	1.8	2.1	2.3	2.4	2.4	2.4	2.3	2.1	1.8	1.6	1.3	1.1	0.9	0.8	0.8
96	0.8	0.8	1.0	1.1	1.3	1.6	1.8	2.1	2.2	2.4	2.4	2.4	2.2	2.1	1.8	1.6	1.3	1.1	1.0	0.8	0.8
98	0.8	0.9	1.0	1.1	1.3	1.6	1.8	2.0	2.2	2.3	2.4	2.3	2.2	2.0	1.8	1.6	1.3	1.1	1.0	0.9	0.8
100	0.9	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.3	2.4	2.3	2.2	2.0	1.8	1.6	1.4	1.2	1.0	0.9	0.9
102	0.9	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.3	2.3	2.3	2.2	2.0	1.8	1.6	1.4	1.2	1.0	0.9	0.9
104	0.9	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.3	2.3	2.3	2.2	2.0	1.8	1.6	1.4	1.2	1.0	0.9	0.9
106	0.9	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.3	2.3	2.3	2.2	2.0	1.8	1.6	1.4	1.2	1.0	0.9	0.9
108	0.9	1.0	1.1	1.2	1.4	1.6	1.8	2.0	2.1	2.2	2.3	2.2	2.1	2.0	1.8	1.6	1.4	1.2	1.1	1.0	0.9
110	1.0	1.0	1.1	1.2	1.4	1.6	1.8	2.0	2.1	2.2	2.3	2.2	2.1	2.0	1.8	1.6	1.4	1.2	1.1	1.0	1.0
112	1.0	1.0	1.1	1.2	1.4	1.6	1.8	2.0	2.1	2.2	2.2	2.2	2.1	2.0	1.8	1.6	1.4	1.2	1.1	1.0	1.0
114	1.0	1.0	1.1	1.2	1.4	1.6	1.8	2.0	2.1	2.2	2.2	2.2	2.1	2.0	1.8	1.6	1.4	1.2	1.1	1.0	1.0
116	1.0	1.0	1.1	1.2	1.4	1.6	1.8	1.9	2.1	2.2	2.2	2.2	2.1	1.9	1.8	1.6	1.4	1.2	1.1	1.0	1.0
250	1.5	1.5	1.5	1.5	1.6	1.6	1.6	1.6	1.7	1.7	1.7	1.7	1.7	1.6	1.6	1.6	1.6	1.5	1.5	1.5	1.5
500	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
750	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
1000	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6

Figure A.2 *Concentration Plume (Effluent %) for Scenario 2 Effluent Conditions (552 m³/d)*

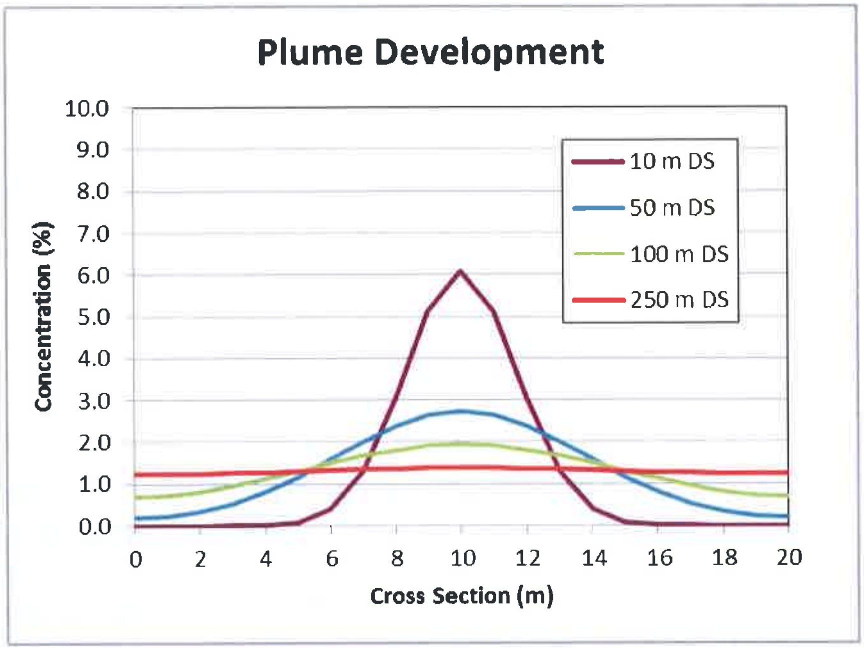


Figure A.3 *Plume Cross-Sections (Effluent %) for Scenario 1 Effluent Conditions (451 m³/d)*

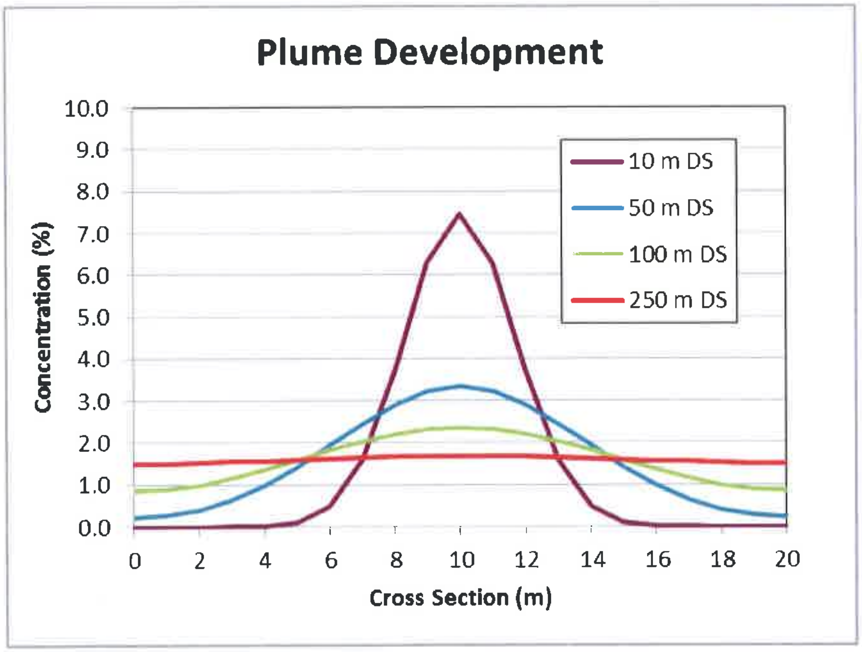


Figure A.4 *Plume Cross-Sections (Effluent %) for Scenario 2 Effluent Conditions (552 m³/d)*

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XCG File No.: 3-3756-01-01
January 11, 2017

ASSIMILATIVE CAPACITY STUDY OF THE GRAND RIVER IN THE VICINITY OF A PROPOSED WWTP IN WALDEMAR, ON

SUMMARY DOCUMENT

Prepared for:

SARAH PROPERTIES LTD.
2 Prince Edward Road
Woodstock, ON
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Attention: Walter Broos

Prepared by:

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APPENDICES

1. INTRODUCTION

Sarah Properties Ltd. is proposing the construction of a new sewage treatment system in Waldemar with dry ditch discharge and subsequent discharge to the ultimate receiver, the Grand River. It is anticipated that the sewage treatment facility will have an average day flow (ADF) capacity of 552 m^3/d.

A critical component of this study is the completion of an assimilative capacity assessment of the receiving water body, in this case the Grand River. An assimilative capacity assessment requires that both water quality and quantity be evaluated. To-date, a number of memoranda, technical memoranda, and other documents have been prepared and circulated as part of this assignment. The Ontario Ministry of the Environment and Climate Change (MOECC) requested that a summary document be prepared that includes all documentation and correspondence prepared throughout the duration of this study.

The intent of this document is to present a summary of the technical assessment of the assimilative capacity of the Grand River, correspondence between the project team and the MOECC, and proposed effluent requirements for a new wastewater treatment plan (WWTP) in Waldemar, ON.

This document provides a summary of all work completed on this assessment to-date. All previously submitted memoranda, technical memoranda, and pertinent correspondence including meeting notes, letters and emails, as well as additional supporting technical information are included as appendices.

2. REVIEW OF ACTIVITIES COMPLETED TO-DATE

2.1 Ambient Conditions and Proposed Study Methodology

XCG prepared and submitted a memorandum dated May 15, 2015 which presented the preliminary results of ambient conditions in the vicinity of the proposed WWTP in Waldemar, Ontario. The document summarized available water quality data used for the purposes of developing ambient conditions, including Provincial Water Quality Monitoring Network (PWQMN) and Grand River Conservation Authority (GRCA) data. The document also identified the proposed equivalent 7Q20 flow to be used for the purposes of completing the Assimilative Capacity Study (ACS). Because the Grand River is a regulated stream, the proposed equivalent 7Q20 flow was proposed to be 0.4 m^3/s, which was documented in the Grand River Watershed Water Management Plan (2014), co-authored by the MOECC and GRCA. A copy of this memorandum can be found in Appendix A.

A meeting was then held on May 19, 2015 to discuss the results of the preliminary results of the ambient conditions. Representatives from MOECC and GRCA were in attendance, and a copy of the meeting notes can be found in Appendix B. GRCA indicated that additional monitoring data were available, and it was agreed that this information would be incorporated into the review of ambient conditions. MOECC raised concerns with respect to the proposed equivalent 7Q20 flow value proposed, suggesting that the value be reduced from the proposed value of 0.4 m^3/s to 0.08 m^3/s. MOECC and GRCA agreed to discuss the low flow value, and provide XCG with a 7Q20 value to be used for the purposes of completing the ACS.

A memorandum outlining the updated review of ambient conditions was prepared by XCG and submitted to MOECC for review on October 30, 2015. A copy of this memorandum is provided in Appendix C. This memorandum incorporated the additional water quality data provided by GRCA. In terms of the proposed 7Q20 flow, no additional guidance had been provided by MOECC. As such, the proposed value remained unchanged at 0.4 m^3/s.

A conference call meeting was then held on November 25, 2015 to discuss the updated memorandum. Minutes of this meeting are provided in Appendix C. At that time, MOECC agreed that an equivalent 7Q20 value of 0.4 m^3/s is reasonable for the Grand River in the vicinity of the proposed discharge. Subsequent to the meeting, both MOECC and GRCA approved the proposed assimilative capacity assessment methodology which follows the MOECC's "Green Book" and incorporated the following:

- Utilizing the equivalent 7Q20 flow value of 0.4 m^3/s for mass balance calculations;
- Utilizing 75th percentile values for ambient water concentrations for key parameters for mass balance calculations; and
- Assuming the upstream Grand Valley WPCP is continuously discharging at its current ECA rated ADF capacity and effluent compliance limits.

2.2 Assimilative Capacity Study

An Assimilative Capacity Study (ACS) report was submitted to MOECC on March 29, 2016 for review. The report included mass balance and mixing zone analyses, and recommended effluent objectives for the new proposed WWTP in Waldemar, ON. Because the design ADF of the WWTP had not yet been finalized, proposed effluent requirements were developed for two flow scenarios (namely 451 m^3/d and 552 m^3/d) which spanned the range of anticipated potential WWTP design ADF values. The ACS report is provided in Appendix D.

Subsequently, MOECC issued a letter dated April 28, 2016, which provided comments on the ACS report. XCG prepared a response to these comments in a letter dated July 7, 2016, which included an update to the mixing zone analysis. Copies of these letters are provided in Appendix E. At that time, it was agreed that a follow-up meeting would be held to discuss the ACS report, MOECC's comments, XCG's responses, and any outstanding questions or concerns related to the receiver study.

A meeting was held on August 15, 2016, with representatives from MOECC, GRCA, the Township of Amaranth-East Gary, XCG, Sarah Properties Ltd., and ASI Group. Meeting notes are provided in Appendix F. During that meeting, the Policy 2 status of the Grand River with respect to total phosphorus was discussed. Post-meeting, it was determined that a Policy 2 Deviation Request, if required, would follow the process outlined in Appendix C of MOECC's "Green Book" and that the process would be driven and overseen by MOECC's Approvals Branch and, possibly, Policy Branch. It was also agreed at that time that effluent requirements would be evaluated for one flow scenario only, namely a design ADF of 552 m^3/d. It was noted that if the final design ADF is less than 552 m^3/d, the concentration objectives and limits would remain unchanged, but that the loading limits would decrease accordingly. Should the final design ADF be greater than 552 m^3/d, an updated ACS would be submitted to obtain agreement from MOECC for effluent requirements for this higher design flow value. Finally, post-meeting, MOECC requested that estimates of unionized ammonia, TP and temperature within the mixing zone be developed.

As a follow-up to the meeting, XCG prepared a letter dated September 23, 2016 which provided a clear summary of the PWQMN data used as part of this study, estimates of unionized ammonia, TP and temperature within the mixing zone, and a summary table clearly outlining the proposed effluent objectives and limits based on a design ADF capacity of 552 m^3/d. A copy of this letter is provided in Appendix F. The proposed effluent objectives and limits remained unchanged from those presented in the March 2016 ACS report for this design ADF value.

Subsequently, MOECC requested via email on December 1, 2016 that dissolved oxygen (DO) modelling be conducted to estimate the impact of the proposed discharge on DO concentrations in the receiver. A copy of this email chain can be found in Appendix F. The results of this analysis are presented in Section 2.3. A summary of the proposed effluent requirements for a WWTP design ADF of 552 m^3/d is presented in Table 2.1.

Table 2.1 Proposed Effluent Compliance Objectives and Limits for a Design ADF of 552 m³/d

Effluent Parameter	Concentration		Loading Limit (kg/d)
	Objective (mg/l)	Limit (mg/L)	
cBOD5	8.0	10.0	5.52
Total Suspended Solids	8.0	10.0	5.52
Total Phosphorus	0.08	0.10	0.055
Total Ammonia Nitrogen			
Winter (Dec - Feb)	3.0	3.8	2.1
Spring (Mar - May)	2.5	3.3	1.8
Summer (Jun - Sep)	1.0	1.8	1.0
Fall (Oct - Nov)	1.6	2.4	1.3

Notes:

E.coli effluent objective and limit of less than 100 organisms per 100 mL based on monthly geometric mean values.

Above concentration limits based on monthly average values. Loading limits based on annual average values and a design ADF of 552 m³/d.

2.3 *Dissolved Oxygen Modelling*

The goal of this assessment was to determine the approximate impact on in-stream dissolved oxygen levels associated with the proposed Waldemar WWTP discharge, during summer low flow conditions. To achieve this, a straightforward Streeter-Phelps dissolved oxygen model, developed by the Alabama Department of Environmental Management (ADEM, 2001) was applied. Details of the analysis are provided in Appendix G.

A plot of dissolved oxygen downstream of the proposed Waldemar WWTP discharge is provided in Figure 2.1 below. Results with and without the additional effluent are included. As illustrated, the dissolved oxygen impact associated with the WWTP discharge is marginal. The initial drop in dissolved oxygen within the first few hundred meters of the discharge is not a result of the effluent loading, but rather is a result of either an under-estimation of re-aeration rate constants, or an over-estimation of in-stream BOD and nitrogen.

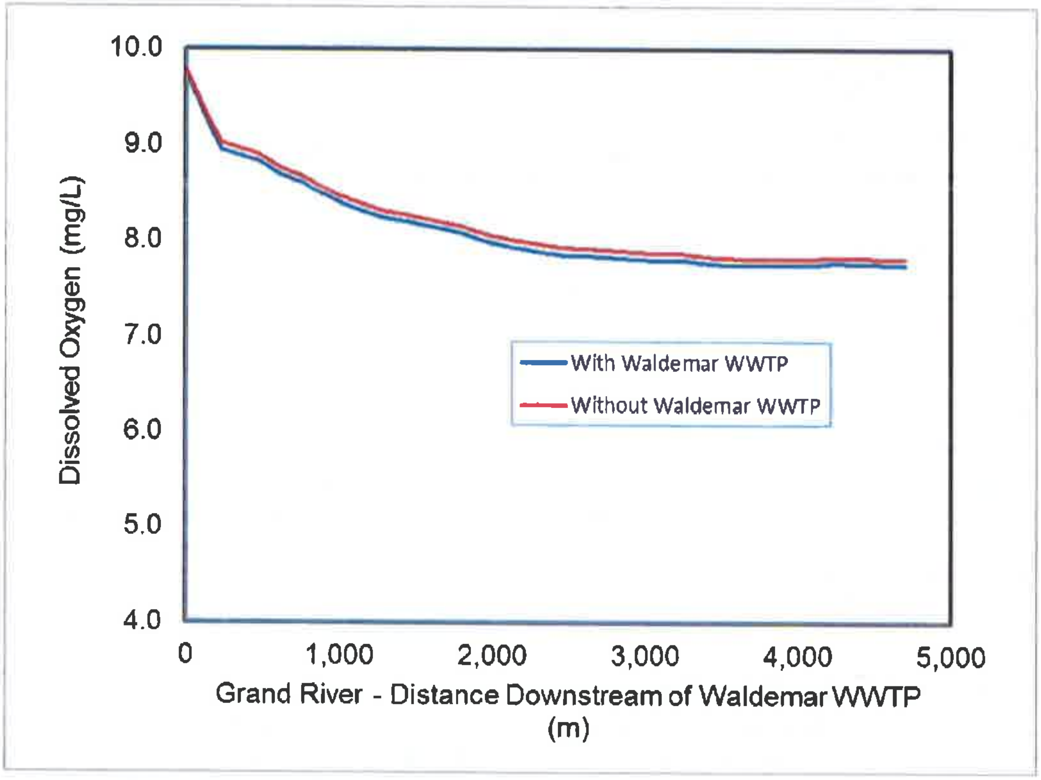

Figure 2.1 Projected DO Concentrations in the Receiver both with and without Proposed WWTP Discharge

As a result, the DO modelling indicates that the proposed Waldemar WWTP effluent discharge will not have a significant impact on in-stream DO levels in the Grand River. As such, no modifications to the proposed effluent requirements for $cBOD_5$ are recommended.

3. SUMMARY

To-date, the following activities have been completed:

- A review of ambient water quality and flows in the Grand River in the vicinity of the proposed outfall.
- Preparation of an Assimilative Capacity Study document that presented proposed effluent requirements for the proposed WWTP.
- Follow-up activities to respond to MOECC's review comments and concerns, including additional mixing zone and DO modelling.

Based on the results of the above tasks, proposed effluent compliance limits and objectives for a new WWTP in the vicinity of Waldemar, ON have been developed and are presented in Table 3.1.

It is acknowledged that the concentration objectives and limits would apply to a new WWTP facility with a design ADF capacity of 552 m^3/d or less. Should the proposed design ADF capacity for the new WWTP increase to a value greater than 552 m^3/d, or should the proposed discharge location change, it is acknowledged that the ACS would need to be updated and resubmitted to MOECC for review and comment.

Table 3.1 Proposed Effluent Compliance Objectives and Limits for a Design ADF of 552 m^3/d

Effluent Parameter	Concentration		Loading Limit (kg/d)
	Objective (mg/l)	Limit (mg/L)	
cBOD5	8.0	10.0	5.52
Total Suspended Solids	8.0	10.0	5.52
Total Phosphorus	0.08	0.10	0.055
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Winter (Dec - Feb)	3.0	3.8	2.1
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Fall (Oct - Nov)	1.6	2.4	1.3

Notes:

E.coli effluent objective and limit of less than 100 organisms per 100 mL based on monthly geometric mean values.

Above concentration limits based on monthly average values. Loading limits based on annual average values and a design ADF of 552 m^3/d.

APPENDIX A

MEMORANDUM – SUMMARY OF PRELIMINARY RESULTS OF AMBIENT CONDITIONS

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Environmental Engineers & Scientists

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Date:	May 15, 2015	**XCG File No.: 3-3756-01-01**
To:	Lindsey Burzese (MOECC), Andrew Herreman (GRCA)	
cc:	Walter Broos (Sarah Properties Ltd.), Lindsay Wolfenberg (ASI)	
From:	Carla Fernandes (XCG)	
Re:	Summary of Preliminary Results of Ambient Conditions in the Vicinity of the Proposed WWTP in Waldemar, Ontario	

---

1. INTRODUCTION

Sarah Properties Ltd. is proposing the construction of a new sewage treatment system in Waldemar with dry ditch discharge and subsequent discharge to the ultimate receiver, the Grand River. It is anticipated that the sewage treatment facility will have an average day flow (ADF) capacity of 300 m^3/d and will provide tertiary level treatment.

A critical component of this study is the completion of an assimilative capacity assessment of the receiving water body, in this case the Grand River. An assimilative capacity assessment requires that both water quality and quantity be evaluated. The intent of this memorandum is to provide a discussion piece between the project team, the Ministry of the Environment and Climate Change (MOECC), and the Grand River Conservation Authority (GRCA). This memorandum includes a preliminary assessment of the ambient water quality and current conditions in the Grand River in the vicinity of the proposed WWTP discharge location.

2. WATER QUALITY SUMMARY

Ideally, in establishing ambient water quality for a receiver, there are recent data available at a location in the vicinity of the discharge location. In the case of the Assimilative Capacity Assessment in support of the proposed Wastewater Treatment Plant (WWTP) in Waldemar, various data sources have been considered to establish the ambient water quality and are identified in Table 1. Figure 1 presents the water quality stations in the vicinity of the proposed discharge location and other points of interest for this study.

Data from each PWQMN station collected during the period from 1994 to 1996 was compared for each parameter of interest. A strong consistency in water quality was observed for each parameter. As such, it can be reasonably assumed that the water quality upstream and downstream of the proposed discharge location does not differ significantly. Therefore, data collected from PWQMN Station 16018406702 (downstream) will be used for the purposes of this study, as it provides current data, while PWQMN Station 16018403902 (upstream) is dated with a period of record ending in 2006.

Table 1 Table of Data Sources for Ambient Water Quality

Source	Distance From Proposed Discharge Location	Period of Record	Parameters of Interest
PWQMN Station 16018403902	3.0 km	1972 - 2006	DO, pH, water temperature, TP, TSS, TAN, NO3
PWQMN Station 16018406702	3.6 km	1975 - 1996	DO, pH, water temperature, TP, TSS, TAN, NO3
		2007 - 2014	DO, pH, water temperature, TP, TSS, TAN, NO3
GRCA Data Collected at PWQMN Station 16018406702	3.6 km	2004 - 2006	pH, water temperature, TP, TSS, NH3, NO3

Figure 1 Location Map Identifying Points of Interest

Where possible, ambient water quality conditions for parameters of interest were characterized on a seasonal basis as follows:

Winter: January – March
Spring: April – June
Summer: July – September
Fall: October – December

For the preliminary analysis, water quality data from PWQMN Station 16018406702 and the GRCA samples collected at this same location were examined. The seasonal 75th percentile concentrations were calculated. The resultant 75th percentile, observed ranges, associated policy designation (if any), and comments are shown in Table 2 for each parameter of interest.

Table 2 Water Quality Summary

Parameter	Percentile / Value Presented	Value / Range	Policy Status / Comments
Total Phosphorous (mg/L) Winter Spring Summer Fall Overall	75th percentile	 0.062 0.027 0.036 0.022 0.031	Policy 2 for total phosphorous in the Grand River near the proposed WWTP discharge location.
BOD_5 (mg/L)	n/a	No data	No recent BOD_5 data were available, however it is expected that the BOD_5 concentration would be less than 2 mg/L.
Dissolved Oxygen (mg/L)	Overall range of recorded values	5.80 – 17.00	In total there were 373 discrete observations of dissolved oxygen; the range of these values are presented in the second column. All of the observations were well above the PWQO, based on temperature. Based on these observations the receiver is Policy 1 with respect to dissolved oxygen.
E. coli (cfu/100mL)	75th percentile	0 - 1	Based on 5 analysis results from samples collected by the GRCA in 2005, the receiver appears to be Policy 1 with respect to *E. coli*. It is expected that the proposed WWTP will meet the PWQO for effluent bacteriological quality.
pH Winter Spring Summer Fall Overall	75th percentile	 7.98 8.45 8.60 8.40 8.47	The majority of recorded pH values fall within the acceptable PWQO range of 6.5 – 8.5, however approximately 20% of the results exceed a pH value of 8.5. Exceedances primarily occurred between May and October and may be a result of aquatic life, primarily plant, activity.
Unionized NH_3 (ug/L-NH_3) Winter Spring Summer Fall Overall	75th percentile	 0.94 3.76 5.98 0.99 3.80	Policy 1 for unionized ammonia in the Grand River near the proposed WWTP discharge location.
Nitrate (mg/L-NO_3) Winter Spring Summer Fall Overall	75th percentile	 5.89 5.76 1.86 7.18 5.36	There is no PWQO for nitrate, however there is a Canadian Water Quality Guideline (CWQG) for the Protection of Aquatic Life. Historically, all observations of nitrate have remained below the CWQG of 13 mg/L-NO_3.
Total Suspended Solids (mg/L) Winter Spring Summer Fall Overall	75th percentile	 33.0 6.00 10.0 6.75 9.00	There are no criteria for TSS however, the observed concentrations are generally high.

3. GRAND RIVER FLOWS

Typically for assimilative capacity analyses, the 7Q20 stream flow represents an appropriate design-case estimate. At the location of the proposed sewage treatment facility discharge, low flow is governed by outflows from an upstream reservoir. It is proposed that a low flow value of 0.40 m^3/s be used in this analysis. This flow was provided by the GRCA and is documented in the Grand River Watershed Water Management Plan (2014) as the design 7Q20 equivalent flow to be used for WWTPs discharging to the regulated river system near the Leggatt stream gauge.

4. SUMMARY OF AMBIENT CONDITIONS

- Water quality data applicable to the study area have been identified.
- A 7Q20 flow value of 0.40 m^3/s is proposed for use in the determination of effluent limits, as presented in the Grand River Watershed Water Management Plan (2014), approved by the MOECC and the GRCA.
- The receiver appears to be Policy 1 for dissolved oxygen and unionized ammonia, and Policy 2 for TP.

5. PROPOSED METHODOLOGY

It is proposed that recommended effluent limits be developed for the proposed facility by completing a seasonal mass balance analysis using the proposed sewage treatment facility ADF of 300 m^3/d, the ambient water quality data, and low flow value. As part of this mass balance assessment, impacts of loadings from the upstream Grand Valley WPCP will be considered as part of the analysis. The mass balance model will be used to ensure that the end-of-pipe water quality is non-acutely lethal and that fully mixed concentrations are lower than PWQO values.

APPENDIX B

MEETING NOTES – MAY 19, 2015 MEETING WITH MOECC AND GRCA

ASI Water

Project:	Waldemar Development: Assimilative Capacity Study Meeting with the MOECC and GRCA
Meeting Date:	Tuesday, May 19, 2015 1:00 PM
Location:	MOECC Hamilton Office 119 King Street West, 12th Floor
Attendees:	Gary Tomlinson (GT), Ministry of the Environment and Climate Change (MOECC) Craig Fowler (CF), MOECC Barbara Slaughtery (BS), MOECC Andrew Herreman (AH), Grand River Conservation Authority (GRCA) Mark Anderson (MA), GRCA Sandra Cooke (SC), GRCA Walter Broos (WB), Sarah Properties Ltd. Lindsay Wolfenberg (LW), ASI Group (ASI) John Levie (JL), ASI Mike Hulley (MH), XCG Consultants Ltd. (XCG) Melody Johnson (MJ), XCG Carla Fernandes (CMF), XCG
Regrets:	Lindsey Burzese (LB), MOECC
Notes By:	Carla Fernandes, XCG Lindsay Wolfenberg, ASI

Item	**Action**
1. Introductions	
• Meeting attendees introduced themselves and provided job title and description of project involvement.	Info

Item	Action
2. Project Background	
• MA and CF raised questions around the calculated ADF for 300 m3/day. This calculation was based on 2 ppl/household. Since this is not a retirement community, would like to see the ADF re-calculated to better represent the population per household as well as address any potential infiltration into the collection pipes.	ASI
• LW discussed that CF had raised questions during the December 2014 MOECC meeting about possible issues around two-tier sewage treatment existing in the same residential area. LW noted that the modularity of the wastewater treatment plant provides the option to potentially include the neighbouring residence. WB is receptive to this idea. CF said he would like to see the ADF reflect the inclusion of the neighbouring properties. LW will provide two ADF numbers, one exclusive of the neighbouring properties and one inclusive of the neighbouring properties.	ASI
• LW discussed the preferred treated effluent discharge location and route. CF had questions around the treated effluent being accessible to the pubic (discharged to a ditch to flow into the Grand River vs an outfall pipe). JL noted that this would trigger dry ditch effluent criteria which ASI is comfortable meeting. CF noted that the Township will need to review and comment on the proposed discharge location. WB and ASI will discuss the proposed discharge location with the Township.	ASI and WB
• MA – Who will own the WWTP? WB responded that the ownership of the plant still needs to be discussed with the Township to determine if they want to take on the ownership or if they would prefer to enter into an MRA with the WWTP owner (Condo Corporation) and the contracted operator.	
3. Preliminary Results of Ambient Water Quality in the Grand River	
• Water quality data were reviewed for two Provincial Water Quality Management Network (PWQMN) stations – one upstream (Station 16018403902) and one downstream (Station 16018406702) of the proposed discharge location. CMF noted that ambient conditions were determined based on the downstream PWQMN station as it has recent data available while the upstream station is outdated with a period of record ending in 2006.	Info
- MA agreed with this rationale.	Info

Item	Action
- SC noted that some of the data collected from the downstream PWQMN station is outdated and the dataset should be truncated as appropriate. It was suggested that the analysis include data from 1996 to 2015 for nitrogen parameters, as the method of analysis for nitrogen species was changed in 1996. XCG will revise findings accordingly.	XCG
- SC noted that there are limitations to PWQMN data and these should be noted in the report.	Info
• CMF provided a summary of ambient water quality.	Info
- The Grand River is Policy 2 with respect to total phosphorus (TP).	Info
- No recent BOD_5 data were available, however it is expected that the ambient BOD_5 concentration would be less than 2 mg/L.	Info
- The Grand River is Policy 1 with respect to dissolved oxygen (DO). MA commented that the PWQMN data is not continuous and therefore may not capture the lowest concentration experienced diurnally. MA will provide XCG with continuous DO data from one week in June 2004 and one week in August 2004 to include in the water quality analysis. These data indicated DO concentrations, considered in conjunction with 75th percentile temperature data, are greater than the PWQO values (4 mg/L to 7 mg/L, varying with temperature) over the two-week monitoring period.	MA (completed 19-May-15)
Post-meeting note: MA provided CMF with the continuous DO data in an email dated May 19, 2015.	
- The Grand River is Policy 1 with respect to *E. coli*. The data presented were in terms of cfu/100 mL. MA noted that these units may not be correct and that he would provide confirmation regarding the correct units. CF noted that *E. coli* should be presented in terms of geometric mean.	MA
- pH generally falls within the acceptable Provincial Water Quality Objective (PWQO) range of 6.5 to 8.5.	Info
- The Grand River is Policy 1 with respect to unionized ammonia.	Info
- Nitrate has historically remained significantly below the Canadian Water Quality Guideline (CWQG) of 13 mg/L-NO_3.	Info
- CF commented that there is a CWQG for total suspended solids (TSS) and should be considered in this analysis.	Info
• Water quality was summarized by season: Winter (January-March), Spring (April-June), Summer (July-September), and Fall (October-December).	Info

Item		Action
	- SC commented that seasons should be redefined as follows: Winter (December-February), Spring (March-May), Summer (June-September), and Fall (October-November). XCG agreed to this adjustment and will update analysis accordingly.	XCG
4.	**Grand River 7Q20 Flow Value**	
	• CMF proposed that a 7Q20 flow value of 0.4 m^3/s for the Grand River in the vicinity of the proposed discharge be used for this analysis. This value was provided by the GRCA and is documented in the Grand River Watershed Water Management Plan (2014) as the design 7Q20 equivalent flow to be used for WWTPs discharging to the regulated river system near the Leggatt stream gauge. This document was approved by the GRCA and MOECC in 2014.	Info
	• CMF noted that LB had indicated prior to the meeting that a low flow value of 0.08 m^3/s should be applied to this study, however the rationale was not provided. CF noted that the rationale was not known to him and this topic should be further discussed with LB directly.	Info
	• SC noted that the GRCA conducted an in-depth analysis to determine a 7Q20 flow of 0.4 m^3/s. It was also noted that Willow Brook flows into the Grand River downstream of the Grand Valley WPCP contributing additional flow to the River prior to the proposed discharge location.	Info
	• SC commented that the GRCA has prepared a draft Reservoir Reliability Study Report. She will advise whether or not it can be shared with XCG at this time for consideration in this study.	SC
	• It was agreed that the MOECC and GRCA would collaborate and provide XCG with a 7Q20 flow value for use in the assimilative capacity study in support of the proposed WWTP in Waldemar.	MOECC/ GRCA
5.	**Proposed Assimilative Capacity Assessment Methodology**	
	• CMF proposed that a seasonal mass balance analysis using the identified 7Q20, proposed sewage treatment facility average day flow, and the ambient water quality data be completed to develop recommended effluent limits for the proposed facility. As part of this mass balance assessment, impacts of loadings from the upstream Grand Valley WPCP would be considered. The mass balance model would be used to ensure that the end-of-pipe water quality is non-acutely lethal and that fully mixed concentrations are lower than the PWQO values.	Info

Item	Action
• SC and CF requested that a mixing zone analysis be conducted to determine contaminant plume length. MOECC would then comment regarding whether or not the plume is reasonable in length. XCG agreed to complete this assessment on behalf of Sarah Properties Ltd.	XCG

APPENDIX C
UPDATED ANALYSIS AMBIENT CONDITIONS – MEMORANDUM AND MEETING NOTES

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Environmental Engineers & Scientists

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XCG 25 Since 1990

Date:	October 30, 2015	**XCG File No.: 3-3756-01-01**
To:	Lindsey Burzese, Ministry of the Environment (MOECC) Andrew Herreman, Grand River Conservation Authority (GRCA)	
cc:	Walter Broos, Sarah Properties Ltd. Lindsay Wolfenberg, ASI Group (ASI)	
From:	Carla Fernandes, XCG Consultants Ltd. (XCG)	
Re:	Summary of Preliminary Results of Ambient Conditions in the Vicinity of the Proposed WWTP in Waldemar, Ontario	

1. INTRODUCTION

Sarah Properties Ltd. is proposing the construction of a new sewage treatment system in Waldemar with dry ditch discharge and subsequent discharge to the ultimate receiver, the Grand River. It is anticipated that the sewage treatment facility will have an average day flow (ADF) capacity between 450 m^3/d and 552 m^3/d, based on the selected design scenario, and will provide tertiary level treatment.

A critical component of this study is the completion of an assimilative capacity assessment of the receiving water body, in this case the Grand River. An assimilative capacity assessment requires that both water quality and quantity be evaluated. This memorandum includes a preliminary assessment of the ambient water quality and current conditions in the Grand River in the vicinity of the proposed Wastewater Treatment Plant (WWTP) discharge location and incorporates comments received from the MOECC and GRCA. As such, this document will provide the framework for discussion between the project team, the MOECC, and the GRCA regarding completion of this assimilative capacity assessment.

2. WATER QUALITY SUMMARY

Ideally, in establishing ambient water quality for a receiver, there are recent data available at a location in the vicinity of the discharge location. In the case of the Assimilative Capacity Assessment in support of the proposed WWTP in Waldemar, various data sources have been considered to establish the ambient water quality and are identified in Table 1. Figure 1 presents the water quality stations in the vicinity of the proposed discharge location and other points of interest for this study.

Monitoring information from each Provincial Water Quality Monitoring Network (PWQMN) station, collected during the period from 1994 to 1996 was evaluated for each parameter of interest. A strong consistency in water quality was observed for each parameter. Therefore, it can be reasonably assumed that the water quality upstream and downstream of the proposed discharge location does not differ significantly. Therefore, data collected from PWQMN Station 16018406702 (downstream) will be used for the purposes of this study, as it provides current data, while data from PWQMN Station 16018403902 (upstream) is dated with a period of record ending in 2006.

Table 1 **Table of Data Sources for Ambient Water Quality**

Source	Distance From Proposed Discharge Location	Period of Record	Parameters of Interest
PWQMN Station 16018403902	3.0 km	1972 - 2006	DO, pH, water temperature, TP, TSS, TAN, NO3
PWQMN Station 16018406702	3.6 km	1975 - 1996	DO, pH, water temperature, TP, TSS, TAN, NO3
		2007 - 2014	DO, pH, water temperature, TP, TSS, TAN, NO3
GRCA Data Collected at PWQMN Station 16018406702	3.6 km	2004 - 2006	pH, water temperature, TP, TSS, NH3, NO3
GRCA Data Collected Near PWQMN Station 16018406902	3.0 km	June 2004 August 2004	DO

Figure 1 **Location Map Identifying Points of Interest**

Where possible, ambient water quality conditions for parameters of interest were characterized on a seasonal basis as follows, with seasons defined as advised by the GRCA:

Winter: December – February
Spring: March – May
Summer: June – September
Fall: October – November

For the preliminary analysis, water quality data from PWQMN Station 16018406702 and the GRCA samples collected at the same location were examined. The seasonal 75th percentile concentrations were calculated. The resultant 75th percentile, observed ranges, associated policy designation (if any), and comments are shown in Table 2 for each parameter of interest.

Table 2 Water Quality Summary

Parameter	Statistic	Value / Range	Policy Status / Comments
Total Phosphorous (mg/L) Winter Spring Summer Fall Overall	75th percentile	0.032 0.037 0.036 0.022 0.031	Policy 2 for total phosphorous in the Grand River near the proposed WWTP discharge location.
BOD_5 (mg/L)	n/a	No data	No recent BOD_5 data were available, however it is expected that the BOD_5 concentration would be less than 2 mg/L.
Dissolved Oxygen (mg/L)	Overall range of recorded values	5.80 – 17.00	In total there were 373 discrete observations and 1,424 continuous observations of dissolved oxygen; the range of these values are as presented. All of the observations were well above the PWQO, based on temperature. Based on these observations the receiver is Policy 1 with respect to DO.
E. coli (cfu/100mL)	75th percentile	0 - 1	Based on 5 analysis results from samples collected by the GRCA in 2005, the receiver appears to be Policy 1 with respect to *E. coli.* It is expected that the proposed WWTP will adhere to the PWQO for effluent bacteriological quality.
pH Winter Spring Summer Fall Overall	75th percentile	8.28 8.38 8.60 8.41 8.47	The majority of recorded pH values fall within the acceptable PWQO range of 6.5 – 8.5, however approximately 20% of the results exceed a pH value of 8.5. Exceedances primarily occurred between May and October and may be a result of aquatic life, primarily plant activity.
Unionized NH_3 (mg/L-NH_3) Winter Spring Summer Fall Overall	75th percentile	No data 0.002 0.005 0.004 0.004	The dataset was truncated to exclude ammonia water quality data from and prior to 1996 because the analysis method for nitrogen species was changed in 1996. Policy 1 for unionized ammonia in the Grand River near the proposed WWTP discharge location.
Nitrate (mg/L-NO_3) Winter Spring Summer Fall Overall	75th percentile	No data 1.53 0.73 0.94 1.22	The dataset was truncated to exclude ammonia water quality data from and prior to 1996 because the analysis method for nitrogen species was changed in 1996. There is no PWQO for nitrate, however there is a Canadian Water Quality Guideline (CWQG) for the Protection of Aquatic Life. Historically, all observations of nitrate have remained below the CWQG of 13 mg/L-NO_3.
Total Suspended Solids (mg/L) Winter Spring Summer Fall Overall	75th percentile	13.1 10.5 10.0 5.4 9.0	There are no criteria for TSS however, the observed concentrations are generally high.

3. GRAND RIVER FLOWS

Typically for assimilative capacity analyses, the 7Q20 stream flow represents an appropriate design-case estimate. At the location of the proposed sewage treatment facility discharge, low flow is governed by outflows from an upstream reservoir. The Grand River Watershed Water Management Plan (GRCA, 2014) identifies a 7Q20 equivalent value of 0.40 m^3/s be used for WWTPs discharging to the regulated river system near the Leggatt stream gauge. As such, it is proposed that a 7Q20 value of 0.40 m^3/s be used in this analysis.

The MOECC has recommended a 7Q20 value of 0.08 m^3/s to be applied in this assimilative capacity assessment with the possibility of considering flow from Willow Brook which discharges upstream of the proposed WWTP effluent discharge location. Flows associated with Willow Brook would then be considered in addition to the 7Q20 flow value of 0.08 m^3/s.

4. SUMMARY OF AMBIENT CONDITIONS

- Water quality data applicable to the study area have been identified.
- The receiver appears to be Policy 1 for dissolved oxygen and unionized ammonia, and Policy 2 for TP.
- Based on the findings of the Grand River Watershed Water Management Plan (2014) the Grand River 7Q20 value in the vicinity of the proposed WWTP discharge is 0.40 m^3/s. It is proposed that this value is applied to the assimilative capacity assessment with consideration given to reserve capacity.

5. PROPOSED METHODOLOGY

It is proposed that recommended effluent limits be developed for the proposed facility by completing a seasonal mass balance analysis using the proposed sewage treatment facility ADF between 450 m^3/d and 552 m^3/d, based on the selected design scenario, the ambient water quality data, and low flow value. As part of this mass balance assessment, impacts of loadings from the upstream Grand Valley WPCP will be considered. The mass balance model will be used to ensure that the end-of-pipe water quality is non-acutely lethal and that fully mixed concentrations are consistent with MOECC policy.

XCG Environmental Engineers & Scientists

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XCG File No.: 3-3756-01-01

Project: Waldemar Development: Assimilative Capacity Study
Conference Call with the MOECC and GRCA

Meeting Date: Wednesday, November 25, 2015
10:00 AM

Attendees: Lindsey Burzese (LB), Ministry of the Environment and Climate Change (MOECC)
Gary Tomlinson (GT), MOECC
Craig Fowler (CF), MOECC
Barbara Slaughtery (BS), MOECC
Andrew Herreman (AH), Grand River Conservation Authority (GRCA)
Mark Anderson (MA), GRCA
Walter Broos (WB), Sarah Properties Ltd.
Lindsay Wolfenberg (LW), ASI Group (ASI)
John Levie (JL), ASI
Mike Hulley (MH), XCG Consultants Ltd. (XCG)
Melody Johnson (MJ), XCG
Carla Fernandes (CMF), XCG

Regrets: Sandra Cooke (SC), GRCA

Notes By: Carla Fernandes, XCG
Lindsay Wolfenberg, ASI

Item **Action**

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1. **Project Background and Status**
   - WB reviewed the project status including meetings and reports that have been completed to date. This included meetings with Council, servicing reports, hydro reports, financial reports, etc. Info
     - During meetings, Council showed a positive interest in the project since this development would add approximately 20-25% to the current tax base for the area.

       Post-meeting note: Christine Gervais (CG) (Township of Amaranth & Township of East Garafraxa) noted that it is more accurate to say, "Council showed a positive interest in the proposal to develop the subject lands as those lands have been designated for future development for some time but there has been no mention from Council that it was based on the tax revenue that it

Item **Action**

would generate and there has been no commitment on Council's part on this development."

  - Reports completed to date include: Planning Justification Report, Functional Servicing Report, Preliminary Stormwater Report, Hydrogeological Study, Geotechnical Study, Financial Impact Assessment, among others.

- LW provided a brief overview of the project including design flows, the proposed wastewater treatment technology (membrane treatment), and proposed discharge location. During the last meeting on May 19, 2015, MA and CF had raised questions around the average day flow (ADF) being calculated based on 2 people per household as well as address infiltration. Prior to the meeting, ASI had re-calculated the ADF to be 450 m^3/d based on 3 people per household and infiltration. Info
- LW summarized the questions raised by CF during the December 2014 meeting about possible issues around two-tier sewage treatment existing in the same residential area. Prior to the meeting, ASI provided an additional ADF calculation of 552 m^3/d for the potential to tie in existing surrounding properties to the proposed wastewater treatment plant (WWTP). This calculation included 3 people per household and infiltration. Info

2. **Previous Meeting Notes**

- No comments were received on the meeting notes from the previous project meeting held on May 19, 2015, therefore the meeting notes are approved and final. Info

3. **Preliminary Results of Ambient Water Quality Analysis**

- CMF provided a brief summary of the revised preliminary results of the Grand River water quality in the vicinity of the proposed discharge. She noted that comments received on the water quality summary at the project meeting held on May 19, 2015 were addressed in the revised memorandum dated October 30, 2015. Info
- CMF noted that based on 75th percentile values calculated from the data available from PWQMN station 16018406702 (downstream of the Grand Valley Water Pollution Control Plant (WPCP)), the Grand River is Policy 1 with respect to dissolved oxygen, unionized ammonia, and *E. coli* and Policy 2 with respect to total phosphorus (TP). Info

Item	Action
- MA provided written comments via email prior to the conference call. His comments primarily requested that more detail be provided regarding the statistical summary of ambient water quality and provided suggestions to do so. CMF acknowledged these comments and noted that they will be addressed in the assimilative capacity assessment report.	Info
- No other comments on the ambient water quality were received.	Info
4. **Grand River 7Q20 Equivalent Flow Value**	
- CMF proposed that a 7Q20 equivalent flow value of 0.4 m^3/s for the Grand River in the vicinity of the proposed WWTP discharge be used for the assimilative capacity assessment. This value is documented in the Grand River Watershed Water Management Plan (2014) as the design 7Q20 equivalent flow to be used for WWTPs discharging to the regulated river system near the Leggatt stream gauge. This document was approved by the GRCA and MOECC in 2014.	Info
- MA commented that the GRCA conducted a rigorous analysis to determine that the equivalent 7Q20 in this reach of the Grand River is 0.4 m^3/s. Since the Grand River is a regulated system with flow augmentation provided by Luther Marsh, as required, the GRCA is confident that low flows of 0.4 m^3/s can be maintain year-round.	Info
- LB agreed that a 7Q20 equivalent value of 0.4 m^3/s is reasonable for this reach of the Grand River.	Info
5. **Proposed Assimilative Capacity Assessment Approach**	
- CMF proposed that a seasonal mass balance analysis using the identified equivalent 7Q20, seasonal ambient water quality data, the existing Grand Valley WPCP Environmental Compliance Approval (ECA) rated ADF and effluent compliance limits, and the proposed WWTP ADF be completed to develop recommended effluent limits for the proposed facility. The mass balance model will be used to ensure that the end-of-pipe water quality is non-acutely lethal and fully mixed concentrations meet the PWQO, for parameters identified as Policy 1.	Info
- LB recommended a 7Q20 value of 0.08 m^3/s be applied for this study. Reasons for this decrease from the equivalent value of 0.4 m^3/s included existing uses such as the assimilative capacity used by other dischargers, other point-source impacts water takings, reserve capacity for future uses.	Info

Item	Action
• MH acknowledged these considerations however stated that it was unclear as to how such a significant reduction could be calculated. He noted that, typically, assimilative capacity is determined based on existing conditions and not reserved for future users, as this is difficult to quantify unless such users are clearly known. Rather, future users are required to design facilities based on the existing conditions at the time of design.	Info
• CMF assured that many of the factors identified by LB are already taken into consideration in the proposed mass balance approach to determine limits for the proposed facility. As part of this mass balance assessment, impacts of loadings from the upstream Grand Valley WPCP will be included in estimating the ambient water quality upstream of the proposed WWTP discharge location.	Info
• The rationale for a 7Q20 value of 0.08 m^3/s was not understood by XCG and as such was not agreed upon.	Info
• MH and CMF noted that the proposed methodology is consistent with the approach outlined in the MOECC "Green Book" for deriving receiving-water based, point-source effluent requirements for Ontario water and that several levels of conservatism are incorporated into XCG's proposed approach for determining effluent limits: – Ambient flow being applied is the 7Q20 equivalent, the minimum 7 day average flow with a recurrence period of 20 years (i.e. a 5% chance of there being inadequate streamflow to meet the minimum acceptable dilution in any given year). – Ambient water concentrations for key parameters being applied to the mass balance are 75th percentile values. – It will be assumed that the upstream Grand Valley WPCP is continuously discharging at the current ECA rated ADF capacity and effluent compliance limits. – Ambient water quality used for this study is based on data collected at PWQMN station 16018406702 which is located downstream of the Grand Valley WPCP. As such, the ambient water quality considered for this project already includes current and historical contributions from the Grand Valley WPCP.	Info
• LB requested that the proposed approach be submitted to the MOECC in writing. It was agreed that the approach, as discussed during the conference call, would be detailed in the meeting notes for this conference call. This request is satisfied in the statements below:	XCG (Completed 30-Nov-15)

  - The equivalent 7Q20 in the vicinity of the proposed WWTP that will be applied to the mass balance is 0.4 m^3/s. The ambient water quality concentrations that will be applied are those presented in the ambient conditions memorandum prepared by XCG and dated October 30, 2015, as these were reviewed during the meeting and no comments were made.
  - To recommend effluent compliance limits for the proposed WWTP, a mass balance approach will be applied. The mass of a particular constituent (e.g. TP) in the ambient water (calculated using 75th percentile concentrations, based on data collected from PWQMN station 16018406702, multiplied by the equivalent 7Q20 of 0.4 m^3/s experienced in the Grand River in the vicinity of the proposed WWTP discharge) will be added to the mass of that same constituent discharged into the Grand River from the Grand Valley WPCP (calculated by multiplying the rated ADF and effluent compliance limit identified in the existing ECA for the Grand Valley WPCP). The sum of these masses provides a conservative estimate of the constituent's mass in the Grand River at the location of the proposed WWTP discharge.
  - The combined ambient mass will then be used in conjunction with the proposed WWTP ADF to recommend reasonable effluent compliance limits.

- All parties acknowledged the time constraints of this project and agreed to review the meeting notes and the written summary of proposed assimilative capacity assessment methodology described herein and provide approval of the proposed approach and comments on the meeting notes by December 11th, 2015.

  All (Completed 15-Dec-15)

  Post-meeting note: The MOECC and GRCA approved the proposed assimilative capacity assessment methodology described herein. LB noted in her comments that the mass balance will have to demonstrate that the full discharge is feasible and will dictate the level of treatment required. She also commented that the receiver is Policy 2 with respect to TP and as such, a very high level of treatment will be required, likely in combination with offsetting, as loadings are still an issue down the system and into the reservoir. This will have to be discussed further with the MOECC as it is the MOECC that is the governing authority.

- XCG will address all comments received by December 11th, 2015 and issue the meeting notes as final, indicating that the contents of the meeting notes are approved by all parties.

  XCG (Completed 18-Dec-15)

Item	Action
6. **Other Business**	
• BS inquired about the approvals required for the development, the status of these approvals, and the approval authority. WB responded that full approvals are required for the development, including zoning. The applications have been submitted to the Township of Amaranth (Township). The Township had requested WB to provide more detail on the supply of water, which is in the process of being re-submitted. The Functional Servicing Report has been started but can only be completed to a point without knowing if effluent can be discharged to surface or will require a subsurface bed. An Official Plan Amendment will be required. Intention for development is to follow the intensification guidelines set out by the Province. The County is the approval authority. **Post-meeting note:** CG commented that although the County is the approval authority for the Official Plan Amendment application, the Township is the approval authority for the subdivision and rezoning applications.	Info
• WB commented that the WWTP will either be freehold by the Township or held by a condominium corporation for the development. At this point, the Township has reserved the right to defer this decision. WB mentioned that the Class Environmental Assessment will be commencing shortly.	Info
• LW discussed the preferred treated effluent discharge location and route. CF had questions around the treated effluent being accessible to the pubic (discharged to a ditch to flow into the Grand River versus an outfall pipe). JL noted that this would trigger dry ditch effluent criteria which ASI is comfortable meeting. CF noted that the Township will need to review and comment on the proposed discharge location. WB and ASI will discuss the proposed discharge location with the Township.	ASI / WB
• LB had some concerns regarding the use of a storm water ditch that runs between two homes for treated effluent being discharged to the Grand River. LB expressed concerns with shoreline discharge versus outfall discharge and also how TP will be handled since the Grand River is a Policy 2 receiver. LB suggested the review of various discharge options (pipe, diffuser, etc.) and commented that the MOECC would like to see some kind of offsetting for TP.	Info

Item	Action
Post-meeting note: LB re-iterated that an open discharge alongside residences is not appropriate, nor is a discharge that will follow the shoreline. The MOECC, as the approving authority, will consider this when reviewing the proposed discharge strategy.	
• LW commented that various elements will be considered including an outfall into the river. The WWTP will be designed to meet dry ditch criteria.	Info
• LB raised concerns about the potential impact of effluent discharge proximal to a well of unknown status.	Info
• LW commented that the nearby homeowners have not been approached yet. ASI wanted to ensure that surface water discharge was possible before fully examining the discharge location and consulting with homeowners.	Info
• AH noted that an Environmental Impact Study may be required for the outfall. If an outfall pipe into the river is deemed the preferred method of discharge, the design will need to meet the GRCA permit requirements for construction in a watercourse.	Info

Any errors, omissions, or discrepancies should be reported to Carla Fernandes.

APPENDIX D
ASSIMILATIVE CAPACITY STUDY REPORT
DATED MARCH 29, 2016

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XCG File No.: 3-3756-01-01
March 29, 2016

ASSIMILATIVE CAPACITY STUDY OF THE GRAND RIVER IN THE VICINITY OF A PROPOSED WWTP IN WALDEMAR, ON

Prepared for:

SARAH PROPERTIES LTD.
2 Prince Edward Road
Woodstock, ON
N4V 1G7

Attention: Walter Broos

Prepared by:

XCG CONSULTANTS LTD.
2620 Bristol Circle, Suite 300
Oakville, Ontario
L6H 6Z7

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1. INTRODUCTION

1.1 Background

Sarah Properties Ltd. is proposing the construction of a new sewage treatment system in Waldemar with dry ditch discharge and subsequent discharge to the ultimate receiver, the Grand River. It is anticipated that the sewage treatment facility will have an average day flow (ADF) capacity between 451 m^3/d and 552 m^3/d, based on the selected design scenario, and will provide tertiary level treatment.

A critical component of this study is the completion of an assimilative capacity assessment of the receiving water body, in this case the Grand River. An assimilative capacity assessment requires that both water quality and quantity be evaluated. The intent of this technical memorandum is to present proposed effluent requirements for a new wastewater treatment plan (WWTP) in Waldemar, ON.

This technical memorandum includes an assessment of the ambient water quality and current conditions in the Grand River in the vicinity of the proposed WWTP discharge location and the development of proposed effluent objectives and limits for the new WWTP in Waldemar, ON.

1.2 Objectives

The objectives of this analysis are to:

- characterize ambient water quality parameters and to determine critical low flows as well as impacts of the upstream Grand Valley Water Pollution Control Plant (WPCP);
- conduct an assimilative capacity assessment of the receiving waters;
- conduct mixing zone analysis; and
- formulate reasonable recommendations for effluent limits for the new proposed WWTP in Waldemar, ON.

2. AMBIENT CONDITIONS

2.1 Water Quality

Representative background water quality can be defined by examining water quality in the vicinity of the Grand Valley WPCP effluent discharge. For analysis purposes, the 75th percentile threshold is applied to characterize ambient conditions, as recommended by the Ministry of the Environment and Climate Change (MOECC). The MOECC states, "Normally the 75th percentile is used to determine background quality…".[1] The receiving water quality is assigned Policy 1 if the ambient concentration is less than the Provincial Water Quality Objective (PWQO) and Policy 2 if the ambient concentration exceeds the PWQO. The implication of being a Policy 1 or Policy 2 receiver is described briefly below.

- **Policy 1:** In areas which have water quality better than the Provincial Water Quality Objectives, water quality shall be maintained at or above the Objectives.
- **Policy 2:** Water quality which presently does not meet the Provincial Water Quality Objectives shall not be degraded further and all practical measures shall be taken to upgrade the water quality to the Objectives.

Ideally, in establishing ambient water quality for a receiver, there are recent data available at a location in the vicinity of the discharge location. In the case of the Assimilative Capacity Assessment in support of the proposed WWTP in Waldemar, various data sources have been considered to establish the ambient water quality and are identified in Table 1. Figure 1 presents the water quality stations in the vicinity of the proposed discharge location and other points of interest for this study.

Data from each PWQMN station collected during the period from 1994 to 1996 was compared for each parameter of interest. A strong consistency in water quality was observed for each parameter. As such, it can be reasonably assumed that the water quality upstream and downstream of the proposed discharge location does not differ significantly. Therefore, data collected from PWQMN Station 16018406702 (downstream) will be used for the purposes of this study, as it provides current data, while PWQMN Station 16018403902 (upstream) is dated with a period of record ending in 2006.

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[1] Ministry of Environment and Energy, *Water Management: Policies, Guidelines, Provincial Water Quality Objectives*. July 1994 (MOE Blue Book).

Table 1 **Table of Data Sources for Ambient Water Quality**

Source	Distance From Proposed Discharge Location	Period of Record	Parameters of Interest
PWQMN Station 16018403902 (Upstream)	3.0 km	1972 - 2006	DO, pH, water temperature, TP, TSS, TAN, NO3
PWQMN Station 16018406702 (Downstream)	3.6 km	1975 - 1996	DO, pH, water temperature, TP, TSS, TAN, NO3
		2007 - 2014	DO, pH, water temperature, TP, TSS, TAN, NO3
GRCA Data Collected at PWQMN Station 16018406702 (Downstream)	3.6 km	2004 - 2006	pH, water temperature, TP, TSS, NH_3, NO_3, *E. coli*

Figure 1 **Location Map Identifying Points of Interest**

Where possible, ambient water quality conditions for parameters of interest were characterized on a seasonal basis as follows, with seasons defined as advised by the GRCA:

- Winter: December – February
- Spring: March – May
- Summer: June – September
- Fall: October – November

2.1.1 *Total Phosphorus*

The MOE PWQO state that, as an interim guideline for streams and rivers, total phosphorus (TP) should not exceed 0.03 mg/L to prevent excessive plant growth. The statistical summary of the total phosphorus concentration data is shown in Table 2. Most seasons are at or above the Policy 2 threshold. For characterization, the annual value for TP of 0.031 mg/L was used to represent ambient conditions. This concentration exceeds the PWQO and therefore the receiver is MOE Policy 2 in the vicinity of the proposed WWTP with respect to TP. This means that a Policy 2 deviation will be required for the proposed WWTP.

Table 2 Summary of Grand River Total Phosphorus Near Proposed Outfall

Season	Median TP (mg/L)	75th Percentile TP (mg/L)	Number of Observations
Winter (Dec - Feb)	0.030	0.032	57
Spring (Mar - May)	0.025	0.037	115
Summer (Jun - Sep)	0.024	0.033	164
Fall (Oct - Nov)	0.014	0.020	67
Annual	**0.022**	**0.031**	**403**

2.1.2 *Un-ionized Ammonia*

The percentage of un-ionized ammonia in aqueous solution varies depending on the temperature and pH of the water. The 75th percentile concentrations of ammonia, pH, and temperature are summarized in Table 3, Table 4, and Table 5, respectively.

Table 3 Summary of Grand River Ammonia Data Near Outfall

Season	Median Ammonia (mg/L)	75th Percentile Ammonia (mg/L)	Number of Observations
Winter (Dec - Feb)	0.032 (1)	0.058 (1)	No Data
Spring (Mar - May)	0.032	0.058	28
Summer (Jun - Sep)	0.032	0.050	48
Fall (Oct - Nov)	0.028	0.050	20

Notes:
1. No data were available for winter. Therefore, winter ammonia concentrations assumed to be equivalent to spring (Mar - May) concentrations.

The PWQMN dataset for ammonia showed an increasing trend. To remove the trend, all data prior to 1997 was truncated, as per GRCA's comment, and the statistics shown in Table 3 were generated. As a result of truncation, no data was available for winter (Dec - Feb). Therefore it was assumed that winter concentrations would be equivalent to those observed in spring (Mar - May).

Table 4 **Summary of Grand River pH Field Data Near Outfall**

Season	Median pH	75th Percentile pH	Number of Observations
Winter (Dec - Feb)	7.99	8.28	25
Spring (Mar - May)	8.17	8.38	49
Summer (Jun - Sep)	8.39	8.55	87
Fall (Oct - Nov)	8.31	8.40	33

The PWQO for pH states that the pH should be maintained within the range of 6.5 and 8.5 to protect aquatic life; and both alkaline and acid water may cause irritation to anyone using the water from recreational purposes. Based on the data presented in Table 4, the Grand River is Policy 1 with respect to pH during all seasons with the exception summer (June - September). Higher pH during these months may be a result of aquatic life activity.

Table 5 **Summary of Grand River Temperature Near Outfall**

Season	Median Temperature (°C)	75th Percentile Temperature (°C)	Number of Observations
Winter (Dec - Feb)	0.55	1.00	48
Spring (Mar - May)	7.50	13.4	102
Summer (Jun - Sep)	20.5	23.0	158
Fall (Oct - Nov)	7.70	10.1	65

In order to determine the 75th percentile in-stream un-ionized ammonia, it is first necessary to calculate the unionized ammonia concentration for days in which synoptic measurements of ammonia, pH, and temperature are available.

As mentioned above, the ammonia data showed an increasing trend and, as such, only the data collected after 1997 was used to calculate unionized ammonia with synoptic measurements of pH and temperature. Seasonal unionized concentrations are shown in Table 6. It should be noted that no data were for available for winter. Concentrations in winter are expected to be similar to those observed in spring. Based on the data provided, the receiver is Policy 1 with respect to unionized ammonia.

Table 6 **Summary of Grand River Unionized Ammonia Near Outfall**

Season	Median Unionized Ammonia (mg/L)	75th Percentile Unionized Ammonia (mg/L)	Number of Observations
Winter (Dec - Feb)	0.001 (1)	0.002 (1)	No Data
Spring (Mar - May)	0.001	0.002	27
Summer (Jun - Sep)	0.003	0.006	42
Fall (Oct - Nov)	0.001	0.001	15

Notes:
1. Assumed to be equivalent to spring concentrations.

2.1.3 *Dissolved Oxygen and Biological Oxygen Demand (BOD$_5$)*

For dissolved oxygen (DO), low concentrations are indications of degraded water quality; therefore, 25th percentiles are typically used, rather than 75th percentiles, to characterize ambient conditions. The PWQO for DO ranges from 5 to 8 mg/L for a warm water fishery based on temperature; cooler temperatures have a higher PWQO than warmer temperatures.

The Grand River is Policy 1 with regard to DO for a warm water fishery, based on the PWQMN data. The monthly statistics are shown in Table 7.

Table 7 Summary of Grand River Dissolved Oxygen Near Outfall

Season	Median DO (mg/L)	25th Percentile DO (mg/L)	Number of Observations
Winter (Dec - Feb)	12.8	12.2	55
Spring (Mar - May)	12.2	11.2	98
Summer (Jun - Sep)	10.6	9.8	156
Fall (Oct - Nov)	12.4	11.5	64

The DO concentrations reported in Table 7 show that the 25th percentile concentrations and the minimum observed concentrations are higher than the PWQO for DO in all seasons. Therefore, based on the available instantaneous DO data, the Grand River in the vicinity of the proposed outfall is MOE Policy 1 with respect to DO. In spite of this, the possibility does exist that aquatic plant respiration may result in lower instantaneous DO concentrations, particularly during the late summer and early fall.

The available BOD$_5$ measurements from the PWQMN were quite dated (period of record 1978 - 1981), and the reported annual 75th percentile BOD$_5$ concentration was 1.2 mg/L. Based on the available data, a conservative estimate of ambient BOD$_5$ concentrations is 1.5 mg/L.

2.1.4 *E.coli*

The *E.coli* data from the PWQMN dataset was limited, with a total of 5 results from samples collected by the GRCA in 2005. Based on these data, the receiver appears to be Policy 1 with respect to *E.coli*, with all five samples results less than 1 cfu/100mL. Total Suspended Solids

2.1.5 *TSS*

There are no PWQO values for total suspended solids (TSS). Reported PWQMN TSS concentrations were available over the period 1975 to 2015, however the results from 1984 to 1986 were excluded as they were several orders of magnitude higher than concentrations reported both before and after that period. Generally, TSS concentrations are elevated in the spring and summer. A statistical summary of TSS concentrations is provided in Table 8.

Table 8 Summary of Grand River TSS Near Outfall

Season	Median TSS (mg/L)	75th Percentile TSS (mg/L)	Number of Observations
Winter (Dec - Feb)	3.0	5.4	28
Spring (Mar - May)	3.3	9.7	83
Summer (Jun - Sep)	4.7	8.0	123
Fall (Oct - Nov)	2.0	3.9	48
Annual	**3.6**	**8.0**	**282**

2.1.6 *Nitrate*

While there is no PWQO for nitrate, there is a Canadian Water Quality Guideline (CWQG) for the Protection of Aquatic Life. The CWQG is 2.93 mg/L-N. The dataset was truncated to exclude nitrate water quality data from and prior to 1996 because the analysis method for nitrogen species was changed in 1996. The 75th percentile concentration for nitrate was well below the CWQG of 2.93 mg/L-N on both a seasonal and annual basis. This indicates that the Grand River has ample assimilative capacity for nitrate at this location. A statistical summary of nitrate concentrations is provided in Table 9.

Table 9 Summary of Grand River Nitrate Near Proposed Outfall

Season	Mean Nitrate (mg/L-N)	75th Percentile Nitrate (mg/L-N)	Number of Observations
Winter (Dec - Feb)	No data	No data	No data
Spring (Mar - May)	1.12	1.53	28
Summer (Jun - Sep)	0.33	0.47	50
Fall (Oct - Nov)	0.58	1.23	20
Annual	**0.52**	**1.00**	**98**

2.2 *Grand River Flows*

Typically for assimilative capacity analyses, the 7Q20 stream flow represents an appropriate design-case estimate. At the location of the proposed sewage treatment facility discharge, low flow is governed by outflows from an upstream reservoir. It was proposed that a low flow value of 0.40 m^3/s be used in this analysis. This flow was provided by the GRCA and is documented in the Grand River Watershed Water Management Plan (2014) as the design 7Q20 equivalent flow to be used for WWTPs discharging to the regulated river system near the Leggatt stream gauge. During a conference call held on November 25, 2015, both the MOECC and GRCA agreed that a low flow value of 0.40 m^3/s should be used for the assimilative capacity assessment of the Grand River in the vicinity of the newly proposed WWTP.

3. DETERMINATION OF EFFLUENT LIMITS

3.1 Effluent cBOD$_5$

At a design flow of 552 m^3/d, a conservative estimated background BOD$_5$ concentration of 1.5 mg/L, and a cBOD5 concentration effluent limit of 10 mg/L, the ambient BOD$_5$ concentration would increase marginally by 10 percent. Given the Policy 1 status of the receiver in terms of DO, it is proposed that a cBOD5 compliance limit of 10 mg/L and design objective of 8 mg/L be used for the proposed WWTP for both design ADF scenarios (451 m^3/d and 552 m^3/d).

3.2 Effluent Total Suspended Solids

Total suspended solids concentrations are high in the receiver with a 75th percentile value of 8.0 mg/L on an annual basis. At a design flow of 552 m^3/d and a TSS concentration effluent limit of 10 mg/L, the ambient TSS concentration would increase marginally by less than 2 percent. Therefore, it is proposed that a TSS compliance limit of 10 mg/L and design objective of 8 mg/L be used for the proposed WWTP for both design ADF scenarios (451 m^3/d and 552 m^3/d).

3.3 Effluent Total Phosphorus

As indicated in Table 2, the Grand River in the vicinity of the proposed outfall is MOECC Policy 2 with respect to total phosphorus and therefore has no available capacity for TP assimilation; however, for a MOECC Policy 2 receiver, "Water quality which presently does not meet the Provincial Water Quality Objectives shall not be degraded further and all practical measures shall be taken to upgrade the water quality to the Objectives." Approval of a new point-source discharge with an effluent TP concentration in excess of the PWQO of 0.030 mg/L will require a Policy 2 deviation.

To address the Policy 2 status of the receiver, it is proposed that the new WWTP be designed to provide a level of treatment consistent with Limit of Technology (LoT) for phosphorus removal. It is therefore proposed that the new WWTP have an effluent TP limit of 0.10 mg/L and objective of 0.08 mg/L for both design ADF scenarios (451 m^3/d and 552 m^3/d). At the design 7Q20 flow of 0.40 m^3/s, and assuming the facility is operating at an ADF of 552 m^3/d and the TP limit of 0.10 mg/L, the WWTP effluent would result in an increase in the receiver TP concentration of approximately 0.0016 mg/L, or approximately a 5% increase over the annual 75th percentile background concentration of 0.031 mg/L.

3.4 Effluent Total Ammonia

For ammonia limits, it was assumed that current MOECC policy requiring a non-toxic effluent would apply. Extensive research by the US EPA and others has demonstrated that a non-toxic limit for un-ionized ammonia ranges between 0.1 and 0.5 mg/L depending on the fish species of interest. Therefore, a conservative non-toxic limit for un-ionized ammonia in the Grand Valley WPCP effluent is 0.1 mg/L-NH$_3$.

In the recently released federal Wastewater Systems Effluent Regulations under the Fisheries Act, effluent toxicity limits are set to 1.25 mg/L for un-ionized ammonia (at 15°C). The assumption of un-ionized toxicity at 0.1 mg/L, as discussed above, is more stringent and thus the effluent limits discussed below are more conservative than required and complies with the new federal regulation.

For the proposed effluent limits to be acceptable, the resultant unionized ammonia concentration in the effluent stream (based on the proposed effluent limit) must be less than or equal to 0.1 mg/L at end-of-pipe and the receiver unionized ammonia concentration (based on fully mixed conditions between the effluent and the receiver) must be less than or equal to the PWQO of 0.02 mg/L.

The percentage of un-ionized ammonia in aqueous solution varies depending on the temperature and pH of the water. The seasonal end-of-pipe effluent dissociation ratios were estimated based on assumed effluent quality from the new WWTP. As a conservative measure and based on experience at other similar treatment facilities in Ontario, a pH of 8.0 was used for all seasons and seasonal temperatures of 12°C, 14°C, 22°C and 18°C were used for Winter, Spring, Summer and Fall, respectively.

In order to determine the in stream un-ionized ammonia concentrations, it was necessary to calculate the seasonal 75th percentile ammonia dissociation ratios based on synoptic measurements of pH and temperature (taken at the same time). The seasons applied for the analysis align with those previously defined.

To ensure a conservative evaluation of fully mixed conditions within the receiver, the impacts of the upstream Grand Valley WPCP on receiver water quality were also considered. To accomplish this, it was assumed that the Grand Valley WPCP would be operating at its rated capacity of 1,244 m3/d and at its ECA total ammonia nitrogen (TAN) limit of: 4.0 mg/L from December 1 to March 31, 1.0 mg/L from April 1 to May 31, 0.7 mg/L from June 1 to September 30, and 1.0 mg/L from October 1 to November 30. This additional TAN loading was used to develop an adjusted background unionized ammonia concentration. Because the month of March has been included in the definition of Spring for this study, it was assumed that the Grand Valley WPCP would be discharging effluent at a TAN concentration of 4.0 mg/L for both the Winter and Spring seasons.

The dissociation ratios, proposed effluent ammonia concentrations, and resultant unionized ammonia concentrations are shown in Table 10 and Table 11 for both the end-of-pipe and fully mixed receiver conditions, respectively.

The compliance limits for TAN are recommended to be 3.8 mg/L for Winter (December to February), 3.3 mg/L for Spring (March - May), 1.8 mg/L for Summer (June - September) and 2.4 mg/L for Fall (October - November). Meeting end-of-pipe non-toxicity requirements limits the recommended TAN limits, therefore the proposed effluent TAN limits are the same for both design ADF scenarios (451 m^3/d and 552 m^3/d).

Table 10 End of Pipe Effluent Un-ionized Ammonia Data Summary

Discharge Period	**Proposed TAN Limit (mg/L-N)**	**Estimated Dissociation Ratio (1)**	**Un-ionized ammonia at End-of-Pipe (mg/L-NH_3)**
Winter	3.8	0.0212	0.098
Spring	3.3	0.0247	0.099
Summer	1.8	0.0438	0.096
Fall	2.4	0.0331	0.096

Notes:

1. Based on conservative estimates of plant effluent pH and seasonal temperatures, as specified in text above.

Table 11 Fully Mixed Receiver Un-ionized Ammonia Data Summary

Discharge Period	**Proposed TAN Limit (mg/L-N)**	**Adjusted Receiver Background TAN (mg/L-N) (2)**	**75th Percentile Dissociation Ratio (3)**	**Fully Mixed Un-ionized Ammonia (mg/L-NH_3) (4)**
Winter (1)	3.8	0.1945	0.0524	0.016
Spring	3.3	0.1945	0.0524	0.015
Summer	1.8	0.0726	0.1114	0.013
Fall	2.4	0.0830	0.0378	0.005

Notes:

1. Background receiver TAN concentrations and dissociation ratios were not available for the winter period. Therefore, the values from Spring were assumed for Winter conditions.
2. Adjusted receiver background TAN concentration based on the background 75th percentile TAN concentrations, the 7Q20 flow of 0.4 m3/s for all seasons, and the Grand Valley WPCP operating at its rated capacity of 1,244 m3/d and at its current TAN limits of 4.0 mg/L Winter / Spring, 0.7 mg/L Summer, and 1.0 mg/L Fall.
3. 75th percentile dissociation ratio in the receiver based on background water quality data in terms of synoptic pH and temperature data.
4. Fully mixed un-ionized ammonia concentration based on a new WWTP design ADF of 552 m^3/d.

3.5 Effluent E.coli

The receiver is MOE Policy 1 with respect to *E.coli*. A compliance limit of 200 cfu/100 mL and design objective of 100 cfu/100 mL is proposed for both design ADF scenarios (451 m^3/d and 552 m^3/d).

4. MIXING ZONE ANALYSIS

4.1 Introduction and Methodology

An analysis was conducted to define the low-flow mixing zone in the Grand River near Marsville for two proposed WPCP effluent scenarios, namely 451 m^3/d and 552 m^3/d. The general approach involved application of an analytical solution of the two-dimensional adjective dispersive transport equation (Equation [1]) for steady state conditions[2].

$$v\frac{\partial C}{\partial x} = E\left[\frac{\partial^2 C}{\partial x^2} + \frac{\partial^2 C}{\partial y^2}\right] - kC \pm S \qquad [1]$$

Where:

C = Concentration of contaminate (mg/L)
E = Dispersion coefficient (m^2/s)
v = Velocity (m/s)
k = Decay constant (s^{-1})
S = Sources and sinks (mg/L/s)

The dispersion coefficient, E, can be approximated using an empirical relationship presented below as Equation [2][3].

$$E \cong 0.6d\sqrt{gdS} = 0.6du \qquad [2]$$

Where:

d = Channel depth (m)
g = Gravitational constant (m/s^2)
S = Average channel slope (m/m)
u = Channel shear velocity (m/s)

Plume superposition was applied to address channel boundaries. Assumptions included that effluent is completely mixed vertically, average flow and average depth can be applied with Manning's equation to estimate depth for low-flow conditions, momentum of effluent can be ignored, steady-state conditions have been achieved, the channel is rectangular with a constant width of 20 m, and effluent is introduced in the center of the channel.

A summary of key parameters used in the analysis are presented in Table 12.

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[2] Fischer, H.B., List, E.J., Koh, R.Y., Imberger, J., and Brooks, N.H., "Mixing in Inland And Coastal Waters", Academic Press, New York, 1979.

[3] Ibid.

Table 12 Key Parameter Values for Mixing Zone Analysis

Parameter	**Variable**	**Value**	**Units**
Channel Width	w	20.0	m
Average Channel Depth - Low-Flow	d	0.30	m
WPCP Flow	Qe	451 or 552	m^3/d
River Low-Flow	Qr	0.4	m^3/s
Average Channel Slope	S	0.001	m/m
Shear velocity	u	0.054	m/s
Dispersion Coefficient	Et	0.010	m^2/s

4.2 *Results*

The estimated mixing zones corresponding to Scenarios 1 (451 m^3/d) and 2 (552 m^3/d) are provided as Figures A1 and A2 in Appendix A, respectively. Illustrative plume cross-sections for each scenario are provided in Figures A3 and A4 in Appendix A, respectively. For each Scenario, completely mixed conditions are achieved within approximately 250 m downstream of the source. Effluent concentrations are greater than 5% for a relatively small area (2 m in width and from 12 to 20 m in length) immediately downstream of the source for each scenario. Completely mixed concentrations for Scenario 1 and 2 are 1.3% and 1.6%, respectively.

5. SUMMARY

- It was found that the Grand River in the vicinity of the proposed outfall is MOE Policy 2 for total phosphorus, and pH in the summer season. All other parameters were MOE Policy 1 or did not have a PWQO.
- Design equivalent 7Q20 flows for all seasons in the vicinity of the proposed outfall were set to 0.4 m^3/s as per the Grand River Watershed Water Management Plan (2014).
- As a conservative approach, proposed effluent limits for the new proposed WWTP were generated based on the available assimilative capacity in the Grand River and an ADF of 552 m^3/d from a new WPCP. The proposed compliance limits and design objectives are shown in Table 13 and Table 14, respectively. Loading limits have been defined for both ADF scenarios (451 m^3/d and 552 m^3/d).
- A Policy 2 deviation with respect to phosphorus will be required for approval of this new point-source discharge. The proposed TP limit and objective are consistent with providing Limit of Technology for phosphorus removal. Mixing zones length was found to be reasonable in extent.

Proposed effluent compliance limits and objectives are presented in Table 13 and Table 14, respectively.

Table 13 Proposed Effluent Compliance Limits

Effluent Parameter	Average Concentration (mg/L)	Average Waste Loading (kg/d)	
		Design ADF of 451 m^3/d	Design ADF of 552 m^3/d
cBOD5	10.0	4.51	5.52
Total Suspended Solids	10.0	4.51	5.52
Total Phosphorus	0.10	0.045	0.055
Total Ammonia Nitrogen			
Winter (Dec - Feb)	3.8	1.7	2.1
Spring (Mar - May)	3.3	1.5	1.8
Summer (Jun - Sep)	1.8	0.8	1.0
Fall (Oct - Nov)	2.4	1.1	1.3
Notes: *E.coli* less than 200 organisms per 100 mL.			

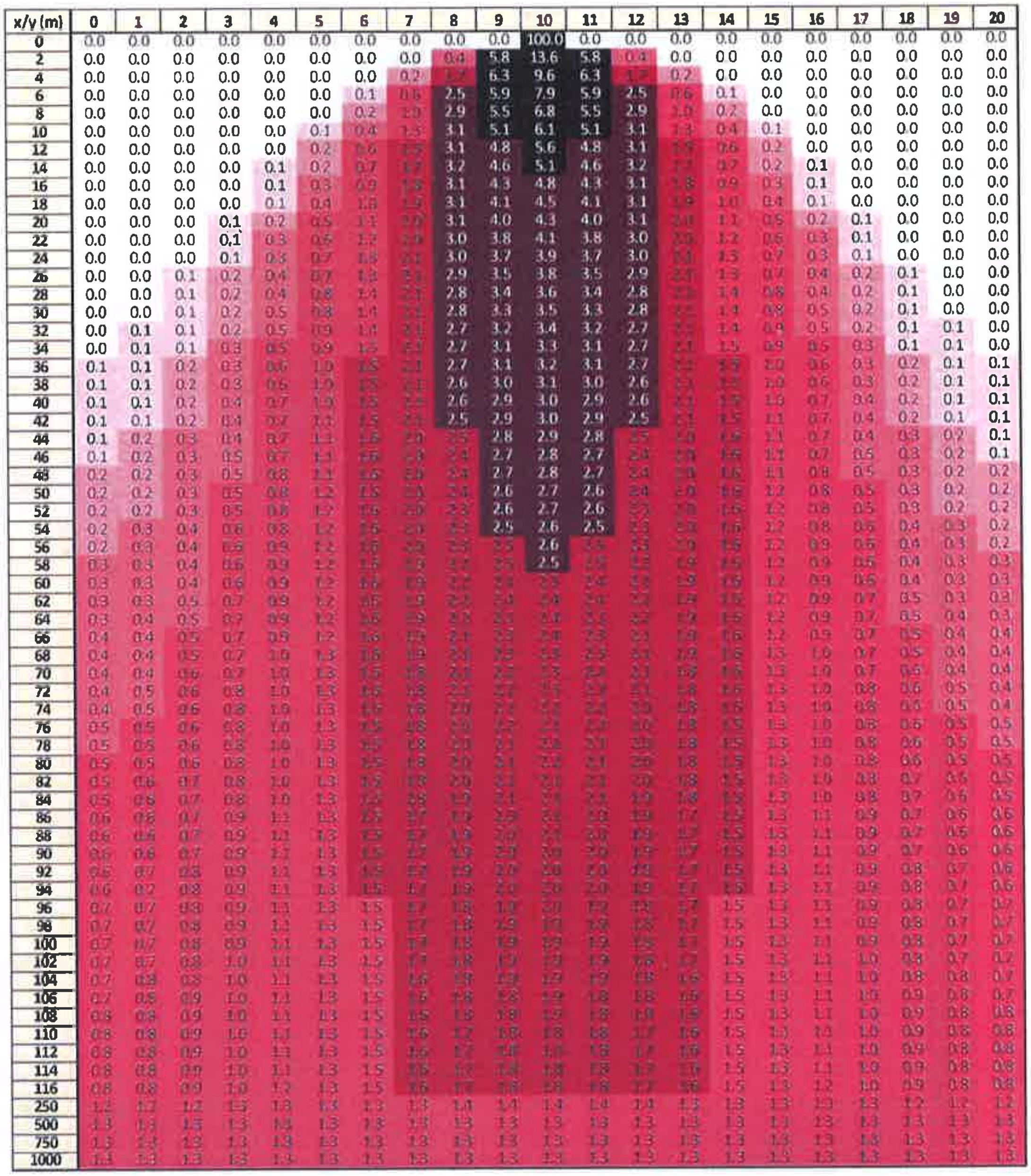
Table 14 Proposed Effluent Objectives

Effluent Parameter	Average Concentration (mg/L)
cBOD5	8.0
Total Suspended Solids	8.0
Total Phosphorus	0.08
Total Ammonia Nitrogen	
Winter (Dec - Feb)	3.0
Spring (Mar - May)	2.5
Summer (Jun - Sep)	1.0
Fall (Oct - Nov)	1.6

Notes:

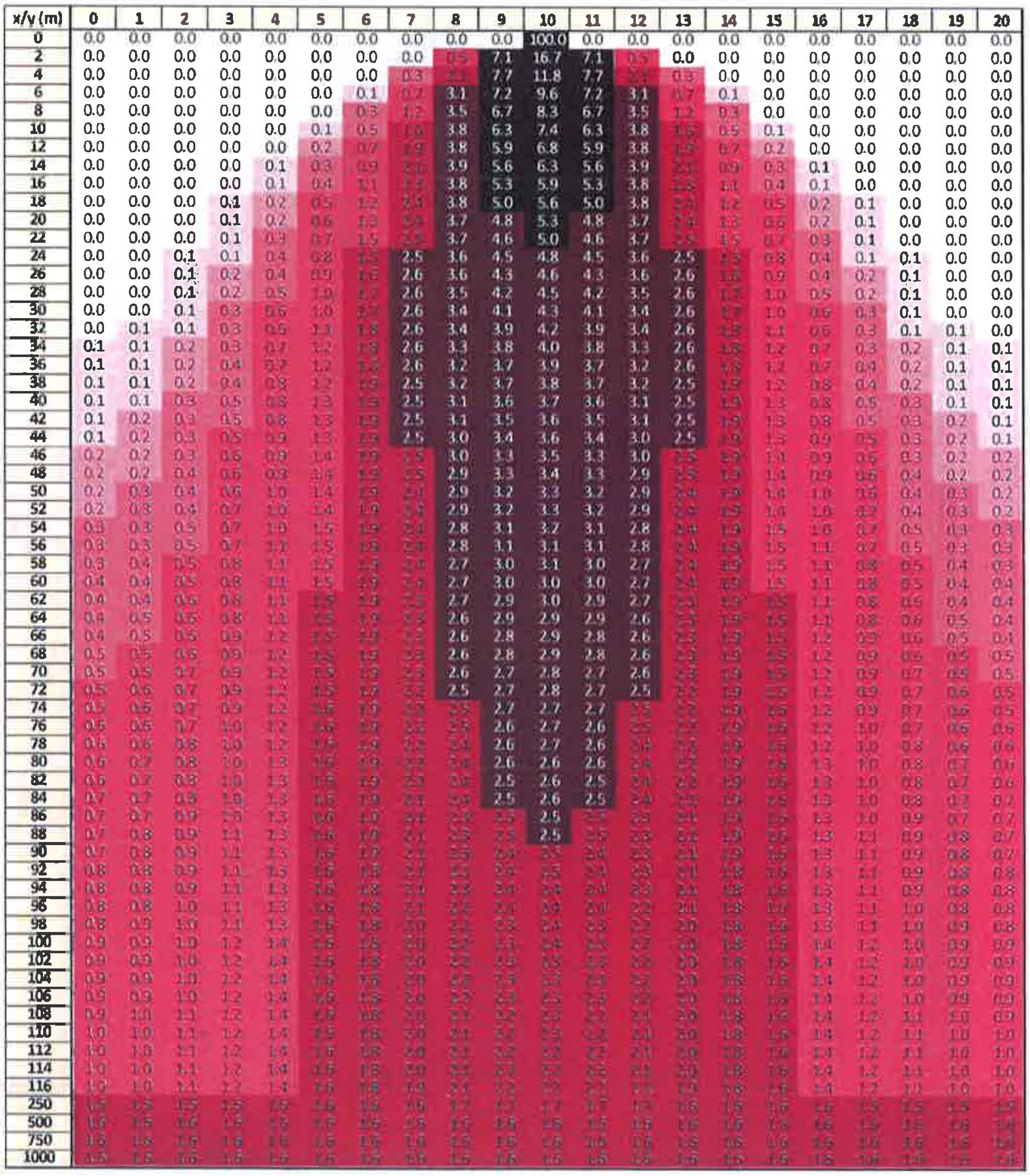
E.coli less than 100 organisms per 100 mL

APPENDIX A
MIXING ZONE ANALYSIS FIGURES



x/y (m)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	5.8	13.6	5.8	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.2	6.3	9.6	6.3	1.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6	2.5	5.9	7.9	5.9	2.5	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.0	2.9	5.5	6.8	5.5	2.9	1.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.1	0.4	1.3	3.1	5.1	6.1	5.1	3.1	1.3	0.4	0.1	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.2	0.6	1.5	3.1	4.8	5.6	4.8	3.1	1.5	0.6	0.2	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.1	0.2	0.7	1.7	3.2	4.6	5.1	4.6	3.2	1.7	0.7	0.2	0.1	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.1	0.3	0.9	1.8	3.1	4.3	4.8	4.3	3.1	1.8	0.9	0.3	0.1	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.1	0.4	1.0	1.9	3.1	4.1	4.5	4.1	3.1	1.9	1.0	0.4	0.1	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.1	0.2	0.5	1.1	2.0	3.1	4.0	4.3	4.0	3.1	2.0	1.1	0.5	0.2	0.1	0.0	0.0	0.0
22	0.0	0.0	0.0	0.1	0.3	0.6	1.2	2.0	3.0	3.8	4.1	3.8	3.0	2.0	1.2	0.6	0.3	0.1	0.0	0.0	0.0
24	0.0	0.0	0.0	0.1	0.3	0.7	1.3	2.1	3.0	3.7	3.9	3.7	3.0	2.1	1.3	0.7	0.3	0.1	0.0	0.0	0.0
26	0.0	0.0	0.1	0.2	0.4	0.7	1.3	2.1	2.9	3.5	3.8	3.5	2.9	2.1	1.3	0.7	0.4	0.2	0.1	0.0	0.0
28	0.0	0.0	0.1	0.2	0.4	0.8	1.4	2.1	2.8	3.4	3.6	3.4	2.8	2.1	1.4	0.8	0.4	0.2	0.1	0.0	0.0
30	0.0	0.0	0.1	0.2	0.5	0.8	1.4	2.1	2.8	3.3	3.5	3.3	2.8	2.1	1.4	0.8	0.5	0.2	0.1	0.0	0.0
32	0.0	0.1	0.1	0.2	0.5	0.9	1.4	2.1	2.7	3.2	3.4	3.2	2.7	2.1	1.4	0.9	0.5	0.2	0.1	0.1	0.0
34	0.0	0.1	0.1	0.3	0.5	0.9	1.5	2.1	2.7	3.1	3.3	3.1	2.7	2.1	1.5	0.9	0.5	0.3	0.1	0.1	0.0
36	0.1	0.1	0.2	0.3	0.6	1.0	1.5	2.1	2.7	3.1	3.2	3.1	2.7	2.1	1.5	1.0	0.6	0.3	0.2	0.1	0.1
38	0.1	0.1	0.2	0.3	0.6	1.0	1.5	2.1	2.6	3.0	3.1	3.0	2.6	2.1	1.5	1.0	0.6	0.3	0.2	0.1	0.1
40	0.1	0.1	0.2	0.4	0.7	1.0	1.5	2.1	2.6	2.9	3.0	2.9	2.6	2.1	1.5	1.0	0.7	0.4	0.2	0.1	0.1
42	0.1	0.1	0.2	0.4	0.7	1.1	1.5	2.1	2.5	2.9	3.0	2.9	2.5	2.1	1.5	1.1	0.7	0.4	0.2	0.1	0.1
44	0.1	0.2	0.3	0.4	0.7	1.1	1.6	2.0	2.5	2.8	2.9	2.8	2.5	2.0	1.6	1.1	0.7	0.4	0.3	0.2	0.1
46	0.1	0.2	0.3	0.5	0.7	1.1	1.6	2.0	2.4	2.7	2.8	2.7	2.4	2.0	1.6	1.1	0.7	0.5	0.3	0.2	0.1
48	0.2	0.2	0.3	0.5	0.8	1.1	1.6	2.0	2.4	2.7	2.8	2.7	2.4	2.0	1.6	1.1	0.8	0.5	0.3	0.2	0.2
50	0.2	0.2	0.3	0.5	0.8	1.2	1.6	2.0	2.4	2.6	2.7	2.6	2.4	2.0	1.6	1.2	0.8	0.5	0.3	0.2	0.2
52	0.2	0.2	0.3	0.5	0.8	1.2	1.6	2.0	2.3	2.6	2.7	2.6	2.3	2.0	1.6	1.2	0.8	0.5	0.3	0.2	0.2
54	0.2	0.3	0.4	0.6	0.8	1.2	1.6	2.0	2.3	2.5	2.6	2.5	2.3	2.0	1.6	1.2	0.8	0.5	0.4	0.3	0.2
56	0.2	0.3	0.4	0.6	0.9	1.2	1.6	2.0	2.3	2.5	2.6	2.5	2.3	2.0	1.6	1.2	0.9	0.6	0.4	0.3	0.2
58	0.3	0.3	0.4	0.6	0.9	1.2	1.6	1.9	2.2	2.5	2.5	2.5	2.2	1.9	1.6	1.2	0.9	0.6	0.4	0.3	0.3
60	0.3	0.3	0.4	0.6	0.9	1.2	1.6	1.9	2.2	2.4	2.5	2.4	2.2	1.9	1.6	1.2	0.9	0.6	0.4	0.3	0.3
62	0.3	0.3	0.5	0.7	0.9	1.2	1.6	1.9	2.2	2.4	2.4	2.4	2.2	1.9	1.6	1.2	0.9	0.7	0.5	0.3	0.3
64	0.3	0.4	0.5	0.7	0.9	1.2	1.6	1.9	2.2	2.3	2.4	2.3	2.2	1.9	1.6	1.2	0.9	0.7	0.5	0.4	0.3
66	0.4	0.4	0.5	0.7	0.9	1.2	1.6	1.9	2.1	2.3	2.4	2.3	2.1	1.9	1.6	1.2	0.9	0.7	0.5	0.4	0.4
68	0.4	0.4	0.5	0.7	1.0	1.3	1.6	1.9	2.1	2.3	2.3	2.3	2.1	1.9	1.6	1.3	1.0	0.7	0.5	0.4	0.4
70	0.4	0.4	0.6	0.7	1.0	1.3	1.6	1.9	2.1	2.2	2.3	2.2	2.1	1.9	1.6	1.3	1.0	0.7	0.5	0.4	0.4
72	0.4	0.5	0.6	0.8	1.0	1.3	1.6	1.8	2.1	2.2	2.3	2.2	2.1	1.8	1.6	1.3	1.0	0.8	0.6	0.5	0.4
74	0.4	0.5	0.6	0.8	1.0	1.3	1.5	1.8	2.0	2.2	2.2	2.2	2.0	1.8	1.5	1.3	1.0	0.8	0.6	0.5	0.4
76	0.5	0.5	0.6	0.8	1.0	1.3	1.5	1.8	2.0	2.1	2.2	2.1	2.0	1.8	1.5	1.3	1.0	0.8	0.6	0.5	0.5
78	0.5	0.5	0.6	0.8	1.0	1.3	1.5	1.8	2.0	2.1	2.2	2.1	2.0	1.8	1.5	1.3	1.0	0.8	0.6	0.5	0.5
80	0.5	0.5	0.6	0.8	1.0	1.3	1.5	1.8	2.0	2.1	2.2	2.1	2.0	1.8	1.5	1.3	1.0	0.8	0.6	0.5	0.5
82	0.5	0.6	0.7	0.8	1.0	1.3	1.5	1.8	2.0	2.1	2.1	2.1	2.0	1.8	1.5	1.3	1.0	0.8	0.7	0.6	0.5
84	0.5	0.6	0.7	0.8	1.0	1.3	1.5	1.8	1.9	2.1	2.1	2.1	1.9	1.8	1.5	1.3	1.0	0.8	0.7	0.6	0.5
86	0.6	0.6	0.7	0.9	1.1	1.3	1.5	1.7	1.9	2.0	2.1	2.0	1.9	1.7	1.5	1.3	1.1	0.9	0.7	0.6	0.6
88	0.6	0.6	0.7	0.9	1.1	1.3	1.5	1.7	1.9	2.0	2.1	2.0	1.9	1.7	1.5	1.3	1.1	0.9	0.7	0.6	0.6
90	0.6	0.6	0.7	0.9	1.1	1.3	1.5	1.7	1.9	2.0	2.0	2.0	1.9	1.7	1.5	1.3	1.1	0.9	0.7	0.6	0.6
92	0.6	0.7	0.8	0.9	1.1	1.3	1.5	1.7	1.9	2.0	2.0	2.0	1.9	1.7	1.5	1.3	1.1	0.9	0.8	0.7	0.6
94	0.6	0.7	0.8	0.9	1.1	1.3	1.5	1.7	1.9	2.0	2.0	2.0	1.9	1.7	1.5	1.3	1.1	0.9	0.8	0.7	0.6
96	0.7	0.7	0.8	0.9	1.1	1.3	1.5	1.7	1.8	1.9	2.0	1.9	1.8	1.7	1.5	1.3	1.1	0.9	0.8	0.7	0.7
98	0.7	0.7	0.8	0.9	1.1	1.3	1.5	1.7	1.8	1.9	1.9	1.9	1.8	1.7	1.5	1.3	1.1	0.9	0.8	0.7	0.7
100	0.7	0.7	0.8	0.9	1.1	1.3	1.5	1.7	1.8	1.9	1.9	1.9	1.8	1.7	1.5	1.3	1.1	0.9	0.8	0.7	0.7
102	0.7	0.7	0.8	1.0	1.1	1.3	1.5	1.7	1.8	1.9	1.9	1.9	1.8	1.7	1.5	1.3	1.1	1.0	0.8	0.7	0.7
104	0.7	0.8	0.8	1.0	1.1	1.3	1.5	1.6	1.8	1.9	1.9	1.9	1.8	1.6	1.5	1.3	1.1	1.0	0.8	0.8	0.7
106	0.7	0.8	0.9	1.0	1.1	1.3	1.5	1.6	1.8	1.8	1.9	1.8	1.8	1.6	1.5	1.3	1.1	1.0	0.9	0.8	0.7
108	0.8	0.8	0.9	1.0	1.1	1.3	1.5	1.6	1.8	1.8	1.9	1.8	1.8	1.6	1.5	1.3	1.1	1.0	0.9	0.8	0.8
110	0.8	0.8	0.9	1.0	1.1	1.3	1.5	1.6	1.7	1.8	1.8	1.8	1.7	1.6	1.5	1.3	1.1	1.0	0.9	0.8	0.8
112	0.8	0.8	0.9	1.0	1.1	1.3	1.5	1.6	1.7	1.8	1.8	1.8	1.7	1.6	1.5	1.3	1.1	1.0	0.9	0.8	0.8
114	0.8	0.8	0.9	1.0	1.1	1.3	1.5	1.6	1.7	1.8	1.8	1.8	1.7	1.6	1.5	1.3	1.1	1.0	0.9	0.8	0.8
116	0.8	0.8	0.9	1.0	1.2	1.3	1.5	1.6	1.7	1.8	1.8	1.8	1.7	1.6	1.5	1.3	1.2	1.0	0.9	0.8	0.8
250	1.2	1.2	1.2	1.3	1.3	1.3	1.3	1.3	1.4	1.4	1.4	1.4	1.4	1.3	1.3	1.3	1.3	1.3	1.2	1.2	1.2
500	1.3	1.3	1.3	1.3	1.4	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
750	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
1000	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3

Figure A.1 ***Concentration Plume (Effluent %) for Scenario 1 Effluent Conditions ($451\ m^3/d$)***



x/y (m)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	7.1	16.7	7.1	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	2.1	7.7	11.8	7.7	2.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.7	3.1	7.2	9.6	7.2	3.1	0.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.2	3.5	6.7	8.3	6.7	3.5	1.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.1	0.5	1.6	3.8	6.3	7.4	6.3	3.8	1.6	0.5	0.1	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.2	0.7	1.9	3.8	5.9	6.8	5.9	3.8	1.9	0.7	0.2	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.1	0.3	0.9	2.1	3.9	5.6	6.3	5.6	3.9	2.1	0.9	0.3	0.1	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.1	0.4	1.1	2.3	3.8	5.3	5.9	5.3	3.8	2.3	1.1	0.4	0.1	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.1	0.2	0.5	1.2	2.4	3.8	5.0	5.6	5.0	3.8	2.4	1.2	0.5	0.2	0.1	0.0	0.0	0.0
20	0.0	0.0	0.0	0.1	0.2	0.6	1.3	2.4	3.7	4.8	5.3	4.8	3.7	2.4	1.3	0.6	0.2	0.1	0.0	0.0	0.0
22	0.0	0.0	0.0	0.1	0.3	0.7	1.5	2.5	3.7	4.6	5.0	4.6	3.7	2.5	1.5	0.7	0.3	0.1	0.0	0.0	0.0
24	0.0	0.0	0.1	0.1	0.4	0.8	1.5	2.5	3.6	4.5	4.8	4.5	3.6	2.5	1.5	0.8	0.4	0.1	0.1	0.0	0.0
26	0.0	0.0	0.1	0.2	0.4	0.9	1.6	2.6	3.6	4.3	4.6	4.3	3.6	2.6	1.6	0.9	0.4	0.2	0.1	0.0	0.0
28	0.0	0.0	0.1	0.2	0.5	1.0	1.7	2.6	3.5	4.2	4.5	4.2	3.5	2.6	1.7	1.0	0.5	0.2	0.1	0.0	0.0
30	0.0	0.0	0.1	0.3	0.6	1.0	1.7	2.6	3.4	4.1	4.3	4.1	3.4	2.6	1.7	1.0	0.6	0.3	0.1	0.0	0.0
32	0.0	0.1	0.1	0.3	0.6	1.1	1.8	2.6	3.4	3.9	4.2	3.9	3.4	2.6	1.8	1.1	0.6	0.3	0.1	0.1	0.0
34	0.1	0.1	0.2	0.3	0.7	1.2	1.8	2.6	3.3	3.8	4.0	3.8	3.3	2.6	1.8	1.2	0.7	0.3	0.2	0.1	0.1
36	0.1	0.1	0.2	0.4	0.7	1.2	1.8	2.6	3.2	3.7	3.9	3.7	3.2	2.6	1.8	1.2	0.7	0.4	0.2	0.1	0.1
38	0.1	0.1	0.2	0.4	0.8	1.2	1.9	2.5	3.2	3.7	3.8	3.7	3.2	2.5	1.9	1.2	0.8	0.4	0.2	0.1	0.1
40	0.1	0.1	0.3	0.5	0.8	1.3	1.9	2.5	3.1	3.6	3.7	3.6	3.1	2.5	1.9	1.3	0.8	0.5	0.3	0.1	0.1
42	0.1	0.2	0.3	0.5	0.8	1.3	1.9	2.5	3.1	3.5	3.6	3.5	3.1	2.5	1.9	1.3	0.8	0.5	0.3	0.2	0.1
44	0.1	0.2	0.3	0.5	0.9	1.3	1.9	2.5	3.0	3.4	3.6	3.4	3.0	2.5	1.9	1.3	0.9	0.5	0.3	0.2	0.1
46	0.2	0.2	0.3	0.6	0.9	1.4	1.9	2.5	3.0	3.3	3.5	3.3	3.0	2.5	1.9	1.4	0.9	0.6	0.3	0.2	0.2
48	0.2	0.2	0.4	0.6	0.9	1.4	1.9	2.5	2.9	3.3	3.4	3.3	2.9	2.5	1.9	1.4	0.9	0.6	0.4	0.2	0.2
50	0.2	0.3	0.4	0.6	1.0	1.4	1.9	2.4	2.9	3.2	3.3	3.2	2.9	2.4	1.9	1.4	1.0	0.6	0.4	0.3	0.2
52	0.2	0.3	0.4	0.7	1.0	1.4	1.9	2.4	2.9	3.2	3.3	3.2	2.9	2.4	1.9	1.4	1.0	0.7	0.4	0.3	0.2
54	0.3	0.3	0.5	0.7	1.0	1.5	1.9	2.4	2.8	3.1	3.2	3.1	2.8	2.4	1.9	1.5	1.0	0.7	0.5	0.3	0.3
56	0.3	0.3	0.5	0.7	1.1	1.5	1.9	2.4	2.8	3.1	3.1	3.1	2.8	2.4	1.9	1.5	1.1	0.7	0.5	0.3	0.3
58	0.3	0.4	0.5	0.8	1.1	1.5	1.9	2.4	2.7	3.0	3.1	3.0	2.7	2.4	1.9	1.5	1.1	0.8	0.5	0.4	0.3
60	0.4	0.4	0.5	0.8	1.1	1.5	1.9	2.4	2.7	3.0	3.0	3.0	2.7	2.4	1.9	1.5	1.1	0.8	0.5	0.4	0.4
62	0.4	0.4	0.6	0.8	1.1	1.5	1.9	2.3	2.7	2.9	3.0	2.9	2.7	2.3	1.9	1.5	1.1	0.8	0.6	0.4	0.4
64	0.4	0.5	0.6	0.8	1.1	1.5	1.9	2.3	2.6	2.9	2.9	2.9	2.6	2.3	1.9	1.5	1.1	0.8	0.6	0.5	0.4
66	0.4	0.5	0.6	0.9	1.2	1.5	1.9	2.3	2.6	2.8	2.9	2.8	2.6	2.3	1.9	1.5	1.2	0.9	0.6	0.5	0.4
68	0.5	0.5	0.6	0.9	1.2	1.5	1.9	2.3	2.6	2.8	2.9	2.8	2.6	2.3	1.9	1.5	1.2	0.9	0.6	0.5	0.5
70	0.5	0.5	0.7	0.9	1.2	1.5	1.9	2.3	2.6	2.7	2.8	2.7	2.6	2.3	1.9	1.5	1.2	0.9	0.7	0.5	0.5
72	0.5	0.6	0.7	0.9	1.2	1.5	1.9	2.2	2.5	2.7	2.8	2.7	2.5	2.2	1.9	1.5	1.2	0.9	0.7	0.6	0.5
74	0.5	0.6	0.7	0.9	1.2	1.6	1.9	2.2	2.5	2.7	2.7	2.7	2.5	2.2	1.9	1.6	1.2	0.9	0.7	0.6	0.5
76	0.6	0.6	0.7	1.0	1.2	1.6	1.9	2.2	2.5	2.6	2.7	2.6	2.5	2.2	1.9	1.6	1.2	1.0	0.7	0.6	0.6
78	0.6	0.6	0.8	1.0	1.2	1.6	1.9	2.2	2.4	2.6	2.7	2.6	2.4	2.2	1.9	1.6	1.2	1.0	0.8	0.6	0.6
80	0.6	0.7	0.8	1.0	1.3	1.6	1.9	2.2	2.4	2.6	2.6	2.6	2.4	2.2	1.9	1.6	1.3	1.0	0.8	0.7	0.6
82	0.6	0.7	0.8	1.0	1.3	1.6	1.9	2.2	2.4	2.5	2.6	2.5	2.4	2.2	1.9	1.6	1.3	1.0	0.8	0.7	0.6
84	0.7	0.7	0.8	1.0	1.3	1.6	1.9	2.1	2.4	2.5	2.6	2.5	2.4	2.1	1.9	1.6	1.3	1.0	0.8	0.7	0.7
86	0.7	0.7	0.9	1.0	1.3	1.6	1.9	2.1	2.3	2.5	2.6	2.5	2.3	2.1	1.9	1.6	1.3	1.0	0.9	0.7	0.7
88	0.7	0.8	0.9	1.1	1.3	1.6	1.9	2.1	2.3	2.5	2.5	2.5	2.3	2.1	1.9	1.6	1.3	1.1	0.9	0.8	0.7
90	0.7	0.8	0.9	1.1	1.3	1.6	1.9	2.1	2.3	2.4	2.5	2.4	2.3	2.1	1.9	1.6	1.3	1.1	0.9	0.8	0.7
92	0.8	0.8	0.9	1.1	1.3	1.6	1.8	2.1	2.3	2.4	2.5	2.4	2.3	2.1	1.8	1.6	1.3	1.1	0.9	0.8	0.8
94	0.8	0.8	0.9	1.1	1.3	1.6	1.8	2.1	2.3	2.4	2.4	2.4	2.3	2.1	1.8	1.6	1.3	1.1	0.9	0.8	0.8
96	0.8	0.8	1.0	1.1	1.3	1.6	1.8	2.1	2.2	2.3	2.4	2.3	2.2	2.1	1.8	1.6	1.3	1.1	1.0	0.8	0.8
98	0.8	0.9	1.0	1.1	1.3	1.6	1.8	2.0	2.2	2.3	2.3	2.3	2.2	2.0	1.8	1.6	1.3	1.1	1.0	0.9	0.8
100	0.9	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.3	2.3	2.3	2.2	2.0	1.8	1.6	1.4	1.2	1.0	0.9	0.9
102	0.9	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.3	2.3	2.3	2.2	2.0	1.8	1.6	1.4	1.2	1.0	0.9	0.9
104	0.9	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.3	2.3	2.3	2.2	2.0	1.8	1.6	1.4	1.2	1.0	0.9	0.9
106	0.9	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.2	2.3	2.2	2.2	2.0	1.8	1.6	1.4	1.2	1.0	0.9	0.9
108	0.9	1.0	1.1	1.2	1.4	1.6	1.8	2.0	2.1	2.2	2.2	2.2	2.1	2.0	1.8	1.6	1.4	1.2	1.1	1.0	0.9
110	1.0	1.0	1.1	1.2	1.4	1.6	1.8	2.0	2.1	2.2	2.2	2.2	2.1	2.0	1.8	1.6	1.4	1.2	1.1	1.0	1.0
112	1.0	1.0	1.1	1.2	1.4	1.6	1.8	2.0	2.1	2.2	2.2	2.2	2.1	2.0	1.8	1.6	1.4	1.2	1.1	1.0	1.0
114	1.0	1.0	1.1	1.2	1.4	1.6	1.8	2.0	2.1	2.2	2.2	2.2	2.1	2.0	1.8	1.6	1.4	1.2	1.1	1.0	1.0
116	1.0	1.0	1.1	1.2	1.4	1.6	1.8	2.0	2.1	2.1	2.2	2.1	2.1	2.0	1.8	1.6	1.4	1.2	1.1	1.0	1.0
250	1.5	1.5	1.5	1.5	1.6	1.6	1.6	1.6	1.7	1.7	1.7	1.7	1.7	1.6	1.6	1.6	1.6	1.5	1.5	1.5	1.5
500	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
750	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
1000	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6

Figure A.2 **Concentration Plume (Effluent %) for Scenario 2 Effluent Conditions ($552\ m^3/d$)**

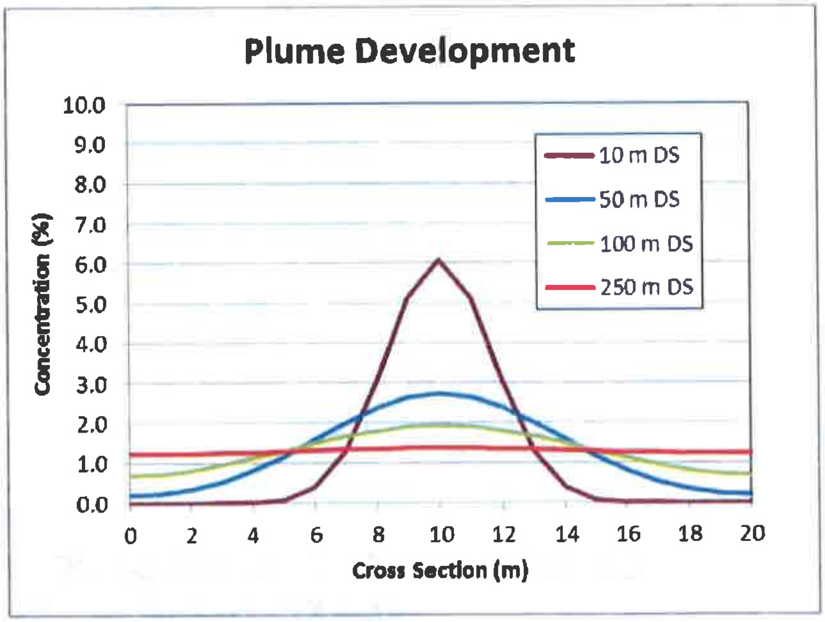


Figure A.3 *Plume Cross-Sections (Effluent %) for Scenario 1 Effluent Conditions ($451\ m^3/d$)*

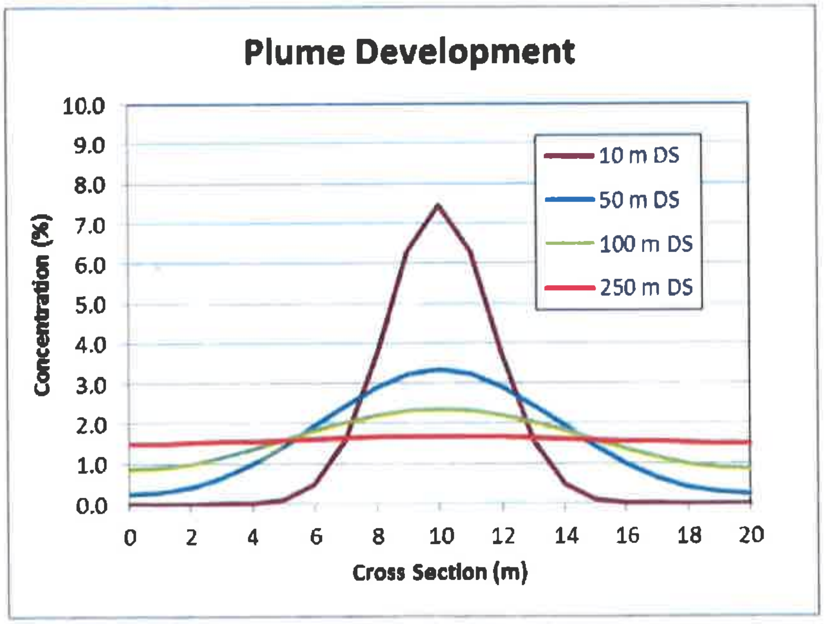


Figure A.4 *Plume Cross-Sections (Effluent %) for Scenario 2 Effluent Conditions ($552\ m^3/d$)*

APPENDIX E
COMMENTS ON ACS FROM MOECC (APRIL 2016) AND XCG RESPONSES (JULY 2016)

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April 28, 2016

Ms. Carla Fernandes, B.E.Sc., P.Eng.
XCG Consulting Limited Environmental Engineers & Scientists
2620 Bristol Circle, Suite 300
Oakville, Ontario, L6H 6Z7

RE: Sarah Properties Proposed Wastewater Treatment Plant in Waldemar

We have completed our review of the *Assimilative Capacity Study of the Grand River in the Vicinity of a proposed WWTP in Waldemar, ON.*, dated March 2016. This ACS is being done to support the proposal by Sarah Properties for a large residential development to be serviced by a wastewater treatment plant that includes a dry-ditch discharge to the Grand River. In order to meet the sewage flow that will be generated by residents of the proposed subdivision along with the possibility of providing servicing to existing development in Waldemar, the proposed wastewater treatment plant has been based on an average daily flow between 451 m^3/day and 552 m^3/day.

Comments and Recommendations

The purpose of this review was to evaluate the proposed assimilative capacity study and indicate additional work that is required. The following comments are based on information presented in the subject report.

1. Recognizing that the final design for the treatment system is still to be determined, an assimilative capacity can't be fully evaluated or deemed acceptable until a design flow has been finalized.

2. Clarification needs to be provided on what period the data is from for determining ambient water quality conditions for each parameter as the discussion regarding 1996-1998 data confounds the understanding. Using PWQMN Station 16018406702 to represent background water quality conditions is reasonable which would negate the need to statistically correlate data that is dated and from different stations. Water chemistry data collected more than 5 years ago is not reflective of current conditions. If recent data (2014-2016) is not available, a monitoring plan should begin soon to establish background conditions.

3. If total phosphorous is a Policy 2 parameter, obtaining a deviation is unlikely. Therefore, a level of treatment is required to ensure concentrations and loadings that do not further degrade the receiver. Further discussion of the proposed effluent limit of 0.1 mg/L is required to determine if improvements can be made.

4. The Canadian Water Quality Guideline for total particulate matter which speaks to total suspended solids should be used for evaluating potential impacts related to this parameter.

5. Absolute values in discussing changes to background concentrations (Section 3) need to be used for the assessment. Discussing changes in relative percentages is not useful.

6. E. coli was determined to be a Policy 1 parameter. A compliance limit of 200 CFU/100 mL is not appropriate when the PWQO is 100 CFU/100 mL (based on a geometric mean of a minimum of five samples).

7. The mixing zone analysis assumes steady state conditions and that the effluent is introduced into the centre of the channel. However, it appears that the discharge will be a shoreline discharge. Clarification should be provided as to the type of outlet and the mixing zone analysis should reflect the approach to be used. The suitability of a dry ditch discharge in terms of location and possible receptors has not been agreed upon to date.

We would also like to take this opportunity to reiterate the following additional matters:

- Given the timing and delegation of planning approval to Dufferin County, have formal planning applications been made for subdivision approval to the County?
- Has a decision been made whether this development will be freehold or condominium tenure form? Tenure form has significant ramifications as a wastewater treatment plant for a freehold residential development will require municipal assumption, ownership and operation. We have not received any direct indication from the Township of their willingness to become owner/operators of a wastewater treatment plant. Conversely, if the development is to be condominium ownership, a municipal responsibility agreement (with adequate financial assurance) will need to be entered into by the developer and the Township.
- The development of a wastewater treatment facility to service residential development is a Schedule "C" undertaking under the MCEA. As such, an EA study is required with the developer as the proponent. Integrating the EA with the required planning approvals is provided for in Section 2.9 of the MCEA and is highly recommended.
- We recall the comment having been made that the existing water supply servicing Waldemar will need to be upgraded/expanded if it is to provide water to this development. This may also require an EA under the MCEA depending on what is needed to provide more water. It would make sense for this work to be undertaken together given all of the interdependencies that stem from the development proposal.

We note that you have also been provided with comments from the GRCA noting some concerns with this initial ACS. It may be beneficial to all parties to convene a meeting to discuss both the ACS and the broader servicing-related issues. To accommodate all parties, a meeting at the ministry's Guelph District Office is offered for consideration.

Should you have questions or wish to discuss these comments, please contact me at 905 578-4952 or at Barbara.slattery@ontario.ca

Yours truly,

Barbara Slattery

Barbara Slattery
EA/Planning Coordinator

cc. Sandra Cooke, Mark Anderson, GRCA (via email only)
Christine Gervais, Township Planner (via email only)
Wendy Wingate, MOECC (via email only)
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July 7, 2016 **XCG File No.: 3-3756-01-01**

Ms. Barbara Slattery
EA/Planning Coordinator
Ministry of the Environment and Climate Change
119 King Street West, 12th Floor
Hamilton, Ontario L8P 4Y7

Re: Sarah Properties Proposed Wastewater Treatment Plant in Waldemar

Dear Ms. Slattery:

We are in receipt of your letter dated April 28, 2016 that provides the Ministry of the Environment and Climate Change's (MOECC's) comments from your review of the "Assimilative Capacity Study of the Grand River in the Vicinity of a Proposed WWTP in Waldemar, ON," dated March 2016 along with questions regarding the status of the development application process.

This letter provides our responses to the MOECC's comments and questions.

1. ASSIMILATIVE CAPACITY STUDY COMMENTS

Below, please find each of your comments related to the Assimilative Capacity Study (ACS) along with our response to each.

MOECC Comment No. 1: *Recognizing that the final design for the treatment system is still to be determined, an assimilative capacity can't be fully evaluated or deemed acceptable until a design flow has been finalized.*

Response: At this time, we propose that the ACS be evaluated against the higher design average day flow (ADF) value of 552 m^3/d to develop effluent concentration and loading limits. These loading limits would then be the maximum allowable loadings to the Grand River from the proposed Wastewater Treatment Plant (WWTP).

Should the final design ADF capacity of the WWTP be less than 552 m^3/d, the effluent concentration limits would remain the same as those defined for 552 m^3/d, and the loading limits reduced accordingly. In this way, the total loadings to the Grand River will not exceed the maximum allowable loadings defined as part of this ACS study.

MOECC Comment No. 2: *Clarification needs to be provided on what period the data is from for determining ambient water quality conditions for each parameter as the discussion regarding 1996-1998 data confounds the understanding. Using PWQMN Station 16018406702 to represent background water quality conditions is reasonable which would negate the need to statistically correlate data that is dated and from different stations. Water chemistry data collected more than 5 years ago is not reflective of current conditions. If recent data (2014-2016) is not available, a monitoring plan should begin soon to establish background conditions.*

Response: The PWQMN Station No. 16018406702 has a recent period of record of only 7 years (2007 to 2014). Previous data from this station (1975 to 1996) was not considered complete, as there was a ten year gap (1997 to 2006). As such, the data from PWQMN Station 16018403902 (period of record 1972 to 2006) was used to supplement the data from the other PWQMN station. This provides a continuous period of record that spans over 35 years. Comments received from the Grand River Conservation Authority (GRCA) were incorporated into the ACS report dated March 2016.

Please note that the data used to develop ambient water quality for all parameters of interest was defined in our draft memorandum dated May 15, 2015 and updated final memorandum dated October 30, 2015. The ambient water quality data was subsequently discussed during a meeting held on November 25, 2015. No concerns regarding the proposed development of ambient water quality values were raised by the MOECC at that time.

At this time, we do not feel there is a need to conduct any receiver monitoring. The background water quality dataset used to support this ACS, which spans 1972 to 2014, provides sufficient data to establish background conditions.

MOECC Comment No. 3: *If total phosphorous is a Policy 2 parameter, obtaining a deviation is unlikely. Therefore, a level of treatment is required to ensure concentrations and loadings that do not further degrade the receiver. Further discussion of the proposed effluent limit of 0.1 mg/L is required to determine if improvements can be made.*

Response: It was understood by all parties that the receiver was Policy 2 with respect to phosphorus, and this fact was discussed during the meeting held on November 25, 2016. The meeting notes state that "the receiver is Policy 2 with respect to TP and as such, a very high level of treatment will be required, likely in combination with offsetting, as loadings are still an issue down the system and into the reservoir. This will have to be discussed further with the MOECC as it is the MOECC that is the governing authority."

We therefore understand that a Policy 2 deviation request will need to be submitted. We would be happy to discuss the required level of treatment with respect to TP in the context of available treatment technologies and other options available to reduce loadings to the receiver.

MOECC Comment No. 4: *The Canadian Water Quality Guideline for total particulate matter which speaks to total suspended solids should be used for evaluating potential impacts related to this parameter.*

Response: The Canadian Water Quality Guideline for suspended sediments is a maximum increase of 25 mg/L from background levels for any short-term exposure, and 5 mg/L for longer term exposure. Based on the proposed TSS concentration limit of 10 mg/L and the equivalent 7Q20 flow of 0.4 m^3/s, the proposed discharge (based on an ADF of 552 m^3/d) would increase TSS by 0.16 mg/L over background levels, which is well below the maximum increase for longer term exposure of 5 mg/L.

MOECC Comment No. 5: *Absolute values in discussing changes to background concentrations (Section 3) need to be used for the assessment. Discussing changes in relative percentages is not useful.*

Response: Table 1 below provides absolute values for the increases to background concentrations for $cBOD_5$, TSS, and TP. Note that the un-ionized ammonia concentrations at fully mixed conditions are defined in the ACS Report, and are below the PWQO of 0.02 mg/L for all seasons.

Table 1 ***Changes to Background Concentrations Based on Proposed Effluent Limits and WWTP ADF of 552 m3/d***

Parameter	Background Value [(1)] (mg/L)	Fully-Mixed Concentration Downstream of Proposed WWTP (mg/L)	% Increase from Background Value
$cBOD_5$	1.5 mg/L	1.66 mg/L	10.7%
TSS	8.0 mg/L	8.16 mg/L	2.0%
TP	0.031 mg/L	0.0326 mg/L	5.2%

Notes:

1. Annual 75th percentile background values for TSS and TP. Available data for cBOD5 was limited. Reported annual 75th percentile value was 1.2 mg/L, therefore a conservative estimate of 1.5 mg/L was used.

MOECC Comment No. 6: *E. coli was determined to be a Policy 1 parameter. A compliance limit of 200 CFU/100 mL is not appropriate when the PWQO is 100 CFU/100 mL (based on a geometric mean of a minimum of five samples).*

Response: Acknowledged. We propose revised *E. coli* objective and limit of 100 CFU/100 mL (based on geometric mean).

MOECC Comment No. 7: *The mixing zone analysis assumes steady state conditions and that the effluent is introduced into the centre of the channel. However, it appears that the discharge will be a shoreline discharge. Clarification should be provided as to the type of outlet and the mixing zone analysis should reflect the approach to be used. The suitability of a dry ditch discharge in terms of location and possible receptors has not been agreed upon to date.*

Response: We have updated the mixing zone assessment to reflect the proposed shoreline discharge. Please see Attachment 1 to this letter. The results indicate that, for Scenarios 1 (451 m^3/d) and 2 (552 m^3/d), completely mixed conditions are achieved within approximately 250 metres downstream of the source. Effluent concentrations are greater than 5% for a relatively small area (2 metres in width and less than 100 metres in length) immediately downstream of the source for each scenario. Completely mixed concentrations for Scenario 1 and 2 are 1.3% and 1.6%, respectively.

2. STATUS OF THE DEVELOPMENT APPLICATION PROCESS

XCG is not currently involved in the development application process for the proposed residential development. Sarah Properties Ltd. has provided responses to the MOECC's questions regarding the status of this process, which have been summarized below:

Table 2 Status of the Development Application Process

MOECC Question / Comment	Response from Sarah Properties Ltd.
Given the timing and delegation of planning approval to Dufferin County, have formal planning applications been made for subdivision approval to the County?	Formal planning applications have been submitted. Completed reports include: Archaeological Assessment, Minimum Distance Separation, Tree Inv. & Preservation Plan, Functional Servicing Report, Environmental Site Assessment, Traffic Study, Financial Impact Assessment, Planning Report, Geotechnical Report, Hydrogeological Report and Water Supply Report.
Has a decision been made whether this development will be freehold or condominium tenure form? Tenure form has significant ramifications as a wastewater treatment plant for a freehold residential development will require municipal assumption, ownership and operation. We have not received any direct indication from the Township of their willingness to become owner/operators of a wastewater treatment plant. Conversely, if the development is to be condominium ownership, a municipal responsibility agreement (with adequate financial assurance) will need to be entered into by the developer and the Township.	The Township of Amaranth will determine the ownership of the wastewater treatment facility after the planning process has been completed. In any case, the houses in the subdivision will be freehold.
The development of a wastewater treatment facility to service residential development is a Schedule "C" undertaking under the MCEA. As such, an EA study is required with the developer as the proponent. Integrating the EA with the required planning approvals is provided for in Section 2.9 of the MCEA and is highly recommended.	The wastewater treatment EA will be integrated with the required planning approvals.
We recall the comment having been made that the existing water supply servicing Waldemar will need to be upgraded/expanded if it is to provide water to this development. This may also require an EA under the MCEA depending on what is needed to provide more water. It would make sense for this work to be undertaken together given all of the interdependencies that stem from the development proposal.	Agreed, the water supply EA will run concurrently with the wastewater treatment EA.

3. CLOSURE

We would like to thank you for providing your comments related to the proposed WWTP in the vicinity of Waldemar, Ontario. As suggested in your April 28, 2016 letter, a meeting between all parties, including Sarah Properties Ltd., ASI Group, MOECC, XCG and GRCA would provide an opportunity to discuss the responses we have provided above, as well as define next steps. We will be in contact with you to schedule this meeting.

In the meantime, should you have any questions or concerns, please do not hesitate to contact the undersigned.

Yours very truly,

XCG CONSULTING LIMITED

Melody Johnson

Melody Johnson, M.A.Sc., P.Eng.
Senior Project Manager

cc: Sandra Cooke and Mark Anderson, GRCA
Lindsay Wolfenberg, ASI
Wendy Wingate, MOECC
Laura Daly, MAH
Walter Broos, Sharah Properties Ltd.
Mike Newbigging, XCG
Christine Gervais, Township Planner

Attachment: Grand River at Marsville, Mixing Zone Assessment

GRAND RIVER AT MARSVILLE, MIXING ZONE ASSESSMENT

Grand River at Marsville
Mixing Zone Assessment
February 2016, Revised May 2016

1. *Objective*

The objective was to define the low-flow mixing zone in the Grand River near Marsville, for two proposed WPCP effluent scenarios: 451 and 552 m^3/d.

2. *Approach*

The general approach involved application of an analytical solution of the two-dimensional advective dispersive transport equation (Equation [1]) for steady state conditions (Fischer et al., 1979).

$$v\frac{\partial C}{\partial x} = E\left[\frac{\partial^2 C}{\partial x^2} + \frac{\partial^2 C}{\partial y^2}\right] - kC \pm S \qquad [1]$$

Where:

C = Concentration of contaminate (mg/L)
E = Dispersion coefficient (m^2/s)
v = Velocity (m/s)
k = Decay constant (s^{-1})
S = Sources and sinks (mg/L/s)

The dispersion coefficient, E, can be approximated using an empirical relationship presented below as Equation [2] (Fischer et al., 1979).

$$E \cong 0.6d\sqrt{gdS} = 0.6du \qquad [2]$$

Where:

d = Channel depth (m)
g = Gravitational constant (m/s^2)
S = Average channel slope (m/m)
u = Channel shear velocity (m/s)

Plume superposition was applied to address channel boundaries.

3. *Assumptions*

Important assumptions include:

- Effluent is completely mixed vertically.

- Average flow and average depth can be applied, with Manning's equation to estimate depth for low-flow conditions.
- Momentum of effluent flow can be ignored.
- Steady state conditions have been achieved.
- The channel is rectangular, constant width (20 m) and uniform.
- Shoreline effluent discharge is assumed.

4. *Parameter Summary*

A summary of key parameter assignments is provided in Table 1.

Key parameter Assignments

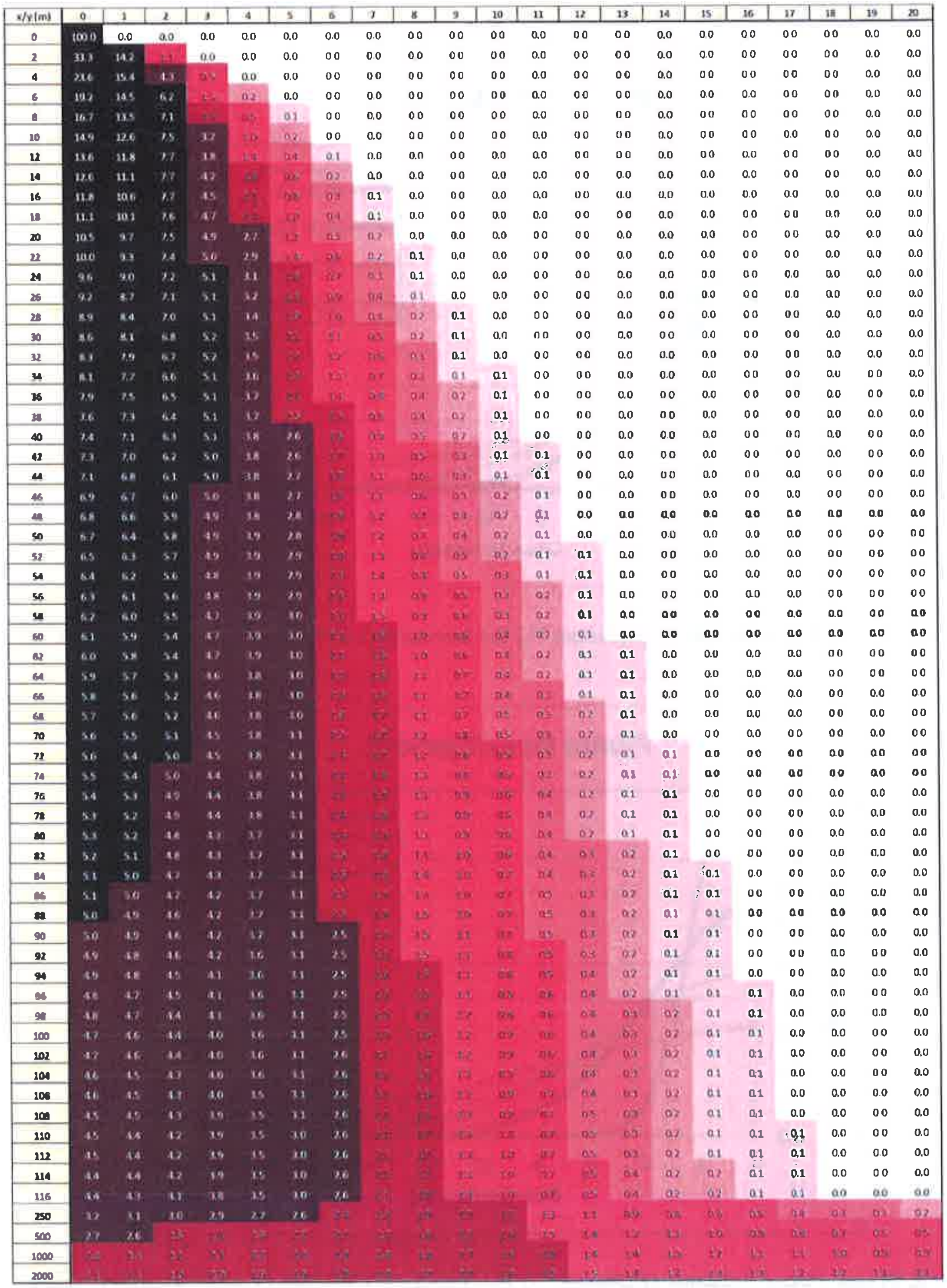
Parameter	Variable	Value	Units
Channel Width	*w*	20.0	m
Average Channel Depth - Low-Flow	*d*	0.30	m
WPCP Flow	*Qe*	451-552	m^3/d
River Low-Flow	*Qr*	0.4	m^3/s
Average Channel Slope	*S*	0.001	m/m
Shear velocity	*u*	0.054	m/s
Dispersion Coefficient	*Et*	0.010	m^2/s

5. *Results*

The estimated mixing zones corresponding to Scenarios 1 (451 m^3/d) and 2 (552 m^3/d) are provided as Figures 1 and 2, respectively. Illustrative plume cross-sections for each scenario are provided in Figures 3 and 4, respectively. For each Scenario, completely mixed conditions are achieved within (approximately) 250 m downstream of the source. Effluent concentrations are greater than 5% for a relatively small area (2m in width and less than 100 m in length) immediately downstream of the source for each scenario. Completely mixed concentrations for Scenario 1 and 2 are 1.3 and 1.6%, respectively.

x/y (m)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	22.2	11.6	[illegible]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	19.2	12.6	3.5	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	15.7	11.8	5.6	[illegible]	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	13.8	11.0	5.8	[illegible]	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	12.2	10.3	6.1	2.6	[illegible]	[illegible]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	11.1	[illegible]	6.3	3.1	[illegible]	0.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	10.3	9.1	5.9	3.4	[illegible]	0.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	9.6	[illegible]	5.3	3.7	[illegible]	[illegible]	[illegible]	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	9.1	[illegible]	6.2	3.9	[illegible]	0.8	[illegible]	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	8.6	7.9	6.1	4.0	[illegible]	1.0	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	8.2	7.6	6.0	4.1	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	7.6	7.3	5.9	4.1	2.5	[illegible]	[illegible]	[illegible]	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	7.5	7.1	5.8	4.2	2.6	[illegible]	[illegible]	[illegible]	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	7.3	6.8	5.7	4.2	2.7	[illegible]	[illegible]	[illegible]	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	7.0	6.6	5.6	4.2	2.8	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	6.8	6.4	5.5	4.2	2.9	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	6.6	6.3	5.4	4.2	3.0	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	6.4	6.1	5.3	4.2	3.0	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	6.2	6.0	5.2	4.2	3.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	6.1	5.8	5.1	4.1	3.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	5.9	5.7	5.0	4.1	3.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	5.8	5.6	5.0	4.1	3.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	5.7	5.5	4.9	4.1	3.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	5.6	5.4	4.8	4.0	3.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	5.4	5.3	4.7	4.0	3.2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	5.3	5.2	4.7	4.0	3.2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
54	5.2	5.1	4.6	3.9	3.2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
56	5.1	5.0	4.6	3.9	3.2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
58	5.1	4.9	4.5	3.9	3.2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	5.0	4.8	4.4	3.8	3.2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
62	4.9	4.8	4.4	3.8	3.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
64	4.8	4.7	4.3	3.8	3.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
66	4.7	4.5	4.3	3.8	3.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
68	4.7	4.6	4.2	3.7	3.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70	4.6	4.5	4.2	3.7	3.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
72	4.5	4.4	4.1	3.7	3.1	2.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	4.5	4.4	4.1	3.6	3.1	2.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
76	4.4	4.3	4.0	3.6	3.1	2.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
78	4.4	4.3	4.0	3.6	3.1	2.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
80	4.3	4.2	4.0	3.6	3.1	2.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
82	4.3	4.2	3.9	3.5	3.0	2.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
84	4.2	4.2	3.9	3.5	3.0	2.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
86	4.2	4.1	3.8	3.5	3.0	2.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
88	4.1	4.0	3.8	3.4	3.0	2.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.1	0.0	0.0	0.0	0.0	0.0
90	4.1	4.0	3.8	3.4	3.0	2.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.1	0.0	0.0	0.0	0.0	0.0
92	4.0	3.9	3.7	3.4	3.0	2.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.1	0.0	0.0	0.0	0.0	0.0
94	4.0	3.9	3.7	3.4	3.0	2.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.1	0.0	0.0	0.0	0.0	0.0
96	[illegible]	[illegible]	3.7	3.3	3.0	2.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.1	0.0	0.0	0.0	0.0	0.0
98	[illegible]	[illegible]	3.6	3.3	2.9	2.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.1	0.0	0.0	0.0	0.0	0.0
100	[illegible]	[illegible]	3.6	3.3	2.9	2.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.1	0.0	0.0	0.0	0.0	0.0
102	[illegible]	3.7	3.6	3.3	2.9	2.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.1	0.1	0.0	0.0	0.0	0.0
104	[illegible]	3.7	3.5	3.3	2.9	2.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.1	0.0	0.0	0.0	0.0
106	3.7	3.7	3.5	3.2	2.9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.1	0.0	0.0	0.0	0.0
108	3.7	3.6	3.5	3.2	2.9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.1	0.0	0.0	0.0	0.0
110	3.7	3.6	3.5	3.2	2.9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.1	0.0	0.0	0.0	0.0
112	3.6	3.6	3.4	3.2	2.8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.1	0.0	0.0	0.0	0.0
114	3.6	3.6	3.4	3.2	2.8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.1	0.0	0.0	0.0	0.0
116	3.6	3.5	3.4	3.1	2.8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.1	0.1	0.0	0.0	0.0
250	2.6	2.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
500	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Figure 1. Concentration Plume (Effluent %) for Scenario 1 Effluent Conditions (451 m^3/d)



x/y (m)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	33.3	14.2	[illegible]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	23.6	15.4	4.3	[illegible]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	19.2	14.5	6.2	[illegible]	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	16.7	13.5	7.1	[illegible]	[illegible]	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	14.9	12.6	7.5	3.2	[illegible]	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	13.6	11.8	7.7	3.8	[illegible]	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	12.6	11.1	7.7	4.2	[illegible]	[illegible]	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	11.8	10.6	7.7	4.5	[illegible]	[illegible]	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	11.3	10.1	7.6	4.7	[illegible]	[illegible]	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	10.5	9.7	7.5	4.9	2.7	[illegible]	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	10.0	9.3	7.4	5.0	2.9	[illegible]	[illegible]	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	9.6	9.0	7.2	5.1	3.1	[illegible]	[illegible]	[illegible]	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	9.2	8.7	7.1	5.1	3.2	[illegible]	[illegible]	[illegible]	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	8.9	8.4	7.0	5.1	3.4	[illegible]	[illegible]	[illegible]	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	8.6	8.1	6.8	5.2	3.5	[illegible]	[illegible]	[illegible]	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	8.3	7.9	6.7	5.2	3.5	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	8.1	7.7	6.6	5.1	3.6	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	7.9	7.5	6.5	5.1	3.7	[illegible]	[illegible]	[illegible]	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	7.6	7.3	6.4	5.1	3.7	[illegible]	[illegible]	[illegible]	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	7.4	7.1	6.3	5.1	3.8	2.6	[illegible]	[illegible]	0.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	7.3	7.0	6.2	5.0	3.8	2.6	[illegible]	[illegible]	0.5	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	7.1	6.8	6.1	5.0	3.8	2.7	[illegible]	[illegible]	0.6	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	6.9	6.7	6.0	5.0	3.8	2.7	[illegible]	[illegible]	0.6	0.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	6.8	6.6	5.9	4.9	3.8	2.8	[illegible]	1.2	[illegible]	[illegible]	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	6.7	6.4	5.8	4.9	3.9	2.8	[illegible]	1.2	[illegible]	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	6.5	6.3	5.7	4.9	3.9	2.9	[illegible]	1.3	[illegible]	0.5	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
54	6.4	6.2	5.6	4.8	3.9	2.9	[illegible]	1.4	0.8	0.5	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
56	6.3	6.1	5.6	4.8	3.9	2.9	[illegible]	[illegible]	0.9	0.5	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
58	6.2	6.0	5.5	4.7	3.9	3.0	[illegible]	[illegible]	[illegible]	0.6	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	6.1	5.9	5.4	4.7	3.9	3.0	[illegible]	[illegible]	1.0	0.6	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
62	6.0	5.8	5.4	4.7	3.9	3.0	[illegible]	[illegible]	1.0	0.6	0.4	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
64	5.9	5.7	5.3	4.6	3.8	3.0	[illegible]	[illegible]	[illegible]	0.7	0.4	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
66	5.8	5.6	5.2	4.6	3.8	3.0	[illegible]	[illegible]	[illegible]	0.7	0.4	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
68	5.7	5.6	5.2	4.6	3.8	3.0	[illegible]	[illegible]	[illegible]	0.7	0.5	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70	5.6	5.5	5.1	4.5	3.8	3.1	[illegible]	[illegible]	[illegible]	0.8	0.5	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
72	5.6	5.4	5.0	4.5	3.8	3.1	[illegible]	[illegible]	[illegible]	0.8	0.5	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
74	5.5	5.4	5.0	4.4	3.8	3.1	[illegible]	[illegible]	[illegible]	0.8	0.5	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
76	5.4	5.3	4.9	4.4	3.8	3.1	[illegible]	[illegible]	[illegible]	0.9	0.6	0.4	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
78	5.3	5.2	4.9	4.4	3.8	3.1	[illegible]	[illegible]	[illegible]	0.9	0.6	0.4	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
80	5.3	5.2	4.8	4.3	3.7	3.1	[illegible]	[illegible]	[illegible]	0.9	0.6	0.4	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
82	5.2	5.1	4.8	4.3	3.7	3.1	[illegible]	[illegible]	[illegible]	1.0	0.6	0.4	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
84	5.1	5.0	4.7	4.3	3.7	3.1	[illegible]	[illegible]	[illegible]	1.0	0.7	0.4	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0
86	5.1	5.0	4.7	4.2	3.7	3.1	[illegible]	[illegible]	[illegible]	1.0	0.7	0.5	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0
88	5.0	4.9	4.6	4.2	3.7	3.1	[illegible]	[illegible]	[illegible]	1.0	0.7	0.5	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0
90	5.0	4.9	4.6	4.2	3.7	3.1	2.5	[illegible]	[illegible]	1.1	0.7	0.5	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0
92	4.9	4.8	4.6	4.2	3.6	3.1	2.5	[illegible]	[illegible]	1.1	0.8	0.5	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0
94	4.9	4.8	4.5	4.1	3.6	3.1	2.5	[illegible]	[illegible]	1.1	0.8	0.6	0.4	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0
96	4.8	4.7	4.5	4.1	3.6	3.1	2.5	[illegible]	[illegible]	1.1	0.8	0.6	0.4	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.0
98	4.8	4.7	4.4	4.1	3.6	3.1	2.5	[illegible]	[illegible]	1.2	0.8	0.6	0.4	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0
100	4.7	4.6	4.4	4.0	3.6	3.1	2.5	[illegible]	[illegible]	1.2	0.9	0.6	0.4	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0
102	4.7	4.6	4.4	4.0	3.6	3.1	2.6	[illegible]	[illegible]	1.2	0.9	0.6	0.4	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0
104	4.6	4.5	4.3	4.0	3.6	3.1	2.6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.4	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0
106	4.6	4.5	4.3	4.0	3.5	3.1	2.6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.4	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0
108	4.5	4.5	4.3	3.9	3.5	3.1	2.6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.5	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0
110	4.5	4.4	4.2	3.9	3.5	3.0	2.6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.5	0.3	0.2	0.1	0.1	0.1	0.0	0.0	0.0
112	4.5	4.4	4.2	3.9	3.5	3.0	2.6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.5	0.3	0.2	0.1	0.1	0.1	0.0	0.0	0.0
114	4.4	4.4	4.2	3.9	3.5	3.0	2.6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.5	0.4	0.2	0.2	0.1	0.1	0.0	0.0	0.0
116	4.4	4.3	4.1	3.8	3.5	3.0	2.6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.5	0.4	0.2	0.2	0.1	0.1	0.0	0.0	0.0
250	3.2	3.1	3.0	2.9	2.7	2.6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.3	1.1	0.9	0.6	0.5	0.5	0.4	0.3	0.3	0.2
500	2.7	2.6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.4	1.2	1.1	1.0	0.9	0.8	0.7	0.5	0.5
1000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Figure 2. Concentration Plume (Effluent %) for Scenario 2 Effluent Conditions (552 m^3/d)

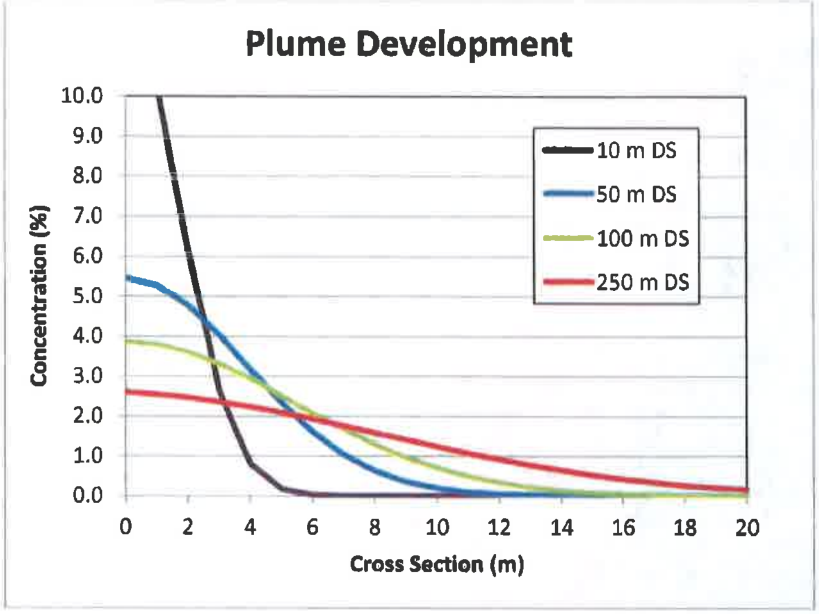


Figure 3. Plume Cross-Sections (Effluent %) for Scenario 1 Effluent Conditions (451 m^3/d)

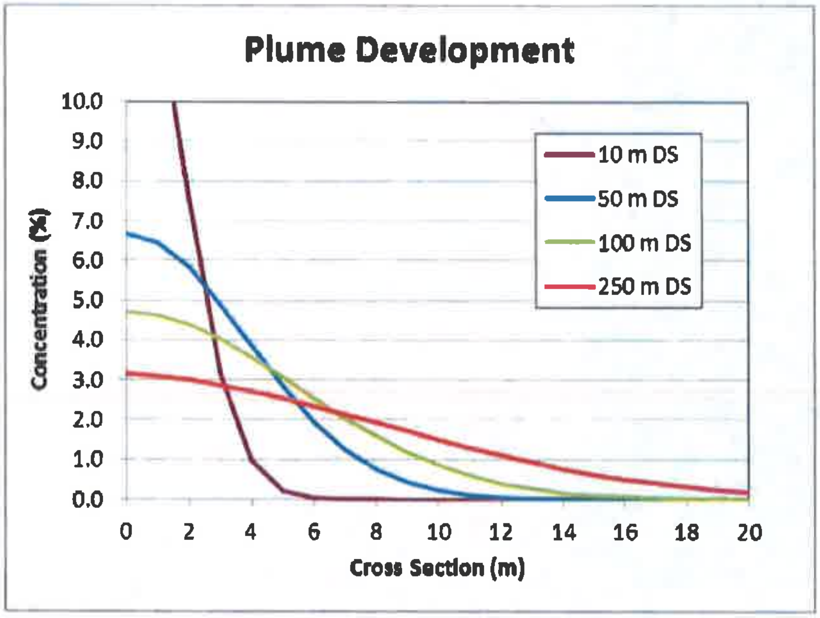


Figure 4. Plume Cross-Sections (Effluent %) for Scenario 2 Effluent Conditions (552 m^3/d)

APPENDIX F

MEETING NOTES – AUGUST 15, 2016 MEETING WITH MOECC AND GRCA AND FOLLOW-UP CORRESPONDENCE

XCG
Environmental Engineers & Scientists

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XCG File No.: 3-3756-01-01

Project:	Waldemar Development: Assimilative Capacity Study Meeting with the MOECC and GRCA
Meeting Date:	Monday, August 15, 2016 1:00 PM
Attendees:	Craig Fowler (CF), MOECC Barbara Slattery (BS), MOECC Kevin Noll (KN), MOECC Wendy Wingate (WW), MOECC Gord Feniak (GF), R.J. Burnside & Associates Ltd. (RJB) Mark Anderson (MA), Grand River Conservation Authority (GRCA) Walter Broos (WB), Sarah Properties Ltd. Lindsay Wolfenberg (LW), ASI Group (ASI) Mike Hulley (MH), XCG Consultants Ltd. (XCG) Melody Johnson (MJ), XCG
Regrets:	Christine Gervais (CG), Township of Amaranth-East Gary (Township) Gary Tomlinson (GT), MOECC Sandra Cooke (SC), GRCA
Notes By:	Melody Johnson Walter Broos
Status:	Sept 9, 2016 (Draft), Sept 23, 2016 (Comments by – none received), Nov 29, 2016 (Final)

Item	Action
1. **Project Background and Status**	
• WB provided a brief background of the proposed development and the on-going application process:	Info
– Class EA for the wastewater treatment facility is underway. CC Tatham & Associates have been retained to complete the Class EA. BS noted that the MOECC has not yet received a Notice of Commencement for this study.	
– Formal planning applications have been submitted, and a number of supporting reports have been completed (these are outlined in XCG's July 7, 2016 letter).	

Item	Action
• LW provided a brief overview of the wastewater treatment facility technology (membrane treatment), and proposed discharge location. It was noted that the option of surface water discharge is being investigated first to determine its feasibility. As such, the ongoing Assimilative Capacity Study (ACS) was initiated to determine if a new point source discharge to the Grand River would be approved by MOECC.	Info
• MJ provided an overview of the status of the ACS. Through consultation with the MOECC and GRCA, agreement was reached regarding the equivalent 7Q20 flow to be used as the basis for the study. An ACS report was submitted to MOECC on March 29, 2016 for MOECC review, and comments were received from MOECC on April 28, 2016. XCG issued a letter responding to those comments on July 7, 2016.	Info
• The purpose of the meeting, therefore, was to discuss XCG's responses to the MOECC's comments, and determine required next steps for this study.	Info
• During the last meeting on May 19, 2015, MA and CF had raised questions around the average day flow (ADF) being calculated based on two people per household as well as address infiltration. Prior to the meeting, ASI had re-calculated the ADF to be 450 m^3/d based on three people per household and infiltration.	Info
• LW summarized the questions raised by CF during the December 2014 meeting about possible issues around two-tier sewage treatment existing in the same residential area. Prior to the meeting, ASI provided an additional ADF calculation of 552 m^3/d for the potential to tie in existing surrounding properties to the proposed wastewater treatment plant (WWTP). This calculation included 3 people per household and infiltration.	Info
2. **Review of MOECC Comments and Team's Response**	
• MOECC Comment: *Recognizing that the final design for the treatment system is still to be determined, an assimilative capacity can't be fully evaluated or deemed acceptable until a design flow has been finalized.* – Two potential design flows were presented in the ACS report (451 m^3/d and 552 m^3/d). XCG has suggested that the higher value (552 m^3/d) be used for the purposes of developing effluent requirements for the new treatment facility. In this way, should the final design value be less than 552 m^3/d, the effluent concentration limits would remain the same as those defined for 552 m^3/d, and the loading limits reduced accordingly. MOECC and GRCA agreed with this approach.	Info

Item	Action
– CF requested clarification regarding the difference between the two design values, and why they are much higher than the design flow discussed at the beginning of this project (300 m^3/d). LW indicated that the design flows were updated during the project to increase the persons per unit value to 3 PPU from 2 PPU, and to include an allowance for infiltration, resulting in an ADF value of 451 m^3/d for the new development. To address MOECC's concerns regarding a "two-tier" sewage treatment system (with existing residential units remaining on septic systems), an allowance was added to the design ADF to include tie-in of existing properties to the new treatment system, yielding a design ADF of 552 m^3/d.	Info
• MOECC Comment: *Clarification needs to be provided on what period the data is from for determining ambient water quality conditions for each parameter as the discussion regarding 1996-1998 data confounds the understanding. Using PWQMN Station 16018406702 to represent background water quality conditions is reasonable which would negate the need to statistically correlate data that is dated and from different stations. Water chemistry data collected more than 5 years ago is not reflective of current conditions. If recent data (2014-2016) is not available, a monitoring plan should begin soon to establish background conditions.*	Info
– MJ indicated that the dataset used for the assessment of background water quality was based on data spanning the 1975 to 2015 collected at the downstream PWQMN station (no. 16018406702). MJ acknowledged that the response in XCG's July 7, 2016 needs to be revised to provide further clarity.	
– CF suggested utilizing the last 5 years' worth of monitoring data to assess ambient conditions. MA indicated that this would likely not provide sufficient data points for an accurate analysis.	
– MA asked if there were any trends observed in any of the background water quality data over time that would support truncating the data set to provide a more accurate representation of current ambient conditions. MH indicated that a visual assessment of the data was done for all parameters, and that no trends were observed. XCG will conduct a statistical analysis of the background TP to confirm that there are no trends.	XCG

Item	Action
– MA indicated that the PWQMN laboratory may have been under-reporting total phosphorus concentrations since November 2012 after changing analytical methods. MA also noted that around 1995 to 1996, changes were also made to ammonia analyses. XCG will consider these items in their statistical evaluation of the background water quality data.	XCG
• MOECC Comment: *If total phosphorous is a Policy 2 parameter, obtaining a deviation is unlikely. Therefore, a level of treatment is required to ensure concentrations and loadings that do not further degrade the receiver. Further discussion of the proposed effluent limit of 0.1 mg/L is required to determine if improvements can be made.*	Info
– MJ noted that, due to the ambient water quality and the effluent quality achievable by the proposed treatment technology (MBR), the proposed discharge would increase instream TP concentrations. As such, it does not meet the Policy 2 requirements, and it is understood that a deviation request would need to be approved for the discharge to be approved.	
– CF indicated that, in principle, he is not against the proposed effluent TP concentration limit of 0.10 mg/L and objective of 0.08 mg/L, but requested that a review be completed to determine if there are any supplemental treatment technologies that could be used to further reduce the effluent TP concentration. MJ noted that the proposed concentration objective of 0.08 mg/L is based on equipment supplier guarantees, but that MBR technologies have been capable of achieving lower average effluent TP concentrations. However, the design of the system must be such that it can consistently meet the design objective and, therefore, introduces conservatism into the design.	
– CF noted that he is unaware of any Policy 2 deviation requests being made or granted in MOECC's West Central Region over the past 25 to 30 years, aside from one temporary deviation.	
– **After meeting note**: CF indicated that there exists a formal process to apply for a Policy 2 Deviation contained in Appendix C of the MOECC "Green Book." The process is not driven by or overseen by Technical Services; rather, approval would need to come from the Regional Director, Approvals Branch and possibly Policy Branch.	

Item	Action
– MJ and LW noted that the MBR treatment system being proposed is considered to be current "best available treatment" for phosphorus removal, and as such, would meet one of the pre-requisites for a deviation request to be considered.	Info
– MA noted that GRCA's concern relates to the downstream Bellwood reservoir, which becomes eutrophic during the summer months. Any additional phosphorus loading would not help conditions in the reservoir and, as such, GRCA would like to see any possible measures to be implemented to limit phosphorus loading to the Grand River (such as storm water treatment).	
– CF asked if phosphorus offsetting had been considered. GF noted that this would be difficult for a private developer to implement. MA noted that this approach has not yet been implemented in the GRCA to-date.	
• The remaining MOECC comments, and XCG's responses, were discussed. No issues were raised.	Info
3. **Status of the Development Application Process**	
• WB indicated that OPA, Re-zoning and Draft Plan applications have been submitted. In addition, 11 reports have been completed as outlined in XCG's July 7, 2016 letter.	Info
• The Class EA for the wastewater treatment facility will be completed by C.C. Tatham & Associates Ltd.	Info
4. **Other Business**	
• MJ asked if MOECC's Technical Services area would consider providing a letter stating their position with respect to proposed effluent requirements outside of the Class EA process. In this way, the MOECC's decision can be used to help guide the Class EA process. MJ noted that, if as part of the Class EA study it is determined that the design ADF is some value greater than 552 m^3/d, an updated ACS would be submitted at that time. BS indicated that she foresees no reason why the MOECC wouldn't be able to provide their opinion regarding the ACS prior to the official start of the Class EA study.	Info

Item	Action
5. **Next Steps**	
• XCG to prepare a letter for MOECC that includes the following: – Clear summary of PWQMN and other data used to develop ambient conditions, along with a statistical analysis of the data to identify TP concentration trends, if any, over the course of the data set. – Estimates of unionized ammonia and TP concentrations within the mixing zone. **After meeting note**: CF also requested that temperature effects within the mixing zone be evaluated. – A summary table clearly outlining the proposed effluent objectives and limits based on an ADF of 552 m^3/d.	XCG
• ASI to conduct a high-level assessment of the potential to provide seasonal discharge to address eutrophication in the downstream Bellwood reservoir.	ASI
• ASI to investigate the potential to provide additional treatment step(s) downstream or in combination with the proposed MBR system that may be capable of further reducing effluent TP concentrations.	ASI

Any errors, omissions, or discrepancies should be reported to Melody Johnson.

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September 23, 2016 **XCG File No.: 3-3756-01-01**

Ms. Barbara Slattery
EA/Planning Coordinator
Ministry of the Environment and Climate Change
119 King Street West, 12th Floor
Hamilton, Ontario L8P 4Y7

Re: Sarah Properties Proposed Wastewater Treatment Plant in Waldemar, Ontario

Dear Ms. Slattery:

As per our meeting on August 15, 2016, below please find additional clarification and information regarding the *Assimilative Capacity Study of the Grand River in the Vicinity of a Proposed WWTP in Waldemar, ON*, the Ministry of the Environment and Climate Change's (MOECC's) comments in a letter dated April 28, 2016, and our response letter dated July 7, 2016. Items addressed include:

- Providing a clear summary of the Provincial Water Quality Monitoring Network (PWQMN) data used to develop ambient conditions;
- Estimates of unionized ammonia, total phosphorus (TP), and temperature within the mixing zone;
- A summary table clearly outlining the proposed effluent objectives and limits based on a design average day flow (ADF) capacity of 552 m^3/d.

The above items are discussed in more detail in the following sections.

1. PWQMN DATA USED TO DEVELOP AMBIENT CONDITIONS

As part of our ACS, PWQMN data used to develop ambient conditions in the Grand River in the vicinity of Waldemar were as follows:

- PWQMN Station No. 16018406702, located approximately 3.6 km downstream of the proposed discharge location.
  - These data span the periods 1975, 1978 to 1996, inclusive, and 2004 to 2014, inclusive (providing 31 years' worth of data).
  - Parameter concentrations available over that period include: dissolved oxygen (DO), temperature, ammonia (total and unionized), pH, total phosphorus (TP), and total suspended solids (TSS).
- Additional data provided by Grand River Conservation Authority (GRCA).
  - These data span 2015. The samples from this data set were collected at the location of PWQMN Station No. 16018406702.
  - Parameter concentrations available over that period include: ammonia (total and unionized), TP, TSS.

- Ammonia (total and unionized) data were truncated to remove data prior to 1997 to eliminate an increasing trend in the data. This was based on input received from the Grand River Conservation Authority (GRCA).
- For all other parameters, all available data were used to determine ambient conditions.

During the August 15, 2016 meeting, MOECC raised concerns regarding the long period of record of the background water quality data set, since it is possible that data collected five or more years ago may not be representative of existing conditions in the receiver. As noted above, the ammonia data set was truncated to include only data from 1997 to 2015 to eliminate an increasing trend in the data.

To address the MOECC's concern regarding the remaining data set, a statistical analysis was conducted to determine if there were any trends in a representative parameter (in this case, chosen to be TP) over the period of record. No significant trends were observed, indicating that background water quality data over the entire period of record is suitable for determining ambient water quality. See Attachment 1 for details of the statistical assessment.

2. ADDITIONAL MIXING ZONE ANALYSIS

As requested during the August 15, 2016 meeting, additional mixing zone analyses were conducted to estimate the thermal impacts of effluent as well as to estimate the concentrations of unionized ammonia and TP within the mixing zone. The basis for these analyses was the previously developed 2-dimensional mixing-zone analysis, as presented in our July 7, 2016 letter. All analyses below were based on an equivalent receiver 7Q20 flow of 0.4 m^3/s and the proposed facility design ADF of 552 m^3/d.

Thermal Impacts

Estimates of in-stream temperature were generated for winter and summer conditions for a range of ambient and effluent temperatures.

Based on the results of the analysis, the largest anticipated in-stream difference in temperature is 1.5°C for summer and 7.3°C for winter, located at a downstream distance of 1.0 m from the discharge point. Temperature differences of 1°C or more were limited to a region less than 1 m wide by 5 m long in summer, and 2 m wide and 42 m long in winter. The "worst-case" conditions for both summer and winter are presented in detail in Attachment 2.

Unionized Ammonia

Estimates of in-stream unionized ammonia concentrations were generated for winter and summer conditions, using the "worst-case" thermal impacts developed above and effluent total ammonia concentration (TAN) limits equivalent to the proposed effluent limits of 1.8 mg/L in summer and 3.8 mg/L in winter. In-stream pH and ambient TAN concentrations were assumed to be the 75th percentile of background water quality values.

The maximum anticipated unionized ammonia concentrations exceed the Provincial Water Quality Objective (PWQO) threshold of 0.02 mg/L for a region less than 3 m from the shore, and no farther than 100 m downstream based on summer conditions. For winter conditions, this mixing zone is considerably smaller and is confined to 1 m from the shore and 3 m downstream of the discharge location. Details of this analysis are presented in Attachment 3.

Total Phosphorus

Estimates of in-stream TP concentrations were generated based on ambient TP concentrations of 0.031 mg/L, the 75th percentile value of background concentration values. Because the ambient TP concentration exceeds the PWQO of 30 µg/L, the extent of the mixing zone cannot be defined in terms of size of the plume where the TP concentration is greater than the PWQO. However, the results indicate that the TP concentration in the mixing zone is 10 percent higher or more than the ambient TP concentration (i.e. >0.034 mg/L) for a region less than 4 m from the shore, and no farther downstream than 112 m.

3. SUMMARY OF PROPOSED EFFLUENT REQUIREMENTS

As request during the August 15, 2016 meeting, Table 1 presents the proposed effluent concentration objectives and limits, as well as the proposed loading limits, for all parameters of interest based on a design ADF value of 552 m^3/d. As agreed-to with the MOECC, should the final design ADF value be less than 552 m^3/d, the concentration objectives and limits as proposed in Table 1 would remain unchanged, however the loading limits would be reduced accordingly.

Table 1 Proposed Effluent Compliance Objectives and Limits for a Design ADF of 552 m^3/d

Effluent Parameter	Concentration		Loading Limit (kg/d)
	Objective (mg/l)	Limit (mg/L)	
$cBOD_5$	8.0	10.0	5.52
Total Suspended Solids	8.0	10.0	5.52
Total Phosphorus	0.08	0.10	0.055
Total Ammonia Nitrogen			
Winter (Dec - Feb)	3.0	3.8	2.1
Spring (Mar - May)	2.5	3.3	1.8
Summer (Jun - Sep)	1.0	1.8	1.0
Fall (Oct - Nov)	1.6	2.4	1.3
Notes: *E.coli* effluent objective and limit of less than 100 organisms per 100 mL based on monthly geometric mean values. Above concentration limits based on monthly average values. Loading limits based on annual average values and a design ADF of 552 m^3/d.			

4. CLOSURE

We trust the above addresses all of your outstanding concerns related to the *Assimilative Capacity Study of the Grand River in the Vicinity of a Proposed WWTP in Waldemar, ON*, dated March 2016 and all follow-up correspondence. While we understand that the Policy 2 status of the receiver with respect to TP would necessitate approval of a Policy 2 Deviation Request before a new discharge could be approved, we understand that this Request is not required for Technical Support Section of West Central Region to complete their review of the above-noted ACS, and the effluent objectives and limits as proposed.

Should you have any questions or concerns, please do not hesitate to contact the undersigned.

Yours very truly,

XCG CONSULTANTS LTD.

Melody Johnson

Melody Johnson, M.A.Sc., P.Eng.
Senior Project Manager

cc: Craig Fowler, MOECC
Wendy Wingate, MOECC
Sandra Cook and Mark Anderson, GRCA
Lindsay Wolfenberg, ASI
Walter Broos, Sarah Properties Ltd.
Christine Gervais, Township Planner
Mike Newbigging, XCG

Attachments: Attachment 1 – Trend Assessment
Attachment 2 - Thermal Impacts In Mixing Zone
Attachment 3 - Unionized Ammonia Concentrations In Mixing Zone
Attachment 4 – TP Concentrations in Mixing Zone

ATTACHMENT 1 – TREND ASSESSMENT

Trend Assessment

A seasonal and annual trend assessment was completed for Total Phosphorus for PWQMN Station 16018406702. A non-parametric slope, β, as defined by Theil (1950) and Sen (1968), was applied to address any serial autocorrelation, and trend was assessed using a modified Mann-Kendal test for trend, similar to an approach defined by Yue and Wang (2004). However, rather than a single pre-whitening process, an iterative approach as described by Zhang et al. (2010) was applied. Assuming a 95% confidence limit, a Mann-Kendall tau statistic of greater than 1.96 or less than -1.96, would indicate a significant trend. In this case, no significant trends were observed.

A summary of the results is provided in Table 1 below, and time series plots of the seasonal averaged total phosphorus monitoring results are provided in Figures 1 through 5.

Table 1 Non-Parametric Trend Assessment Summary

Season	Mann-Kendall tau Statistic	Significant at 95%
Spring	-0.82	No
Summer	0.80	No
Fall	-0.71	No
Winter	-0.86	No
Annual	-0.65	No

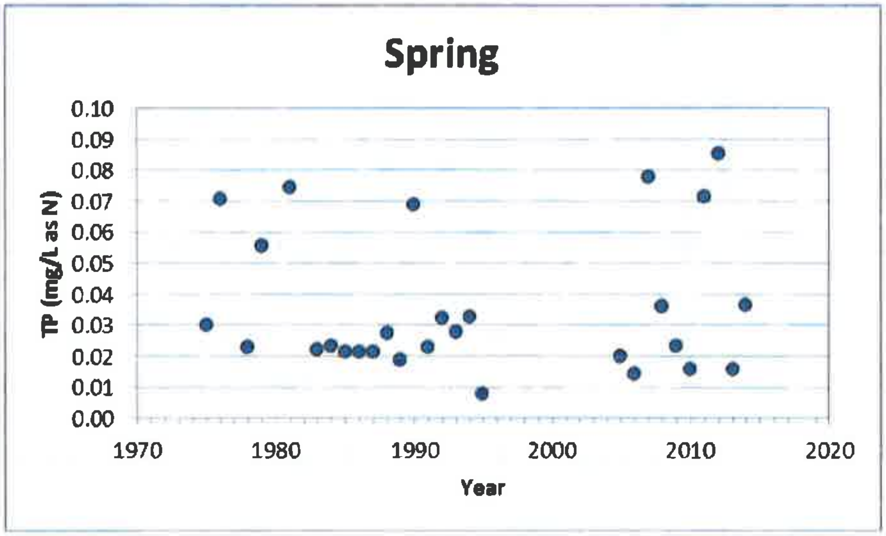

Figure 1 Spring Average TP Monitoring Results for PWQMN Station 16018406702

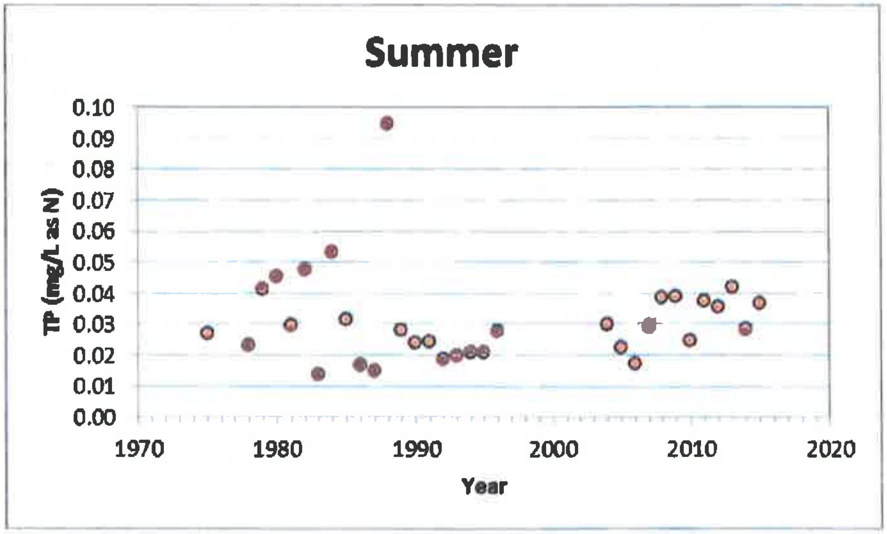

Figure 2 *Summer TP Monitoring Results for PWQMN Station 16018406702*

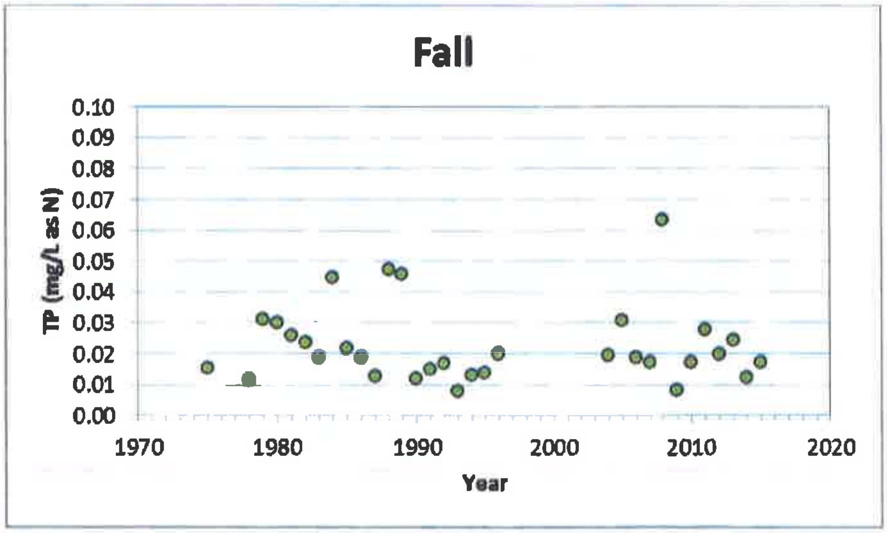

Figure 3 *Fall Average TP Monitoring Results for PWQMN Station 16018406702*

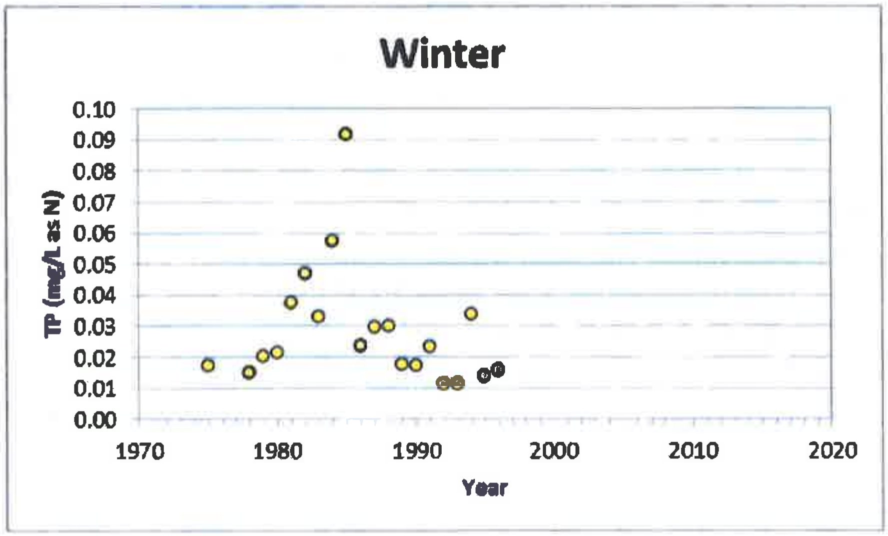

Figure 4 Winter Average TP Monitoring Results for PWQMN Station 16018406702

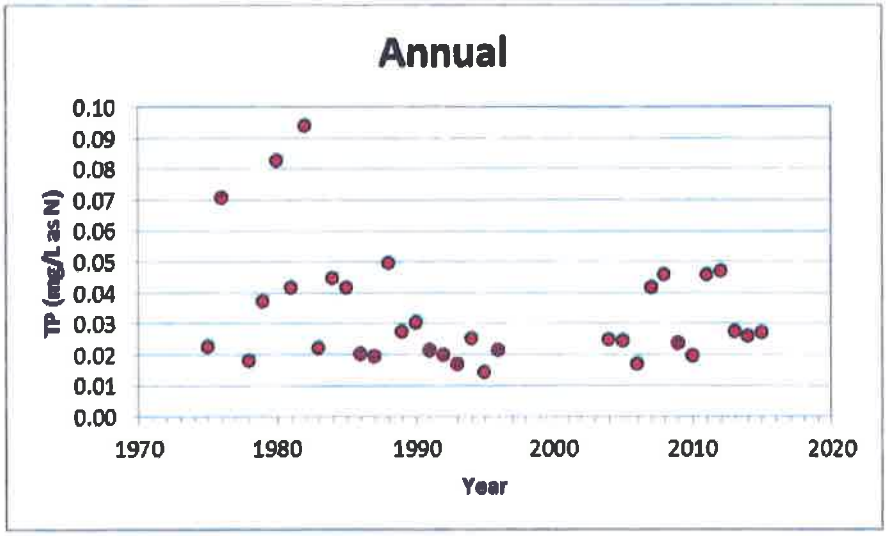

Figure 5 Annual Average TP Monitoring Results for PWQMN Station 16018406702

References:

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ATTACHMENT 2

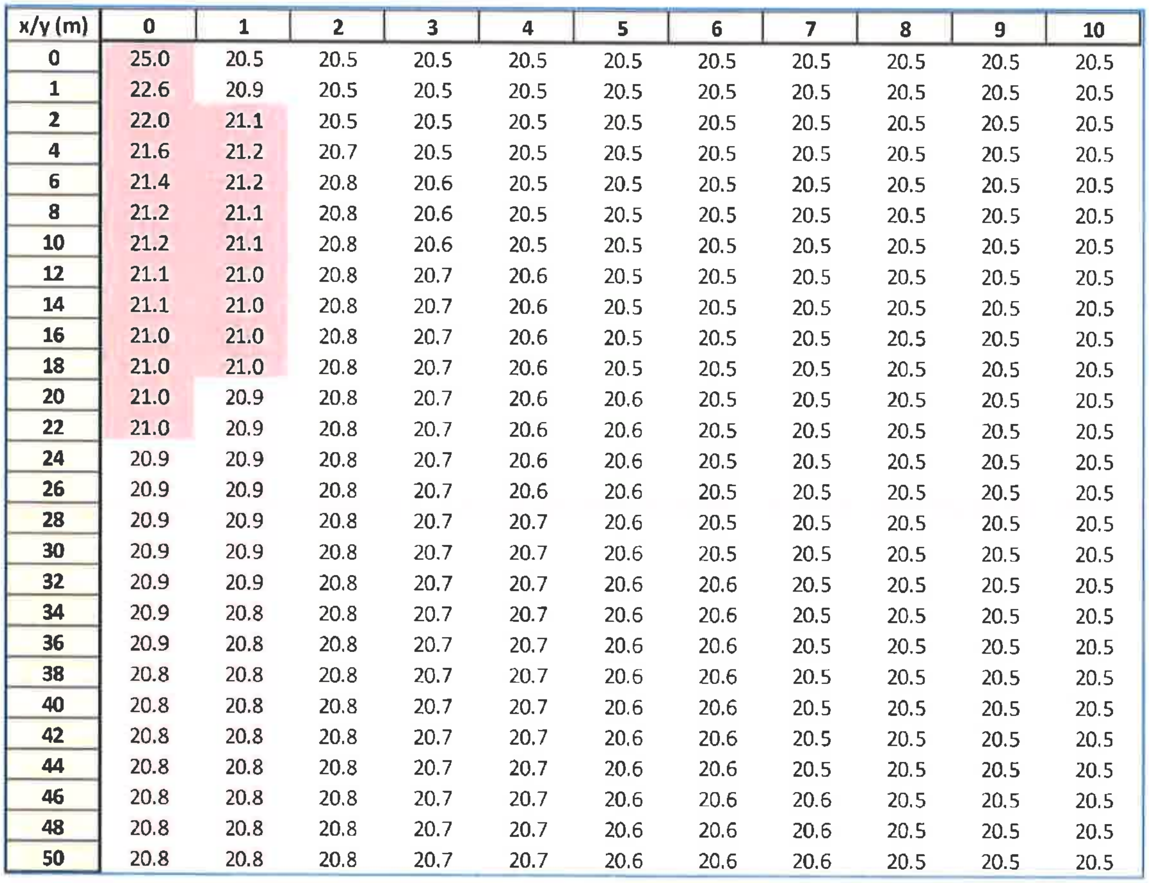
THERMAL IMPACTS IN MIXING ZONE

Thermal Impacts

Using the results of the 2-dimensional mixing-zone analysis, estimates of in-stream temperature were generated for summer and winter conditions for a range of ambient and effluent temperatures. Figures 6 and 7 present the results for the anticipated worst case conditions. In each of Figures 6 and 7, the column headings represent lateral distance from discharge, while the left most column represents the longitudinal distance downstream. Figures 6 and 7 illustrate the results corresponding to median ambient temperature and expected high effluent temperature for summer and winter, respectively. Assumed temperatures are summarised in Table 2. The largest anticipated increase in in-stream temperature, at a downstream distance of 1.0 m from the discharge point, is also presented in Table 2.

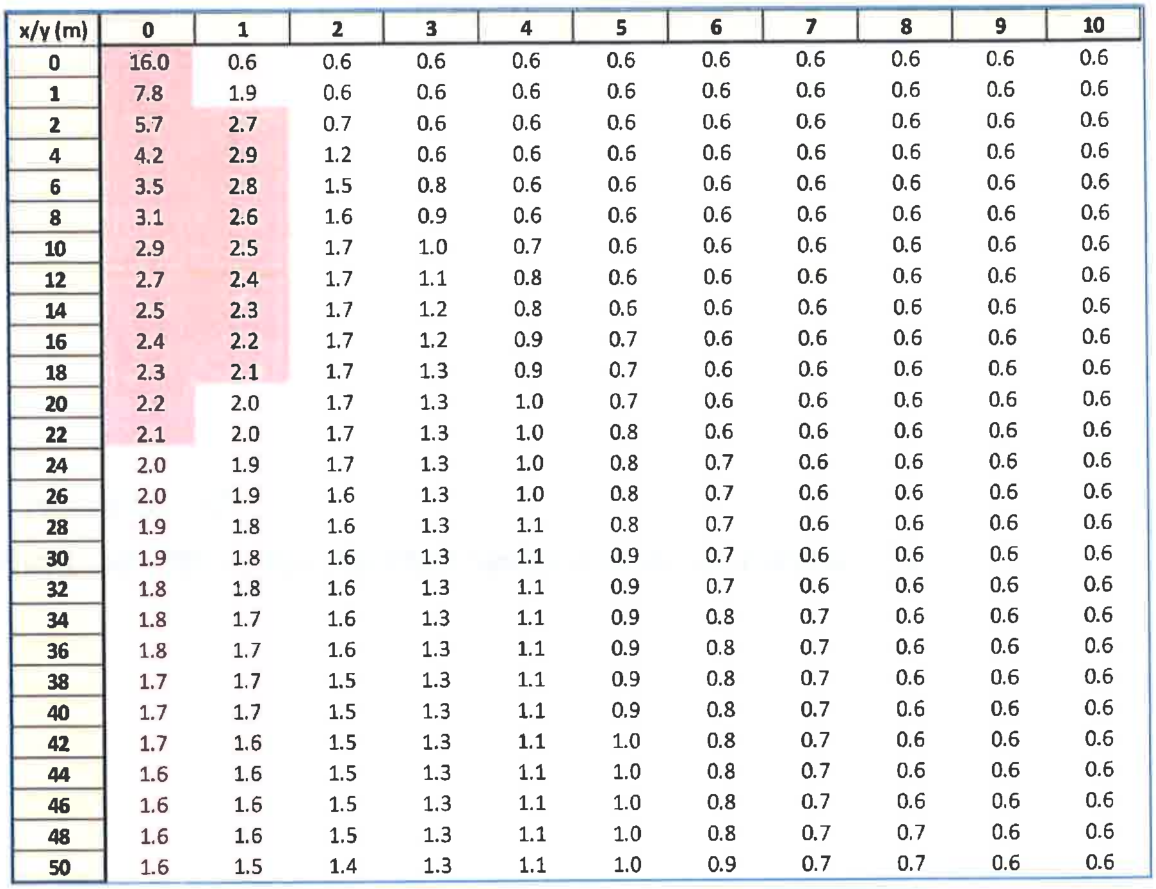
Table 2 Assumed Temperature

Season	River Ambient Temperature °C	Effluent Temperature °C	Largest in-Stream Difference °C
Summer	20.5	25.0	1.5
Winter	0.55	16.0	7.3



x/y (m)	0	1	2	3	4	5	6	7	8	9	10
0	25.0	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5
1	22.6	20.9	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5
2	22.0	21.1	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5
4	21.6	21.2	20.7	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5
6	21.4	21.2	20.8	20.6	20.5	20.5	20.5	20.5	20.5	20.5	20.5
8	21.2	21.1	20.8	20.6	20.5	20.5	20.5	20.5	20.5	20.5	20.5
10	21.2	21.1	20.8	20.6	20.5	20.5	20.5	20.5	20.5	20.5	20.5
12	21.1	21.0	20.8	20.7	20.6	20.5	20.5	20.5	20.5	20.5	20.5
14	21.1	21.0	20.8	20.7	20.6	20.5	20.5	20.5	20.5	20.5	20.5
16	21.0	21.0	20.8	20.7	20.6	20.5	20.5	20.5	20.5	20.5	20.5
18	21.0	21.0	20.8	20.7	20.6	20.5	20.5	20.5	20.5	20.5	20.5
20	21.0	20.9	20.8	20.7	20.6	20.6	20.5	20.5	20.5	20.5	20.5
22	21.0	20.9	20.8	20.7	20.6	20.6	20.5	20.5	20.5	20.5	20.5
24	20.9	20.9	20.8	20.7	20.6	20.6	20.5	20.5	20.5	20.5	20.5
26	20.9	20.9	20.8	20.7	20.6	20.6	20.5	20.5	20.5	20.5	20.5
28	20.9	20.9	20.8	20.7	20.7	20.6	20.5	20.5	20.5	20.5	20.5
30	20.9	20.9	20.8	20.7	20.7	20.6	20.5	20.5	20.5	20.5	20.5
32	20.9	20.9	20.8	20.7	20.7	20.6	20.6	20.5	20.5	20.5	20.5
34	20.9	20.8	20.8	20.7	20.7	20.6	20.6	20.5	20.5	20.5	20.5
36	20.9	20.8	20.8	20.7	20.7	20.6	20.6	20.5	20.5	20.5	20.5
38	20.8	20.8	20.8	20.7	20.7	20.6	20.6	20.5	20.5	20.5	20.5
40	20.8	20.8	20.8	20.7	20.7	20.6	20.6	20.5	20.5	20.5	20.5
42	20.8	20.8	20.8	20.7	20.7	20.6	20.6	20.5	20.5	20.5	20.5
44	20.8	20.8	20.8	20.7	20.7	20.6	20.6	20.5	20.5	20.5	20.5
46	20.8	20.8	20.8	20.7	20.7	20.6	20.6	20.6	20.5	20.5	20.5
48	20.8	20.8	20.8	20.7	20.7	20.6	20.6	20.6	20.5	20.5	20.5
50	20.8	20.8	20.8	20.7	20.7	20.6	20.6	20.6	20.5	20.5	20.5

Figure 6 Estimated In-stream Temperature for Summer Conditions



x/y (m)	0	1	2	3	4	5	6	7	8	9	10
0	16.0	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
1	7.8	1.9	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
2	5.7	2.7	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
4	4.2	2.9	1.2	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
6	3.5	2.8	1.5	0.8	0.6	0.6	0.6	0.6	0.6	0.6	0.6
8	3.1	2.6	1.6	0.9	0.6	0.6	0.6	0.6	0.6	0.6	0.6
10	2.9	2.5	1.7	1.0	0.7	0.6	0.6	0.6	0.6	0.6	0.6
12	2.7	2.4	1.7	1.1	0.8	0.6	0.6	0.6	0.6	0.6	0.6
14	2.5	2.3	1.7	1.2	0.8	0.6	0.6	0.6	0.6	0.6	0.6
16	2.4	2.2	1.7	1.2	0.9	0.7	0.6	0.6	0.6	0.6	0.6
18	2.3	2.1	1.7	1.3	0.9	0.7	0.6	0.6	0.6	0.6	0.6
20	2.2	2.0	1.7	1.3	1.0	0.7	0.6	0.6	0.6	0.6	0.6
22	2.1	2.0	1.7	1.3	1.0	0.8	0.6	0.6	0.6	0.6	0.6
24	2.0	1.9	1.7	1.3	1.0	0.8	0.7	0.6	0.6	0.6	0.6
26	2.0	1.9	1.6	1.3	1.0	0.8	0.7	0.6	0.6	0.6	0.6
28	1.9	1.8	1.6	1.3	1.1	0.8	0.7	0.6	0.6	0.6	0.6
30	1.9	1.8	1.6	1.3	1.1	0.9	0.7	0.6	0.6	0.6	0.6
32	1.8	1.8	1.6	1.3	1.1	0.9	0.7	0.6	0.6	0.6	0.6
34	1.8	1.7	1.6	1.3	1.1	0.9	0.8	0.7	0.6	0.6	0.6
36	1.8	1.7	1.6	1.3	1.1	0.9	0.8	0.7	0.6	0.6	0.6
38	1.7	1.7	1.5	1.3	1.1	0.9	0.8	0.7	0.6	0.6	0.6
40	1.7	1.7	1.5	1.3	1.1	0.9	0.8	0.7	0.6	0.6	0.6
42	1.7	1.6	1.5	1.3	1.1	1.0	0.8	0.7	0.6	0.6	0.6
44	1.6	1.6	1.5	1.3	1.1	1.0	0.8	0.7	0.6	0.6	0.6
46	1.6	1.6	1.5	1.3	1.1	1.0	0.8	0.7	0.6	0.6	0.6
48	1.6	1.6	1.5	1.3	1.1	1.0	0.8	0.7	0.7	0.6	0.6
50	1.6	1.5	1.4	1.3	1.1	1.0	0.9	0.7	0.7	0.6	0.6

Figure 7 ***Estimated In-stream Temperature for Winter Conditions***

ATTACHMENT 3

UNIONIZED AMMONIA CONCENTRATIONS IN MIXING ZONE

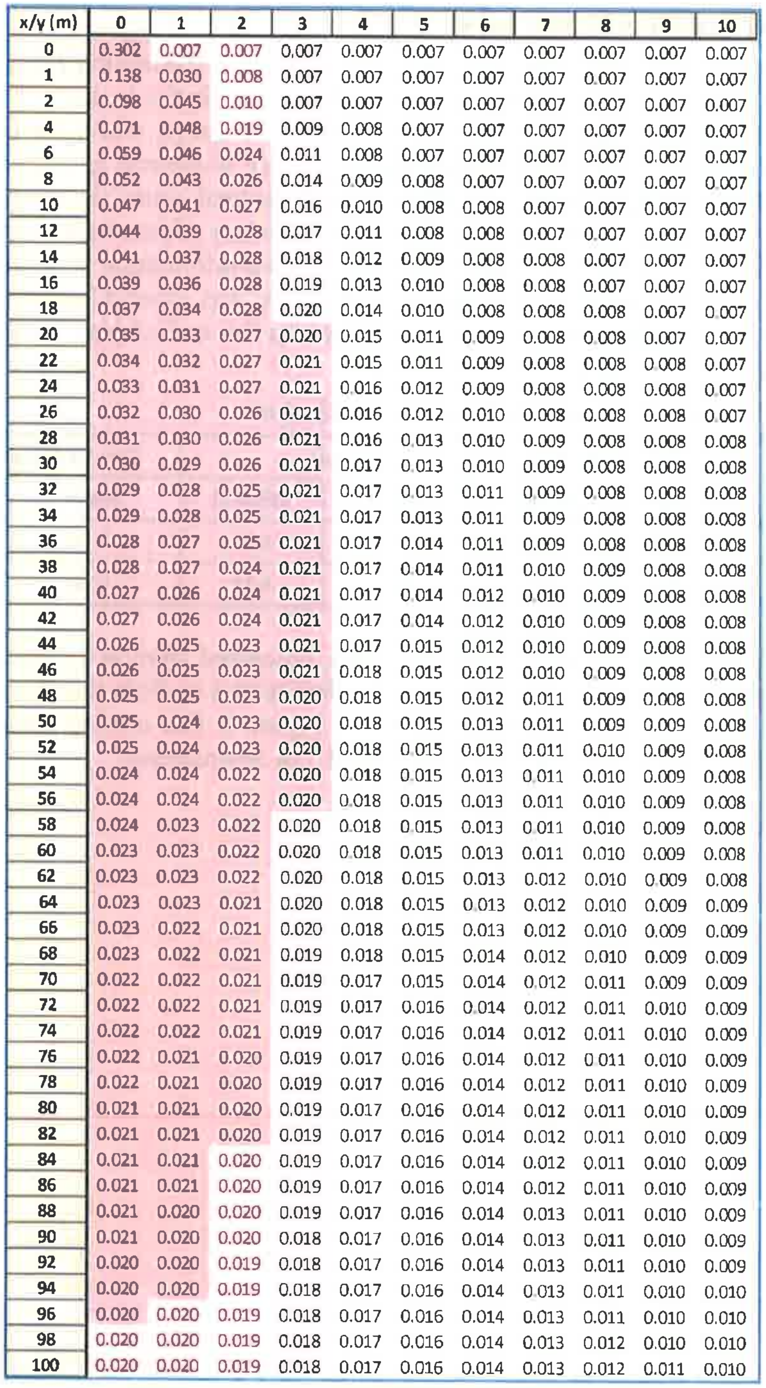
Unionized Ammonia In Mixing Zone

Maximum anticipated unionized ammonia concentrations in the mixing zone, for summer and winter conditions, are presented in Figures 8 and 9, respectively. In each of Figures 8 and 9, the column headings represent lateral distance from discharge, while the left most column represents the longitudinal distance downstream. Since unionized ammonia concentrations increase with increasing temperature, pH, and ambient total ammonia levels, 75th percentile values where applied for all ambient conditions. A summary of parameter assignments for this analysis is provided in Table 3. Since considerable more information is required to model in-stream pH, in order to simplify the analysis, effluent pH was assumed equal to 75th percentile ambient levels. Application of effluent pH results in end-of-pipe unionized ammonia concentrations of less than 0.1 mg/L.

Table 3 Unionized Ammonia Parameterization

Season	Temperature °C		pH		Total Ammonia as N (mg/L)	
	River	Effluent	River	Effluent	River	Effluent
Summer	23	25	8.55	8.55	0.05	1.80
Winter	1.0	16	8.28	8.28	0.06	3.80

As illustrated in Figure 8, for summer conditions, unionized ammonia concentrations exceed the PWQO threshold of 0.02 mg/L for a region less than 3 m from the shore, and no farther downstream than 100 m. For winter conditions, Figure 9, this mixing zone is considerably smaller and is confined to 1 m from the shore and 3 m downstream.



x/y (m)	0	1	2	3	4	5	6	7	8	9	10
0	0.302	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
1	0.138	0.030	0.008	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
2	0.098	0.045	0.010	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
4	0.071	0.048	0.019	0.009	0.008	0.007	0.007	0.007	0.007	0.007	0.007
6	0.059	0.046	0.024	0.011	0.008	0.007	0.007	0.007	0.007	0.007	0.007
8	0.052	0.043	0.026	0.014	0.009	0.008	0.007	0.007	0.007	0.007	0.007
10	0.047	0.041	0.027	0.016	0.010	0.008	0.008	0.007	0.007	0.007	0.007
12	0.044	0.039	0.028	0.017	0.011	0.008	0.008	0.007	0.007	0.007	0.007
14	0.041	0.037	0.028	0.018	0.012	0.009	0.008	0.008	0.007	0.007	0.007
16	0.039	0.036	0.028	0.019	0.013	0.010	0.008	0.008	0.007	0.007	0.007
18	0.037	0.034	0.028	0.020	0.014	0.010	0.008	0.008	0.008	0.007	0.007
20	0.035	0.033	0.027	0.020	0.015	0.011	0.009	0.008	0.008	0.007	0.007
22	0.034	0.032	0.027	0.021	0.015	0.011	0.009	0.008	0.008	0.008	0.007
24	0.033	0.031	0.027	0.021	0.016	0.012	0.009	0.008	0.008	0.008	0.007
26	0.032	0.030	0.026	0.021	0.016	0.012	0.010	0.008	0.008	0.008	0.007
28	0.031	0.030	0.026	0.021	0.016	0.013	0.010	0.009	0.008	0.008	0.008
30	0.030	0.029	0.026	0.021	0.017	0.013	0.010	0.009	0.008	0.008	0.008
32	0.029	0.028	0.025	0,021	0.017	0.013	0.011	0.009	0.008	0.008	0.008
34	0.029	0.028	0.025	0.021	0.017	0.013	0.011	0.009	0.008	0.008	0.008
36	0.028	0.027	0.025	0.021	0.017	0.014	0.011	0.009	0.008	0.008	0.008
38	0.028	0.027	0.024	0.021	0.017	0.014	0.011	0.010	0.009	0.008	0.008
40	0.027	0.026	0.024	0.021	0.017	0.014	0.012	0.010	0.009	0.008	0.008
42	0.027	0.026	0.024	0.021	0.017	0.014	0.012	0.010	0.009	0.008	0.008
44	0.026	0.025	0.023	0.021	0.017	0.015	0.012	0.010	0.009	0.008	0.008
46	0.026	0.025	0.023	0.021	0.018	0.015	0.012	0.010	0.009	0.008	0.008
48	0.025	0.025	0.023	0.020	0.018	0.015	0.012	0.011	0.009	0.008	0.008
50	0.025	0.024	0.023	0.020	0.018	0.015	0.013	0.011	0.009	0.009	0.008
52	0.025	0.024	0.023	0.020	0.018	0.015	0.013	0.011	0.010	0.009	0.008
54	0.024	0.024	0.022	0.020	0.018	0.015	0.013	0.011	0.010	0.009	0.008
56	0.024	0.024	0.022	0.020	0.018	0.015	0.013	0.011	0.010	0.009	0.008
58	0.024	0.023	0.022	0.020	0.018	0.015	0.013	0.011	0.010	0.009	0.008
60	0.023	0.023	0.022	0.020	0.018	0.015	0.013	0.011	0.010	0.009	0.008
62	0.023	0.023	0.022	0.020	0.018	0.015	0.013	0.012	0.010	0.009	0.008
64	0.023	0.023	0.021	0.020	0.018	0.015	0.013	0.012	0.010	0.009	0.009
66	0.023	0.022	0.021	0.020	0.018	0.015	0.013	0.012	0.010	0.009	0.009
68	0.023	0.022	0.021	0.019	0.018	0.015	0.014	0.012	0.010	0.009	0.009
70	0.022	0.022	0.021	0.019	0.017	0.015	0.014	0.012	0.011	0.009	0.009
72	0.022	0.022	0.021	0.019	0.017	0.016	0.014	0.012	0.011	0.010	0.009
74	0.022	0.022	0.021	0.019	0.017	0.016	0.014	0.012	0.011	0.010	0.009
76	0.022	0.021	0.020	0.019	0.017	0.016	0.014	0.012	0.011	0.010	0.009
78	0.022	0.021	0.020	0.019	0.017	0.016	0.014	0.012	0.011	0.010	0.009
80	0.021	0.021	0.020	0.019	0.017	0.016	0.014	0.012	0.011	0.010	0.009
82	0.021	0.021	0.020	0.019	0.017	0.016	0.014	0.012	0.011	0.010	0.009
84	0.021	0.021	0.020	0.019	0.017	0.016	0.014	0.012	0.011	0.010	0.009
86	0.021	0.021	0.020	0.019	0.017	0.016	0.014	0.012	0.011	0.010	0.009
88	0.021	0.020	0.020	0.019	0.017	0.016	0.014	0.013	0.011	0.010	0.009
90	0.021	0.020	0.020	0.018	0.017	0.016	0.014	0.013	0.011	0.010	0.009
92	0.020	0.020	0.019	0.018	0.017	0.016	0.014	0.013	0.011	0.010	0.009
94	0.020	0.020	0.019	0.018	0.017	0.016	0.014	0.013	0.011	0.010	0.010
96	0.020	0.020	0.019	0.018	0.017	0.016	0.014	0.013	0.011	0.010	0.010
98	0.020	0.020	0.019	0.018	0.017	0.016	0.014	0.013	0.012	0.010	0.010
100	0.020	0.020	0.019	0.018	0.017	0.016	0.014	0.013	0.012	0.011	0.010

Figure 8 ***Mixing Zone Unionized Ammonia Concentrations (mg/L) for Summer Conditions***

x/y (m)	0	1	2	3	4	5	6	7	8	9	10
0	0.202	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
1	0.054	0.007	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
2	0.033	0.012	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
4	0.021	0.013	0.004	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
6	0.017	0.012	0.005	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001
8	0.014	0.011	0.006	0.003	0.001	0.001	0.001	0.001	0.001	0.001	0.001
10	0.012	0.010	0.006	0.003	0.002	0.001	0.001	0.001	0.001	0.001	0.001
12	0.011	0.010	0.006	0.004	0.002	0.001	0.001	0.001	0.001	0.001	0.001
14	0.010	0.009	0.006	0.004	0.002	0.001	0.001	0.001	0.001	0.001	0.001
16	0.010	0.009	0.006	0.004	0.002	0.002	0.001	0.001	0.001	0.001	0.001
18	0.009	0.008	0.006	0.004	0.003	0.002	0.001	0.001	0.001	0.001	0.001
20	0.009	0.008	0.006	0.004	0.003	0.002	0.001	0.001	0.001	0.001	0.001
22	0.008	0.008	0.006	0.004	0.003	0.002	0.001	0.001	0.001	0.001	0.001
24	0.008	0.007	0.006	0.004	0.003	0.002	0.001	0.001	0.001	0.001	0.001
26	0.008	0.007	0.006	0.004	0.003	0.002	0.002	0.001	0.001	0.001	0.001
28	0.007	0.007	0.006	0.004	0.003	0.002	0.002	0.001	0.001	0.001	0.001
30	0.007	0.007	0.006	0.005	0.003	0.002	0.002	0.001	0.001	0.001	0.001
32	0.007	0.007	0.006	0.005	0.003	0.002	0.002	0.001	0.001	0.001	0.001
34	0.007	0.006	0.006	0.004	0.003	0.002	0.002	0.001	0.001	0.001	0.001
36	0.007	0.006	0.005	0.004	0.003	0.003	0.002	0.001	0.001	0.001	0.001
38	0.006	0.006	0.005	0.004	0.003	0.003	0.002	0.002	0.001	0.001	0.001
40	0.006	0.006	0.005	0.004	0.004	0.003	0.002	0.002	0.001	0.001	0.001
42	0.006	0.006	0.005	0.004	0.004	0.003	0.002	0.002	0.001	0.001	0.001
44	0.006	0.006	0.005	0.004	0.004	0.003	0.002	0.002	0.001	0.001	0.001
46	0.006	0.006	0.005	0.004	0.004	0.003	0.002	0.002	0.001	0.001	0.001
48	0.006	0.006	0.005	0.004	0.004	0.003	0.002	0.002	0.001	0.001	0.001
50	0.006	0.005	0.005	0.004	0.004	0.003	0.002	0.002	0.001	0.001	0.001

Figure 9 ***Mixing Zone Unionized Ammonia Concentrations (mg/L) for Winter Conditions***

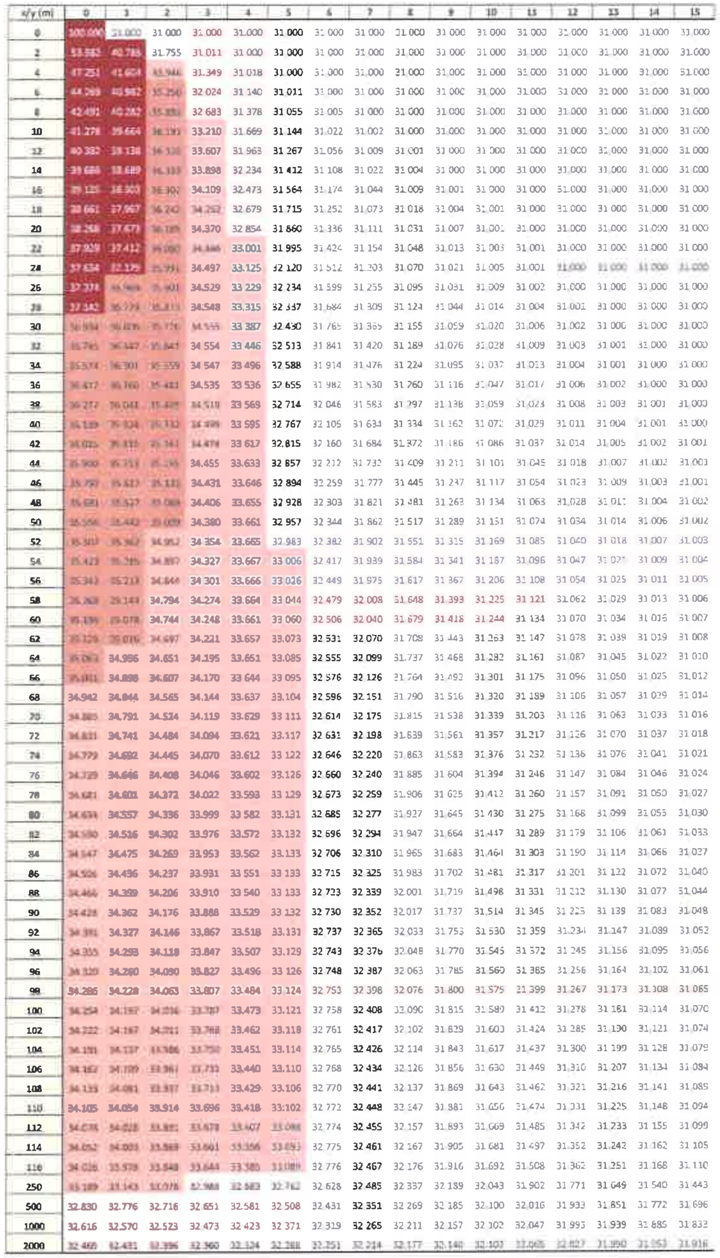
ATTACHMENT 4

TP CONCENTRATIONS IN MIXING ZONE

TP Concentrations in Mixing Zone

Maximum anticipated TP concentrations in the mixing zone are presented in Figures 10. In Figure 10, the column headings represent lateral distance from discharge, while the left most column represents the longitudinal distance downstream. Ambient TP concentrations were based on the overall 75th percentile values of background water quality data (31 µg/L), and it was assumed that the effluent TP is equivalent to the proposed limit of 0.10 mg/L (100 µg/L).

Because the ambient TP concentration exceeds the PWQO of 30 µg/L, the extent of the mixing zone cannot be defined in terms of size of the plume where the TP concentration is greater than the PWQO. However, the results indicate that the TP concentration in the mixing zone is 10 percent higher or more than the ambient TP concentration for a region less than 4 m from the shore, and no farther downstream than 112 m.



x/y (m)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	100.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000
2	53.582	40.785	31.755	31.011	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000
4	47.251	41.604	33.946	31.349	31.018	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000
6	44.269	40.982	35.250	32.024	31.140	31.011	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000
8	42.491	40.282	35.893	32.683	31.378	31.055	31.005	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000
10	41.278	39.664	36.195	33.210	31.669	31.144	31.022	31.002	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000
12	40.382	39.138	36.320	33.607	31.963	31.267	31.056	31.009	31.001	31.000	31.000	31.000	31.000	31.000	31.000	31.000
14	39.686	38.689	36.333	33.898	32.234	31.412	31.108	31.022	31.004	31.000	31.000	31.000	31.000	31.000	31.000	31.000
16	39.125	38.303	36.302	34.109	32.473	31.564	31.174	31.044	31.009	31.001	31.000	31.000	31.000	31.000	31.000	31.000
18	38.661	37.967	36.242	34.252	32.679	31.715	31.252	31.073	31.018	31.004	31.001	31.000	31.000	31.000	31.000	31.000
20	38.258	37.673	36.185	34.370	32.854	31.860	31.336	31.111	31.031	31.007	31.001	31.000	31.000	31.000	31.000	31.000
22	37.929	37.412	36.080	34.446	33.001	31.995	31.424	31.154	31.048	31.013	31.003	31.001	31.000	31.000	31.000	31.000
24	37.654	37.175	35.991	34.497	33.125	32.120	31.512	31.203	31.070	31.021	31.005	31.001	31.000	31.000	31.000	31.000
26	37.378	36.969	35.901	34.529	33.229	32.234	31.599	31.255	31.095	31.031	31.009	31.002	31.000	31.000	31.000	31.000
28	37.142	36.779	35.815	34.548	33.315	32.337	31.684	31.309	31.124	31.044	31.014	31.004	31.001	31.000	31.000	31.000
30	36.934	36.626	35.726	34.555	33.387	32.430	31.765	31.365	31.155	31.059	31.020	31.006	31.002	31.000	31.000	31.000
32	36.745	36.447	35.643	34.554	33.446	32.513	31.841	31.420	31.189	31.076	31.028	31.009	31.003	31.001	31.000	31.000
34	36.574	36.301	35.559	34.547	33.496	32.588	31.914	31.476	31.224	31.095	31.037	31.013	31.004	31.001	31.000	31.000
36	36.437	36.160	35.481	34.535	33.536	32.655	31.982	31.530	31.260	31.116	31.047	31.017	31.006	31.002	31.000	31.000
38	36.272	36.041	35.409	34.518	33.569	32.714	32.046	31.583	31.297	31.138	31.059	31.023	31.008	31.003	31.001	31.000
40	36.139	35.924	35.332	34.499	33.595	32.767	32.105	31.634	31.334	31.162	31.072	31.029	31.011	31.004	31.001	31.000
42	36.025	35.835	35.261	34.478	33.617	32.815	32.160	31.684	31.372	31.186	31.086	31.037	31.014	31.005	31.002	31.001
44	35.900	35.751	35.195	34.455	33.633	32.857	32.212	31.732	31.409	31.211	31.101	31.045	31.018	31.007	31.002	31.001
46	35.787	35.637	35.131	34.431	33.646	32.894	32.259	31.777	31.445	31.237	31.117	31.054	31.023	31.009	31.003	31.001
48	35.681	35.537	35.068	34.406	33.655	32.928	32.303	31.821	31.481	31.263	31.134	31.063	31.028	31.011	31.004	31.002
50	35.586	35.442	35.009	34.380	33.661	32.957	32.344	31.862	31.517	31.289	31.151	31.074	31.034	31.014	31.006	31.002
52	35.501	35.362	34.952	34.354	33.665	32.983	32.382	31.902	31.551	31.315	31.169	31.085	31.040	31.018	31.007	31.003
54	35.423	35.286	34.897	34.327	33.667	33.006	32.417	31.939	31.584	31.341	31.187	31.096	31.047	31.021	31.009	31.004
56	35.343	35.213	34.844	34.301	33.666	33.026	32.449	31.975	31.617	31.367	31.206	31.108	31.054	31.025	31.011	31.005
58	35.268	35.144	34.794	34.274	33.664	33.044	32.479	32.008	31.648	31.393	31.225	31.121	31.062	31.029	31.013	31.006
60	35.196	35.078	34.744	34.248	33.661	33.060	32.506	32.040	31.679	31.418	31.244	31.134	31.070	31.034	31.016	31.007
62	35.129	35.016	34.697	34.221	33.657	33.073	32.531	32.070	31.708	31.443	31.263	31.147	31.078	31.039	31.019	31.008
64	35.063	34.956	34.651	34.195	33.651	33.085	32.555	32.099	31.737	31.468	31.282	31.161	31.087	31.045	31.022	31.010
66	35.001	34.898	34.607	34.170	33.644	33.095	32.576	32.126	31.764	31.492	31.301	31.175	31.096	31.050	31.025	31.012
68	34.942	34.844	34.565	34.144	33.637	33.104	32.596	32.151	31.790	31.516	31.320	31.189	31.106	31.057	31.029	31.014
70	34.885	34.791	34.524	34.119	33.629	33.111	32.614	32.175	31.815	31.538	31.339	31.203	31.116	31.063	31.033	31.016
72	34.831	34.741	34.484	34.094	33.621	33.117	32.631	32.198	31.839	31.561	31.357	31.217	31.126	31.070	31.037	31.018
74	34.779	34.692	34.445	34.070	33.612	33.122	32.646	32.220	31.863	31.583	31.376	31.232	31.136	31.076	31.041	31.021
76	34.729	34.646	34.408	34.046	33.602	33.126	32.660	32.240	31.885	31.604	31.394	31.246	31.147	31.084	31.046	31.024
78	34.681	34.601	34.372	34.022	33.593	33.129	32.673	32.259	31.906	31.625	31.412	31.260	31.157	31.091	31.050	31.027
80	34.634	34.557	34.336	33.999	33.582	33.131	32.685	32.277	31.927	31.645	31.430	31.275	31.168	31.099	31.055	31.030
82	34.590	34.516	34.302	33.976	33.572	33.132	32.696	32.294	31.947	31.664	31.447	31.289	31.179	31.106	31.061	31.033
84	34.547	34.475	34.269	33.953	33.562	33.133	32.706	32.310	31.965	31.683	31.464	31.303	31.190	31.114	31.066	31.027
86	34.506	34.436	34.237	33.931	33.551	33.133	32.715	32.325	31.983	31.702	31.481	31.317	31.201	31.122	31.072	31.040
88	34.466	34.399	34.206	33.910	33.540	33.133	32.723	32.339	32.001	31.719	31.498	31.331	31.212	31.130	31.077	31.044
90	34.428	34.362	34.176	33.888	33.529	33.132	32.730	32.352	32.017	31.737	31.514	31.345	31.223	31.139	31.083	31.048
92	34.391	34.327	34.146	33.867	33.518	33.131	32.737	32.365	32.033	31.753	31.530	31.359	31.234	31.147	31.089	31.052
94	34.355	34.293	34.118	33.847	33.507	33.129	32.743	32.376	32.048	31.770	31.545	31.372	31.245	31.156	31.095	31.056
96	34.320	34.260	34.090	33.827	33.496	33.126	32.748	32.387	32.063	31.785	31.560	31.385	31.256	31.164	31.102	31.061
98	34.286	34.228	34.063	33.807	33.484	33.124	32.753	32.398	32.076	31.800	31.575	31.399	31.267	31.173	31.108	31.065
100	34.254	34.197	34.036	33.787	33.473	33.121	32.758	32.408	32.090	31.815	31.589	31.412	31.278	31.181	31.114	31.070
102	34.222	34.167	34.011	33.768	33.462	33.118	32.761	32.417	32.102	31.829	31.603	31.424	31.289	31.190	31.121	31.074
104	34.191	34.137	33.986	33.750	33.451	33.114	32.765	32.426	32.114	31.843	31.617	31.437	31.300	31.199	31.128	31.079
106	34.162	34.109	33.961	33.731	33.440	33.110	32.768	32.434	32.126	31.856	31.630	31.449	31.310	31.207	31.134	31.084
108	34.133	34.081	33.937	33.713	33.429	33.106	32.770	32.441	32.137	31.869	31.643	31.462	31.321	31.216	31.141	31.089
110	34.105	34.054	33.914	33.696	33.418	33.102	32.772	32.448	32.147	31.881	31.656	31.474	31.331	31.225	31.148	31.094
112	34.078	34.028	33.891	33.678	33.407	33.098	32.774	32.455	32.157	31.893	31.669	31.485	31.342	31.233	31.155	31.099
114	34.052	34.003	33.869	33.661	33.396	33.093	32.775	32.461	32.167	31.905	31.681	31.497	31.352	31.242	31.162	31.105
116	34.026	33.979	33.848	33.644	33.385	33.088	32.776	32.467	32.176	31.916	31.692	31.508	31.362	31.251	31.168	31.110
250	33.189	33.143	33.076	32.988	32.883	32.762	32.628	32.485	32.337	32.189	32.043	31.902	31.771	31.649	31.540	31.443
500	32.830	32.776	32.716	32.651	32.581	32.508	32.431	32.351	32.269	32.185	32.100	32.016	31.933	31.851	31.772	31.696
1000	32.616	32.570	32.523	32.473	32.423	32.371	32.319	32.265	32.211	32.157	32.102	32.047	31.993	31.939	31.885	31.832
2000	32.465	32.431	32.396	32.360	32.324	32.288	32.251	32.214	32.177	32.140	32.103	32.065	32.027	31.990	31.953	31.916

Figure 10 Maximum Anticipated TP Concentrations In The Mixing Zone

From: Fowler, Craig (MOECC)
To: Melody Johnson; Slattery, Barbara (MOECC)
Cc: Wingate, Wendy (MOECC); wbroos@rogers.com; lwolfenberg@asi-group.com; Michael Hulley (Michael.Hulley@rmc.ca); Andrea Dwight; Michael Newbigging
Subject: RE: ACS for proposed WWTP in Waldemar - Follow-up to MOECC''s outstanding comments
Date: Monday, December 05, 2016 7:38:37 AM
Attachments: image002.jpg

Sounds good Melody. Thanks.

Craig

From: Melody Johnson [mailto:melody@bskyeng.com]
Sent: December 4, 2016 8:05 PM
To: Fowler, Craig (MOECC); Slattery, Barbara (MOECC)
Cc: Wingate, Wendy (MOECC); wbroos@rogers.com; lwolfenberg@asi-group.com; Michael Hulley (Michael.Hulley@rmc.ca); Andrea Dwight; Michael Newbigging
Subject: RE: ACS for proposed WWTP in Waldemar - Follow-up to MOECC's outstanding comments

Hi Craig,

Thank you for clarifying that MOECC wishes to see the results of DO modelling to determine impacts, if any, of the proposed discharge on DO concentrations in the receiver. We have contacted GRCA to obtain any data they have available regarding stream cross section and/or slope in the vicinity of the proposed outfall. Once we obtain this information, we will proceed with a desk-top modelling exercise and summarize these results for MOECC's review.

Upon completion of the modelling, we will also prepare a consolidated document that summarizes a timeline of this study, key results of our data analysis, and the proposed effluent objectives and limits for a new WWTP in the vicinity of Waldemar, ON. We will ensure all memoranda, reports, and correspondence related to this study are appended to the summary report.

To clarify the process we have followed for this study, our approach (as documented in our ACS report dated March 29, 2016) follows the standard procedure we have used for other, similar studies in Ontario. BOD and DO were addressed in the ACS report (Sections 2.13 and 3.1); based on our technical evaluation of ambient water quality, proposed discharge volume, and proposed effluent cBOD limit of 10 mg/L, no formal DO modelling was recommended at that time. Written comments regarding the ACS report that we received from MOECC, and issues raised by MOECC and GRCA during our August 2016 meeting, did not identify DO as an item of concern. Now that this concern has been raised, we are more than willing to conduct the required follow-up work to ensure MOECC is satisfied with the technical aspects of our ACS.

As noted above, we will be submitting a consolidated document to you once the DO modelling activities are complete. At that time, provided there are no outstanding concerns, we understand that a formal response will be provided by Barb Slattery on behalf of the MOECC.

Thanks,

Melody Johnson, M.A.Sc., P.Eng., Senior Consultant
melody@bskyeng.com | www.bskyeng.com | T. 416.463.7644 | M. 647.721.7644

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From: Fowler, Craig (MOECC) [mailto:Craig.Fowler2@ontario.ca]
Sent: December 1, 2016 9:18 AM
To: Melody Johnson <melody@bskyeng.com>; Slattery, Barbara (MOECC) <barbara.slattery@ontario.ca>
Cc: Wingate, Wendy (MOECC) <wendy.wingate@ontario.ca>; wbroos@rogers.com; lwolfenberg@asi-group.com; Michael Hulley (Michael.Hulley@rmc.ca) <Michael.Hulley@rmc.ca>; Andrea Dwight <Andrea@bskyeng.com>
Subject: RE: ACS for proposed WWTP in Waldemar - Follow-up to MOECC's outstanding comments

Hi Melody,

I'm not sure what you mean by requirements that need to be met with respect to the proposed effluent objectives and limits. Outside of the finalized ACS, I can't think of any other requirements relating to the assessment of the receiver. In principle, the proposed objectives/limits have been accepted, but the assessment will need to include a discussion of CBOD/DO. I take responsibility for not clearly communicating the need to evaluate the potential impacts related to CBOD/DO. To be fair, the ministry's role is to review the proposal, not to prescribe what is required particularly with completing an ACS, which is where the consultants expertise factors in. Submitting parts of an assessment piecemeal and asking what is required essentially means to me "Is this the bare minimum that is acceptable?" Where there are obvious omissions then my role is to provide feedback and I have erred in this regard, but the study with respect to this parameter could've also been raised by those involved completing the study. The fact that DO concentrations demonstrate desirable background water quality does not exclude it from the assessment, so yes CBOD/DO (depending what side of the coin you wish to discuss) modelling will be required.

In terms of receiving a formal response I think I addressed that yesterday. I would like to see a final report that has all of the information in one document.

If there are any questions or concerns remaining, I suggest that we have a teleconference.

Regards,

Craig Fowler, M.Sc. | Surface Water Specialist | Technical Support Section | Ministry of the Environment and Climate Change | 119 King St West, 12th Floor, Hamilton, Ontario, L8P 4Y7 | ph: 905-521-7823 | fax: 905-521-7820 | craig.fowler2@ontario.ca

From: Melody Johnson [mailto:melody@bskyeng.com]
Sent: November 30, 2016 10:31 AM
To: Fowler, Craig (MOECC); Slattery, Barbara (MOECC)
Cc: Wingate, Wendy (MOECC); wbroos@rogers.com; lwolfenberg@asi-group.com; Michael Hulley (Michael.Hulley@rmc.ca); Andrea Dwight
Subject: RE: ACS for proposed WWTP in Waldemar - Follow-up to MOECC's outstanding comments

Hi Craig,

I apologize if my email wasn't clear. We understood that your concerns would be related to the potential for DO sag in the receiver. However, my intention was to point out that this issue had not been raised before, and also to indicate that the background DO concentrations are quite high – thus, potentially the reason that this was not raised as an item of concern by MOECC or GRCA up to this point.

At this time, we are looking for clear direction from MOECC regarding what requirements need to be met to obtain agreement with respect to the proposed effluent objectives and limits for a new WWTP in the vicinity of Waldemar. Will DO modelling be required before a formal response will be provided by MOECC?

Thanks,

Melody Johnson, M.A.Sc., P.Eng., Senior Consultant
melody@bskyeng.com | www.bskyeng.com | T. 416.463.7644 | M. 647.721.7644

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From: Fowler, Craig (MOECC) [mailto:Craig.Fowler2@ontario.ca]
Sent: November 30, 2016 8:42 AM
To: Melody Johnson <melody@bskyeng.com>; Slattery, Barbara (MOECC) <barbara.slattery@ontario.ca>
Cc: Wingate, Wendy (MOECC) <wendy.wingate@ontario.ca>; wbroos@rogers.com; lwolfenberg@asi-group.com; Michael Hulley (Michael.Hulley@rmc.ca) <Michael.Hulley@rmc.ca>; Andrea Dwight <Andrea@bskyeng.com>
Subject: RE: ACS for proposed WWTP in Waldemar - Follow-up to MOECC's outstanding comments

Hi Melody,

Let me clarify, I wasn't referring to the policy status with respect to dissolved oxygen, but rather the potential/resulting concentrations of DO in the river from the discharge. More specifically, what is the effect of the oxygen-demanding substances in the discharge on DO and the minimum concentration of DO i.e. sag point that could be expected within the river/mixing zone.

Anything formal will come from Barb Slattery as she is the point of contact for the EA process. That said, before anything formal comes from the ministry I think it is appropriate to have a final and complete report that has incorporated the various revisions/updates and would ultimately be what is deemed acceptable.

Regards,

Craig Fowler, M.Sc. | Surface Water Specialist | Technical Support Section | Ministry of the Environment and Climate Change | 119 King St West, 12th Floor, Hamilton, Ontario, L8P 4Y7 | ph: 905-521-7823 | fax: 905-521-7820 | craig.fowler2@ontario.ca

Please consider the environment before printing this mail note

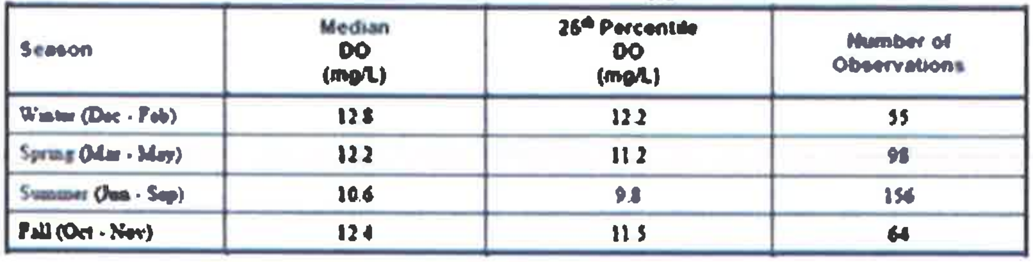
From: Melody Johnson [mailto:melody@bskyeng.com]
Sent: November 30, 2016 8:07 AM
To: Fowler, Craig (MOECC); Slattery, Barbara (MOECC)
Cc: Wingate, Wendy (MOECC); wbroos@rogers.com; lwolfenberg@asi-group.com; Michael Hulley (Michael.Hulley@rmc.ca); Andrea Dwight
Subject: RE: ACS for proposed WWTP in Waldemar - Follow-up to MOECC's outstanding comments

Hi Craig,

Thank you for your note.

Per our records, DO was not discussed at our August 15th meeting, nor do we remember it being raised as an item of concern by MOECC or GRCA. (See the last page of the attached meeting notes – phosphorus and temperature in the mixing zone were discussed.) The Grand River was determined to be Policy 1 with respect to DO in the vicinity of the proposed outfall. For your ease of reference, below please find the summary of background DO concentrations in the receiver that was included in our ACS report.

Table 7 Summary of Grand River Dissolved Oxygen Near Outfall



Season	Median DO (mg/L)	25th Percentile DO (mg/L)	Number of Observations
Winter (Dec - Feb)	12.8	12.2	55
Spring (Mar - May)	12.2	11.2	98
Summer (Jun - Sep)	10.6	9.8	156
Fall (Oct - Nov)	12.4	11.5	64

We trust that the above addresses concerns related to DO.

Will the MOECC be issuing a formal letter stating that the proposed effluent limits have been deemed acceptable?

Thanks,

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From: Fowler, Craig (MOECC) [mailto:Craig.Fowler2@ontario.ca]
Sent: November 28, 2016 9:55 AM
To: Melody Johnson <melody@bskyeng.com>; Slattery, Barbara (MOECC) <barbara.slattery@ontario.ca>
Cc: Wingate, Wendy (MOECC) <wendy.wingate@ontario.ca>; wbroos@rogers.com; lwolfenberg@asi-group.com; Michael Hulley (Michael.Hulley@rmc.ca) <Michael.Hulley@rmc.ca>
Subject: RE: ACS for proposed WWTP in Waldemar - Follow-up to MOECC's outstanding comments

Hi Melody,

I find the report acceptable in terms of the parameters that were discussed, proposed effluent limits, and the resulting water quality changes within the mixing zone. After the meeting Aug 14/16 I thought I had also mentioned looking at dissolved oxygen and if I remember correctly CVC had also mentioned temperature (which has been addressed) and dissolved oxygen at some point as well.

Craig Fowler, M.Sc. | Surface Water Specialist | Technical Support Section| Ministry of the Environment and Climate Change| 119 King St West, 12th Floor, Hamilton, Ontario, L8P 4Y7 | ph: 905-521-7823 | fax: 905-521-7820 | craig.fowler2@ontario.ca

Please consider the environment before printing this mail note

From: Melody Johnson [mailto:melody@bskyeng.com]
Sent: November 28, 2016 8:34 AM
To: Fowler, Craig (MOECC); Slattery, Barbara (MOECC)
Cc: Wingate, Wendy (MOECC); wbroos@rogers.com; lwolfenberg@asi-group.com; Michael Hulley (Michael.Hulley@rmc.ca)
Subject: RE: ACS for proposed WWTP in Waldemar - Follow-up to MOECC's outstanding comments

Hi Craig / Barbara:

Has the MOECC completed the review of our letter dated September 23, 2016? Craig, we did receive your follow-up question re: mixing zone (see email chain below), however we have yet to receive a formal response from MOECC. Please let us know the anticipated timing for the review comments at your earliest convenience. For your ease of reference, I have attached the letter to this email.

As we had discussed during our last meeting, we would like to obtain the MOECC's agreement, in principle, to the proposed effluent requirements for a new WWTP in Waldemar, ON operating at a rated ADF capacity of 552 m3/d. This information will then be used to assess alternatives and develop treatment options for consideration as part of the on-going Class EA process.

Thanks, and have a great day.

Melody Johnson, M.A.Sc., P.Eng., Senior Consultant
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BLUE SKY Energy Engineering & Consulting Inc.
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From: Melody Johnson
Sent: October 3, 2016 8:24 AM
To: 'Fowler, Craig (MOECC)' <Craig.Fowler2@ontario.ca>
Cc: Wingate, Wendy (MOECC) <wendy.wingate@ontario.ca>; wbroos@rogers.com; lwolfenberg@asi-group.com; Slattery, Barbara (MOECC) <barbara.slattery@ontario.ca>; Michael Hulley (Michael.Hulley@rmc.ca) <Michael.Hulley@rmc.ca>
Subject: RE: ACS for proposed WWTP in Waldemar - Follow-up to MOECC's outstanding comments

Hi Craig,

The mixing zone is normally defined as the point at which PWQO's are achieved. In the case of a Policy 2 parameter, PWQO will never be achieved, and an alternative boundary is required.

In light of this, we chose to define the extent of the zone within which the total phosphorus concentration is >10% above ambient concentrations. This is a reasonable threshold for defining the boundary at which effluent impact on phosphorus concentration is marginal. The modelled concentrations of TP within the receiver, using the ambient value of 30 ug/L as a "baseline", are presented in Figure 10 of our September 23, 2016 letter.

Let me know if you have any other comments or concerns.

Thanks,

Melody Johnson, M.A.Sc., P.Eng., Senior Consultant
melody@bskyeng.com | www.bskyeng.com | T. 416.463.7644 | M. 647.721.7644

BLUE SKY Energy Engineering & Consulting Inc.
EXPERTISE | BEST PRACTICES | CREATIVE THINKING

From: Fowler, Craig (MOECC) [mailto:Craig.Fowler2@ontario.ca]
Sent: September 30, 2016 9:22 AM
To: Melody Johnson <melody@bskyeng.com>
Cc: Wingate, Wendy (MOECC) <wendy.wingate@ontario.ca>; wbroos@rogers.com; lwolfenberg@asi-group.com; Slattery, Barbara (MOECC) <barbara.slattery@ontario.ca>
Subject: RE: ACS for proposed WWTP in Waldemar - Follow-up to MOECC's outstanding comments

Hi Melody,

I have one question regarding the section on total phosphorus. How does the ambient concentration exceeding the PWQO prevent the definition of the mixing zone? If the ambient concentration is above the PWQO then that is the baseline used for the assessment and it will be lower than the sewage discharge. My understanding is that the PWQO shouldn't factor into the mixing zone analysis.

Regards,

Craig Fowler, M.Sc. | Surface Water Specialist | Technical Support Section| Ministry of the Environment and Climate Change| 119 King St. West, 12th Floor, Hamilton, Ontario, L8P 4Y7 | ph. 905-521-7823 | fax. 905-521-7820 | craig.fowler2@ontario.ca

From: Melody Johnson [mailto:melody@bskyeng.com]
Sent: September 28, 2016 8:31 AM
To: Slattery, Barbara (MOECC)
Cc: Fowler, Craig (MOECC); Wingate, Wendy (MOECC); wbroos@rogers.com; lwolfenberg@asi-group.com
Subject: RE: ACS for proposed WWTP in Waldemar - Follow-up to MOECC's outstanding comments

Thanks for the update. We look forward to hearing from MOECC.

Melody Johnson, M.A.Sc., P.Eng., Senior Consultant
melody@bskyeng.com | www.bskyeng.com | T 416.463.7644 | M 647.721.7644

BLUE SKY Energy Engineering & Consulting Inc.
EXPERTISE | BEST PRACTICES | CREATIVE THINKING

From: Slattery, Barbara (MOECC) [mailto:barbara.slattery@ontario.ca]
Sent: September 28, 2016 8:27 AM
To: Melody Johnson <melody@bskyeng.com>
Cc: Fowler, Craig (MOECC) <Craig.Fowler2@ontario.ca>; Wingate, Wendy (MOECC) <wendy.wingate@ontario.ca>
Subject: RE: ACS for proposed WWTP in Waldemar - Follow-up to MOECC's outstanding comments

Hello Melody, your letter/report is in the queue for review and I hope to be able to get back to you with any comments, suggestions etc. that we will have by this time next month.

From: Melody Johnson [mailto:melody@bskyeng.com]
Sent: September 23, 2016 10:27 AM
To: Slattery, Barbara (MOECC); Fowler, Craig (MOECC); Wingate, Wendy (MOECC); scooke@grandriver.ca; Mark Anderson; lwolfenberg@asi-group.com; wbroos@rogers.com; cgervais@amaranth-eastgary.ca; Michael Newbigging
Cc: Michael Hulley
Subject: ACS for proposed WWTP in Waldemar - Follow-up to MOECC's outstanding comments

All:

Attached please find a letter that addresses the comments raised by MOECC during our meeting held on August 15, 2016. Should you have any questions or concerns related to the attached, please do not hesitate to contact me.

Thanks, and have a great weekend.

Melody Johnson, M.A.Sc., P.Eng., Senior Consultant
melody@bskyeng.com | www.bskyeng.com | T. 416.463.7644 | M. 647.721.7644

BLUE SKY Energy Engineering & Consulting Inc.
EXPERTISE | BEST PRACTICES | CREATIVE THINKING

APPENDIX G
DISSOLVED OXYGEN MODELLING

Assessment of In-stream Dissolved Oxygen Impacts Associated with the Proposed Waldemar WWTP Discharge

1. Overview of In-stream Dissolved Oxygen Assessment

The goal of this assessment was to determine the approximate impact on in-stream dissolved oxygen levels associated with the proposed Waldemar WWTP discharge, during summer low flow conditions. To achieve this, a straightforward Streeter-Phelps dissolved oxygen model, developed by the Alabama Department of Environmental Management (ADEM, 2001) was applied. In addition, the hydrodynamics of the Grand River near Waldemar were defined using GRCA's hydrodynamic river model, which is based on the U.S. Corps of Engineers HEC-RAS model. A brief summary of the approach, parameter assignments, and results are provided below. In general, results indicate that the proposed Waldemar WWTP discharge will have no significant impact on in-stream dissolved oxygen levels.

2. Methodology

ADEM's dissolved oxygen model combines oxygen demand associated with organic nitrogen, sediments, and biochemical oxygen demand, with re-aeration, to estimate in-stream dissolved oxygen under steady-state conditions. Model application requires discretization of the river, downstream of the waste discharge, into reasonably homogenous reaches, with reach specific velocity, depth, and re-aeration. Reach definition downstream was based on GRCA's HEC-RAS model discretization. GRCA's HEC-RAS model defines reaches based on cross-section geometry and slope over a distance of about 4.5 km downstream of the Waldemar WWTP, reach lengths vary from 60 m to about 320 m. A low flow of 0.4 m^3/s was applied to the HEC-RAS model, and site-specific velocity and depth were extracted from the HEC-RAS results for use in ADEM's dissolved oxygen model.

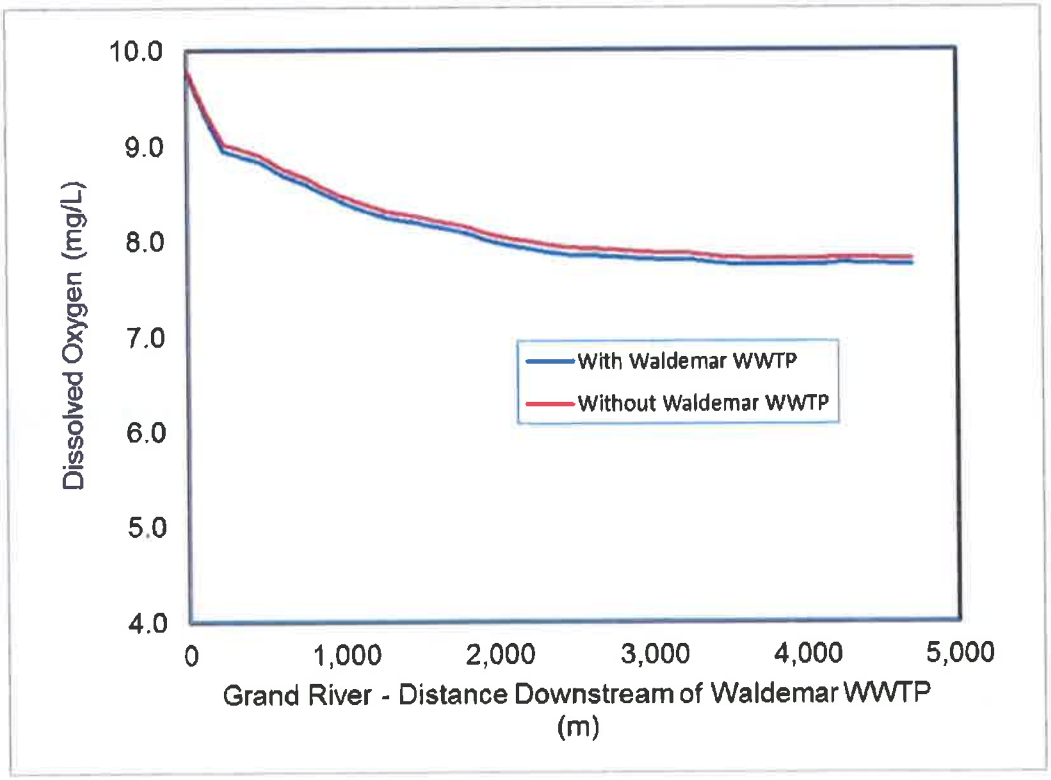
Re-aeration is a critical factor in any dissolved oxygen model, and in this application, reach-specific re-aeration rate constants were defined using an empirical model as recommended by USGS (Melching and Flores, 1999). In general, velocity, flow and river bed slope are used as a basis for estimation of individual re-aeration constants, that are in-turn used in ADEM's dissolved oxygen model.

Ambient water quality was defined according to 75th percentile water quality, as summarized in XCG's recent Assimilative Capacity Assessment (XCG, 2016). Total ammonia, temperature and dissolved oxygen (25th percentile) concentrations were 0.05 mg/L, 23°C, and 9.8 mg/L, respectively. In-stream BOD was not addressed in the recent assimilative capacity assessment, and was assumed to be 3 mg/L for this analysis.

Effluent quality was defined according to recommended effluent limits presented in the recent assimilative capacity assessment (XCG, 2016). Effluent BOD and total ammonia were defined as 10 mg/L and 1.8 mg/L, respectively.

3. Results

A plot of dissolved oxygen downstream of the proposed Waldemar WWTP discharge is provided below. Results with and without the additional effluent are included. As illustrated, the dissolved oxygen impact associated with the WWTP discharge is marginal. The initial drop in dissolved oxygen within the first few hundred meters of the discharge is not a result of the effluent loading, but rather is a result of either an under-estimation of re-aeration rate constants, or an over-estimation of in-stream BOD and nitrogen.



4. Conclusion

The proposed Waldemar WWTP effluent will have no significant impact on in-stream dissolved oxygen levels in the Grand River.

A4:

TREE INVENTORY

BEACON
ENVIRONMENTAL

February 13, 2015

BEL 213436

Walter Broos
Sarah Properties Ltd.
2 Prince Edward Road
Woodstock, ON
N4V 1G7

Re: Tree Inventory and Preservation Plan – Waldemar Property

Dear Mr. Broos:

This report presents the findings of a tree inventory and preservation plan that was completed for the subject property located west of 10th Line and south of the Upper Grand Trailway in the community of Waldemar, Town of Grand Valley, Ontario (see **Figure 1**). The report characterizes the trees on and immediately adjacent to the subject property, including standalone trees and tree groupings and provides recommendations for tree protection during construction. Trees located off the property within the road allowances for the Main St and Church St extensions were not included in the inventory.

The tree inventory was conducted on March 7 and May 7, 2014 by an Ecologist and ISA Certified Arborist from Beacon Environmental. Individual trees on the subject property were tagged with numbered aluminum forestry tags. Trees were measured to determine their trunk diameter (DBH), identified to species, and their condition was assessed. Trees located on neighbouring properties were documented but not tagged. Where trees occurred in groupings, the entire grouping was characterized in terms of species composition, size class, and the general condition.

Tree condition was assessed in terms of overall health and structural integrity based on indicators such as live buds, dead wood, decay, structural defects, and presence of disease. Each tree was assigned a condition rating of good, fair, poor, or dead, based on the following criteria:

- **Poor** – Severe dieback, significant lean, missing leader, major defects, significant decay and/or disease presence
- **Fair** – Moderate dieback and/or lean, limb defects, multiple stems, moderate foliage damage from stress
- **Good** – Healthy vigorous growth, minor visible defects or damage

- **Dead** – No live growth

Findings

A total of 39 trees were individually tagged and assessed (see **Table 1**). Additionally, where the property boundary was unclear, additional trees were assessed but not tagged. A summary and evaluation of the individual trees is presented in **Table 2**, appended to this report. The locations of trees that were inventoried and assessed are shown on **Figure 2**.

A singletree resembling Butternut (*Juglans cinerea*) was observed from the adjacent property (tree 964). Butternut is a provincially endangered species and is protected under the Endangered Species Act, 2007 (ESA). The specimen exhibited several characteristics typical of a hybrid or Japanese Walnut (*Juglans ailantifolia*) and appears to have been planted as there is a white plastic collar guard around its base. Butternut hybrids and planted specimens are exempt from protection under the ESA.

In addition to the individual trees that were inventoried and assessed, 10 tree groupings that were delineated and characterized. The tree groupings are generally situated at the periphery of the subject property (see **Figure 2**). A description of the tree groupings is provided below.

Tree Group A

This small tree grouping is situated at the south end of the subject property and consists entirely of Trembling Aspen (*Populus tremuloides*) regeneration. The grouping extends onto the property to the south. The group contains a total of 87 trees. Fifty-six trees are located on the subject property, ranging in size from less than 5 cm DBH to 33 cm DBH (see **Table 1**). The majority of trees are less than 10 cm DBH (see **Table 1**).

Table 1. Size range of trees in Group A on Subject Property

DBH Range	Number of Trees
< 5 cm	18
5-9.5 cm	17
10-14.5 cm	9
15-19.5 cm	6
20-29.5 cm	5
30-40 cm	1
Total	**56**

Thirty-one Trembling Aspen trees in this grouping were recorded on the property to the south, including:

- 15 trees less than 5 cm DBH
- 14 trees 5-9.5 cm DBH
- 2 trees 10-14.5 cm DBH

The trees in this grouping were observed to be in generally fair to good condition. Four dead trees were also recorded.

Tree Group B

This tree grouping is situated on the east side of the subject property and consists entirely of regenerating White Poplar (*Populus alba*). White Poplar is a non-native species that can be invasive. A total of 15 trees were recorded in this grouping. Trees range in diameter from 5 to 13 cm DBH, with a median DBH of 10 cm. Trees in this grouping are generally in good condition.

Tree Group C

This tree grouping is located near the subject property boundary and consists of eight trees including four spruce, three White Pine, and one maple. Tree diameters range from 20 to 45 cm DBH and all trees appeared to be in good condition.

Tree Group D

This tree grouping is comprised of 13 spruce trees. Tree diameters range rom 15-20 cm DBH and all trees are in good condition.

Tree Group E

This tree grouping consists of a row of young planted multi-stem Silver Maples (8-12 cm DBH) and several small White Cedars.

Tree Group F

This tree grouping consists of a row of young planted trees including three Silver Maples (8-14 cm DBH), two Sugar Maples (7 cm DBH), one White Pine (5 cm DBH), and eight spruce trees (10-15 cm DBH). Trees are good condition.

Tree Group G

This tree grouping consists of approximately 30-40 young White Cedar trees, all less than 10 cm DBH

Tree Group H

The tree grouping consists of approximately 20 spruce trees and several Scotch Pines ranging in size from 10-15 cm DBH as well as about 25-30 young White Cedar. A single poplar with a DBH of 20 cm is located at the north end of the grouping. With the exception of a few dead spruce, all trees were observed to be in good condition.

Tree Group I

The group includes four spruce trees in good condition, ranging in size from 20-25 cm DBH.

Tree Group J

This group is comprised of four spruce trees and four White Pine in good condition, ranging in size from 10-20 cm DBH.

Recommendations

Based on a review of the proposed Draft Plan of Subdivision and Preliminary Grading Plan, as well as discussions with the consulting engineers (Crozier and Associates), it may be possible to protect many of trees growing along the property boundary. The feasibility of retaining trees along the boundary of the site will confirmed at detailed design.

All trees internal to the proposed development will require removal to accommodate site grading, lots, and infrastructure, including 14 individual trees and four tree groupings (A, B, F and G). An additional three (3) trees are recommended for removal because they are dead or in poor health (see **Table 2**).

Trees to be retained shall be protected through the establishment of a Tree Protection Zone (TPZ). The TPZ shall be established at the dripline of individual trees and one meter from the edge of tree groupings (see **Table 2** and **Figure 2**).

Erosion and Sediment Control (ESC) fencing, which will be established at the limit of development, shall also function as tree protection fencing for those trees and tree groupings identified for preservation. The limit of the ESC fencing will demarcate the TPZ (see **Figure 2**).

It is strongly recommended that there be no grading, soil disturbance, or surface treatments within the TPZ. No equipment or materials shall be stored inside the TPZ.

In addition to the establishment of the TPZ, the following specifications are recommended to ensure the health and survival of any retained trees:

- Before the beginning of work, the contractor and Beacon Environmental, or other qualified arborist, should meet on site to review work procedures, access routes, storage areas and the TPZ or other tree protection measures.

- Where underground utilities are to be installed, the route shall be outside any TPZ, or use tunnelling or boring methods for installation.
- Any root damage occurring during construction should be cut cleanly with a hand saw or pruning shears
- Any injury to a tree during construction should be evaluated by a qualified arborist.
- Any pruning of trees for construction clearance shall be performed by a qualified arborist.

Report prepared by:
Beacon Environmental

Dan Westerhof

Dan Westerhof, B.Sc, MES
Terrestrial Ecologist, Certified Arborist

Report reviewed by:
Beacon Environmental

Ken Ursic

Ken Ursic, B.Sc, M.Sc.
Principal, Senior Ecologist

Site Location

Figure 1

Waldemar TIPP

First Base Solutions
Web Mapping Service 2010

UTM Zone 17 N, NAD 83

N
W E
S

0 100 200 400 Metres

1:12,000

BEACON
ENVIRONMENTAL

Project 213436
June 2014

Tree Locations

Figure 2a

Waldemar TIPP

Legend

- 🟥 Subject Property
- — Development Plan
- • Individual Trees
- ▭ Tree Protection Zone
- ▭ Tree Groups

First Base Solutions
Web Mapping Service 2010

UTM Zone 17 N, NAD 83

0 20 40 80 Metres

1:2,200

BEACON
ENVIRONMENTAL

Project 213436
February 2015

Tree Locations

Figure 2b

Waldemar TIPP

Legend

🟥 Subject Property

• Individual Trees

☐ Tree Protection Zone

☐ Tree Groups

— Development Plan

First Base Solutions
Web Mapping Service 2010

UTM Zone 17 N, NAD 83

0 20 40 80 Metres

1:2,200

BEACON ENVIRONMENTAL

Project 213436
February 2015

Tree Locations

Figure 2c

Waldemar TIPP

Legend

- 🟥 Subject Property
- ● Individual Trees
- ▭ Tree Protection Zone
- ▭ Tree Groups
- —— Development Plan

First Base Solutions
Web Mapping Service 2010

UTM Zone 17 N, NAD 83

0 20 40 80 Metres

1:2,200

BEACON
ENVIRONMENTAL

Project 213436
February 2015

Table 2. Tree Inventory and Evaluation

Tag	Species	Common Name	DHB (cm)	Condition	Comments	Recommendation
19	*Acer saccharum*	Sugar Maple	60	Good	Good from and vigour: slightly asymetric crown	Protect
20	*Ulmus americana*	White Elm	22	Fair	Codominant leaders; forked at 8 m, asymetic crown due to crowding	Protect
21	*Acer saccharum*	Sugar Maple	32/32	Fair-Good	forked at base, approx 0.5 m of included bark, large partially healed wound on upper trunk	Protect
22	*Acer saccharum*	Sugar Maple	75	Fair-Good	small cavity at branch stub, one dead branch	Protect
23	*Acer saccharum*	Sugar Maple	55	Fair	Asymetrical crown due to crowding	Protect
24	*Acer saccharum*	Sugar Maple	63	Fair-Good	Asymetrical crown due to crowding, growing into fence	Protect
25	*Dead*		26/26/20	Dead		Remove
26	*Dead*		28/25	Dead		Remove
27	*Prunus serotina*	Black Cherry	20	Poor	Major lean, 2 large broken/haning limbs, poor form	Remove
28	*Ulmus americana*	White Elm	52	Fair	Codominant stems with included bark; many small dead branches; over extended lower branch	Protect
29	*Acer saccharum*	Sugar Maple	65	Good	small trees/offshoots growing around base; good from and vigour	Protect
30	*Acer saccharum*	Sugar Maple	90	Fair-Good	one broked leader	Protect
31	*Ulmus americana*	White Elm	30/30/20/15/15	Poor	Mostly dead; few live buds	Remove
32	*Acer saccharum*	Sugar Maple	70	Fair	Codominant leaders; large cavity in upper trunk; grown into fence; asymetric crown; 6 dead/broken branches	Protect
33	*Acer saccharum*	Sugar Maple	70	Fair	cavity in mid-trunk (20 cm), one leader recently snapped off and haning (20 cm); other leader broken off–old wound	Protect
34	*Ulmus americana*	White Elm	48/36/36	Fair	stressed; extensive epicormic branching; corrected bend in trunk; moderate lean toward east	Protect
35	*Prunus sp.*	Cherry species	20/15/15	Fair	large area of exfoliated bark up lower trunk - unknown damage	Protect
36	*Ulmus americana*	White Elm	25/30	Fair	Extensive epicormic branches; fair form	Protect
37	*Ulmus americana*	White Elm	27/25/15	Fair-Good	Extensive epicormic branches; grown into fence; good form	Protect
38	*Acer negundo*	Manitoba Maple	18/1513	Good	Good vigour; minor winter storm damage; one small broken branch; several arching branches	Remove
39	*Acer negundo*	Manitoba Maple	15	Poor	Main trunk split in crotch and hanging	Remove
40	*Acer negundo*	Manitoba Maple	20/10/10/10	Fair		Remove
41	*Dead*		15			Remove
42	*Pinus sylvestria*	Scotch Pine	15		Good vigour	Protect
43	*Picea glauca*	White Spruce	25	Good	Good form and vigour	Remove
44	*Picea glauca*	White Spruce	25	Good	good form and vigour	Remove
45	*Ulmus americana*	White Elm	45	Fair	Extensive epicormic branches; asymetric crown; six small dead lower branches; codominant leaders	Protect

Tag	Species	Common Name	DHB (cm)	Condition	Comments	Recommendation
46	*Ulmus americana*	White Elm	15-20	Good	Five trunks between 15 and 20 cm; some epicormic branches	Protect
47	*Malus pumila*	Common Apple	20-30	Fair	multi-stem, shrub form, extenisve epicormic branching	Protect
48	*Populus sp.*	Poplar species	15	Good		Protect
49	*Populus tremuloides*	Trembling Aspen	13.5	Good		Remove
50	*Acer saccharinum*	Silver Maple	14/10/10/8	Good		Protect
51	*Acer negundo*	Manitoba Maple	20/14	Poor	Main trunk split in crotch and hanging	Remove
52	*Picea sp.*	Spruce species	24	Good		Remove
53	*Picea sp.*	Spruce species	24	Good		Protect
54	*Picea sp.*	Spruce species	20	Good		Protect
55	*Salix sp.*	Willow species	25/25	Good		Remove
56	*Acer negundo*	Manitoba Maple	24/18/15	Good		Remove
57	*Picea sp.*	Spruce species	18	Good		Protect
Untagged Trees						
893	*Picea sp.*	Spruce species	15	Good		Protect
896	*Acer saccharinum*	Silver Maple	100	Good		Protect
897	*Picea abies*	Norway Spruce	50	Good		Protect
964	*Juglans cinerea/Juglans ailantifolia*	Butternut hybrid/Japanese Walnut	8	Good	Japanese walnut or Butternut showing hybrid characteristics, planted on neighbouring property	Protect
965	*Juglans nigra*	Black Walnut	30	Good	on neighbouring property	Protect
969	*Acer saccharinum*	Silver Maple	20/20	Good	on neighbouring property	Protect

A5:

ARCHAEOLOGICAL ASSESSMENT

THE STAGE 2-3 ARCHAEOLOGICAL ASSESSMENT OF THE SARAH PROPERTIES LTD. PROPERTY, 1 EVANS AVENUE AND 9 MILL STREET, PART OF LOTS 2 & 3, CONCESSION 10, TOWNSHIP OF AMARANTH, DUFFERIN COUNTY

(original)

ARCHAEOLOGICAL ASSESSMENTS LTD.

THE STAGE 2-3 ARCHAEOLOGICAL ASSESSMENT OF THE SARAH PROPERTIES LTD. PROPERTY, 1 EVANS AVENUE AND 9 MILL STREET, PART OF LOTS 2 & 3, CONCESSION 10, TOWNSHIP OF AMARANTH, DUFFERIN COUNTY

(original)

Prepared by

Archaeological Assessments Ltd.
2227 Wuthering Heights Way, Oakville, Ontario L6M 0A3
Telephone - 905-469-8690   Facsimile - 905-469-8702

Consulting Archaeologist: Rick Sutton
Archaeological Consulting Licence Number P013
P.I.F. Numbers P013-1047-2014 & P013-1089-2014
December 8, 2014

TABLE OF CONTENTS

PROJECT PERSONNEL

Project Director	Rick Sutton (License P013)
Field Director	Chris Brown (License P361)
Report Preparation	Richard Sutton (License P013)
Field Assistants	Ian Dutcher, Andrew Holmes, Sally Lynch

EXECUTIVE SUMMARY

This report details the rationale, methods and results of the Stage 2-3 Archaeological Assessment of the Sarah Properties Ltd. Property, 1 Evans Avenue and 9 Mill Street, Part of Lots 2 & 3, Concession 10, Township of Amaranth, Dufferin County. This project was conducted as a component of a draft plan application for a residential development and in order to comply with the Planning Act (1990).

The 35 hectare subject property consists mostly of agricultural lands along with a few small scrubland areas. The subject property was subjected to a Stage 1assessment by our firm in 2011 (AAL 2011). The results of the Stage 1 assessment indicated that the vast majority of the subject property did have some potential for both aboriginal and Euro-Canadian archaeological resources.

Our Stage 2 assessment of the subject property was conducted in June and October, 2014. All of the agricultural lands were ploughed and pedestrian surveyed at 5 metre intervals. The scrubland areas were shovel test pitted at 5 metre intervals.

One site was found as a result of the assessment and has been registered as the James Tate site (AlHb-14). The James Tate site (AlHb-14) is a late 19th century Euro-Canadian homestead. Our firm carried out a Stage 3 assessment of the site in October and November, 2014. The Stage 3 assessment included a controlled surface collection and the excavation of 42 one metre square test units at 5-10 metre intervals across the site. The results of the Stage 3 assessment and archival research indicate that the site was occupied between the 1860's and the 1880's.

Given the relatively late date of occupation, the James Tate site (AlHb-14) is not considered to have cultural value and will not require Stage 4 mitigation. The James Tate site (AlHb-14) does not require any further investigation and is no longer a planning concern. Accordingly, there are no other further concerns for impacts to archaeological resources on these lands. No further archaeological assessment of this parcel of land is required.

1.0 PROJECT CONTEXT

1.1 INTRODUCTION AND DEVELOPMENT CONTEXT

This report details the rationale, methods and results of the Stage 2-3 Archaeological Assessment of the Sarah Properties Ltd. Property, 1 Evans Avenue and 9 Mill Street, Part of Lots 2 & 3, Concession 10, Township of Amaranth, Dufferin County. This project was conducted as a component of a draft plan application for a residential development and in order to comply with the Planning Act (1990).

The assessment was conducted by Archaeological Assessments Ltd., under archaeological consulting licence No. P013 issued to Rick Sutton. The assessment was conducted in accordance with the provisions of the Ontario Heritage Act (Government of Ontario 1980) and the technical guidelines for archaeological assessments formulated by the Ministry of Tourism and Culture (MCL 2011). Archaeological Assessments Ltd. accepts responsibility for the long term curation of any artifacts recovered or documents produced as a result of the assessment.

1.2 ARCHAEOLOGICAL CONTEXT

Property Description
The 35 hectare subject property is located in the Community of Waldemar, north of Regional Road 25 on the west side of Mill Street (Figures 1, 2 and 3). The Stage 2 assessment was conducted by Chris Brown (P361) on June 12 and October 14-16, 2014.

The subject property is comprised primarily of agricultural lands. The topography is generally rolling with a number of broad ridges and knolls. There are also some lower lying poorly drained areas in the north, central and southern sections of the subject property. Areas to the south of the dead end at the south end of James Street were characterized by uneven, lightly treed scrublands.

The Grand River is located 150 metres east of the subject property. A small seasonal or relic watercourse passes through the central section of the property and drains to the east into the Grand River. The relic watercourse is associated with a small lower lying spillway. An abandoned rail line which is now part of a trail system, borders the property to the north.

The subject property is located on the northeastern edge of the Stratford Till Plain physiographic region (Chapman and Putnam 1984). This is a broad till plain interrupted by several moraines. The subject property itself consists of gently undulating tablelands which contain well drained clay loam and sandy loam soils.

Previous Archaeological Research
The subject property was subjected to a Stage 1archaeological assessment by our firm in 2011 (AAL 2011). The results of the Stage 1 assessment indicated that the vast majority of the subject property did have some potential for both aboriginal and Euro-Canadian archaeological resources. The subject property was considered to have archaeological potential because the majority of this

parcel of land is located within 300 metres of a source of water or of an area of early Euro-Canadian settlement. It was therefore recommended that the subject property should be subjected to a Stage 2 archaeological assessment prior to the development of this parcel of land (AAL 2011).

There are currently no registered archaeological sites located either on or immediately adjacent to the subject property (Rob Von Bitter MTCS: personal communication). A survey of the Ministry of Tourism and Culture archaeological files located in Toronto indicates that there was only one previously registered archaeological site located within a one kilometre radius of the subject property. The previously registered site is the Rothfusz site (AlHb-1), a Late Archaic findspot located 450 metres northeast of the subject property (no report reference available). A cultural chronology for Southern Ontario that also applies to the study area in presented in Table 1.

Table 1. Cultural Chronology For Southern Ontario

PERIOD	GROUP	TIME RANGE	COMMENT
PALEO-INDIAN			
Early	Fluted	9000 - 8500 B.C.	Big Game Hunters and Small Nomadic Groups
Late	Non-fluted	8500 - 7500 B.C.	
ARCHAIC			
Early	Nettling	8000 - 7000 B.C.	Nomadic Hunters and Gatherers
	Bifurcate Based	7000 - 6000 B.C.	
Middle	Stemmed, Otter Creek and Brewerton	6000 - 2500 B.C.	Transition to Territorial Settlement
Late	Narrow Point	2500 - 1800 B.C.	More Diverse Resource Base
	Broad Point	1800 - 1500 B.C.	
	Small Point	1500 - 800 B.C.	
WOODLAND			
Early	Meadowood and Middlesex	1000 - 300 B.C.	Introduction of Pottery
Middle	Point Peninsula	300 B.C.- 700 A.D.	Long Distance Trade
Transitional	Princess Point	500 - 900 A.D.	Early Agriculture
Late	Early Iroquoian	900 - 1275 A.D.	Transition to Village Life
	Middle Iroquoian	1275 - 1400 A.D.	Large Villages and Dependence on Agriculture
	Late Iroquoian	1400 - 1650 A.D.	Tribal Development, Warfare, European Contact
HISTORIC			
Early	Odawa, Ojibwa, Mississauga	1700 - 1875 A.D.	Social Displacement
Late	Euro-Canadian	1800 A.D.- present	European Settlement

1.3 HISTORICAL CONTEXT

The subject property is comprised of Part of Lots 2 and 3, Concession 10 in Amaranth Township, Dufferin County. The survey of Amaranth Township was not completed until 1832 although the first settlers started to arrive in the 1820's (Sawden 1952). Early settlement was slow, with the population of Amaranth and the adjacent Township Melancthon being only 100 people by 1840. By 1860, the population of Amaranth Township had risen to 1200, with the bulk of settlement occurring from 1845 to 1865 (Sawden 1952). In 1841 Amaranth Township became part of Wellington County. In 1881, Amaranth Township became part of the newly created County of Dufferin, which was formed from parts of Wellington, Grey and Simcoe Counties.

The subject property is located immediately west of Waldemar. Waldemar is a small village located in the southwestern corner of the Township of Amaranth where the Grand River meets Willow Brook, and was founded in 1869. It was described at this time as being merely dense forest, which grew to a prosperous village by 1871. Some early milling work occurred in the area in the 1850s and 1860s, attracted by the abundant river power. In 1871, it featured a church, a schoolhouse, grist mill, two saw mills, a lath factory, a hotel, a general store, a blacksmith shop and a number of buildings under construction (Orangeville Sun, 1871). In 1870, the first postmaster was appointed and the Toronto Grey & Bruce Railway Company constructed a railway through the town along with a station and residence, a telegraph, water tank, grain elevator and stockyards (Sawden 1952). In 1872, Municipal Plan 4 divided up ten acres of land in Lot 2, Concession 10 (south of Henry Street, west of the Grand River) for town lots. A school was constructed in the village in 1879. Following an initial dispute with the railway company which left it without a station, nearby Grand Valley rose in prominence as the centre of business activity in the area. This lead to a decline in the broader importance of Waldemar (Sawden 1952).

The James Tate site (AlHb-14) is located in the East Half of Lot 3, Concession 10, Amaranth Township. The Abstract Index Book for Amaranth Township (Volume A: 126) reveals that this 200 acre lot was initially patented to the Canada Company in 1846. The eastern half, 100 acres, was purchased by John Mitchell in 1864, and the easternmost quarter was then quickly sold to Abraham Row. In 1865, the west half of the east half of the lot, which contains the archaeological site, was purchased by James Tate. Just over 2 acres within this quarter were sold for the construction of the Toronto Grey and Bruce Railway in 1871. With some small transactions, James Tate held the majority of the 50 acre parcel until his death in 1916, where it was willed to William James Tate.

Table 2. Land Ownership History of Lot 3, Concession 10, Amaranth Township (Abstract Index Book, Amaranth Township, Vol. A: 126; Vol. B: 451, 498; Vol. C: 444)

Date	Type	Grantor	Grantee	Notes
1846	Patent	Crown	The Canada Company	Lot 3, 200 acres
1864	Grant & Release	The Canada Company	John Mitchell	East ½ Lot 3, 100 acres
1864	Bargain & Sale	John Mitchell	Abraham Roe	Northeast ¼, 50 acres, with road reservation
1865	Bargain & Sale	John Mitchell & wife	James Tate	West ½ of East ½, 50 acres, right of road
1871	Bargain & Sale	James Tate & wife	Toronto Grey & Bruce Railway	Part, West ½ of East ½, 2 23/100 acres
1872	Conveyance	Joseph Cooper	James Tate	Northwest ¼ of East ½, 25 acres
1871-1874	Deed	John Main Warder Reynold, Treasurer	Thomas Saunders	South ½ of West ½ of East ½, 12 ½ acres
1872-1874	Bargain & Sale	Thomas Saunders & wife	James Tate	South ½ of West ½ of East ½, 12 ½ acres
1875	Bargain & Sale	William Hunter & wife	James Tate	Southeast part of Southeast ¼
1915	Grant	James Tate et al	Canadian Pacific Railway	Part, East ½
1913-1916	Probate	James Tate	William James Tate	East ½, subject to annuity to Elizabeth Tate & CPR
1917	Quitclaim	Robert John Tate	William James Tate	East ½
1924	Quitclaim	Elizabeth Tate, widow of James Tate	Frank Tate	East ½ less CPR & Road Allowance & Part East of Grand River
1926	Quitclaim	Frank Tate & Christine Tate	William Garfield Tolton	Part, East ½, to correct error
1927-1928	Grant	Frank Tate & Christine Tate	Samuel Hutchinson & Eva Sabrina Hutchinson as Joint Tenants	West ½ of East ½ less CPR & Road Allowance & Part East of Grand River
1929	Grant	Samuel Hutchinson & Eva Sabrina Hutchinson	Mary E. Saigeon & Philip Saigeon as Joint Tenants	West ½ of East ½ less CPR & Road Allowance & Part East of Grand River
1938	Quitclaim	Mary E. Saigeon & Philip Saigeon	The Commission of Agricultural Loans	All less CPR & Township Lands
1940	Grant	The Commission of Agricultural Loans	William H. Burke & Alberta E. Burke as Joint Tenants	All less CPR & Township Lands
1943	Grant	William H. Burke & Alberta E. Burke	Corporation of the Township of Amaranth	Parts
1963	Grant	William H. Burke & Alberta E. Burke	David J. Bland & Hazel G. Bland	All less Parts

The earliest available census information for Amaranth Township dates to 1851. Unfortunately the agricultural portion is missing, so no occupational information for the property can be obtained from this period. In 1861, no occupants are listed for the East Half of Lot 3, Concession 10. By 1871, James Tate is listed as the owner of 50 acres in the section of Lot 3 where the archaeological site is located (1861 Census of Canada West, Amaranth Township: 16). James Tate is listed as a 28-year-old Irishman, who lived with his Scottish wife Elizabeth and their Canadian born son David (aged 3) (1871 Census of Canada West, Amaranth Township: 92).

Information on potential Euro-Canadian archaeological planning concerns was also derived in part from an examination of the 1861 Wheelock Map of Wellington County and the 1877-1881 Illustrated Historical Atlas of Waterloo and Wellington Counties (H. Parsell & Company 1877). In 1861 the entire subject property appears to have been owned by David Jenkins, although he is not listed in the land title abstracts (Figure 4). No buildings are shown on the subject property although a grist mill was located on the Grand River on the future site of the Village of Waldemar. By 1877 the area of the subject property where the archaeological site is located was owned by James Tate (Figure 5). Waldemar has become established by this time and a post office and grist mill are shown east of the subject property.

It appears likely that the James Tate site (AlHb-14) marks the location of a house occupied by James Tate and his family, who occupied just under 50 acres in this section of the subject property beginning in 1865. In his obituary dated 23 March, 1916, James Tate is said to have been born in County Antrim, Ireland, before coming to Canada early in his life, initially settling in Pickering, Ontario. He arrived in Waldemar and came to occupy a farm to the north of the town, before marrying Elizabeth Young, the daughter of a milling family (Orangeville Banner, March 23, 1916).

2.0 STAGE 2 FIELD ASSESSMENT

2.1 FIELD METHODS

The Stage 2 assessment of the subject property was conducted under the field supervision of Chris Brown (License P361), Archaeological Assessments Ltd., on June 12 and October 14-16, 2014. On June 12, 2014 a small area in the southeastern section of the property had been ploughed and planted in a crop that was a few inches high at the time of the survey. The weather was a mixture of sun and cloud with warm temperatures. This area was pedestrian surveyed at 5 metre intervals and was well weathered with good visibility. All of the remaining agricultural lands were ploughed and were pedestrian surveyed at 5 metre intervals on October 14-16, 2014. The weather was a mixture of sun and cloud with cool temperatures. All of the ploughed lands were well weathered with excellent visibility at the time of the fall survey. The ploughed and pedestrian surveyed areas represent approximately 95% of the subject property (Figure 6). When an archaeological site or artifact was encountered, the pedestrian survey interval was reduced to one metre within a 50 metre radius of each site or artifact.

All of the small scrubland areas on the property were shovel test pitted at 5 metre intervals to within one metre of all building foundations and hard scaped areas (Figure 6). Each test pit measured more than 30 cm (one foot) in diameter and was excavated 5cm into the subsoil. The soil from each test pit was screened through 6mm mesh in order to look for artifacts. Each test pit was then backfilled.

The results of the shovel test pitting indicated that some of these scrubland areas had been disturbed in the past. Some mounded areas were found, mainly south of the end of James Street. These mounded areas contained heavily mottled soil, with gravel, asphalt and other modern building debris. The scrubland area in the northeastern section of the subject property, at the northwest end of Henry Street, consisted of an area featuring no topsoil, mounded earth and modern building debris. Low lying poorly drained areas in the central section of the property have no archaeological potential and were not shovel test pitted. The shovel test pitted areas and poorly drained areas combined represent approximately 5% of the subject property (Figure 6).

2.2 RECORD OF FINDS

One archaeological site was found as a result of the assessment. The site has been registered as the James Tate site (AlHb-14) and is a late 19th century Euro-Canadian homestead. The James Tate site (AlHb-14) consists of a large number of historic surface artifacts spread over an area measuring 120 metres north-south by 35 metres east-west. The site is located along the eastern edge of a large agricultural field, along the eastern edge of the subject property, just west of the dead end of Evans Avenue. It is situated on a broad plateau overlooking lower lands to the south and northeast. The terrain is elevated and level to gently sloping down to the north. The bulk of the surface scatter is located in its southern two-thirds, which contains the majority of the surface artifacts. The northern portion of the overall surface scatter is significantly more diffuse and contains relatively few artifacts and is referred to here as the north locus. The location and dimensions of the site were recorded with a hand held GPS unit (see supporting document). After the site was located it was almost immediately subjected to a Stage 3 controlled surface collection, which is described in Section 3.0 of this report.

2.3 ANALYSIS AND CONCLUSIONS

The results of the Stage 2 archaeological assessment indicated that the James Tate site (AlHb-14) represented the location of a Euro-Canadian homestead that was likely occupied sometime in the late 19th century. As per the MTC's Standards and Guidelines for Consultant Archaeologists (2011: 35), 19th century domestic archaeological sites where most of the time span of occupation dates to before 1870 are considered to have cultural heritage value and will require Stage 4 mitigation. In order to determine if Stage 4 mitigation will be required, a Stage 3 assessment must be conducted in order to collect more information regarding the site's precise location, limits, integrity, date of occupation and function. For this type of site this would involve conducting a controlled surface collection and test excavations. A series of one metre square test units should be excavated at 10 metre intervals across the site. Additional units, amounting to 40% of the initial grid total, should also be excavated in areas of interest within the site (MTC 2011: 28).

3.0 STAGE 3 ASSESSMENT OF THE JAMES TATE SITE (AlHb-14)

3.1 FIELD METHODS

A Stage 3 assessment of the site was conducted under the field supervision of Chris Brown (License P361) between October 24 and November 7, 2014 under a mixture of sun and cloud and cool temperatures. A temporary datum was established in the central section of the site (300N 100E) and was tied into a fixed property datum. A five metre grid system was then established in the area where the site was located.

A Stage 3 controlled surface collection of the site was conducted on October 24, 2014. The Stage 3 controlled surface collection consisted of an intensive surface examination at one metre intervals of a large area with a minimum radius of 50 metres surrounding the surface artifacts, and the recording of all artifact locations with a transit and stadia rod. All of the visible surface artifacts were then collected for washing and cataloguing. The Stage 3 controlled surface collection resulted in the recovery of a total of 133 surface artifacts (Figure 7). This included 123 artifacts from the main site area and 10 artifacts from the north locus. The main site area covers an area measuring 60 metres north-south by 35 metres east-west. The north locus is located 15-20 metres north of the main site area and consists of a lighter more diffuse surface scatter spread over an area measuring 30 metres north-south by 30 metres east-west. The field crew did not record detailed information regarding each individual surface artifact type due to the fact that all of the surface artifacts were considered to be diagnostic of the late 19th century.

A total of 29 one metre square test units were then excavated at 10 metre intervals across the main site area and the north locus between October 27 and November 7, 2014 (Figure 7). As per the MTC's Standards and Guidelines for Consultant Archaeologists (2011: 28) for sites of this type that may require Stage 4 excavation, another 13 units (40% or more of the grid unit total) were placed in between the 10 metre interval test units in areas of interest (Units 295N 85E, 295N 90E, 295N 95E, 300N 85N, 300N 95E, 305N 85E, 305N 90E, 305N 95E, 310N 85E, 355N 105E, 360N 105E, 365N 105E & 375N 105E).

At the time of the Stage 3 assessment it was thought that the site may require Stage 4 mitigation and therefore this was considered to be the appropriate Stage 3 assessment strategy. However, once the analysis of the artifact collection and archival research had been completed, it was determined that Stage 4 mitigation would not be required. Nonetheless, the Stage 3 assessment strategy and the number of test units that were excavated are considered to be sufficient in this case. This is due to the fact that a large number of test units were excavated across what was considered to be a large site (MTC 2011: 31). Consequently, the excavation of additional units at 5 metre intervals across the entire site area was not required in this case.

All of the soils from each square were screened through 6mm mesh to facilitate the recovery of artifacts. The units varied in depth from 25-38cm and consisted of a clay loam ploughzone. All of the units were excavated into the first 5cm of the subsoil. A total of 42 one metre square test units were excavated across the site. Thirty-four of the test units were positive with artifact counts ranging from 1-64 per unit (Figure 7).

Potential subsurface features were identified in six of the test units (300N 90E, 300N 95E, 305N 85E, 305N 90E, 310N 85E and 320N 90E). The potential features were drawn, photographed, covered in geotextile and backfilled (Figure 8).

No potential midden areas were identified at the site. Nineteenth century domestic sites sometimes contain sheet or slope middens which consist of areas containing high artifact densities, often dominated by domestic ceramics (MacDonald 1997). No slope or sheet middens were identified at the James Tate site (AlHb-14) as a result of our Stage 3 assessment. Our firm's experience gained through the excavation of over 50 nineteenth century domestic sites, indicates that midden areas contain very high artifact densities, often exceeding 200 historic artifacts per one metre unit (AAL 2006, 2012). The highest one metre unit artifact count at the James Tate site (AlHb-14) was 64. Nineteenth century domestic site middens also often contain a partially undisturbed rich organic layer, situated on a slope or the periphery of the site area (AAL 2006, 2012). No deposits of this type were found at the James Tate site (AlHb-14). The density and distribution of artifacts types at the James Tate site (AlHb-14) is typical of the general low density plough zone artifact component which is common to these types of sites (Poulton and Dodd 2007).

3.2 RECORD OF FINDS

The artifact assemblage recovered from the site is summarized in Table 3. More details regarding artifact provenience and characteristics are provide in Tables 4 and 5. As indicated in Table 3, a total of 671 artifacts were recovered from the site during the Stage 3 investigations. This includes 629 artifacts from the main site area and 41 artifacts from the north locus. The compositions of the two loci suggest that they are contemporaneous with one another and that the north locus may have been the location of one or more outbuildings associated with the main occupation area. Overall, the combined artifact assemblage consists of household ceramics (n= 478: 71.2%), followed by architectural elements and miscellaneous hardware (n=136: 20.3%), household glass (n=56: 8.3%), and personal material (n=1: 0.1%). The artifact categories, typologies and diagnostic data are derived from Adams (1993) and (Kenyon 1991).

The most common ceramic type within the ceramic assemblage was red earthenware (n=185: 38.7%), followed by ironstone (n=125: 26.1%), white ware (n=89: 18.6%), transfer printed ware (n=22: 4.6%), small fragmented unidentified ceramics (n=16: 3.3%), stamped ware (n=15: 3.1%), relief moulded ironstone (n=13: 2.7%), edged ware (n=7: 1.5%), and small amounts of banded ware, yellow ware, stone ware and semi-porcelain.

The transfer printed wares included blue geometric (n=10), blue floral (n=6), blue curvilinear (n=2), red floral (n=2), and black landscape (n=2) motifs. The 15 pieces of stamped ware include purple floral (n=7), brown floral (n=6), blue floral (n-1) and blue spiral (n=1). All of the edged ware was straight blue edged. The 13 pieces of relief moulded ironstone had various types of plan motifs (n=10) along with two floral motifs and one curvilinear motif. The two pieces of banded ware both had blue bands. The single piece of sponged ware was blue. The single piece of stone ware had a brown glaze and appears to be Bristol ware.

Table 3. Site (AlHb-14) Stage 3 Artifact Assemblage

COMPONENT/CATEGORY	**Site Total**	**%**
Household Ceramics		
Red Earthenware	185	
Ironstone	125	
White Ware	89	
Transfer Printed	22	
Stamped Ware	15	
Relief Moulded Ironstone	13	
Edged Ware	7	
Banded Ware	2	
Sponged Ware	1	
Yellow Ware	1	
Semi-Porcelain	1	
Stone Ware	1	
Unidentified	16	
Subtotal	***478***	***71.2***
HOUSEHOLD GLASS		
Bottle Glass	56	
Subtotal	***56***	***8.3***
ARCHITECTURAL ELEMENTS & HARDWARE		
Cut Nails	51	
Window Glass	37	
Miscelaneous Metal	24	
Unidentified Nails	21	
Brick Fragments	2	
Horseshoe Nails	1	
Subtotal	***136***	***20.3***
PERSONAL MATERIAL		
Slate Pencil	1	
Subtotal	***1***	***0.1***
TOTALS	**671**	

Overall, the ceramic assemblage from the James Tate site (AlHb-14) suggests that it was occupied between the 1860's and the 1880's. Ironstone became available in Ontario during the 1840's and tends to be the dominant ceramics over white wares on sites by the 1870's (Kenyon 1991). The higher weighting of ironstone in relationship to white ware in this assemblage suggests that the site was primarily occupied in the 1870's. Transfer printed ceramics were available in Ontario during most of the nineteenth century (Kenyon 1991). Straight edged ceramics are more common from sites dating to after 1850 (Kenyon 1980). Banded ware consisting of simple blue bands tend to date to after 1860. Stamped ware and sponged ware was popular from the 1840's to 1870's. Yellow ware was introduced in the 1840's and was common after that. The stoneware recovered from the site consists of Bristol ware, which was not imported into Ontario until the 1880's (Kenyon 1991). Semi-porcelain did not become available in Ontario until the 1880's or 1890's.

Table 4. Site (AlHb-14) Artifact Counts and Provenience

Surface		25	21	42	5		1	1			1	5	4	2	4	10	1				1	123
280N 90E		1	1														2					4
280N 100E		1		1																		2
280N 110E												1										1
290N 90E		17	1	3									1	1	1		4				2	30
290N 100E		3	2											1							1	7
290N 110E		1										1				1						3
295N 85E		6	4	1								1		1	4	3	5	5			1	31
295N 90E		8		3					1					1	1	4	1				1	20
295N 95E		4	5	7										1	2	3	3					25
300N 80E		4													1		4					9
300N 85E		9	4	5	1			1					1		7	3	7	2			1	41
300N 90E		27	5	6						1		6		2	4	6	3		1		3	64
300N 95E		6	2	5								1				1					1	16
300N 100E		6											1	1	1							9
300N 110E		6	3	2						1					2	2	2					18
305N 85E	1	8	7	10								1	1		3	5	5	3			1	45
305N 90E		13	5	9	3			1				1	3	3	2	1	5	3				49
310N 80E		3	3	2				2								2	1	2				15
310N 85E		3	7	11	1			2				1	1			4	1	1				32
310N 90E		10	5	8								1		1	1	1	1				1	29
310N 100E		7	1		1									1								10
310N 110E		1												1	2	1						5
320N 80E		2	1		1								1									5
320N 90E		10		2		1						2	2		1	2	1	2			8	31
320N 100E	1	1	2	1																	1	6
North Locus																						
Surface			3	4											1	2						10
350N 100E		2	1																			3
355N 105E		1	2													1	1					5
360N 90E																1	1				2	4
360N 100E																	2					2
360N 105E			3	1													1	2				7
360N 110E				2	1							1										4
365N 105E																1		1				2
370N 100E																				1		1
380N 100E			1													2						3
TOTAL	2	185	89	125	13	1		7	1	2	1	22	15	16	37	56	51	21	1	1	24	671

Artifact Catalogue Legend

BRI- Brick
WHI – Plain Whiteware
IRM- Relief Moulded Ironstone
STO- Stoneware SEM-Semi-Porcelain
YEL- Yellow Ware
SP- Sponged Ware
STA- Stamped
GWI – Window Glass
NCU – Cut Nails NUN – Unidentified Nails
MIS- Miscellaneous Metal

RED – Red Earthenware
IRO- Ironstone
SEM- Semi-porcelain
ED- Edged Ware
BAN- Banded Ware
TR- Transfer Printed
CUN- Unidentified Ceramics
GBO – Bottle Glass
NHR- Horseshoe Nails
PER- Personal Items

Architectural Elements and Miscellaneous Hardware

Architectural elements and miscellaneous hardware recovered from the site include cut iron nails (n=51), window glass (n=37), miscellaneous metal (n=24), unidentified nails (n=21), brick fragments (n=2) and one horseshoe nail. The miscellaneous metal included 18 pieces of scrap metal, 2 horseshoe fragments, 2 screws, one bolt and one buckle.

Household Glass

The 56 pieces of bottle glass include aqua (n=32), clear (n=14), green (n=7) and brown (n=3).

Personal Material

The only personal item recovered from the site was a slate pencil.

The documentary record for the Stage 2-3 assessment includes 28 digital photographs, eight field maps, 4 pages of field notes, 2 test unit square summery forms, and one banker's box of 671 artifacts.

3.3 ANALYSIS AND CONCLUSIONS

The results of the Stage 3 assessment indicate that the James Tate site (AlHb-14) represents the location of a homestead occupied between the 1860's and the 1880's. The Ministry of Cultures (now MTCS) *Standards and Guidelines for Consultant Archaeologists* (2011: 35) state that domestic Euro-Canadian archaeological sites in southern Ontario which were primarily occupied before 1870 (80% or more), have cultural heritage value and require Stage 4 mitigation. The majority of the occupation of the James Tate site (AlHb-14) clearly postdates 1870. Given the relatively late date of occupation, the James Tate site (AlHb-14) is not considered to have cultural value and will not require Stage 4 mitigation.

Table 5. Site (AlHb-14) Artifact Catalogue

Cat #	Unit	Class	Material	Type	Comment	Form	*Common Date Ranges
1-25	Surface	HC	Ceramic	Red Earthenware	glazed and unglazed	holloware	19th-20th Century
26-46	Surface	HC	Ceramic	Whiteware	plain fragments	unknown	1830-1870
47-88	Surface	HC	Ceramic	Ironstone	plain fragments	unknown	1845-1890
89-91	Surface	HC	Ceramic	Relief Moulded Ironstone	moulded plant motif on rims	plates	1845-1890
92	Surface	HC	Ceramic	Relief Moulded Ironstone	moulded plant motif on rim	plate/saucer	1845-1890
93	Surface	HC	Ceramic	Relief Moulded Ironstone	geometric motif	unknown	1845-1890
94	Surface	HC	Ceramic	Edged	blue straight edged rim	plate/saucer	1850-1875
95	Surface	HC	Ceramic	Sponged	blue sponged	unknown	1840-1875
96	Surface	HC	Ceramic	Transfer Printed	printed blue geometric motif	unknown	1830-1890
97-98	Surface	HC	Ceramic	Transfer Printed	printed blue floral motif	unknown	1830-1870
99-100	Surface	HC	Ceramic	Transfer Printed	printed blue floral motif	unknown	1830-1870
101-103	Surface	HC	Ceramic	Stamped	stamped brown floral motif	unknown	1845-1880
104	Surface	HC	Ceramic	Stamped	stamped brown spiral motif	unknown	1845-1880
105-106	Surface	HC	Ceramic	Unidentified	small exfoliated sherds	unknown	-
107-110	Surface	AEH	Glass	Window Glass	small clear fragments	-	-
111-114	Surface	HG	Glass	Bottle Glass	aqua fragments	container	-
115-117	Surface	HG	Glass	Bottle Glass	clear fragments	container	-
118-119	Surface	HG	Glass	Bottle Glass	green fragments	container	-
120	Surface	HG	Glass	Bottle Glass	brown fragment	container	-
121	Surface	AEH	Metal	Cut Nail	cut nail	cut	1830-1890
122	Surface	AEH	Metal	Misc. Metal	horseshoe fragment	horseshoe	-
123	280N 90E	HC	Ceramic	Red Earthenware	unglazed	holloware	19th-20th Century
124	280N 90E	HC	Ceramic	Whiteware	plain fragment	unknown	1830-1870
125-126	280N 90E	AEH	Metal	Cut Nail	cut nail	cut	1830-1890
127	280N 100E	HC	Ceramic	Red Earthenware	unglazed	holloware	19th-20th Century
128	280N 100E	HC	Ceramic	Ironstone	plain fragment	unknown	1845-1890
129	280N 110E	HC	Ceramic	Transfer Printed	printed blue geometric motif	unknown	1830-1890
130-146	290N 90E	HC	Ceramic	Red Earthenware	glazed and unglazed	holloware	19th-20th Century
147	290N 90E	HC	Ceramic	Whiteware	plain fragment	unknown	1830-1870
148-150	290N 90E	HC	Ceramic	Ironstone	plain fragments	unknown	1845-1890
151	290N 90E	HC	Ceramic	Stamped	stamped brown floral motif	unknown	1845-1880
152	290N 90E	HC	Ceramic	Unidentified	small exfoliated sherd	unknown	-
153	290N 90E	AEH	Glass	Window Glass	small clear fragments	-	-
154-157	290N 90E	AEH	Metal	Cut Nail	cut nail	cut	1830-1890
158	290N 90E	AEH	Metal	Misc. Metal	screw	screw	-
159	290N 90E	AEH	Metal	Misc. Metal	scrap metal	scrap	-
160-162	290N 100E	HC	Ceramic	Red Earthenware	glazed and unglazed	holloware	19th-20th Century
163-164	290N 100E	HC	Ceramic	Whiteware	plain fragments	unknown	1830-1870
165	290N 100E	HC	Ceramic	Unidentified	small exfoliated sherd	unknown	-
166	290N 100E	AEH	Metal	Misc. Metal	scrap metal	scrap	-
167	290N 110E	HC	Ceramic	Red Earthenware	unglazed	holloware	19th-20th Century
168	290N 110E	HC	Ceramic	Transfer Printed	printed blue geometric motif	unknown	1830-1890
169	290N 110E	HG	Glass	Bottle Glass	aqua fragment	container	-
170-175	295N 85E	HC	Ceramic	Red Earthenware	glazed and unglazed	holloware	19th-20th Century
176-179	295N 85E	HC	Ceramic	Whiteware	plain fragments	unknown	1830-1870
180	295N 85E	HC	Ceramic	Ironstone	plain fragment	unknown	1845-1890
181	295N 85E	HC	Ceramic	Transfer Printed	printed blue geometric motif	unknown	1830-1890
182	295N 85E	HC	Ceramic	Unidentified	small exfoliated sherd	unknown	-
183-186	295N 85E	AEH	Glass	Window Glass	small clear fragments	-	-
187	295N 85E	HG	Glass	Bottle Glass	aqua fragment	container	-
188-189	295N 85E	HG	Glass	Bottle Glass	clear fragments	container	-
190-194	295N 85E	AEH	Metal	Cut Nail	cut nails	cut	1830-1890
195-199	295N 85E	AEH	Metal	Unidentified Nail	unidentifiable fragments	unknown	-
200	295N 85E	AEH	Metal	Misc. Metal	scrap metal	scrap	-
201-208	295N 90E	HC	Ceramic	Red Earthenware	glazed and unglazed	holloware	19th-20th Century
209-211	295N 90E	HC	Ceramic	Ironstone	plain fragment	unknown	1845-1890
212	295N 90E	HC	Ceramic	Yellow Ware	yellow glaze	holloware	1840-1890

*(Adams 1993) & (Kenyon 1991)
NL- North Locus HC- Household Ceramic; AEH-Architectural Elements and Hardware; HG-Household Glass; PER-Personal

Cat #	Unit	Class	Material	Type	Comment	Form	*Common Date Ranges
213	295N 90E	HC	Ceramic	Unidentified	small exfoliated sherd	unknown	-
214	295N 90E	AEH	Glass	Window Glass	small clear fragment	-	-
215-218	295N 90E	HG	Glass	Bottle Glass	aqua fragments	container	-
219	295N 90E	AEH	Metal	Cut Nail	cut nails	cut	1830-1890
220	295N 90E	AEH	Metal	Misc. Metal	scrap metal	scrap	-
221-224	295N 95E	HC	Ceramic	Red Earthenware	glazed and unglazed	holloware	19th-20th Century
225-229	295N 95E	HC	Ceramic	Whiteware	plain fragments	unknown	1830-1870
230-236	295N 95E	HC	Ceramic	Ironstone	plain fragments	unknown	1845-1890
237	295N 95E	HC	Ceramic	Unidentified	small exfoliated sherd	unknown	-
238-239	295N 95E	AEH	Glass	Window Glass	small clear fragment	-	-
240	295N 95E	HG	Glass	Bottle Glass	aqua fragment	container	-
241	295N 95E	HG	Glass	Bottle Glass	green fragment	container	-
242	295N 95E	HG	Glass	Bottle Glass	clear fragment	container	-
243-246	295N 95E	AEH	Metal	Cut Nail	cut nails	cut	1830-1890
247-250	300N 80E	HC	Ceramic	Red Earthenware	glazed and unglazed	holloware	19th-20th Century
251	300N 80E	AEH	Glass	Window Glass	small clear fragment	-	-
252-255	300N 80E	AEH	Metal	Cut Nail	cut nails	cut	1830-1890
256-264	300N 85E	HC	Ceramic	Red Earthenware	glazed and unglazed	holloware	19th-20th Century
265-268	300N 85E	HC	Ceramic	Whiteware	plain fragments	unknown	1830-1870
269-273	300N 85E	HC	Ceramic	Ironstone	plain fragments	unknown	1845-1890
274	300N 85E	HC	Ceramic	Relief Moulded Ironstone	moulded plant motif on rim	saucer	1845-1890
275	300N 85E	HC	Ceramic	Edged	blue straight edged rim	plate/saucer	1850-1875
276	300N 85E	HC	Ceramic	Stamped	stamped purple floral motif	unknown	1845-1880
277-283	300N 85E	AEH	Glass	Window Glass	small clear fragment	-	-
284	300N 85E	HG	Glass	Bottle Glass	green fragment	container	-
285-286	300N 85E	HG	Glass	Bottle Glass	clear fragment	container	-
287-293	300N 85E	AEH	Metal	Cut Nail	cut nails	cut	1830-1890
294-295	300N 85E	AEH	Metal	Unidentified Nail	unidentifiable fragments	unknown	-
296	300N 85E	AEH	Metal	Misc. Metal	scrap metal	scrap	-
297-323	300N 90E	HC	Ceramic	Red Earthenware	glazed and unglazed	holloware	19th-20th Century
324-328	300N 90E	HC	Ceramic	Whiteware	plain fragments	unknown	1830-1870
329-334	300N 90E	HC	Ceramic	Ironstone	plain fragments	unknown	1845-1890
335	300N 90E	HC	Ceramic	Banded	blue slip bands	unknown	1830-1890
336	300N 90E	HC	Ceramic	Transfer Printed	printed blue floral motif	unknown	1830-1890
337-338	300N 90E	HC	Ceramic	Transfer Printed	printed blue curvilinear motif	unknown	1830-1890
339	300N 90E	HC	Ceramic	Transfer Printed	printed blue geometric motif	plate/saucer	1830-1890
340-341	300N 90E	HC	Ceramic	Transfer Printed	printed black landscape motif	unknown	1830-1870
342-343	300N 90E	HC	Ceramic	Unidentified	small exfoliated sherds	unknown	-
344-347	300N 90E	AEH	Glass	Window Glass	small clear fragment	-	-
349-350	300N 90E	HG	Glass	Bottle Glass	aqua fragments	container	-
351-353	300N 90E	HG	Glass	Bottle Glass	clear fragments	container	-
354-356	300N 90E	AEH	Metal	Cut Nail	cut nails	cut	1830-1890
357	300N 90E	AEH	Metal	Horseshoe Nail	horseshoe nail	nail	19th Century
358-359	300N 90E	AEH	Metal	Misc. Metal	scrap metal	scrap	-
360	300N 90E	AEH	Metal	Misc. Metal	screw	screw	-
361-366	300N 95E	HC	Ceramic	Red Earthenware	glazed and unglazed	holloware	19th-20th Century
367-368	300N 95E	HC	Ceramic	Whiteware	plain fragments	unknown	1830-1870
369-373	300N 95E	HC	Ceramic	Ironstone	plain fragments	unknown	1845-1890
374	300N 95E	HC	Ceramic	Transfer Printed	printed blue geometric motif	plate/saucer	1830-1890
375	300N 95E	HG	Glass	Bottle Glass	aqua fragment	container	-
376	300N 95E	AEH	Metal	Misc. Metal	scrap metal	scrap	-
377-382	300N 100E	HC	Ceramic	Red Earthenware	glazed and unglazed	holloware	19th-20th Century
383	300N 100E	HC	Ceramic	Stamped	stamped purple floral motif	unknown	1845-1880
384	300N 100E	HC	Ceramic	Unidentified	small exfoliated sherd	unknown	-
385	300N 100E	AEH	Glass	Window Glass	small clear fragment	-	-
386-391	300N 110E	HC	Ceramic	Red Earthenware	glazed and unglazed	holloware	19th-20th Century
392-394	300N 110E	HC	Ceramic	Whiteware	plain fragments	unknown	1830-1870

*(Adams 1993) & (Kenyon 1991)

NL- North Locus HC- Household Ceramic; AEH-Architectural Elements and Hardware; HG-Household Glass; PER-Personal

Cat #	Unit	Class	Material	Type	Comment	Form	*Common Date Ranges
395-396	300N 110E	HC	Ceramic	Ironstone	plain fragments	unknown	1845-1890
397	300N 110E	HC	Ceramic	Banded	blue slip bands	unknown	1830-1890
397-398	300N 110E	AEH	Glass	Window Glass	small clear fragment	-	-
399	300N 110E	HG	Glass	Bottle Glass	brown fragment	container	-
400	300N 110E	HG	Glass	Bottle Glass	green fragment	container	-
401-402	300N 110E	AEH	Metal	Cut Nail	cut nail	cut	1830-1890
403	305N 85E	AEH	Brick	Brick	brick fragment	brick	-
404-411	305N 85E	HC	Ceramic	Red Earthenware	glazed and unglazed	holloware	19th-20th Century
412-418	305N 85E	HC	Ceramic	Whiteware	plain fragments	unknown	1830-1870
419-428	305N 85E	HC	Ceramic	Ironstone	plain fragments	unknown	1845-1890
429	305N 85E	HC	Ceramic	Transfer Printed	printed blue geometric motif	unknown	1830-1890
430	305N 85E	HC	Ceramic	Stamped	stamped blue floral motif	unknown	1845-1880
431-433	305N 85E	AEH	Glass	Window Glass	small clear fragment	-	-
434-436	305N 85E	HG	Glass	Bottle Glass	aqua fragments	container	-
437-438	305N 85E	HG	Glass	Bottle Glass	clear fragments	container	-
439-443	305N 85E	AEH	Metal	Cut Nail	cut nail	cut	1830-1890
444-446	305N 85E	AEH	Metal	Unidentified Nail	unidentifiable fragments	unknown	-
447	305N 85E	AEH	Metal	Misc. Metal	scrap metal	scrap	-
448-460	305N 90E	HC	Ceramic	Red Earthenware	glazed and unglazed	holloware	19th-20th Century
461-465	305N 90E	HC	Ceramic	Whiteware	plain fragments	unknown	1830-1870
466-474	305N 90E	HC	Ceramic	Ironstone	plain fragments	unknown	1845-1890
475-476	305N 90E	HC	Ceramic	Relief Moulded Ironstone	moulded plant motif on rims	plates	1845-1890
477	305N 90E	HC	Ceramic	Relief Moulded Ironstone	moulded floral motif on rims	plates	1845-1890
478	305N 90E	HC	Ceramic	Transfer Printed	printed brown landscape motif	unknown	1830-1870
479-480	305N 90E	HC	Ceramic	Stamped	stamped blue floral motif	unknown	1845-1880
481	305N 90E	HC	Ceramic	Stamped	stamped purple floral motif	unknown	1845-1880
482	305N 90E	HC	Ceramic	Edged	blue straight edged rim	plate/ saucer	1850-1875
483-485	305N 90E	HC	Ceramic	Unidentified	small exfoliated sherds	unknown	-
486-487	305N 90E	AEH	Glass	Window Glass	small clear fragment	-	-
488	305N 90E	HG	Glass	Bottle Glass	green fragment	container	-
489-493	305N 90E	AEH	Metal	Cut Nail	cut nail	cut	1830-1890
494-496	305N 90E	AEH	Metal	Unidentified Nail	unidentifiable fragments	unknown	-
497-499	310N 80E	HC	Ceramic	Red Earthenware	glazed and unglazed	holloware	19th-20th Century
500-502	310N 80E	HC	Ceramic	Whiteware	plain fragments	unknown	1830-1870
503-504	310N 80E	HC	Ceramic	Ironstone	plain fragments	unknown	1845-1890
505-506	310N 80E	HC	Ceramic	Edged	blue straight edged rim	plate/ saucer	1850-1875
507-508	310N 80E	HG	Glass	Bottle Glass	aqua fragments	container	-
509	310N 80E	AEH	Metal	Cut Nail	cut nail	cut	1830-1890
510-511	310N 80E	AEH	Metal	Unidentified Nail	unidentifiable fragments	unknown	-
512-514	310N 85E	HC	Ceramic	Red Earthenware	glazed and unglazed	holloware	19th-20th Century
515-521	310N 85E	HC	Ceramic	Whiteware	plain fragments	unknown	1830-1870
522-532	310N 85E	HC	Ceramic	Ironstone	plain fragments	unknown	1845-1890
533	310N 85E	HC	Ceramic	Relief Moulded Ironstone	moulded plant motif on rim	plate	1845-1890
534-535	310N 85E	HC	Ceramic	Edged	blue straight edged rim	plate/ saucer	1850-1875
536	310N 85E	HC	Ceramic	Transfer Printed	printed blue floral motif	unknown	1830-1870
537	310N 85E	HC	Ceramic	Stamped	stamped brown floral motif	unknown	1845-1880
538-540	310N 85E	HG	Glass	Bottle Glass	aqua fragmenta	container	-
541	310N 85E	HG	Glass	Bottle Glass	green fragment	container	-
542	310N 85E	AEH	Metal	Cut Nail	cut nail	cut	1830-1890
543	310N 85E	AEH	Metal	Unidentified Nail	unidentifiable fragments	unknown	-
544-553	310N 90E	HC	Ceramic	Red Earthenware	glazed and unglazed	holloware	19th-20th Century
554-558	310N 90E	HC	Ceramic	Whiteware	plain fragments	unknown	1830-1870
559-565	310N 90E	HC	Ceramic	Ironstone	plain fragments	unknown	1845-1890
566	310N 90E	HC	Ceramic	Transfer Printed	printed blue geometric motif	unknown	1830-1890
567	310N 90E	HC	Ceramic	Unidentified	small exfoliated sherd	unknown	-

*(Adams 1993) & (Kenyon 1991)

NL- North Locus HC- Household Ceramic; AEH-Architectural Elements and Hardware; HG-Household Glass; PER-Personal

Cat #	Unit	Class	Material	Type	Comment	Form	*Common Date Ranges
568	310N 90E	AEH	Glass	Window Glass	small clear fragment	-	-
569	310N 90E	HG	Glass	Bottle Glass	aqua fragments	container	-
570	310N 90E	AEH	Metal	Cut Nail	cut nail	cut	1830-1890
571	310N 90E	AEH	Metal	Misc. Metal	buckle	buckle	-
572-578	310N 100E	HC	Ceramic	Red Earthenware	glazed and unglazed	holloware	19th-20th Century
579	310N 100E	HC	Ceramic	Whiteware	plain fragments	unknown	1830-1870
580	310N 100E	HC	Ceramic	Relief Moulded Ironstone	moulded plant motif on rim	plate	1845-1890
581	310N 100E	HC	Ceramic	Unidentified	small exfoliated sherds	unknown	-
582	310N 110E	HC	Ceramic	Red Earthenware	unglazed	holloware	19th-20th Century
583	310N 110E	HC	Ceramic	Unidentified	small exfoliated sherds	unknown	-
584-585	310N 110E	AEH	Glass	Window Glass	small clear fragment	-	-
586	310N 110E	HG	Glass	Bottle Glass	aqua fragment	container	-
587-588	320N 80E	HC	Ceramic	Red Earthenware	unglazed	holloware	19th-20th Century
589	320N 80E	HC	Ceramic	Whiteware	plain fragment	unknown	1830-1870
590	320N 80E	HC	Ceramic	Relief Moulded Iro	moulded plant motif on rim	plate	1845-1890
591	320N 80E	HC	Ceramic	Stamped	stamped purple floral motif	unknown	1845-1880
592-601	320N 90E	HC	Ceramic	Red Earthenware	glazed and unglazed	holloware	19th-20th Century
602-603	320N 90E	HC	Ceramic	Ironstone	plain fragments	unknown	1845-1890
604	320N 90E	HC	Ceramic	Stoneware	bristol ware brown glaze	holloware	1880-20th Century
605-605	320N 90E	HC	Ceramic	Transfer Printed	printed blue floral motif	unknown	1830-1870
607-608	320N 90E	HC	Ceramic	Stamped	stamped purple floral motif	unknown	1845-1880
609	320N 90E	AEH	Glass	Window Glass	small clear fragment	-	-
610-611	320N 90E	HG	Glass	Bottle Glass	aqua fragment	container	-
612	320N 90E	AEH	Metal	Cut Nail	cut nail	cut	1830-1890
613-614	320N 90E	AEH	Metal	Unidentified Nail	unidentifiable fragments	unknown	-
615-622	320N 90E	AEH	Metal	Misc. Metal	scrap metal	scrap	-
623	320N 100E	AEH	Brick	Brick	brick fragment	brick	-
624	320N 100E	HC	Ceramic	Red Earthenware	glazed and unglazed	holloware	19th-20th Century
625-626	320N 100E	HC	Ceramic	Whiteware	plain fragments	unknown	1830-1870
627	320N 100E	HC	Ceramic	Ironstone	plain fragments	unknown	1845-1890
628	320N 100E	AEH	Metal	Misc. Metal	scrap metal	scrap	-
629-631	NL Surface	HC	Ceramic	Whiteware	plain fragments	unknown	1830-1870
632-635	NL Surface	HC	Ceramic	Ironstone	plain fragments	unknown	1845-1890
636	NL Surface	AEH	Glass	Window Glass	small clear fragment	-	-
637-638	NL Surface	HG	Glass	Bottle Glass	aqua fragments	container	-
639-640	NL 350N 100E	HC	Ceramic	Red Earthenware	glazed and unglazed	holloware	19th-20th Century
641	NL 350N 100E	HC	Ceramic	Whiteware	plain fragment	unknown	1830-1870
642	NL 355N 105E	HC	Ceramic	Red Earthenware	unglazed	holloware	19th-20th Century
643-644	NL 355N 105E	HC	Ceramic	Whiteware	plain fragments	unknown	1830-1870
645	NL 355N 105E	HG	Glass	Bottle Glass	clear fragment	container	-
646	NL 355N 105E	AEH	Metal	Cut Nail	cut nail	cut	1830-1890
647	NL 360N 90E	HG	Glass	Bottle Glass	aqua fragment	container	-
648	NL 360N 90E	AEH	Metal	Cut Nail	cut nail	cut	1830-1890
649	NL 360N 90E	AEH	Metal	Misc. Metal	bolt	bolt	-
650	NL 360N 90E	AEH	Metal	Misc. Metal	horseshoe fragment	horseshoe	-
651-652	NL 360N 100E	AEH	Metal	Cut Nail	cut nail	cut	1830-1890
653-655	NL 360N 105E	HC	Ceramic	Whiteware	plain fragments	unknown	1830-1870
656	NL 360N 105E	HC	Ceramic	Ironstone	plain fragment	unknown	1845-1890
657	NL 360N 105E	AEH	Metal	Cut Nail	cut nail	cut	1830-1890
658-660	NL 360N 105E	AEH	Metal	Unidentified Nail	unidentifiable fragments	unknown	-
661-662	NL 360N 110E	HC	Ceramic	Ironstone	plain fragments	unknown	1845-1890
663	NL 360N 110E	HC	Ceramic	Relief Moulded Ironstone	moulded plant motif on rim	bowl	1845-1890
664	NL 360N 110E	HC	Ceramic	Transfer Printed	printed blue geometric motif	unknown	1830-1890
665	NL 365N 105E	HG	Glass	Bottle Glass	clear fragment	container	-
666	NL 365N 105E	AEH	Metal	Unidentified Nail	unidentifiable fragment	unknown	-
667	NL 370N 100E	PER	Slate	Pencil	slate pencil	pencil	19th Century
668	NL 380N 100E	HC	Ceramic	Whiteware	plain fragment	unknown	1830-1870
669	NL 380N 100E	HG	Glass	Bottle Glass	clear fragment	container	-
670	NL 380N 100E	HG	Glass	Bottle Glass	brown fragment	container	-

*(Adams 1993) & (Kenyon 1991)

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4.0 RECOMMENDATIONS & COMPLIANCE ADVICE

4.1 Recommendations

As detailed in this report, one site was found as a result of the assessment and has been registered as the James Tate site (AlHb-14). The James Tate site (AlHb-14) consists of a late 19th century Euro-Canadian homestead. Our firm carried out a Stage 3 assessment of the site in October and November, 2014. The Stage 3 assessment included a controlled surface collection and the excavation of 42 one metre square test units at 5-10 metre intervals across the site. The results of the Stage 3 assessment and archival research indicate that the site was occupied between the 1860's and the 1880's.

Given the relatively late date of occupation, the James Tate site (AlHb-14) is not considered to have cultural value and will not require Stage 4 mitigation. The James Tate site (AlHb-14) does not require any further investigation and is no longer a planning concern. Accordingly, there are no other further concerns for impacts to archaeological resources on these lands. No further archaeological assessment of this parcel of land is required.

4.2 Compliance Advice

This report is submitted to the Minister of Tourism and Culture as a condition of licensing in accordance with Part VI of the *Ontario Heritage Act*, R.S.O. 1990, c 0.18. The report is reviewed to ensure that it complies with the standards and guidelines that are issued by the Minister, and that the archaeological fieldwork and report recommendations ensure the conservation, protection and preservation of the cultural heritage of Ontario. When all matters relating to archaeological sites within the project area of a development proposal have been addressed to the satisfaction of the Ministry of Tourism and Culture, a letter will be issued by the ministry stating that there are no further concerns with regard to alterations to archaeological sites by the proposed development. It is an offence under Sections 48 and 69 of the *Ontario Heritage Act* for any party other than a licensed archaeologist to make any alteration to a known archaeological site or to remove any artifact or other physical evidence of past human use or activity from the site, until such time as a licensed archaeologist has completed archaeological fieldwork on the site, submitted a report to the Minister stating that the site has no further cultural heritage value or interest , and the report has been filed in the Ontario Public Register of Archaeology Reports referred to in Section 65.1 of the *Ontario Heritage Act.*

It is an offence under Sections 48 and 69 of the *Ontario Heritage Act* for any party other than a licensed archaeologist to make any alteration to a known archaeological site or to remove any artifact or other physical evidence of past human use or activity from the site, until such time as a licensed archaeologist has completed archaeological fieldwork on the site, submitted a report to the Minister stating that the site has no further cultural heritage value or interest, and the report has been filed in the Ontario Public Register of Archaeology Reports referred to in Section 65.1 of the *Ontario Heritage Act.*

Should previously undocumented archaeological resources be discovered, they may be a new archaeological site and therefore subject to Section 48 (1) of the *Ontario Heritage Act*. The proponent or person discovering the archaeological resources must cease alteration of the site immediately and engage a licensed consultant archaeologist to carry out archaeological fieldwork, in compliance with Section 48 (1) of the *Ontario Heritage Act*. The *Cemeteries Act*, R.S.O. 1990 c. C.4 and the *Funeral, Burial and Cremation Services Act*, 2002, S.O. 2002, c.33 (when proclaimed in force) require that any person discovering human remains must notify the police or coroner and the Registrar of Cemeteries at the Ministry of
Consumer Services.

5.0 MAPS

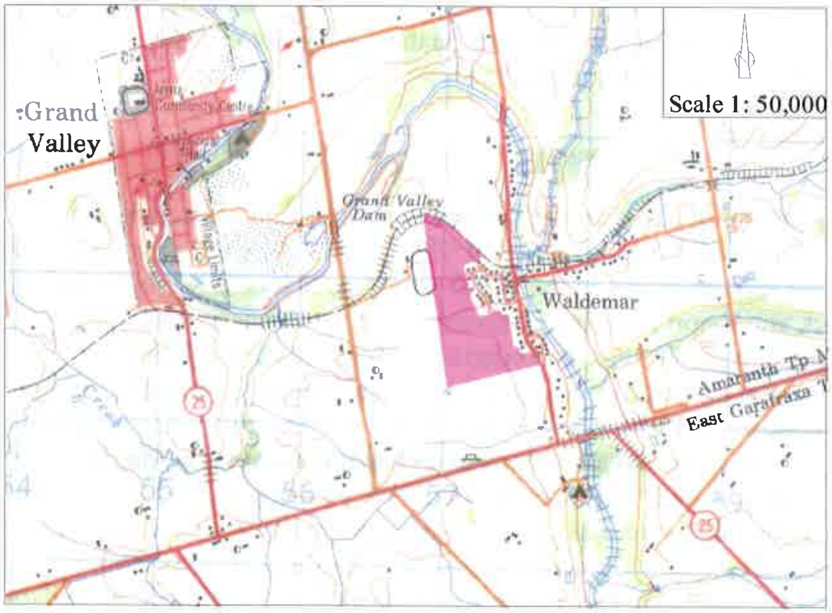

Figure 1. Location of the Subject Property
(Energy, Mines and Resources 1994 Orangeville P/16)

Figure 2. Satellite Image of the Subject Property

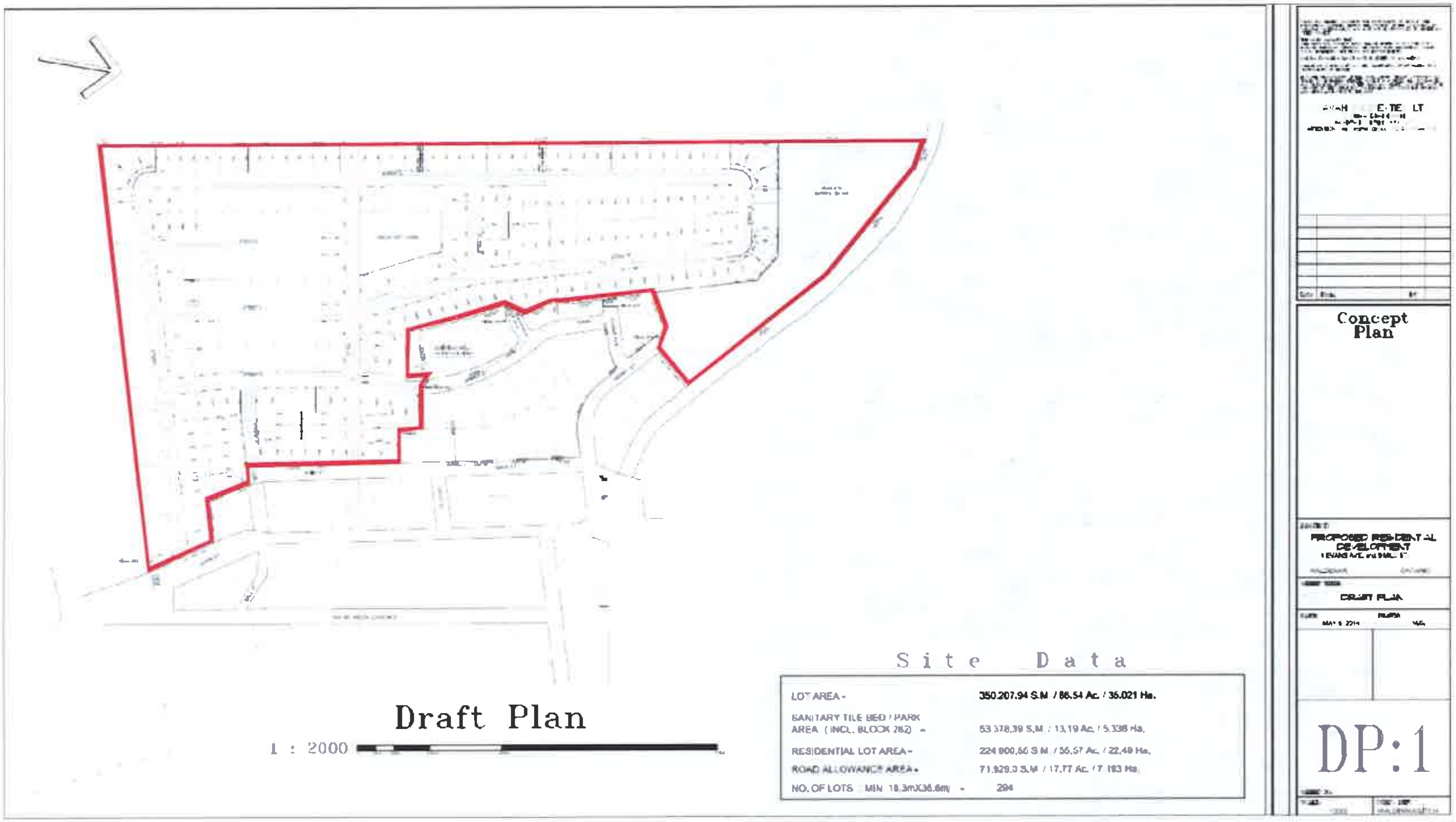

Figure 3. Subject Property Draft Plan

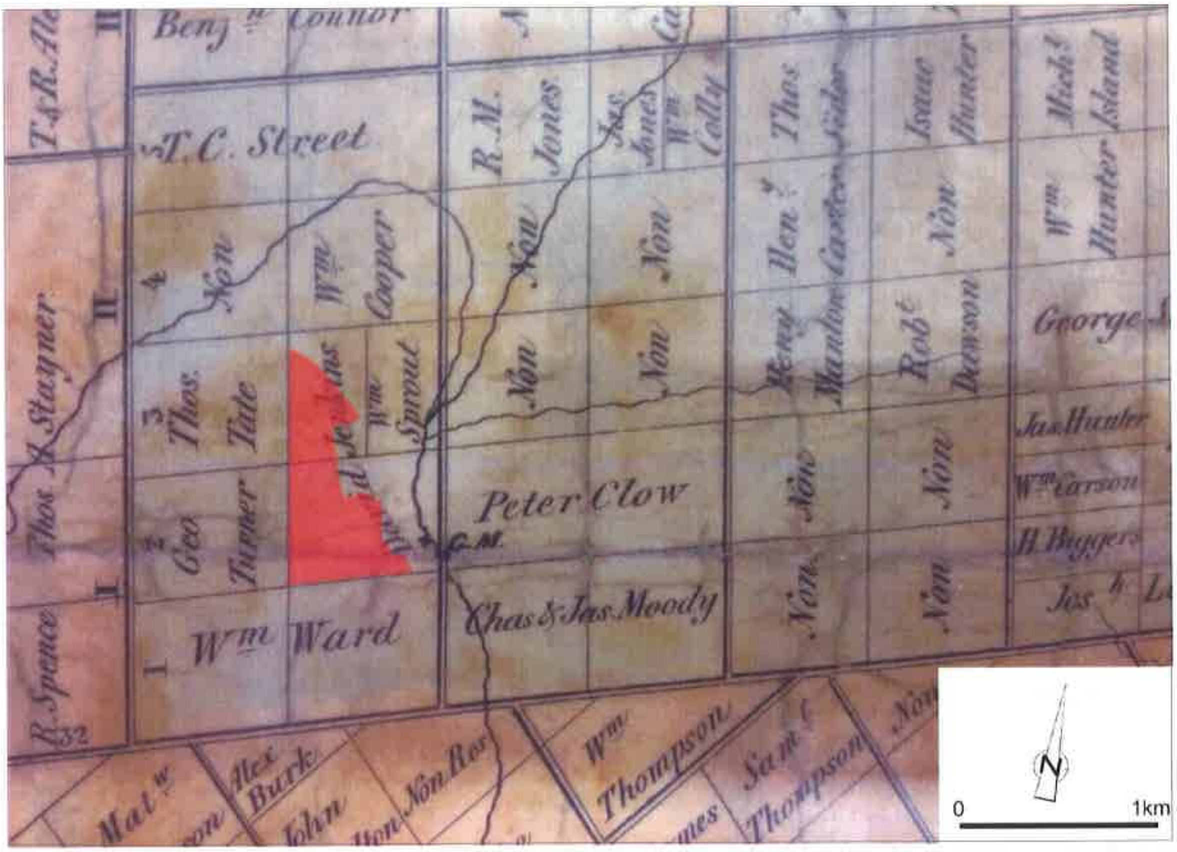

Figure 4. 1861 Wheelock Map of Wellington County Showing Approximate Location of the Subject Property (Wheelock 1861)

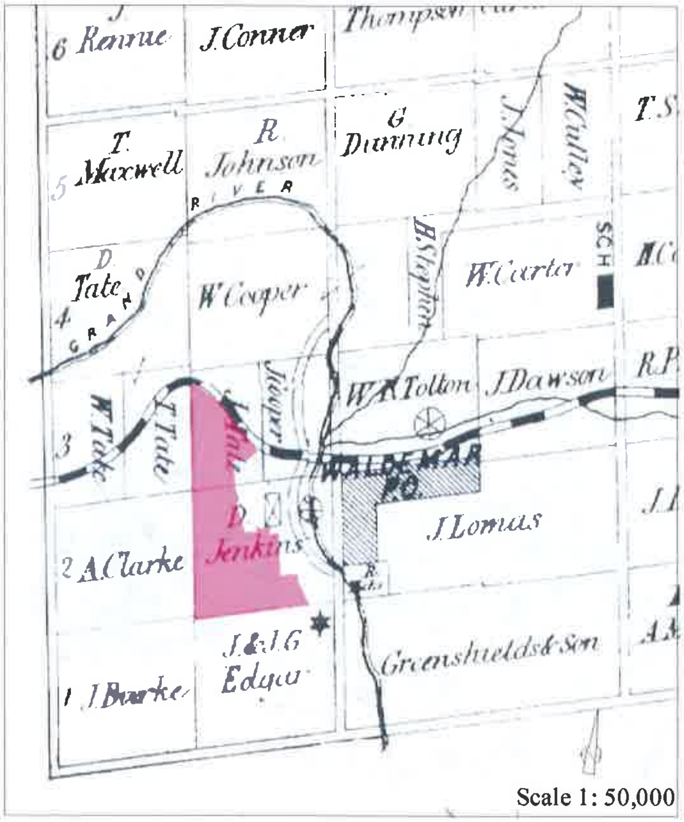

Figure 5. 1877 Historical Atlas Map of Amaranth Township Showing Approximate Location of the Subject Property (H. Parsell and Company 1877)

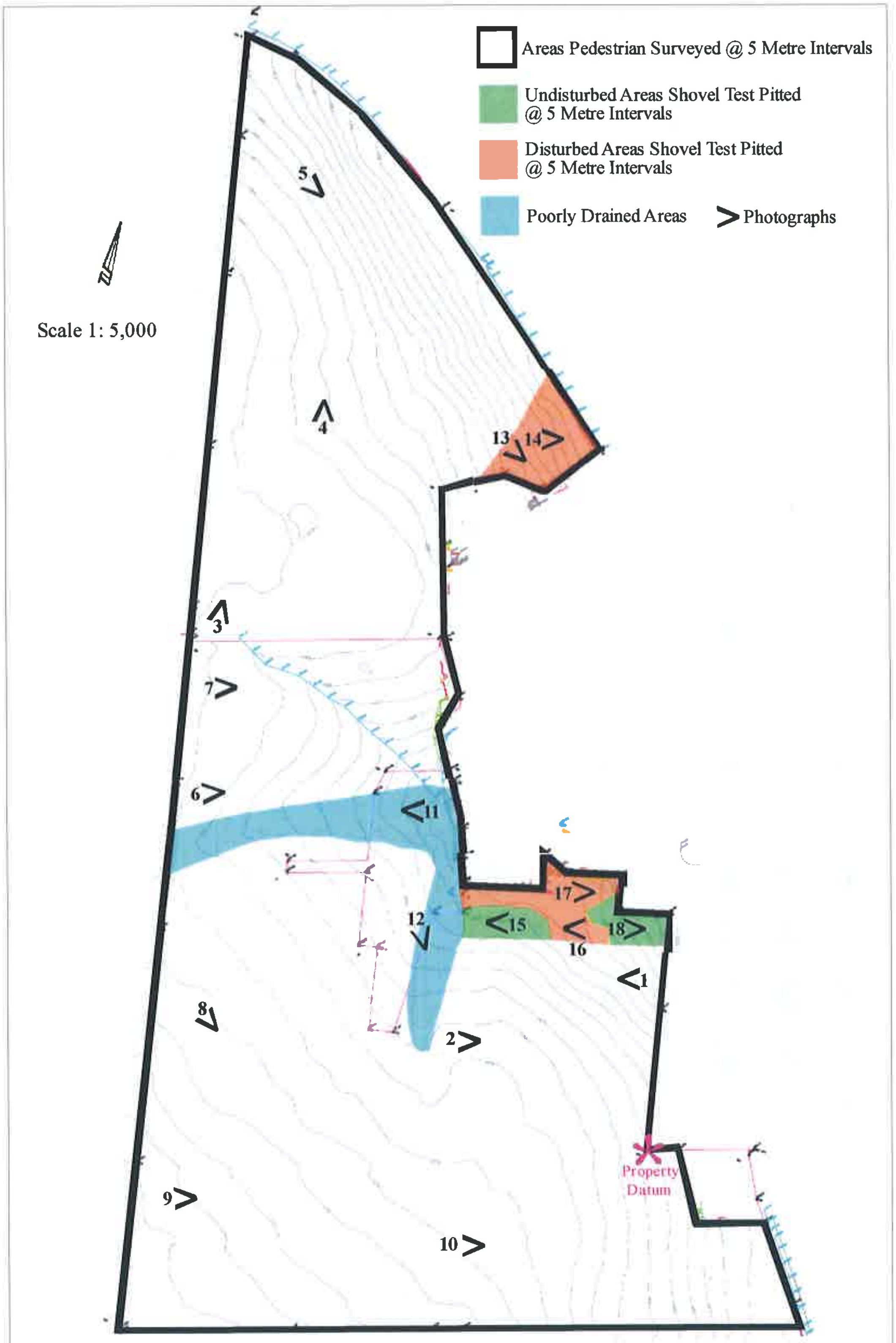

Figure 6. Archaeological Survey Coverage and Techniques

Figure 7. Results of the Stage 3 Assessment of the James Tate Site (AlHb-14)

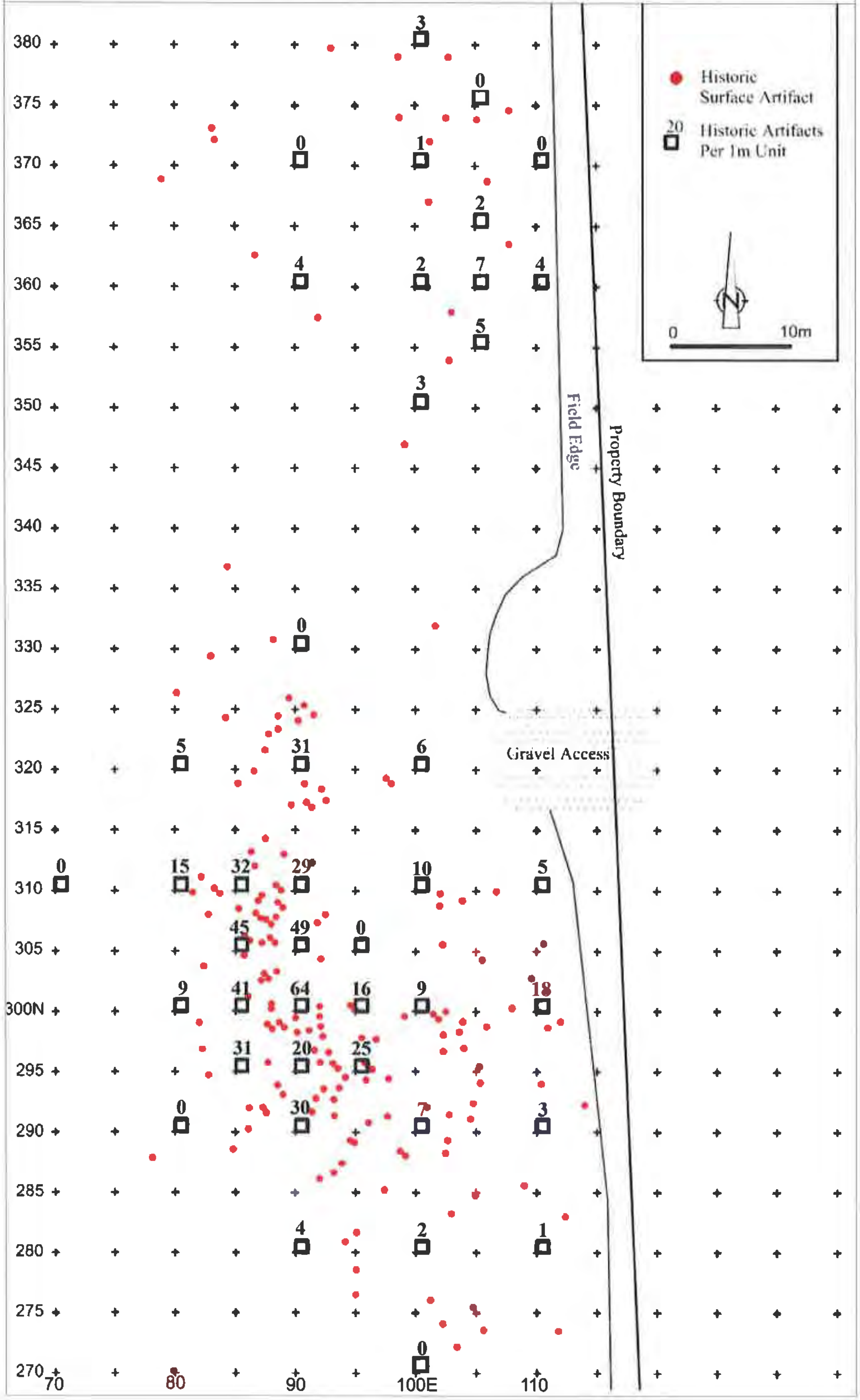

Figure 8. Potential Subsurface Features in the Test Units

6.0 IMAGES


Plate 1. Southeast Field (June Survey)
(view west)


Plate 2. Southeast Field (June Survey)
(view east)


Plate 3. North Field (view north)


Plate 4. North Field (view north)


Plate 5. North Field (view southeast)


Plate 6. Central Field (view east)

Plate 7. Central Field (view east)

Plate 8. South Field (view southeast)

Plate 9. South Field (view east)

Plate 10. South Field (view east)

Plate 11. Low Lying Poorly Drained Area (view west)

Plate 12. Low Lying Poorly Drained Area (view southeast)

Plate 13. Northeast Disturbed Lands
(view southeast)

Plate 14. Northeast Disturbed Lands
(view east)

Plate 15. Central Scrubland Area
(view west)

Plate 16. Disturbed Central Scrubland Area
(view west)

Plate 17. Disturbed Central Scrubland Area
(view east)

Plate 18. Central Scrubland Area
(view east)

Plate 19. James Tate Site (AlHb-14) Surface Scatter (view north)

Plate 20. James Tate Site (AlHb-14) Surface Scatter (view southeast)

Plate 21. James Tate Site (AlHb-14) Stage 3 Test Excavations (view east)

Plate 22. James Tate Site (AlHb-14) Stage 3 Test Excavations (view southeast)

Plate 23. Potential Feature 300N 90E (view north)

Plate 24. Potential Feature 300N 95E (view north)

Plate 25. Potential Feature 305N 85E
(view north)

Plate 26. Potential Feature 305N 90E
(view north)

Plate 27. Potential Feature 310N 85E
(view north)

Plate 28. Potential Feature 320N 90E
(view north)

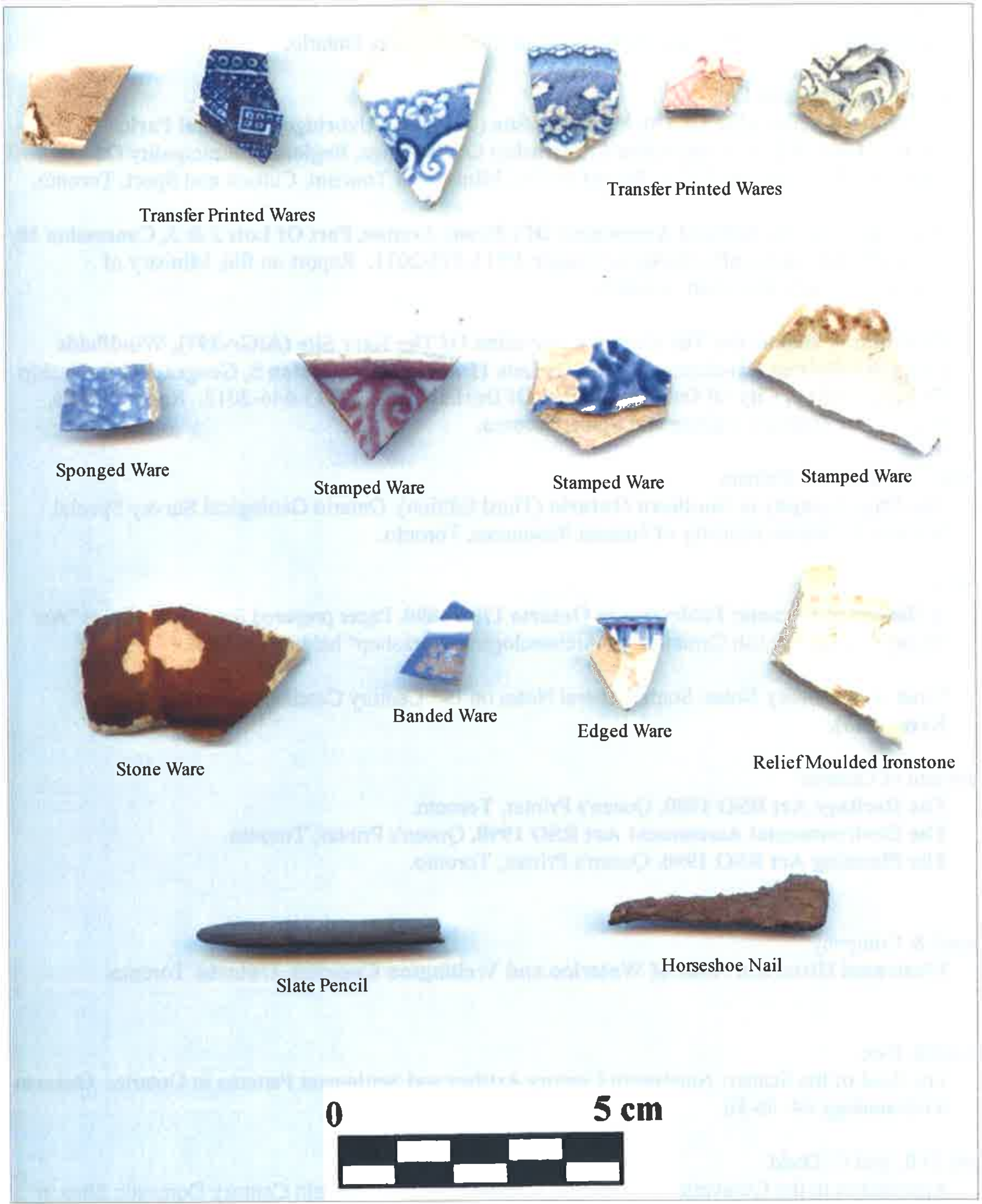

Plate 29. James Tate Site (AlHb-14) Artifact Sample

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H. Parsell & Company
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1861 Census , Microfilmed
1861 Census of Canada West, Wellington, Amaranth Township (Dist. 1), page 72; microfilm C-1084, Dufferin County Museum & Archives, Mulmer, ON.

1871 Census, Microfilmed
James Tate household, 1871 census of Canada, Ontario, Wellington North, Amaranth Township (Dist. 35, Sub Dist. G), page 92, line 18; microfilm C-9950, Dufferin County Museum & Archives, Mulmer, ON.

1871 Census, Microfilmed
James Tate agricultural return, 1871 census of Canada, Ontario, Wellington North, Amaranth Township (Dist. 35, Sub Dist. G), page 16, line 7; microfilm C-9950, Dufferin County Museum & Archives, Mulmer, ON.

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Abstract Index Book, Dufferin County, Amaranth Township, Volume B, page 451 & 498; Dufferin County Museum & Archives, Mulmer, ON.

Abstract Index Book, Dufferin County, Amaranth Township, Volume C, page 444; Dufferin County Museum & Archives, Mulmer, ON.

APPENDIX B:
PHASE 1 CONSULTATION

Notice of Public Information Session and
Notice of Study Commencement
Waldemar Community, Township of Amaranth
Class EA Study for Wastewater Treatment and Disposal

Public Information Session

Sarah Properties Ltd. (the Landowner) will host a Public Information Session regarding the deemed complete planning applications to amend the Township Official Plan and Zoning By-law and for a proposed Draft Plan of Subdivision to permit the development of 334 residential lots for single detached dwellings, a park, various blocks for services, internal public roads and road extensions, a walkway block and residential reserve blocks at Part of Lots 2 and 3, Concession 10, Registered Plan 4A.

The Public Information Session will provide details on the proposed project, including the Class EA Study. Representatives of the Landowner will be in attendance to answer questions and receive input from interested persons.

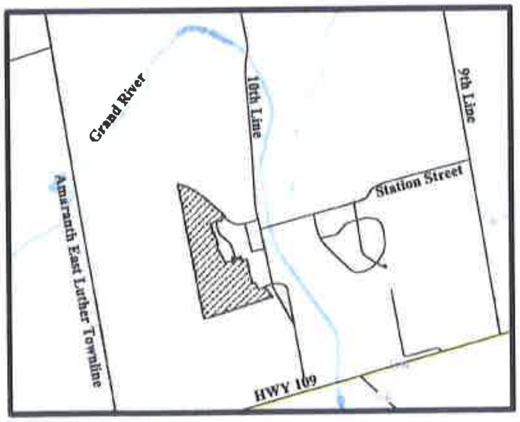
Date: Wednesday, January 11, 2017
Time: 7:00 to 9:00 PM

Location: Township of Amaranth Recreation Hall
374028 6th Line, Amaranth

Commencement of the Class EA Study

Sarah Properties Ltd. is initiating a Municipal Class Environmental Assessment (Class EA) Study to determine the preferred wastewater treatment and effluent disposal approach and design concept for the proposed Waldemar residential development. The wastewater treatment and effluent disposal system must have sufficient capacity to service the proposed 35 ha development and to potentially service existing homes and other proposed developments in the community, comply with MOECC requirements, meet environmental protection objectives, and be cost-effective to operate and maintain.

The Study is being carried out in accordance with the planning and design process for a Schedule C project, and uses the Integrated Approach as outlined in the Municipal Engineers Association Municipal Class EA document to meet the requirements of the Environmental Assessment Act and for approval under the Planning Act. During the Class EA, alternative solutions and design concepts will be identified, potential impacts to the environment and the community will be assessed, and mitigating measures will be defined. Upon completion of the Study, an Environmental Study Report will be available for public and agency review and comment.



Comments Invited

Initial comments and input are invited at this time for consideration in the planning and development of alternatives. If you have comments or input or require additional information, please contact:

For the Class EA study:
Jason R. Covey, B.Sc.(Eng.), P.Eng.
C.C. Tatham & Associates Ltd.
Tel: 705-444-2565
Email: jcovey@cctatham.com

For the planning applications:
Dave Hannam
Zelinka Priamo Ltd.
Tel: 519-474-7137
Email: dave.h@zpplan.com

WALDEMAR COMMUNITY, TOWNSHIP OF AMARANTH

WASTEWATER TREATMENT AND EFFLUENT DISPOSAL CLASS ENVIRONMENTAL ASSESSMENT

PUBLIC INFORMATION SESSION

January 11, 2017

C.C. Tatham & Associates Ltd.
Consulting Engineers

Collingwood Bracebridge Orillia Barrie Ottawa

Waldemar Community Wastewater Treatment and Disposal
Class Environmental Assessment – Phase 1

PROBLEM STATEMENT

- Identify the preferred solution and design concept for wastewater treatment and effluent disposal for the proposed Waldemar residential development.
- The wastewater treatment and effluent disposal system must have sufficient capacity to service the development and to potentially service existing homes and other proposed developments in the community.
- The means of providing wastewater treatment and effluent disposal must be:
  - cost-effective,
  - comply with MOECC requirements, and
  - meet environmental protection objectives.

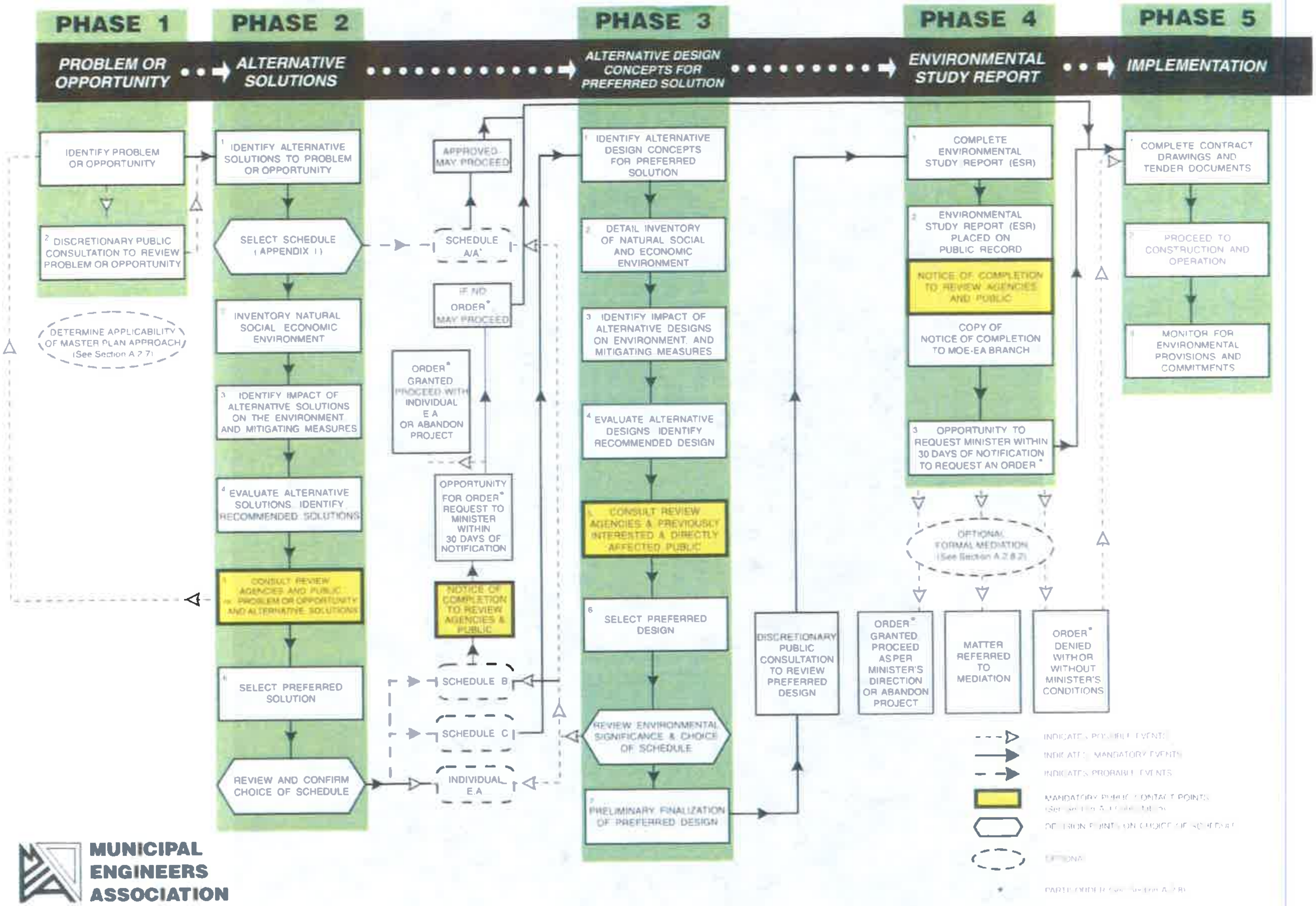
C.C. Tatham & Associates Ltd.
Consulting Engineers
Collingwood Bracebridge Orillia Barrie Ottawa

Waldemar Community Wastewater Treatment and Disposal
Class Environmental Assessment – Phase 1

ALTERNATIVE SOLUTIONS UNDER CONSIDERATION

1. Do Nothing – Status quo
2. Individual septic systems
3. Communal wastewater treatment plant with discharge to the Grand River
4. Communal wastewater treatment plant with discharge to a large subsurface disposal system
5. Connection to Grand Valley wastewater treatment plant in the Township of East Luther

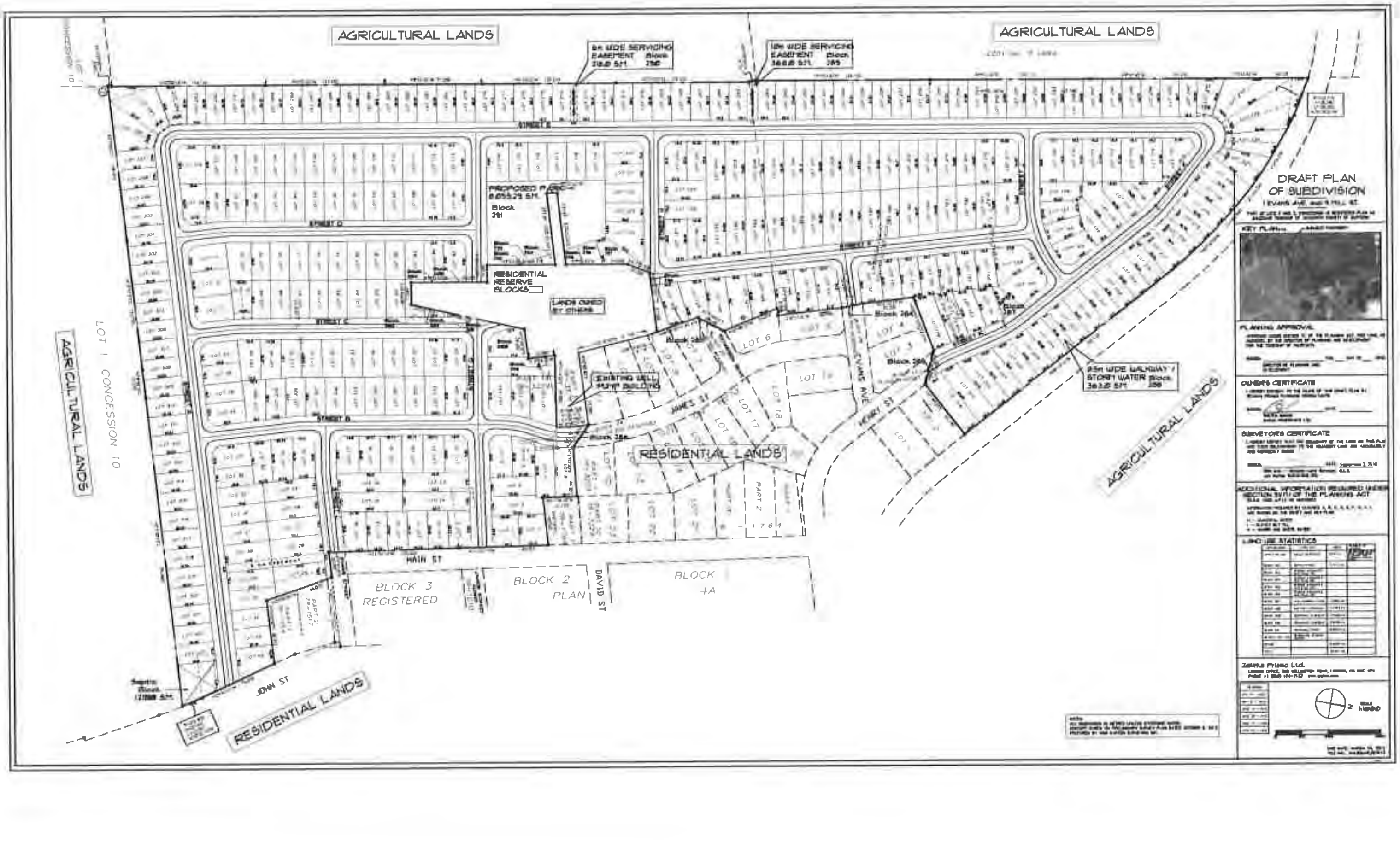
C.C. Tatham & Associates Ltd.
Consulting Engineers
Collingwood Bracebridge Orillia Barrie Ottawa



MUNICIPAL ENGINEERS ASSOCIATION

C.C. Tatham & Associates Ltd.
Consulting Engineers
Collingwood Bracebridge Orillia Barrie Ottawa


UPPER GRAND TRAILWAY
10TH LINE
AMARANTH EAST LUTHER TOWNLINE
9TH LINE
STATION STREET
STATION STREET
MILL STREET
SUBJECT LANDS
ST. JOHN STREET
GRANDVIEW ROAD
10TH LINE
9TH LINE
HIGHWAY #109
HIGHWAY #109


AGRICULTURAL LANDS
6m WIDE SERVICING EASEMENT Block 218.8 S.M. 290
12m WIDE SERVICING EASEMENT Block 366.8 S.M. 289
AGRICULTURAL LANDS
LOT 1 CONCESSION 10
AGRICULTURAL LANDS
STREET A
STREET B
STREET C
STREET D
STREET E
STREET F
STREET G
PROPOSED PARK 8,055.29 S.M.
Block 291
RESIDENTIAL RESERVE BLOCKS
LANDS OWNED BY OTHERS
EXISTING WELL PUMP BUILDING
LOT 6
LOT 16
LOT 17
LOT 18
LOT 19
Block 284
Block 285
Block 287
JAMES ST
EVANS AVE
HENRY ST
RESIDENTIAL LANDS
9.5m WIDE WALKWAY / STORM WATER Block 363.8 S.M. 288
AGRICULTURAL LANDS
PART 2
MAIN ST
BLOCK 3
REGISTERED
BLOCK 2
PLAN
DAVID ST
BLOCK 1
4A
JOHN ST
RESIDENTIAL LANDS
DRAFT PLAN OF SUBDIVISION
1 EVANS AVE. and 9 HILL ST.
KEY PLAN
PLANNING APPROVAL
OWNER'S CERTIFICATE
SURVEYOR'S CERTIFICATE
ADDITIONAL INFORMATION REQUIRED UNDER SECTION 51(17) OF THE PLANNING ACT
LAND USE STATISTICS
Zelinka Priamo Ltd.
N
SCALE 1:1000

APPENDIX C:
PHASE 2 CONSULTATION

Township of Amaranth
374028 6th Line
Amaranth, ON L9W 0M6
Telephone: (519) 941-1007
Fax: (519) 941-1802
Email: info@amaranth.ca

MAY 8, 2017

NOTICE OF STATUTORY PUBLIC MEETING AND NOTICE OF PUBLIC INFORMATION CENTRE
APPLICATION TO AMEND THE TOWNSHIP OFFICIAL PLAN (FILE NO.: OPA2-15) & WASTEWATER TREATMENT AND DISPOSAL CLASS ENVIRONMENTAL ASSESSMENT STUDY
WALDEMAR COMMUNITY, TOWNSHIP OF AMARANTH

Application Number:	OPA2-15		
Related Applications Number:	S2-15 & Z4-15		
Council Statutory Public Meeting:	June 7th, 2017 at 7:00 pm at the Township of Amaranth Recreational Hall; 374028 6th Line, Amaranth		
Owner:	Sarah Properties Ltd.		
Location of Subject Lands:	East Part Lots 2 and 3, Concession 10 in Waldemar, Amaranth	**Area:**	35 hectares (86.5 acres)

PURPOSE: Sarah Properties Ltd. has filed an application with the Township of Amaranth to amend the Official Plan for permission to develop a proposed residential subdivision consisting of 334 single-detached residential lots in the Waldemar community by way of an extension of the municipal water system and a communal sewage treatment system. Related applications to amend the Zoning By-law (File No. Z4-15) and for Draft Plan of Subdivision (File No. S2-15) have also been filed with the Township.

In an integrated approach with the Official Plan Amendment application, Sarah Properties Ltd. is also conducting a related Municipal Class Environmental Assessment (Class EA) Study, Schedule C, to determine the preferred wastewater treatment and effluent disposal approach and design concept for the proposed residential development.

PUBLIC MEETING: This Public Meeting is being held in accordance with the Planning Act and will provide an opportunity for the public to comment on the proposed Official Plan Amendment. Representatives of Sarah Properties Ltd. and the Township will be in attendance to answer any questions. A further Statutory Public Meeting will be held at a later date for the applications to amend the Township Zoning By-law and for Draft Plan of Subdivision.

You are entitled to attend this public hearing in person to express your views about the proposed Official Plan Amendment or you may be represented by counsel for that purpose. If you wish to make written comments, they may be forwarded to the Clerk-Treasurer at the address shown above. A copy of the applications and background materials are available at the Township of Amaranth Administration Office during regular office hours.

FAILURE TO ATTEND HEARING: If a person or public body does not make oral submissions at a Public Meeting, or make written submissions to the Township of Amaranth before the proposed Official Plan Amendment is adopted, the person or public body is not entitled to appeal the decision of the County of Dufferin (approval authority) to the Ontario Municipal Board;

If a person or public body does not make oral submissions at a Public Meeting, or make written submissions to the Township of Amaranth before the proposed Official Plan Amendment is adopted, the person or public body may not be added as a party to the hearing of an appeal before the Ontario Municipal Board unless, in the opinion of the Board, there are reasonable grounds to add the person or public body as a party.

DECISION: If you wish to be notified of the decision of the County of Dufferin on the proposed Official Plan Amendment, you must make a written request to the County of Dufferin, Clerk's Department, 55 Zina St., Orangeville, ON, L9W 1E5. If you wish to appeal to the OMB, a copy of an appeal form is available from the OMB website at www.omb.gov.on.ca. The form must be submitted to the municipality or approval authority within the allotted 20-day period, with applicable fee by certified cheque or money order.

PUBLIC INFORMATION CENTRE: The Class EA Study is being carried out in accordance with the Municipal Engineers Association Municipal Class EA document for a Schedule C project, and uses the Integrated Approach to meet the requirements of the Environmental Assessment Act and for approval under the Planning Act.

The Public Information Centre is being held to provide an opportunity for the public to review and provide input on the wastewater alternatives under consideration. There will be a presentation followed by a question and answer period. Representatives from the project engineering consultant will be present to answer questions.

For illustration purposes only. This is not a plan of survey.

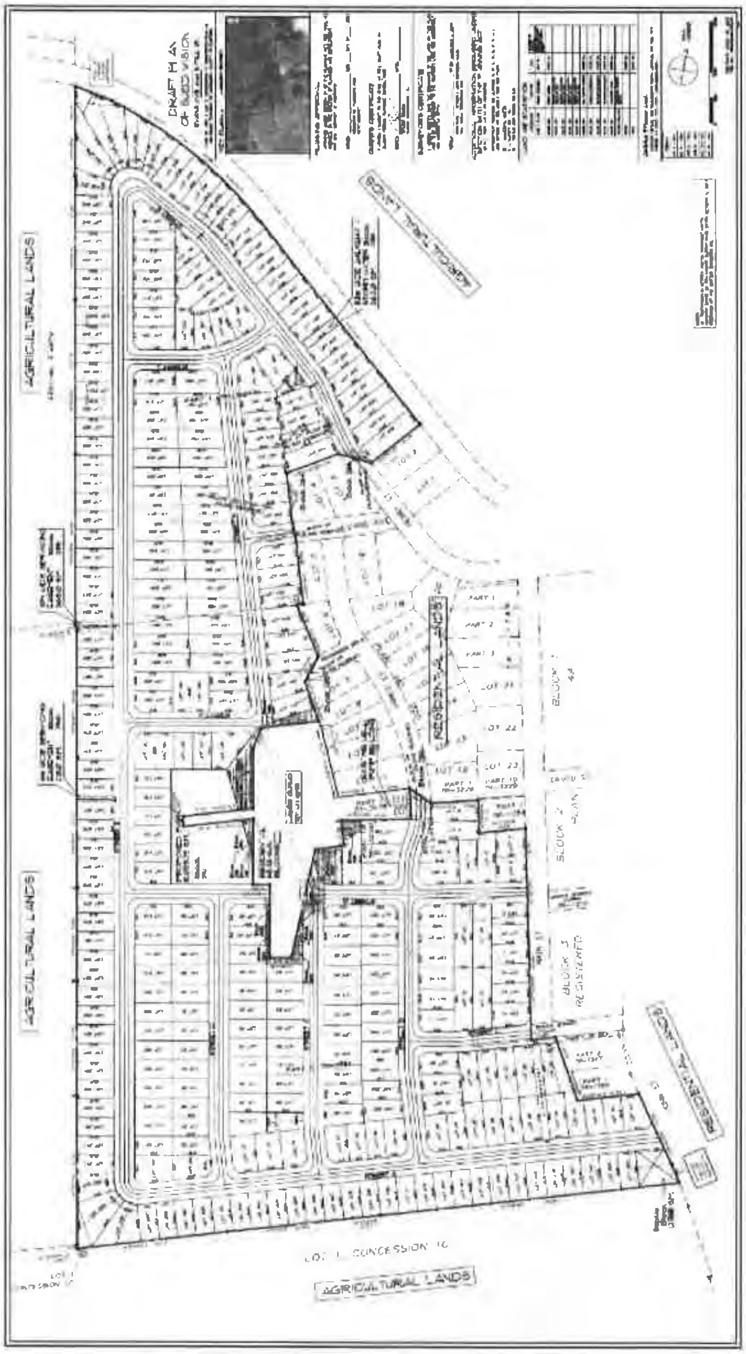
SEE REVERSE FOR MORE INFORMATION

Written comments are also invited and must be received by June 21, 2017. Comments and questions regarding the wastewater alternatives should be submitted to Jason Covey with a copy provided to Susan M. Stone, CAO/Clerk-Treasurer for the Township of Amaranth. Comments and questions regarding the planning applications should be submitted to Dave Hannam also with a copy to Susan M. Stone, CAO/Clerk-Treasurer for the Township of Amaranth.

Jason R. Covey, B.Sc.(Eng.), P.Eng.
Senior Project Engineer
C.C. Tatham & Associates Ltd.
115 Sandford Fleming Drive, Suite 200
Collingwood, ON L9Y 5A6
Tel: 705-444-2565
Email: jcovey@cctatham.com

Dave Hannam, BRP, MCIP, RPP
Senior Planner
Zelinka Priamo Ltd.
318 Wellington Road
London, ON N6C 4P4
Tel: 519-474-7137
Email: dave.h@zpplan.com

Susan M. Stone, A.M.C.T.
CAO/Clerk-Treasurer
Township of Amaranth
374028 6th Line
Amaranth, ON L9W 0M6
Tel: 519-941-1007
Email: suestone@amaranth-eastgary.ca



WALDEMAR COMMUNITY

TOWNSHIP OF AMARANTH

WASTEWATER TREATEMENT AND EFFLUENT DISPOSAL CLASS ENVIRONMENTAL ASSESSMENT

PUBLIC INFORMATION CENTRE #1

June 7, 2017

C.C. Tatham & Associates Ltd.
Consulting Engineers
Collingwood Bracebridge Orillia Barrie Ottawa

Waldemar Community Wastewater Treatment and Effluent Disposal
Class Environmental Assessment

C.C. Tatham & Associates Ltd.

PROBLEM STATEMENT

- Provide wastewater treatment and effluent disposal for proposed SPL residential development that:
    - Is cost effective and environmentally acceptable
    - Has sufficient capacity to service the proposed 35 ha development area
    - Can potentially provide servicing capacity for existing homes and other development lands in Waldemar

STUDY AREA

ALTERNATIVE SOLUTION 1

Do Nothing – For Comparison Only

- No wastewater disposal
- No new homes can be built

ALTERNATIVE SOLUTION 2

Individual Septic Tank and Tile Bed at Each Lot

- Maximum number of lots restricted to 26, to prevent nitrate contamination of groundwater
- No future wastewater servicing opportunities for the community
- The 2014 Provincial Policy Statement does not permit individual septic systems for this site
- Individual septic systems are only allowed under the Township OP if communal system is not feasible
- Potential groundwater contamination if septic systems fail

ALTERNATIVE SOLUTION 3

WWTP with Effluent Discharge to Grand River

- Technically feasible to service 334 lots
- Tertiary wastewater treatment required to maintain Grand River water quality
- No environmental constraints
- Aesthetic impacts can be mitigated
- Low per unit costs ≈ $10,000 / Lot
- Ongoing operation and maintenance for pumping and treatment facilities

Proposed WWTP Effluent Quality	Limit	Objectives
CBOD$_5$ (mg/L)	10	8
Total Suspended Solids (mg/L)	10	8
Total Phosphorous (mg/L)	0.1	0.08
Total Ammonia (Summer) (mg/L)	1.8	1
E.Coli (Counts/100 mL)	200	100

Waldemar Community Wastewater Treatment and Effluent Disposal
Class Environmental Assessment

C.C. Tatham & Associates Ltd.

ALTERNATIVE SOLUTION 4

WWTP with Discharge to Leaching Beds

- Limited number of lots (approx. 50) to prevent groundwater contamination – Does not meet intensification target
- Tertiary wastewater treatment required for nitrate reduction
- Cannot be expanded to service existing and future homes
- Potential groundwater contamination if leaching beds fail
- High per unit cost ≈ $77,000/lot
- Ongoing operation and maintenance costs for wastewater pumping and treatment facilities

ALTERNATIVE SOLUTION 5

Connection to Grand Valley WPCP

- No currently available capacity at Grand Valley WPCP
- Timing of WPCP expansion unknown (at least 5 years)
- Tertiary wastewater treatment required at Grand Valley WPCP to maintain Grand River water quality (same as for Alternative 3)
- Most disruption during construction of forcemain to Grand Valley
- Highest per unit cost ≈ $20,000/lot + WPCP capacity charge
- Ongoing operation and maintenance costs for wastewater pumping and treatment facilities

Waldemar Community Wastewater Treatment and Effluent Disposal
Class Environmental Assessment

C C Tatham & Associates Ltd

Preliminary Assessment of Alternative Solutions

🟥 Very Poor/Very Negative
🟧 Poor/Minor Negative
🟦 No Impact
⬜ Good Positive
🟩 Very Good/Very Positive

Evaluation Criteria	Description	1 Do Nothing	2 Individual Septic Systems	3 Communal WWTP with Surface Discharge	4 Communal WWTP with Subsurface Discharge	5 Connection to Expanded Grand Valley WPCP
Meets Objectives	**Capacity to Service Proposed Development**	Does not meet project objectives. Lands cannot be developed without wastewater disposal solution. No homes can be built. 🟥	Does not meet project objectives, nor conform to the intent of OP and PPS. Only approx. 26 lots can be developed due to nitrate impact on groundwater. 🟥	Can meet project objectives. 334 lots could be developed. Grand River has adequate assimilative capacity. 🟩	Limited potential to meet project objectives. Only approx. 50 lots can be developed due to nitrate impact on groundwater. 🟧	Can't meet project objectives now as excess capacity is not available. Only feasible if Grand Valley expands WPCP in future. 🟧
	Impact on Timing of Development	Development is delayed indefinitely. 🟥	Lots could be developed immediately. 🟩	Lots could be developed immediately. 🟩	Lots could be developed immediately. 🟩	Development delayed until expansion of Grand Valley WPCP (not planned yet). 🟥
Environmental and Heritage Impacts	**Groundwater Quality**	No impact on groundwater quality. 🟦	Potential to increase groundwater nitrate levels up to 10 mg/L. 🟥	No impact on groundwater quality. 🟦	Potential to increase groundwater nitrate levels up to 2.5 mg/L at east property line. 🟧	No impact on groundwater quality. 🟦
	Surface Water Quality	No impact on surface water quality. 🟦	Low potential impact on water quality of the Grand River. Tile beds are not adjacent to any surface water. 🟦	Tertiary wastewater treatment required to maintain PWQO in Grand River. 🟧	Low potential impact on water quality of the Grand River. Leaching beds are not adjacent to any surface water. 🟦	Tertiary wastewater treatment required to maintain PWQO in Grand River. 🟧
	Vegetation	No impact on existing vegetation. 🟦	Existing vegetation removed for individual tile beds. 🟦	Existing vegetation removed for WWTP. WWTP would be located in un-treed area. 🟦	Existing vegetation removed for WWTP and leaching beds. Removal of a few trees may be required to build the beds. 🟧	Existing vegetation removed for sewage lift stations. No significant impact to vegetation. 🟦
	Wildlife and Wildlife Habitat	No impact on wildlife and wildlife habitat. 🟦	No significant wildlife or wildlife habitat. 🟦	No significant wildlife or wildlife habitat. 🟦	No significant wildlife or wildlife habitat. 🟦	No significant wildlife or wildlife habitat. 🟦
	Archaeological or Heritage Resources	No archaeological or heritage impacts. 🟦	No archaeological or heritage impacts. 🟦	No archaeological or heritage impacts. 🟦	No archaeological or heritage impacts. 🟦	No archaeological or heritage impacts. 🟦
Socio-Economic Impacts	**Drinking Water Supplies**	No impact on existing drinking water supplies. 🟦	Potential to increase nitrate and bacteria levels in groundwater wells used for drinking water. 🟥	No impact on existing drinking water supplies. 🟦	Low potential to increase nitrate and bacteria levels in wells used for drinking water. High treatment level and location of leaching beds far from existing wells. 🟧	No impact on existing drinking water supplies. 🟦
	Existing Residential	No opportunity to replace aging septic systems. 🟧	No opportunity to replace aging septic systems. 🟧	Opportunity to replace aging septic systems and connect to new communal system. 🟩	No opportunity to replace aging septic systems. 🟧	Opportunity to replace aging septic systems and connect to new communal system if capacity is available. ⬜
	Temporary during Construction	No temporary construction impacts. 🟦	No temporary construction impacts. 🟦	Minor impacts in Waldemar during construction of WWTP, lift station and effluent pipe. 🟧	Minor impacts in Waldemar during construction of WWTP and lift stations. 🟧	Impacts in Waldemar during construction of lift stations and forcemain. Disruption of Upper Grand Trailway for forcemain construction. 🟥
	Aesthetics: Noise, Visual, Odour	No noise, visual or odour impacts. 🟦	No noise or visual impacts. No odours when functioning properly. 🟦	Typically low and intermittent noise from WWTP and lift station. Minor visual impact of WWTP and lift station buildings. Minor potential for odours at lift station and at WWTP if treatment process is disrupted. 🟧	Typically low and intermittent noise from WWTP and lift station. Minor visual impact of new WWTP and lift station buildings. Minor potential for odours at lift station and at WWTP if treatment process is disrupted. 🟧	Typically low and intermittent noise from lift stations. Minor visual impact and potential for odours at new lift stations. Potential for odours at Grand Valley WPCP in early phases of development due to long residence time in forcemain. 🟥
Technical Considerations	**Technical Feasibility / Ease of Implementation**	No implementation required. 🟦	No technical constraints. 🟦	More complex to implement due to infrastructure required (sewers, lift station, WWTP and outfall). 🟧	More complex to implement due to infrastructure required (sewers, lift station, WWTP, leaching beds). 🟧	Most difficult to implement due to need for coordination with Grand Valley and infrastructure required (sewers, lift stations, forcemain and expansion of WPCP). 🟥
	Flexibility / Ease of Expansion	No ability to expand. 🟥	Does not provide any future benefit for servicing existing homes or other new development. 🟥	WWTP would be designed with ability for future expansion for existing homes or additional new development. 🟩	Does not provide any future benefit for servicing existing homes or other new development. 🟥	Potential for expansion to increase serviced area if capacity is available. ⬜
	Operations and Maintenance Requirements	No operation and maintenance requirements. 🟦	Septic tank pump-out every 3-5 years. No O&M responsibilities for the Township. 🟦	Ongoing O & M for the WWTP and lift station. 🟥	Ongoing O & M for the WWTP, leaching beds and lift station. 🟥	Ongoing O&M for the sewage pumping stations. 🟧
	Approval Requirements	No approvals required. 🟦	Homeowners responsible for obtaining approvals under OBC. 🟦	Environmental Compliance Approval required for wastewater works. 🟧	Environmental Compliance Approval required for wastewater works. 🟧	Grand River to complete Class EA and assimilative capacity study for WPCP expansion. Environmental Compliance Approval required for lift stations and forcemains. 🟥
	Agreements	No requirement for inter-municipal agreement. 🟦	No requirement for inter-municipal agreement. 🟦	No requirement for inter-municipal agreement. 🟦	No requirement for inter-municipal agreement. 🟦	Inter-municipal agreement needs to be developed. 🟥
Financial Impacts	**Estimated Project Costs per Unit**	No project costs. 🟦	Overall project costs are low. Estimated costs per lot of $25,000. 🟧	High total project cost. Estimated costs per lot of $10,000. 🟩	High total project costs. Estimated costs per lot of $77,000 are highest. 🟥	Highest overall project costs. Estimated capital costs per lot of $20,000, plus ongoing costs for WPCP capacity. 🟥
	Land Required for New Infrastructure	No land requirements. 🟦	Each lot must be larger to accommodate a tile bed. 🟦	Land required for lift station and WWTP (small footprint), within the SPL development. 🟧	More land required for lift station, WWTP (small footprint), and leaching beds, within the SPL development lands. 🟥	Land required for lift stations only. 🟧

PRELIMINARY PREFERRED SOLUTION ALTERNATIVE 3

WWTP with Effluent Discharge to Grand River

- Can service the proposed 344-lot development
- Opportunity to provide capacity for existing homes and other development
- Provides a very high level of wastewater treatment
- MOECC and GRCA agreed with proposed effluent quality criteria to maintain water quality in Grand River
- Lowest overall cost per lot and no costs to existing residents
- No inter-municipal agreement required

Township of Amaranth
Council Minutes

Wednesday, June 7, 2017

The Township of Amaranth Council met in the Council Chambers of the municipal office, Laurel, Ontario on June 10, 2017, commencing at 10:00 am.

Present:	Mayor	D. MacIver
	Deputy Mayor	J. Aultman
	Councillor	H. Foster
	Councillor	C. Gerrits
	Councillor	G. Little
	CAO/Clerk-Treasurer	S. Stone
	Deputy Clerk	K. Pearl
	Public Works Director	B. Ryzebol
	Planner	C. Gervais (Planning Matters Only)
	Deputy Treasurer	S. Culshaw (Asset Management Presentation Only)

10:00 am

1. **Opening of Meeting**

Mayor MacIver called the meeting to order.

2. **Late Submissions** (to be in the office prior to the meeting)

Resolution #1

Moved by G. Little – Seconded by J. Aultman

Resolved that the following items be hereby added to / deleted from the agenda:

Added:

1. 3:00 pm – Ian Luckett and Werner Kraus, re item 11.10.1. and 14.5. Clean up of Certain Lands By-law
2. Town of Grand Valley – Transportation Master Plan Study – Notice of Completion

Deleted:

1. Item 11.10.2. and 14.6. – Clean-up of Certain Lands – Allto – By-law

Carried.

3. **Approval of Agenda**

Resolution #2

Moved by C. Gerrits – Seconded by H. Foster

Resolved that Council do hereby approve the agenda as amended.
Carried.

4. **Disclosure of Pecuniary Interest with Reasons**
Can be declared at any time during the meeting. Nothing at this time.

5. **Approval of Minutes**

5.1 Regular meeting minutes held April 19, 2017

Resolution #3

Moved by G. Little – Seconded by J. Aultman

Resolved that Council do hereby approve the minutes of the Regular meeting held May 17, 2017 as circulated. **Carried.**

6 **Public Question Period** **(10:00 am to 10:15 am)**
Nothing at this time.

7 **Delegations**

7.1. **10:15 am** **Amaranth Asset Management Plan, Arunas Kalinauskas, R.J. Burnside & Associates Limited**

Arunas Kalinauskas of R.J. Burnside presented the updated Asset Management Plan to Council. He gave an outline of the Asset Management Plan, which in 2013 only contained roads and bridges. The object is to bring all Township assets into the plan, the most important part being the level of service and risk/criticality assessment, and from there, compile an asset management strategy and present a financing strategy. The Asset Management Plan is a living document and the Provincial Building Together Guide is a good document to read. The Plan recommends that the Township should have a Roads Needs Study done, and it was questioned whether a Roads Needs Study would quantify the number of non-resident traffic, which is a big issue for Amaranth. It was noted that road bases in general are performing well, and that there are $70,000,000.00 in road bases if they were to all be replaced. Road bases are 62% of total replacement with bridges at 40% of replacement. Water is being reported on, but is handled separately from financial perspective. In Waldemar different timing of installations so should stage CCTV scans. Recommended every 15 years. Water system is reaching capacity as future developments are beyond approved plans. There has been an improvement in the Township's Asset Management Strategy since 2013. If a few of the bridges were removed from the infrastructure needs, the Township would be right on track. Province is now mandating climate change to be considered, and Mr. Kalinauskas indicated they did apply the climate change factor to some assets, but would likely need to do so to a greater degree in the future. Financing Strategy is to continue a 1% budgeted amount or approximately $25,000. Recommendation to receive and approve the plan and to consider the Asset Management Plan during annual budget deliberations. Updated TCA policy also provided. Council indicated that they would receive the Plan, but wish to discuss further prior to adopting it.

Resolution #4

Moved by J. Aultman – Seconded by G. Little

Resolved that Council receive the Asset Management Plan as presented; and defer the matter to a future Council meeting. **Carried.**

7.2. **11:00 am** **Alati Auto Truck Service, Percy Way**

Percy Way was in attendance on behalf of Alati Auto Truck Service. He advised that the Province has indicated their licensing requirements, which could mean encroachment into the buffer area of the site plan, for which rezoning and site plan amendment would be required. Changes to dates on Schedule G were discussed and agreed to. Township Planner to red line. Mr. Way states license requirements and changes to site plan are required by September 30, 2017. He is to provide contact information to the Township Planner in order that a meeting can be arranged to determine how their requirements can be met and if amendments to Township documents required.

7.3. **3:00 pm** **Ian Luckett and Werner Kraus, re item 11.10.1. and 14.5. Clean up of Certain Lands By-law**

Ian Luckett and Werner Kraus, along with Jeff Wilker, Township Solicitor, Mike Giles, Chief Building Official, County of Dufferin and Eugene Lammerding, Municipal Law Enforcement Officer, County of Dufferin, were in attendance. Mr. Luckett addressed Council on behalf of Mr. Kraus, and Mr. Kraus also addressed Council. Mr. Wilker indicated the property is an illegal wrecking yard as per the 2010 Superior Court of Justice order, and reviewed the clean-up efforts to date and the by-law before Council today. Mr. Luckett indicated it would be up to the new owners and reiterated that they would be concerned if Council passes the by-law; however, Mr. Wilker indicated the court orders are already registered and questioned how much time they would require to clean things up. Mr. Luckett indicated that not all the materials and equipment on the property belong to Mr. Kraus, and that they are endeavouring to clean up. Also, Mr. Kraus would like access to his funds which were collected previously by the Township for clean up. Mr. Wilker indicated those funds are being held as security, and have and will be used for the ongoing clean up and enforcement in order that there is no financial burden on the rest of the tax payers. The Township will give an accounting of funds to him. Mr. Wilker suggested property taxes could be paid from these funds on direction from Mr. Kraus, in writing, and would stop pending tax sale proceedings. Mr. Luckett and Mr. Kraus are concerned about the by-law being passed and being in effect as of today. Mr. Willker explained the by-law and indicated it is actually a good approach, and in fact, the court order allows immediate clean up, and that the by-law will give them timing. Councillor Little expressed further concern regarding the environment. Mr. Lammerding indicated what kinds of materials are on the property. Council in agreement with change in date to July 31, 2017. Mr. Lammerding will attend and take photos for the July 12, 2017 Council meeting. Mr. Giles indicated he will attend on July 31, 2017 to do an inspection and have Shelburne Iron and Metal on notice for August 1, 2017. CAO Susan Stone provided Mr. Kraus with a copy of the tax arrears statement.

8. Public Meeting(s) (7:00 pm)

8.1. **Sarah Properties – OPA 2-15**
Statutory Public Meeting and Public Information Centre
Application to Amend the Township Official Plan and
Wastewater Treatment and Disposal, Class Environmental Assessment Study Waldemar Community, Township of Amaranth, Jeff Wilker, Township Solicitor, Gord Feniak, Township Engineer and Glenn Wellings, Township Planning Consultant
Walter Broos, Owner/Developer, Dave Hannam – Zelinka Priamo Ltd., Suzanne Troxler and Jason Cover – C.C. Tatham & Associates
8.1.1. Public Meeting Notice
8.1.2. IBI Group – Comments

Resolution # 5

Moved by J. Aultman – Seconded by G. Little

Resolved that Council do now hold Public Meeting(s) regarding the following:

Sarah Properties – OPA2-15 – Statutory Public Meeting re Application to Amend the Township Official Plan; and Public Information Centre re Wastewater Treatment and Disposal, Class Environmental Assessment Study Waldemar Community, Township of Amaranth. **Carried.**

Mayor MacIver called the Public Meeting to order at 7:00 pm, and encouraged those interested in receiving future information to fill in the sign in sheet. Mayor MacIver indicated the purpose of the public meeting for the two matters, Application OPA2 being Official Plan Amendment to permit communal sewage, and the Environmental Assessment being conducted by the proponents. Members of Council and staff in attendance were introduced, and also in attendance were Jeff Wilker, Township Solicitor, Gord Feniak, Township Engineer and Glenn Wellings, Township Planning Consultant (arrived at 7:45 pm). There were approximately 50 people in the gallery.

Township Solicitor Jeff Wilker introduced the matters and explained the purpose of the Official Plan Amendment was to amend the Official Plan to allow a residential subdivision on communal sewage. Also required is an Environmental Assessment regarding wastewater.

Mayor MacIver stated that this is a statutory public meeting under the Planning Act, and an opportunity for the public to speak out. He further stated that Council is here to listen and take in comments, which will all be recorded. At a future date the Development Review Team will bring back a report and recommendation.

Township Planner Christine Gervais explained the purpose of the Official Plan Amendment, to amend the Official Plan to allow a communal system for sewage, noting that all comments received will be posted on the Township website, and those that have not already been on a council agenda will be on an upcoming council agenda.

Ms. Gervais noted that a delegation of residents came to the February 1, 2017 Council meeting and requested a better understanding of the Planning and Environmental Assessment processes and were provided documents explaining how the Planning and EA process work, and the February 15, 2017 agenda of Council also contained a list of studies (16) up to date. Anyone can contact the office to see the reports or be provided copies.

Mr. Wilker emphasized that this meeting is to focus on the Official Plan Amendment and the wastewater treatment. The plan of subdivision and rezoning would be dealt with at a later meeting.

Applicants, Walter Broos, Owner/Developer, Dave Hannam – Zelinka Priamo Ltd., Suzanne Troxler and Jason Cover – C.C. Tatham & Associates addressed Council and the public.

Mr. Hannam, the proponent's planning consultant, discussed their application and the Environmental Assessment, stating that private services are not permitted under Provincial policies, and that it is their opinion that their proposal meets Provincial Policy, along with the County Official Plan, and is not unusual by today's standards. They will have a park, landscaping, and lots will have 60 foot frontage, which is smaller than the existing subdivisions. Mr. Wilker again reiterated that, notwithstanding the proponent's Planner's presentation, this meeting is only for the Official Plan Amendment dealing with communal sewage and the Environmental Assessment. He also clarified that any reference to OPA10, which was an old secondary plan and has since been built into the existing Official Plan, is no longer valid, and corrected statements regarding private servicing, which is not prohibited.

Suzanne Troxler, the proponent's Environmental Engineer, presented the EA Study for Wastewater Treatment, explaining that they considered 5 alternatives, being 1) do nothing; 2) private septic systems; 3) wastewater treatment plant with discharge to the Grand River; 4) wastewater treatment plant with discharge to an on-site sewage treatment facility; 5) wastewater treatment plant with discharge to the Grand Valley Sewage Treatment Plant. Ms. Troxler noted that doing nothing is not an option; that private septic systems no longer supported by the MOECC, and that with requirement to meet 10 mg. nitrate at property line, the maximum number of lots would be 26; discharge to the Grand River is achievable with existing technology and a tertiary sewage treatment plant, and cost to a new home relatively low at $10,000 per new home; to access the Grand Valley Sewage Treatment Plant, the shortest route would be through the trailway, but the STP would need to be expanded, and this method of wastewater treatment not possible at this time as there is no existing capacity, and would be a high cost running a pipe for 3.5 km. Therefore, their analysis has determined that alternative 3 is the preferred solution, where they would have their own sewage treatment plant with possibility of expansion, being the most practical and economical and can meet the effluent quality requirements.

Rick Hilder – 8 James Street – questioned timeframe, and questioned system failure vs septic system failure.

Jan Oorebeek – 16 Mill Street – lot is lowest point in village. Questioned if this would be an MBR system which she feels is the most problem plagued system. Membrane/biofilter is a proprietary membrane, but technology fails, and not all homeowners are careful and the membrane is very sensitive. Overflows will end up in their basement and bypass ends up in the river. Questioned what happens when the system fails.

Trish Hamilton – 15 Mill Street – stated concern about training of technicians and monitoring and questioned if costs fall back on the municipality. Mr. Broos responded that the best possible technology will be applied to this development, and the MOECC favours them. Ms. Hamilton questioned cost and Mr. Broos indicated in Orangeville the residents share the cost. The estimate is $40-$50 per month to build in maintenance capital, that the community does not bear the cost. This system allows other members of the public to hook in as well.

Donna Pasman – 8 Peter Street – moved in just after Walkerton and bore the expense of upgrades. Questioned why they have not looked at a full sewage treatment plant like Grand Valley and noted concerns about their well water. Mr. Broos assured her that the best system will be picked and with best technology.

Johann Rancher – 2 Station Street – questioned current levels of phosphates, etc. and how a problem would be detected. Ms. Troxler indicated that would be monitored.

Susan Graham – 15 Peter Street – noted that each house paid $10,000.00 per house to upgrade, and what they are giving back to the residents. Ms. Graham also stated that bylaw states that no other subdivision is allowed on their water system. Mr. Broos indicated this isn't the purpose of this meeting.

Margaret Vandenhoek – 19 Mill Street – asked for a show of hands of who has a septic system, and which had failed.

Carol Hubert – 24 David Street – questioned the cost of wastewater treatment being offered to them.

Alex Hamilton – 15 Mill Street – noted that Centurian will be building on septics and that places where entire communities fail are old villages. Low density on septic systems is their preference, and questioned if the MOECC has said septic systems are illegal. Ms. Troxler indicated the MOECC do not consider them illegal and agreed that septic systems are not illegal, just drastically reduces lot yield, and that sewage treatment plants easy to design in a modular way for future expansion to add existing homes. Phase 3 of the EA Study looks at failure rate.

Peter Marshall – 223214 Station Street – questioned if Council votes to amend the Official Plan does that tie them to the number of lots. Mr. Wellings, Township Planning Consultant indicated that the actual number not set and would depend on other factors such as road design, grading, etc.

Margaret Oorebeek – 16 Mill Street – questioned assimilative capacity and voiced concern about level of pollution and levels of the river, and cannot understand how more effluent can be put in river. Ms. Troxler stated that they did not do the assimilative capacity study. It was done by another company and reviewed by the Ministry.

Councillor Gerrits – noted that pursuant to their June 5, 2017 letter, XCG recently finished their assimilative capacity which is being reviewed by MOECC.

Peter Torrell – Grand Valley – noted that the river is "bone dry" in his yard, and that it is not true that septics contaminate ground water.

Teresa (?) – 10th Line north of Waldemar – stated that there is not enough water in the Grand River.

Trish Hamilton – 15 Mill Street – stated that she cannot understand how it's acceptable for assimilative capacity, for wastewater to go into the river, and yet Grand Valley cannot expand. Ms. Troxler stated she did not know that was the case.

Chris Letestu - 10 Russell Hill – everyone in the room does not want the subdivision, so what's to stop it. Likes Waldemar as it is. Mr. Broos noted that the existing subdivision was lucky they had no objectors.

Keith Puckett – 20 Mill Street – clarification if stormwater and treated effluent intermingle. Mr. Broos responded that different companies provide different technologies, and will make water better than it is now.

David Moritz – 253407 9th Line – indicated he has extensive experience with water quality and has been in the area for 58 years. Livestock drank and walked in the river and were made to stop due to environmental impacts, yet sewage treatment plants allowed to discharge into the river.

George Jonker – 373413 6th Line – stated that the Official Plan for Waldemar says 80-90 homes, now Province comes along and says we have to crowd our planning. He does not feel this is going to happen, so why are we entertaining it.

Jim Jansen – 2 Station Street – indicated he does not understand assimilative capacity.

Dean Morrison – 2 Evans Avenue – stated they were told when they moved to Waldemar that there would be more development, but large lots on septics. Ms. Troxler indicated they will use gravity and a pumping station. Mr. Morrison commented that in a storm event or failure the effluent goes into the river. Ms. Troxler stated it was designed for possibility of failure.

Peter Marshall – 223214 Station Street – questioned what happens to the solids. Ms. Troxler stated they are stored, then taken to a sewage treatment plant that manages them.

Carol Hubert – 24 David Street – questioned amount of discharge and temperature, also if they will tear up Main Street. Response was yes. Also, what would occur during Hydro failures, whether the new homes would still have power. Response was that the sewage treatment plant will have an emergency generator.

Alex Hamilton – 15 Mill Street – questioned cost which can be charged at any time, noting that condo developments often go out of business. He also questioned the drinking water and assimilative capacity, noting that GRCA admit there is not enough. He noted that density as established in Official Plan and suggested that, with OMB being replaced, we can stick to the Official Plan. He questioned technology failures, noting that the pipe will be out of the water for most of the year. Ms. Troxler will check with GRCA and check into contradictory information. Mr. Broos questioned septics stating that he does not believe they have never failed.

Dean Morrison – 2 Evans Avenue – indicated that septics are small scale failures.

Peter Terrell – Grand Valley – great ideas but septics are only an issue if there's too much density and river is not an open sewer.

Mr. Eberhardt – 9 James Street – questioned smell, fish, insurance, also noted that those walking on the Trailway on a hot day know the Grand Valley sewage treatment plant stinks.

Susan Graham – 15 Peter Street – questioned why this proposal is being entertained, and requested that Mayor MacIver respond. Mayor MacIver explained this is a process under the Planning Act, and we are following the steps. Ms. Graham noted that at one of the other meetings, it was mentioned there would be three phases, and questioned how they would know if there is adequate flow, etc.

George Jonker – 373413 6th Line – questioned if there would be a later meeting to decide and if there would be a recorded vote. Response ye and yes.

David Moritz – 253407 9th Line – questioned what they are actually proposing. Ms. Troxler stated the next phase is to determine sewage treatment method.

Laura Bryce – N/E corner of 10th Line – upset that we are not being listened to. They live here because they don't want to live in urban settings.

Carol Hubert – 24 David Street – suggested taking a vote on the five alternatives. Vote amongst the public in attendance taken and support for septic systems resulted.

Trish Hamilton – 15 Mill Street – questioned if there would be leaching ponds. Response was there would be no ponds.

Peter Marshall – 223214 Station Street – questioned how many houses were in the Official Plan. Township Planners responded it is not specific in Official Plan, but Zoning By-law allows for 1.5 acre lots as a minimum, so number of lots could be roughly calculated based on that. Glenn Wellings, Township Planning Consultant, noted that the developers have applied for a rezoning for smaller lots. Mr. Broos indicated the Province is forcing them to go smaller and smaller.

Bob Matthews – 21 Station Street – stated it is unacceptable to dump sewage.

Jeff Wilker, Township Solicitor, indicated that he started out saying this meeting is about sewage. Growth Plan matters that Mr. Broos has raised will be discussed at a later date.

Gord Feniak, Township Engineer, indicated that Mr. Broos has the right to apply and the Township has to review everything.

Mr. Wellings commented that he was impressed with the questions raised by the public, which leaves a lot to think about, and that there will be a further statutory Public Meeting for the Rezoning and Plan of Subdivision applications.

Resolution # 6

Moved by H. Foster – Seconded by C. Gerrits

Resolved that Council do now adjourn the Public Meeting and resume regular business. **Carried.**

9 **Unfinished Business**

Nothing at this time.

10. **Public Works**

The following were received and/or dealt with:

10.1. **Director of Public Works**

10.1.1. Report

Weather causing issues with road maintenance. Upgraded electrical completed and curtains installed in the pavilion for the Canada 150 celebrations. Has ordered 4 portable toilets and a hand wash station. Tender currently out for a new plow truck.

10.2. **Bridge 15 and 17 Update**

Director of Public Works provided an update on Bridges 15 and 17. GRCA permit should be approved this week for Bridge 15.

10.3. **Other**

The two year old grader has a transmission problem with a bearing, and will probably require a transmission job.

11. **Planning**

The following were received and/or dealt with:

11.1 **Development Updates**

The Planner and CAO provided a summary of the recent meeting regarding Optrust, who will be proceeding with the Site Plan Application for property on 2nd Line for large warehouse in isolation of the other Optrust lands, though some studies, such as the traffic study, will have to be done on a "macro" level.

11.2. **Consent B5-17 – Robert & Elaine Elliott, Ross & Genevieve Trimble (Owners), Ross & Genevieve Trimble (Applicants) – 435265 4th Line, Concession 3, West Part Lot 25**

Consent B5-17 – To create a new lot.
Decision

Resolution # 7

Moved by C. Gerrits – Seconded by H. Foster

Resolved that Consent Application B5-17 by Robert & Elaine Elliott, Ross & Genevieve Trimble (Owners), Ross & Genevieve Trimble (Applicants), 435265 4th Line, Concession 3, West Part Lot 25, for consent to sever approximately 21.85 ha. (54 ac.) for the purpose of creating a new lot be approved.

REASON: Conforms to the Township Official Plan.

CONDITIONS:

1. Park dedication in the amount of $500.00 on the severed parcel.
2. Taxes paid in full on the severed and retained parcels.
3. Conservation Authority approval on the severed and retained parcels.
4. Entrance approval required on the severed parcel.
5. Septic approval required on the severed parcel.

Christine Gervais

From: Suzanne Troxler <STROXLER@cctatham.com>
Sent: Wednesday, June 6, 2018 11:09 AM
To: Christine Gervais
Cc: Susan Stone; Jason Covey; fnatolochny@grandriver.ca; ngarland@grandriver.ca; Carley.Dixon@rjburnside.com; Gord Feniak; wbroos@rogers.com; jwilker@thomsonrogers.com; glenn@wellingsplanning.ca; dave.h@zpplan.com
Subject: RE: GRCA Comments PIC - Waldermar Wastewater Treatment Plant (116026)

Hi Christine,
I did not look back at the Notice. You are correct, those studies were previously available to the GRCA.
Doesn't the Township have the Assimilative Capacity Study?
Suzanne
>>> Christine Gervais <cgervais@amaranth-eastgary.ca> 6/5/2018 5:11 PM >>>
Hi Suzanne,
The Township Notice of Complete Applications of November 3, 2016 (copy attached) was sent to all prescribed Agencies including GRCA. It included the list of studies that had been submitted in support of the planning applications for the proposed development which included among other studies and documents, the studies listed in Appendix A of your March 2018 Report, except for the Stream Assimilative Capacity Study that has not been submitted to the Township at any time during the process of the planning applications to date. The second last paragraph of the Notice indicates that copy of the studies were available and to contact me should they requested any.
Therefore, it is incorrect to say that the Township didn't make the studies available to GRCA.
Christine
Christine Gervais, MCIP, RPP, Director of Planning
Township of Amaranth & Township of East Garafraxa
Tel.: 519-941-1007 | Email: cgervais@amaranth-eastgary.ca

From: Suzanne Troxler <STROXLER@cctatham.com>
Sent: Tuesday, June 5, 2018 4:16 PM
To: Christine Gervais <cgervais@amaranth-eastgary.ca>; ngarland@grandriver.ca
Cc: Jason Covey <JCOVEY@cctatham.com>; fnatolochny@grandriver.ca; wbroos@rogers.com; dave.h@zpplan.com
Subject: RE: GRCA Comments PIC - Waldermar Wastewater Treatment Plant (116026)

Christine,
The Class EA Phases 1 and 2 report was not previously sent to the Township. It was prepared by me but kept to be used for the first part of the final ESR.
My understanding is that the background studies that are attached in Appendix had been previously submitted to the Township but not been made available to the GRCA.
I apologize for any confusion.
Suzanne

>>> Christine Gervais <cgervais@amaranth-eastgary.ca> 6/5/2018 3:42 PM >>>
Hi Suzanne,
When and how was the March 2018 Wastewater Treatment & Effluent Disposal Class EA Phases 1 & 2 Report sent to the Township?
Christine

Christine Gervais, MCIP, RPP, Director of Planning
Township of Amaranth & Township of East Garafraxa
Tel.: 519-941-1007 | Email: cgervais@amaranth-eastgary.ca

From: Suzanne Troxler <STROXLER@cctatham.com>
Sent: Tuesday, June 5, 2018 11:11 AM
To: ngarland@grandriver.ca
Cc: Christine Gervais <cgervais@amaranth-eastgary.ca>; Jason Covey <JCOVEY@cctatham.com>; fnatolochny@grandriver.ca; wbroos@rogers.com; dave.h@zpplan.com
Subject: Re: GRCA Comments PIC - Waldermar Wastewater Treatment Plant (116026)

Nathan,

We realize that we have not previously submitted to you directly the background studies that have been completed in support of the Sarah Properties proposed development in Waldemar, as you requested in your letter of comments. These studies were made available to the Township of Amaranth.
Accordingly, we are providing a link to download the Wastewater Class EA Phases 1 and 2 report that includes these studies in Appendix.

https://filr.cctatham.com/ssf/s/readFile/share/1584/-2667950905862844008/publicLink/Waldemar%20WW%20Class%20EA%20Phases%201%20%26%202%20Report.pdf

We welcome the GRCA's comments.

The Class EA study will proceed to Phase 3 (assessment of alternative design concepts for the preferred wastewater servicing solution) this summer, and we will keep you informed as the study advances.

We trust this is satisfactory.

Suzanne

Suzanne Troxler, B.Eng., M.Sc., P.Eng.
Director, Manager - Environmental Engineering
C.C.Tatham & Associates Ltd.
705 444 2565 Bus
705 888 0898 Cell
stroxler@cctatham.com
www.cctatham.com

>>> Nathan Garland <ngarland@grandriver.ca> 6/28/2017 3:28 PM >>>
Hello,

Please find attached comments from the GRCA on the Waldemar Wastewater Treatment Plan EA. Hard copies will be sent via mail.

Regards,

Nathan Garland
Resource Planner
Grand River Conservation Authority

ngarland@grandriver.ca
Direct Line: 519.621.2763 x 2236
Office: 1.866.900.4722
Fax: 519.621.4945

From: canonupstairs@grandriver.ca [mailto:canonupstairs@grandriver.ca]
Sent: June 28, 2017 3:17 PM
To: Nathan Garland
Subject: Attached Image