
SURFACE WATER ASSESSMENT REPORT

WOOLWICH BIO-EN INC.

Project No.: 2007-0359-10

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WOOLWICH BIO-EN INC.

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DRAWINGS

1.0 INTRODUCTION

The following Surface Water Assessment Report was prepared by WalterFedy (WF) in support of the Woolwich Bio-En Inc. Renewable Energy Plant proposed in Elmira, Ontario. The objective of this report is to provide the design details for the proposed stormwater management system for approval by the Township of Woolwich in compliance with Section 53 of the Ontario Water Resources Act and Ontario Regulation 359/09 made under the Environmental Protection Act Renewable Energy Approvals under Part V.0.1 of the Act.

The proposed facility is located at the Martin's Lane extension, in the Township of Woolwich, in Elmira, Ontario, as shown in Drawing C1-1. The proposed site is approximately 1.5 ha with no off-site contributing drainage area. The proposed development will comprise a renewable energy facility that includes a repository tank, digester and process tanks, a loading and receiving area, support and operations buildings, bio-filters, and a waste gas flare as shown on Drawing C1-2.

2.0 SITE DESCRIPTION

The site is sloped from north to south, beginning at the crest of a local high point and extending south to the Martin's Lane extension. The site is former agricultural land with topsoil over clay deposits extending to a depth in excess of 3 m.

Groundwater inflow into any excavation on site necessary in support of construction is not anticipated due to the large excavation on the neighbouring property that has effectively dewatered the immediate area. Soils in the immediate vicinity of the site area are a tight gray clay.

At least 150 mm of OPSS Granular A should be used as pipe bedding for sewer and water pipes. The bedding material should extend to the spring line of the pipe and should be compacted to at least 95 percent of the Standard Proctor Maximum Dry Density (SPMDD) using suitable vibratory compaction equipment. Cover material, from the spring line of the pipe to at least 300 mm above the top of the pipe, should consist of OPSS Granular A or Granular B Type I with a maximum particle size of 25 mm. It should generally be possible to re-use the glacial till, weathered silty clay, and silty soils as trench backfill. Where the trench will be covered with hard surfaced areas, the type of native material placed in the frost zone (between sub-grade level and 1.8 m depth) should match the soil exposed on the trench walls for frost heave compatibility. Trench backfill should be placed in maximum 300 mm-thick lifts and should be compacted to at least 95 percent SPMDD using suitable compaction equipment.

3.0 EXISTING CONDITIONS

The site is presently an agricultural parcel of land. The site is characterized by a local high ridge running approximately east-to-west on the north property line that divides flow between the area contributing to Canagagigue Creek and the area draining to Cox Creek which outlets to Canagagigue Creek. The western property line also forms a ridge that functions as a drainage divide that contains all surface flow on the site and prevents it from flowing westerly. The site is entirely within the Canagagigue Creek drainage basin. The site has no existing services and Martin's Lane must be extended to provide access to the site.

Runoff from the site drains south and then flows approximately 180 m west in a swale along the north side of Martin's Lane. The swale drains via a culvert, approximately 120 m in length, south under Martins Lane and under the building south of Martins Lane. The culvert discharges to a municipal swale that drains southerly and westerly approximately 180 m to Canagagigue Creek. Stormwater from the site will be collected and treated on site such that the final outflow will meet Ministry of the Environment (MOE) and Grand River Conservation Authority (GRCA) requirements. An on-site wet

pond is proposed for quality and quantity control, in conjunction with lot level controls and best management practices, to provide protection of downstream watercourses. The proposed stormwater management facility will be constructed concurrently with servicing of the development.

The property immediately adjacent on the west and across Martin's Lane to the south is industrial. The property to the north and east is agricultural and undeveloped but zoned future industrial.

3.1 Water Assessment

The following section is intended to provide information satisfactory to meet the requirements of Sections 29, 30, 31, 39 and 40 of Ontario Regulation 359/09. As such, a records review and a site investigation were conducted in support of this water assessment. The following databases were searched in preparation of this assessment:

- The Grand River Conservation Authority Grand River Information Network
- The Ministry of Natural Resources Land Information Office Land Information Data Subscription Service

Through this analysis, it was established that the proposed Facility will not be sited within 120 m of any water bodies listed in O. Reg. 359/09 or within any defined water body or wetland setbacks. Separation distances between the site and any water bodies are illustrated on Figure 1.

Water Records Review

Surface runoff from the site ultimately discharges to Canagagigue Creek which is part of the Grand River Watershed as regulated by the GRCA. Approval of the site development plan falls under the municipal authority of the Township of Woolwich and is not within the GRCA's authority. The site is located greater than 300 m from Canagagigue Creek in the down gradient direction as shown on Figure 1 in Appendix A. The drainage path from the site to Canagagigue Creek is comprised of approximately 180 m of roadside swale, 120 m of culvert, and an additional 170 m of municipal swale representing a total travel distance of 470 m. Should a direct path to the creek be taken by surface runoff of greater flow than that of the existing conveyance channels and culvert, the distance remains greater than 300 m in the down gradient direction.

From Figure 1, it is noted that the Site is within 300 m of Canagagigue Creek to the northwest. Surface runoff or any spills from the site would need to drain uphill, however, in order to discharge to the creek in this direction. The site is also noted to be within 300 m of Cox Creek to the northeast. Cox Creek is a tributary to Canagagigue Creek to the east (downstream) of the site. It is noted that Cox Creek is dramatically different upstream and downstream of Kenning Place. The creek was artificially excavated and dredged to convey tile drainage from the upstream agricultural fields starting at the Kenning Place crossing. Downstream of Kenning Place, the watercourse is highly incised and the average annual high water mark is below the top bank of the artificially-created cross section. The watercourse is classified as intermittent to perennial as it is fed primarily by surface runoff and tile drainage from the adjacent farm field. Limited evidence exists upstream of Kenning Place to indicate that a creek should exist along this alignment and the watercourse alignment is ephemeral.

Surface runoff or any spills from the site would need to drain uphill in order to discharge to Cox Creek. This is illustrated in the photographic record provided in Appendix A.

For this reason, the assessment only considers the potential for water to drain via gravity, down gradient, to Canagagigue Creek and establishes that the site is greater than 300 m from the watercourse in this direction.

The site is outside of any regulatory limits established by the GRCA. Regulatory mapping available from the GRCA website is provided in Appendix A. The site is proposed on the north side of the Martin's Lane extension as highlighted in the GRCA figure. The figure illustrates the local regulatory limits and proximity of the site to Canagagigue Creek.

The site is not within the jurisdiction of the Niagara Escarpment Commission.

The site is not located in a permanent or intermittent stream or within 30 m of the average annual high water mark of a permanent or intermittent stream.

The site is not located within an identified seepage area or within 30 metres of an identified seepage area.

Water Site Investigation

The site was visited by the author historically on numerous occasions as part of preparation of the site plan engineering design for the adjacent Elmira Machine Industries site between 2002 and 2009. An official site visit in support of this application for the Woolwich Bio-En site was conducted on May 26, 2010 between 2:00 and 3:30. The site visit lasted 90 minutes. Weather conditions during the site visit were sunny and warm at 30°C. A photographic record was prepared summarizing the site visit. Figure 1 in Appendix A presents the locations where photos were taken. The photographic record follows in Appendix A. The site investigation did not yield any information with respect to water bodies that was different from that obtained in the records review.

The photos taken during the site visit comprise the field notes made during the site visit. Where a feature of interest was noted in the field, a digital photo was taken. The area is well known to the author and it was unnecessary to make any notes in the field. Rather photos were taken and the report was written based on review of the photos upon return to the office.

A site visit was conducted by Limnoterra Limited to inventory plant and animal species present in each of the water bodies and their associated littoral zones. A copy of this assessment is provided in Appendix A.

4.0 PROPOSED SERVICING

4.1 Water Distribution Design

An existing 150 mm diameter watermain is located in Martin's Lane that will be tapped into with a 100 mm diameter PVC service to provide potable water to the site.

4.2 Sanitary Design

An existing 150 mm diameter sanitary sewer is located in Martin's Lane that terminates at a manhole along the frontage of the existing industrial and commercial buildings along Martin's Lane. A 150 mm sanitary sewer service will be constructed from the site to this manhole within the traveled portion of the private road.

4.3 Storm Sewer Design

Stormwater drainage on Martin's Lane is reflective of a rural road cross section and is comprised of a series of swales and overland sheet flow draining to a low point on the north side of Martin's Lane. A culvert conveys runoff from this location under a building on the south side of Martin's Lane and drains to a municipal/agricultural drain discharging to Canagagigue Creek.

Stormwater from the site will be collected and treated in accordance with the Township of Woolwich requirements such that the final outflow will meet MOE, GRCA, and Township requirements. A stormwater management facility will be constructed to provide end-of-pipe quality and quantity control. This facility, in conjunction with lot level controls and sedimentation and erosion control practices during construction, will provide protection of downstream watercourses. Further stormwater management details are provided in Section 5 of this report.

5.0 STORMWATER MANAGEMENT

5.1 Stormwater Management Requirements

Regulatory agencies were consulted at the pre-design stage and as part of a previous site layout to determine the requirements for managing stormwater from the site. These agencies included the Township of Woolwich, GRCA, and the MOE. The following list summarizes the principal stormwater issues considered in the design:

- Maintain the existing drainage characteristics;
- Minimize impacts from development on Canagagigue Creek, provide Normal protection (70% TSS removal);
- Provide site controls to ensure that no increase in peak flow results from the development;
- Address operations and maintenance issues; and
- Develop an erosion and sediment control plan for implementation during construction.

5.2 Drainage Areas

The overall drainage area is approximately 1.55 ha, as shown on Drawing C2-1. This includes the actual site property limits and grading around the site that will result in surface drainage discharging onto the site and being treated by the on-site stormwater management system. No alterations to the existing drainage patterns are proposed as part of the site development activities.

5.3 Hydrologic Analysis

5.3.1 Rainfall Data

Synthetic rainfall hyetographs using a Chicago distribution were provided by the Township of Woolwich. The parameters used to characterize these hyetographs are summarized in Table 1.

5.3.2 Watershed Data

Input parameters used to characterize the site under pre- and post-development conditions are presented in Table 2.

5.3.3 Hydrograph Generation

The MIDUSS computer model was used to generate hydrographs and calculate peak flow rates and runoff volumes for 5-, 25-, and 100-year Chicago design storms. The site is characterized by a single catchment under both existing and proposed conditions. The calculated runoff volumes for each storm under pre- and post-development conditions are summarized in Table 3. The peak runoff rates from the rainfall events are summarized in Table 4. Detailed MIDUSS output files are provided in Appendix B.

5.4 Stormwater Management Controls and Best Management Practices

The site is proposed to feature a series of drainage swales draining to a stormwater management facility in accordance with the MOE Stormwater Management Planning and Design (SWMPD) Manual, 2003.

5.4.1 Site Level and Conveyance Controls

Site grading follows existing conditions and drains from north-to-south consistent with the existing topography. Surface sheet flow is proposed from all paved surfaces given the generous amount of topographic fall on the site. This runoff is captured by on-site swales and directed to the on-site stormwater management pond. Swales are grass lined in upland areas where limited surface runoff is conveyed by the swales. The primary swale draining to the stormwater management pond is proposed to be armoured with rock rip rap.

No infiltration measures are proposed due to the clay soils present on site.

5.4.2 End-of-Pipe Facility

An end-of-pipe facility in the form of a wet pond was selected for the site for the following reasons:

- a) The clayey soils will not support long-term infiltration techniques including a dry pond.
- b) Water retained in the permanent pool of the stormwater management pond will be used to supplement on-site industrial processes and captured stormwater runoff will replenish this supply.

The stormwater management wet pond was designed to provide both quality and quantity control. The pond is designed to provide Normal (70% long-term suspended solids removal) quality control, in accordance with MOE guidelines, and to reduce the peak flow rate after development to less than pre-development levels for the 5-year and 100-year rainfall events. Supporting design calculations are provided in Appendix C.

While a “normal” level of treatment is appropriate considering the length of urban swale that the discharge will be conveyed through prior to discharge to Canagagigue Creek (which will provide passive treatment also), it is noted that the proposed pond exceeds the requirements for an “Enhanced” level of protection as described in the MOE SWMPD Manual.

5.4.2.1 Stormwater Quantity Control

The stormwater pond is designed to provide quantity control for the 5- through 100-year storm events via a staged pond outlet structure. Low flows are released from the pond via a 200 mm diameter outlet pipe. High flows are released from the pond via a 1.4 m-wide emergency overflow weir. This overflow weir will release water during the 25-year and larger storm events. This control is designed to reduce the peak flow rate from land north of Martin’s Lane (at the pond outlet) so that the peak flow combined with flow from Elmira Machine Industries, to the west at the culvert under Martins Lane and the industrial building south of Martin’s Lane, is less than the peak flow under existing conditions. A summary of the stage-storage relationship for the pond is presented in Appendix C. Discharges from the outlet structure were calculated using the Hydrocalc Hydraulics for Windows software by Dodson and Associates. Detailed output is provided in Appendix C.

5.4.2.2 Stormwater Quality Control

Quality control is required for the proposed site. Quality treatment requirements shall be met through provision of an appropriate permanent pool volume in the wet pond sized in accordance with table 3.2 of the MOE SWM PD Manual.

The low-flow pond outlet is equipped with a sluice gate that may be closed in the event of a spill on the property. In the closed position, the pond will provide a capture volume of approximately 300 m³ prior to discharge occurring via the emergency overflow weir.

5.4.2.3 Pond Volumes

The overall impervious level for the site is estimated to be 56%. The water quality storage volume requirements for a wet pond providing Normal protection is 110 m³/ha, assuming a 56% impervious level (refer to Table 3.2 of the SWMPD Manual). This represents 71.3 m³/ha for permanent pool and 40 m³/ha for extended detention storage. The total required storage volumes for this design, assuming 1.55 ha and 56% impervious level, are approximately 110 m³ for the permanent pool and 62 m³ for extended detention.

As proposed, the permanent pool provides a volume of 300 m³; the required extended detention volume is provided above the permanent pool and represents a volume of 599 m³. Supporting design calculations for the required permanent pool and extended detention volumes and the stage volume relationship for the proposed pond is provided in Appendix C. The performance of the proposed pond was evaluated using MIDUSS and the results are summarized in Table 5.

5.4.2.4 Length-to-Width Ratio

The stormwater management pond features a berm to extend the flow path within the pond that achieves a length-to-width ratio of approximately 3:1.

5.4.2.5 Sediment Forebay

No forebay is proposed since the site will have limited vegetated areas that may be subject to erosion and the relatively small size of the pond will facilitate rapid clean out of the entire pond should the need to conduct sediment removal arise.

5.4.2.6 Outlet Design

The release rate from the extended detention pond is controlled by the size of the outlet pipe and the overflow weir. The outlet is designed to minimize the potential for clogging and to provide attenuation of the peak flows to pre-development levels as per Township requirements.

5.5 **Site Grading and Planting Strategy**

Site grading is intended to create a manageable work area that is relatively flat on the existing hill slope. The slope of the site will remain consistent with the existing drainage direction with steeper slopes at the north and south ends of the site and a gentler slope through the middle section where the site operations will occur.

Landscaping is proposed along the frontage in accordance with township requirements as illustrated on the site plan, Drawing C2-1. Limited planting is proposed in the pond due to the potential requirement to utilize the pond for fire fighting activities and the potential for accumulated vegetative matter to clog the intake.

5.6 Erosion and Sediment Control During Construction

Sediment and erosion controls to be implemented during construction shall include a perimeter silt fence, coir log check dams, rock check dams, intermediate silt fence, temporary vegetation, rock rip rap channel linings, and geo-textile erosion control matting in accordance with the sediment and erosion control plan. Sediment traps shall be inspected to ensure that they have been properly installed and continue to function as designed. The controls shall be maintained and accumulated sediments removed once their capture capacity has been decreased by one-third. The outlets shall also be inspected for signs of sediment migration off site. In the event that sediments have migrated off site, additional sediment controls shall be implemented as necessary to ensure that no additional sediment escapes from the site and any sediment that has migrated off site shall be removed.

The permanent sediment basin shall be constructed at project initiation and dredged prior to commissioning of the site to ensure optimal operational efficiency.

It is proposed that, during construction activities, visual monitoring will be conducted bi-weekly and within 24 hours of any rainfall event of 12 mm or greater. During the construction period, monitoring shall consist of visual observation for the effectiveness of the sediment and erosion controls and sediment migration off-site. The monitoring program conducted during construction shall consist of visual inspections and a written log. A sample inspection form is provided in Appendix D.

Construction inspections shall be conducted until such time as the construction activities are complete and vegetation has established itself to a density equivalent to 70 percent of the background native vegetation density.

5.7 Operation and Maintenance

Maintenance is an important part of any drainage system, and particularly for urban stormwater management systems. The stormwater management pond shall be inspected annually to assess the accumulation of sediment in the bottom of the pond. Sediment accumulation in excess of 0.3 m will result in decreased performance of the fire flow intake pumps should it be necessary to operate the system. All sediment shall, therefore, be removed from the pond once accumulation of sediment has reached 0.3 m as measured using a staff gauge installed in the bottom of the pond. A log shall be kept documenting the annual inspections and any maintenance activities.

6.0 SUMMARY OF DESIGN ELEMENTS, CONCLUSION AND RECOMMENDATIONS

Sanitary and water systems for the proposed development will be extensions of existing municipal systems, which currently have adequate capacities. The proposed work elements are as follows:

1. 100 mm diameter PVC water service - 350 m
2. 150 mm diameter PVC sanitary sewer service - 312 m

Stormwater from the site will be collected and treated in accordance with the Township of Woolwich development criteria such that the final outflow will meet MOE and GRCA requirements. The proposed work elements are as follows:

1. 210 m grassed swales
2. 45 m rip rap lined swale
3. 1 wet pond with a depth of 3.0 m, a permanent pool volume of 300 m³, and an extended detention storage volume of 599 m³ featuring a headwall, 3.45 m – 400 mm diameter outlet pipe, overflow weir, and a sluice gate that may be closed in the event of a spill on site.

This surface water assessment report describes how site conveyance controls are designed to minimize the impact of the proposed development on the municipal and private stormwater collection system and receiving waters. An end-of-pipe stormwater management wet pond complete with a sluice gate is designed to provide Normal quality control and to reduce peak flow rates after development to pre-development levels for events up to the 1:100 year event. The elements of the Stormwater Management Pond are described in Section 5.5 and are detailed on Drawing C2-1.

Sediment and erosion control methods will be implemented during construction of the site in order to minimize construction impacts on downstream watercourses. Maintenance requirements for this development will be typical of conventional storm sewer systems and wet ponds, and will consist primarily of periodic inspection, removal of sediments, and landscape maintenance.

All of which is respectfully submitted,

WALTERFEDY



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TABLES

Tables

Table 1	Design Storm Parameters
Table 2	Hydrologic Model Catchment Parameters
Table 3	Summary of Runoff Volumes
Table 4	Summary of Runoff Peak Flows
Table 5	Summary of Pond Performance

TABLE 1

WOOLWICH TOWNSHIP
DESIGN STORM PARAMETERS
STORMWATER MANAGEMENT PLAN
WOOLWICH BIO-EN INC.
ELMIRA, ONTARIO

<i>Design Storm</i>	<i>Parameters</i>			<i>r</i>	<i>Duration (min)</i>
	<i>a</i>	<i>b</i>	<i>c</i>		
5	1755	12.347	0.895	0.4	180
25	3261	16.193	0.938	0.4	180
100	4692	17.437	0.956	0.4	180

TABLE 2
HYDROLOGIC MODEL CATCHMENT PARAMETERS
STORMWATER MANAGEMENT PLAN
WOOLWICH BIO-EN INC.
ELMIRA, ONTARIO

<i>Catchment</i>	<i>Description</i>	<i>Area (hectares)</i>	<i>W (metres)</i>	<i>L (metres)</i>	<i>Slope (%)</i>	<i>Pervious Manning's Number (n)</i>	<i>Impervious Manning's Number (n)</i>	<i>SCS Runoff Curve No.</i>	<i>Percent Impervious³</i>	<i>Pervious Runoff Coefficient</i>	<i>Impervious Runoff Coefficient</i>	<i>Pervious Ia/S Coefficient</i>	<i>Impervious Ia/S Coefficient</i>	<i>Pervious Initial Abstraction</i>	<i>Impervious Initial Abstraction</i>
Existing Conditions															
100		1.546	120.0	130.0	4.7	0.250	0.015	87	0	98.00	0.49	0.1	0.1	3.795	2.000
Proposed Conditions															
1		1.546	120.0	130.0	4.7	0.250	0.015	87	56	98.00	0.87	0.1	0.1	3.795	2.000

TABLE 3

SUMMARY OF RUNOFF VOLUMES
 STORMWATER MANAGEMENT PLAN
 WOOLWICH BIO-EN INC.
 ELMIRA, ONTARIO

<u>Existing Conditions</u>			
	<u>5-Year</u>	<u>25-Year</u>	<u>100-Year</u>
	(m ³)	(m ³)	(m ³)
100	362	639	924

<u>Post-Development Conditions (with detention)</u>			
	<u>5-Year</u>	<u>25-Year</u>	<u>100-Year</u>
	(m ³)	(m ³)	(m ³)
1	511	814	1111

TABLE 4

SUMMARY OF RUNOFF PEAK FLOWS
 STORMWATER MANAGEMENT PLAN
 WOOLWICH BIO-EN INC.
 ELMIRA, ONTARIO

<u>Existing Conditions</u>			
	<u>5-Year</u>	<u>25-Year</u>	<u>100-Year</u>
	<u>(m³/s)</u>	<u>(m³/s)</u>	<u>(m³/s)</u>
100	0.108	0.232	0.372
<u>Post-Development Conditions (prior to detention)</u>			
	<u>5-Year</u>	<u>25-Year</u>	<u>100-Year</u>
	<u>(m³/s)</u>	<u>(m³/s)</u>	<u>(m³/s)</u>
1	0.246	0.363	0.492
<u>Post-Development Conditions (post detention)</u>			
	<u>5-Year</u>	<u>25-Year</u>	<u>100-Year</u>
	<u>(m³/s)</u>	<u>(m³/s)</u>	<u>(m³/s)</u>
1	0.105	0.180	0.287

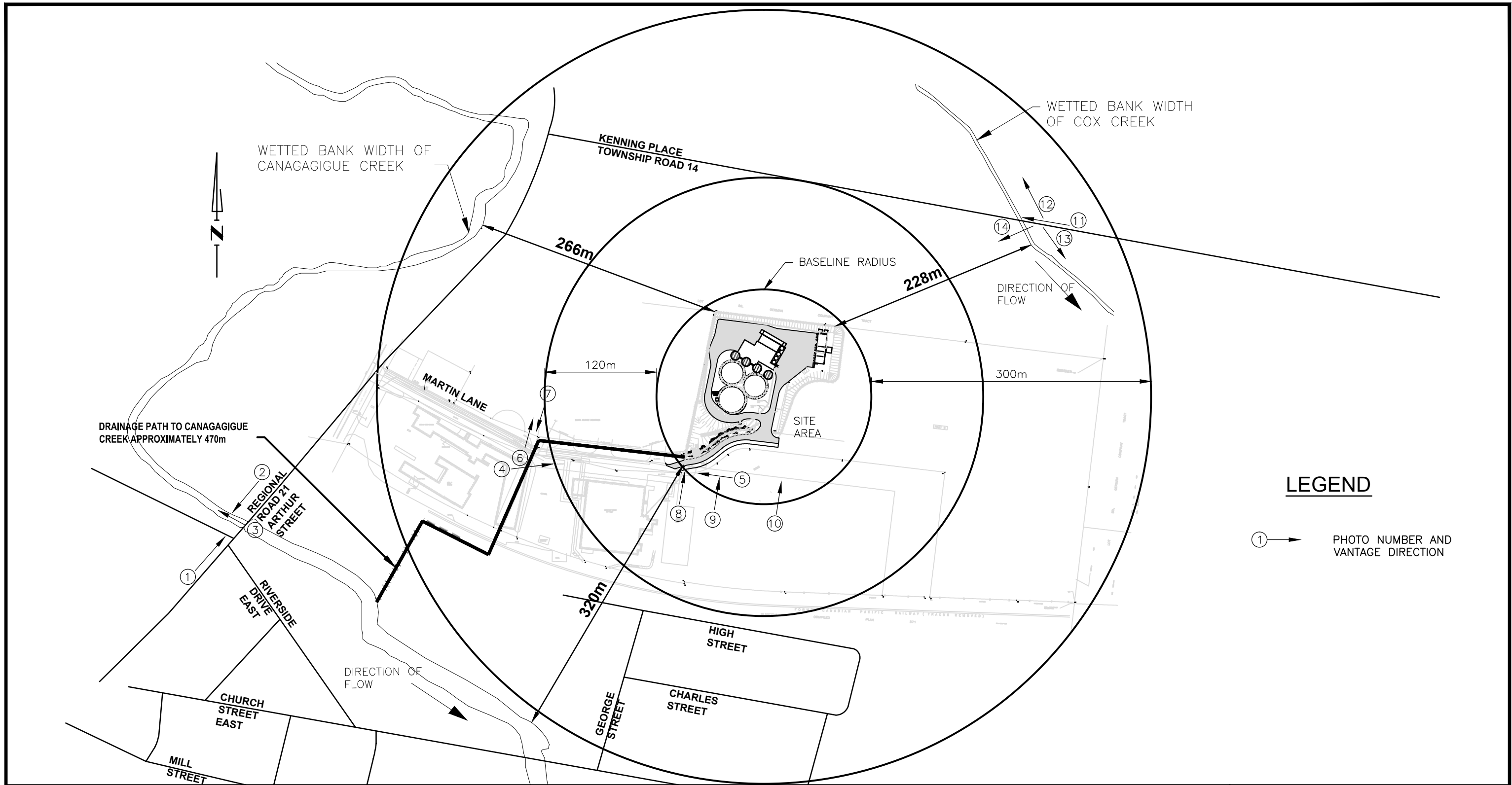
TABLE 5

SUMMARY OF POND PERFORMANCE
 STORMWATER MANAGEMENT PLAN
 WOOLWICH BIO-EN INC.
 ELMIRA, ONTARIO

<u>Pond</u>				
<i>Design Storm</i>	<i>Inflow</i> (m^3/s)	<i>Outflow</i> (m^3/s)	<i>Maximum Depth</i> (m)	<i>Storage</i> (m^3)
5-Year	0.246	0.105	357.149	174
25-Year	0.363	0.180	357.329	279
100-Year	0.492	0.287	357.464	366

APPENDIX A

Site Separation from Canagagigue Creek, GRCA Regulation
Limit Mapping, Photographic Record, and Vegetation and
Habitat Inventory



LEGEND

① → PHOTO NUMBER AND VANTAGE DIRECTION

project:

WOOLWICH BIO EN INC.

title:

SITE SEPARATION FROM CANAGAGIGUE CREEK AND PHOTO LOG KEY INDEX

The contractor shall check and verify all dimensions and report any errors or omissions to the consultant before commencing or proceeding with any work. Do not scale this drawing.

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487 Riverbend Drive, Kitchener, Ontario N2K 3S3
tel: 519.576.2150 fax: 519.576.5499 twfp.com

scale: 1:4000 drawn by: H.S.

date: 10/15/2010 checked by:

job no.: 2007-0359-10

CAD file: 2007-0359-10FIG1

sheet no.:

FIG 1



bioen 2500

LEGEND

- WATERSHED MASK
- BUILDING - SYMBOLIZED (NRVIS)
- BUILDING - TO SCALE (NRVIS)
- WATERSHED BOUNDARY (GRCA)
- UTILITY LINE (NRVIS)
- ROADS-ADDRESSED (MNR)
- RAILWAY (NRVIS)
- DRAINAGE-NETWORK (GRCA)
- FLOODPLAIN (GRCA)
- ENGINEERED
- APPROXIMATE
- ESTIMATED
- PARKS (GRCA)
- REGULATION LIMIT (GRCA)
- DRAINAGE-POLY (NRVIS)
- WOODED AREA (MNR)
- HEDGEROW
- PLANTATION
- TREEED

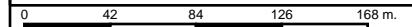


GRCA Disclaimer

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.

The source for each data layer is shown in parentheses in the map legend. For a complete listing of sources and citations go to:

<http://grims.grandriver.ca/docs/SourcesCitations2.htm>



NAD 1983, UTM Zone 17

Scale 1:3,699





1. Canagagigue Creek crossing looking north on Arthur Street.



2. Canagagigue Creek crossing looking south on Arthur Street.



3. Canagagigue Creek looking upstream from Arthur Street.



4. Looking east on Martin's Lane. Site is proposed on left at end of asphalt.



5. Looking west on Martin's Lane. Low point is just past white truck on left.



6. Offsite storm water management pond owned by adjacent property owner (Elmira Machine Industries) at low point in Martin's Lane on north side.



7. Culvert under Martin's Lane at low point where site discharge drains to.



8. Looking north along west property line of proposed site from Martin's Lane extension.



9. Looking north at proposed site from Martin's Lane extension. Property line is at the crest of the hill.



10. Looking north at east property line of proposed site from Martin's Lane extension.



11. Cox Creek crossing at Kenning Place.



12. Cox Creek alignment looking upstream from Kenning Place.



13. Cox Creek looking downstream from Kenning Place. All flow is from tile drains.



14. Looking towards site from Cox Creek crossing of Kenning Place. Site is on opposite side of the crest of the hill in line with visible feed elevator.



Environmental Consulting since 1979

November 1, 2010

Brian Verspagen,
The Walter Fedy Partnership
487 Riverbend Drive,
Kitchener, Ontario, N2K 3S3

Re: General Vegetation Inventory and Habitat Assessment for Cox Creek and Canagagigue Creek in Elmira Ontario near the Proposed Woolwich Bio-en Site

As requested, on October 21 2010, representatives from Limnoterra Limited investigated three locations in Elmira, Ontario where waterbodies were determined to be within 300 m of the proposed Bio-en Elmira site. These areas have all been disturbed by active agricultural use, urban uses and past channel modifications to support the existing farming and urban infrastructure. The weather during our site visit was sunny with some cloudy periods. Our visit took place over a period of approximately 4 hours.

Location 1 - Cox Creek (tributary to Canagagigue Creek)

The waterbody in this case is essentially a ditch with active row cropping on either side. The baseflow derives from tile drainage outlets at the road. The channel bottom has an extensive watercress growth indicating a generally frequent cold water discharge. No fish were observed. The water was very shallow at the time of the site assessment and possibly too shallow and occasionally dry to allow a viable aquatic community.

The vegetation of this system along the banks and the limited upland border consists primarily of common grasses, burdock, mullein, deadly nightshade, and goldenrod. It appears to be frequently disturbed by farming operations since there is no woody vegetation. There is a laneway along one side of the ditch. Farm activities leave limited buffer to the channel, in some locations as little as 1 m from the top of bank.

The ditch is isolated from adjacent terrestrial habitats by tilled fields. Small mammals within the channel and bank vegetation would likely consist of meadow voles and field mice. No mole tunnels were observed. Raccoons have frequented the system as they cross the ditch to access corn growing in the fields. Several trails with raccoon tracks were littered with corn husks. These trails came from two adjacent cedar wood areas and went into the corn field. Avian use of the area would be for opportunistic feeding. No nests were observed in the herbaceous vegetation. The use of agrichemicals, manure spreading and frequent and proximate disturbance have kept this area at a low biotic diversity.

Location 2 - Arthur Street.

Canagagigue Creek in this area has a small floodplain with primarily narrow leafed cattail and canary reed grass (*Phalaris arundinacea*). The flow is slow and approximately 10- 20 m wide. The Creek has been highly disturbed in the past and has been the subject of potential rehabilitation efforts in various locations.

The channel through this location is between a heavily used road and actively tilled farmland. These disturbance factors limit its biotic community. A small group of mallards was resting in the waterway during our visit to the site. It is likely that there is use by some amphibians, frogs and toads. The shallow fringes and floodplain marsh area is like used periodically by great blue heron.



Environmental Consulting since 1979

The floodplain vegetation is predominantly narrow leaved cattail and canary reed grass. No redwing blackbird nests were observed although they may occasionally nest here. No sign of muskrat or other mammalian use was present. The steep bank leading to the roadway is likely used by small passerines such as sparrows for nesting and feeding. The water at this and other visits to the area is turbid. The stream bed is silt dominated. Urban and agricultural runoff have degraded the aquatic diversity.

Location 3 – Canagagigue Creek through Bolander Park

Canagagigue creek through this area is wide (approximately 20m) and shallow (<1m). The banks are steep and dominated by goldenrod and invasive grass species affording little buffer to the mowed lawn of the park. The vegetation provides little cover for other than small passerines for feeding and limited nesting.

The stream bed is silt dominated although a small patch of watercress is growing near the footbridge along the water's edge of the bank. This would normally indicate the presence of some ground water seepage.

No wildlife signs were observed. It is unlikely that this area supports much wildlife due to human and pet disturbance and proximity of the manicured park.

Conclusion

Each of the sites visited as part of this assessment exhibited a strong influence from agricultural or urban development. Vegetative buffers along each of the water courses are physically limited by historic and ongoing human activities. At each location, historic human influences have limited the potential for any significant biodiversity within each of these water bodies or the opportunity for habitat to develop in the vegetative buffer alongside each watercourse. Vegetation is typically limited to invasive species of grasses and goldenrod and habitat is limited to small rodents and sparrows.

Should you have any questions or require additional information, please do not hesitate to contact the undersigned.

Dr. R. J. Planck
President, Limnoterra Limited

A handwritten signature in black ink, appearing to read 'R. J. Planck', is written over a white background.

APPENDIX B

Hydrologic Model Output Files

```

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"      Licensee name:           "
"      Company                  "
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"      Job Number: 2007-0359-10"
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"      *****"
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"      1  Chicago storm"
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"      *****"
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"      1  Triangular SCS"
"      1  Equal length"
"      1  SCS method"
"      100  pre-development"
"      0.000  % Impervious"
"      1.546  Total Area"
"      130.000  Flow length"
"      4.700  Overland Slope"
"      1.546  Pervious Area"
"      130.000  Pervious length"
"      4.700  Pervious slope"
"      0.000  Impervious Area"
"      130.000  Impervious length"
"      4.700  Impervious slope"
"      0.250  Pervious Manning 'n'"

```

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 " 0.492 Pervious Runoff coefficient"
 " 0.100 Pervious Ia/S coefficient"
 " 3.795 Pervious Initial abstraction"
 " 0.015 Impervious Manning 'n'"
 " 98.000 Impervious SCS Curve No."
 " 0.000 Impervious Runoff coefficient"
 " 0.100 Impervious Ia/S coefficient"
 " 0.518 Impervious Initial abstraction"
 " 0.108 0.000 0.000 0.000 c.m/sec"
 " Catchment 100 Pervious Impervious Total Area "
 " Surface Area 1.546 0.000 1.546 hectare"
 " Time of concentration 25.947 3.723 25.946 minutes"
 " Time to Centroid 127.297 91.261 127.297 minutes"
 " Rainfall depth 47.549 47.549 47.549 mm"
 " Rainfall volume 735.11 0.00 735.11 c.m"
 " Rainfall losses 24.137 5.993 24.137 mm"
 " Runoff depth 23.412 41.556 23.412 mm"
 " Runoff volume 361.94 0.00 361.94 c.m"
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 " Maximum flow 0.108 0.000 0.108 c.m/sec"
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 " ***** "
 " Post-development Condition - Onsite "
 " ***** "
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 " 1 Triangular SCS"
 " 1 Equal length"
 " 1 SCS method"
 " 1 post-development"
 " 53.100 % Impervious"
 " 1.546 Total Area"
 " 130.000 Flow length"
 " 4.700 Overland Slope"
 " 0.725 Pervious Area"
 " 130.000 Pervious length"
 " 4.700 Pervious slope"
 " 0.821 Impervious Area"
 " 130.000 Impervious length"
 " 4.700 Impervious slope"
 " 0.250 Pervious Manning 'n'"
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 " 0.492 Pervious Runoff coefficient"
 " 0.100 Pervious Ia/S coefficient"
 " 3.795 Pervious Initial abstraction"
 " 0.015 Impervious Manning 'n'"
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 " 0.874 Impervious Runoff coefficient"
 " 0.100 Impervious Ia/S coefficient"
 " 0.518 Impervious Initial abstraction"

" 0.246 0.000 0.000 0.000 c.m/sec"
 " Catchment 1 Pervious Impervious Total Area "
 " Surface Area 0.725 0.821 1.546 hectare"
 " Time of concentration 25.947 3.723 11.107 minutes"
 " Time to Centroid 127.297 91.261 103.234 minutes"
 " Rainfall depth 47.549 47.549 47.549 mm"
 " Rainfall volume 344.77 390.34 735.11 c.m"
 " Rainfall losses 24.137 5.993 14.503 mm"
 " Runoff depth 23.412 41.556 33.046 mm"
 " Runoff volume 169.75 341.15 510.90 c.m"
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 " 0.320 Target outflow c.m/sec"
 " 510.9 Hydrograph volume c.m"
 " 11. Number of stages"
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 " 3.000 Maximum water level metre"
 " 356.800 Starting water level metre"
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 " Level Discharge Volume"
 " 356.800 0.000 0.000"
 " 356.900 0.01200 46.000"
 " 357.000 0.04300 95.000"
 " 357.100 0.08600 147.000"
 " 357.200 0.1250 203.000"
 " 357.300 0.1650 261.000"
 " 357.400 0.2187 323.000"
 " 357.500 0.3270 390.000"
 " 357.600 0.4638 461.000"
 " 357.700 0.6208 534.000"
 " 357.800 0.7991 609.000"
 " Peak outflow 0.105 c.m/sec"
 " Maximum level 357.149 metre"
 " Maximum storage 174.343 c.m"
 " Centroidal lag 2.331 hours"
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 " 5 Next link "
 " 0.246 0.105 0.105 0.000"
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 " 0.000 Basewidth metre"
 " 3.000 Left bank slope"
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 " 1.000 Gradient %"
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"	Critical depth	0.190 metre"

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"      Company                  "
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"      100 pre-development"
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"      1.546 Total Area"
"      130.000 Flow length"
"      4.700 Overland Slope"
"      1.546 Pervious Area"
"      130.000 Pervious length"
"      4.700 Pervious slope"
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"      0.250 Pervious Manning 'n'"

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 " Time to Centroid 118.302 89.350 118.302 minutes"
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 " Rainfall losses 27.829 6.580 27.829 mm"
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 " 1 Triangular SCS"
 " 1 Equal length"
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 " 1 post-development"
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 " 1.546 Total Area"
 " 130.000 Flow length"
 " 4.700 Overland Slope"
 " 0.725 Pervious Area"
 " 130.000 Pervious length"
 " 4.700 Pervious slope"
 " 0.821 Impervious Area"
 " 130.000 Impervious length"
 " 4.700 Impervious slope"
 " 0.250 Pervious Manning 'n'"
 " 87.000 Pervious SCS Curve No."
 " 0.598 Pervious Runoff coefficient"
 " 0.100 Pervious Ia/S coefficient"
 " 3.795 Pervious Initial abstraction"
 " 0.015 Impervious Manning 'n'"
 " 98.000 Impervious SCS Curve No."
 " 0.905 Impervious Runoff coefficient"
 " 0.100 Impervious Ia/S coefficient"
 " 0.518 Impervious Initial abstraction"

" 0.363 0.000 0.000 0.000 c.m/sec"
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 " Surface Area 0.725 0.821 1.546 hectare"
 " Time of concentration 20.931 3.261 9.772 minutes"
 " Time to Centroid 118.302 89.350 100.017 minutes"
 " Rainfall depth 69.173 69.173 69.173 mm"
 " Rainfall volume 501.55 567.86 1069.41 c.m"
 " Rainfall losses 27.829 6.580 16.546 mm"
 " Runoff depth 41.344 62.593 52.627 mm"
 " Runoff volume 299.77 513.84 813.61 c.m"
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 " 3.000 Maximum water level metre"
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 " 356.900 0.01200 46.000"
 " 357.000 0.04300 95.000"
 " 357.100 0.08600 147.000"
 " 357.200 0.1250 203.000"
 " 357.300 0.1650 261.000"
 " 357.400 0.2187 323.000"
 " 357.500 0.3270 390.000"
 " 357.600 0.4638 461.000"
 " 357.700 0.6208 534.000"
 " 357.800 0.7991 609.000"
 " Peak outflow 0.180 c.m/sec"
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 " Maximum storage 279.082 c.m"
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 " 3.000 Left bank slope"
 " 3.000 Right bank slope"
 " 1.000 Channel depth metre"
 " 1.000 Gradient %"
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"	Channel capacity	4.562	c.m/sec"
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"      Company                 "
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"      *****"
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"      Job Number: 2007-0359-10"
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"      *****"
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"      1  Chicago storm"
"      4692.000  Coefficient A"
"      17.437  Constant B"
"      0.956  Exponent C"
"      0.400  Fraction R"
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"      1  SCS method"
"      100  pre-development"
"      0.000  % Impervious"
"      1.546  Total Area"
"      130.000  Flow length"
"      4.700  Overland Slope"
"      1.546  Pervious Area"
"      130.000  Pervious length"
"      4.700  Pervious slope"
"      0.000  Impervious Area"
"      130.000  Impervious length"
"      4.700  Impervious slope"
"      0.250  Pervious Manning 'n'"

```

```

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" 0.100 Pervious Ia/S coefficient"
" 3.795 Pervious Initial abstraction"
" 0.015 Impervious Manning 'n'"
" 98.000 Impervious SCS Curve No."
" 0.000 Impervious Runoff coefficient"
" 0.100 Impervious Ia/S coefficient"
" 0.518 Impervious Initial abstraction"
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" Time to Centroid 113.196 88.193 113.196 minutes"
" Rainfall depth 89.960 89.960 89.960 mm"
" Rainfall volume 1390.78 0.00 1390.78 c.m"
" Rainfall losses 30.192 7.398 30.192 mm"
" Runoff depth 59.768 82.562 59.768 mm"
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" 1 post-development"
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" 1.546 Total Area"
" 130.000 Flow length"
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" 0.725 Pervious Area"
" 130.000 Pervious length"
" 4.700 Pervious slope"
" 0.821 Impervious Area"
" 130.000 Impervious length"
" 4.700 Impervious slope"
" 0.250 Pervious Manning 'n'"
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" 0.100 Pervious Ia/S coefficient"
" 3.795 Pervious Initial abstraction"
" 0.015 Impervious Manning 'n'"
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" 0.100 Impervious Ia/S coefficient"
" 0.518 Impervious Initial abstraction"

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 " Rainfall volume 652.28 738.51 1390.78 c.m"
 " Rainfall losses 30.192 7.399 18.088 mm"
 " Runoff depth 59.768 82.562 71.872 mm"
 " Runoff volume 433.37 677.77 1111.13 c.m"
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 " 0.320 Target outflow c.m/sec"
 " 1111.1 Hydrograph volume c.m"
 " 11. Number of stages"
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 " 3.000 Maximum water level metre"
 " 356.800 Starting water level metre"
 " 0 Keep Design Data: 1 = True; 0 = False"

" Level Discharge Volume"

" 356.800 0.000 0.000"
 " 356.900 0.01200 46.000"
 " 357.000 0.04300 95.000"
 " 357.100 0.08600 147.000"
 " 357.200 0.1250 203.000"
 " 357.300 0.1650 261.000"
 " 357.400 0.2187 323.000"
 " 357.500 0.3270 390.000"
 " 357.600 0.4638 461.000"
 " 357.700 0.6208 534.000"
 " 357.800 0.7991 609.000"

" Peak outflow 0.287 c.m/sec"
 " Maximum level 357.464 metre"
 " Maximum storage 365.899 c.m"
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" 5 Next link "
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 " 3.000 Left bank slope"
 " 3.000 Right bank slope"
 " 1.000 Channel depth metre"
 " 1.000 Gradient %"
 " Depth of flow 0.354 metre"

"	Velocity	0.762 m/sec"
"	Channel capacity	4.562 c.m/sec"
"	Critical depth	0.285 metre"

APPENDIX C

Design Calculations

APPENDIX C

MOE WATER QUALITY CAPACITY DESIGN CRITERIA CALCULATIONS STORMWATER MANAGEMENT PLAN WOOLWICH BIO-EN INC. ELMIRA, ONTARIO

Task: Calculate Water Quality Storage Requirements

Reference: Stormwater Management Planning and Design Manual (March 2003)

Required Wet Pond Storage		
Protection Level:	Normal	
Impervious Level :	56	%
Permanent Pool Storage Volume:	111.3	m ³ /ha
Contributing Drainage Area	1.55	ha
Required Water Quality Storage Volume:	172	m ³ (1.55ha × 111.3 m ³ /ha)
Required Permanent Pool Volume:	110	m ³
Required Extended Detention Storage Volume:	62	m ³
Total Storage Provided:	899.0	m ³
Provided Permanent Pool Volume:	300	m ³
Provided Extended Detention Storage Volume:	599	m ³

Calculation of Required Permanent Pool Volume

55% Impervious = 110 m³/ha

70% Impervious = 130 m³/ha

Through Linear interpolation, we calculate:

$$(130-110) \div (70-55) \times (56-55) + 110 = 111.333$$

APPENDIX C

IMPERVIOUS AREA CALCULATION STORMWATER MANAGEMENT PLAN WOOLWICH BIO-EN INC. ELMIRA, ONTARIO

Summarise Impervious Areas

	s.m.
Paved Areas	4767
Big Tanks	2022
Little Tanks	302.4
Big Building	1226
Little Building	408.7
Total Impervious Area	8726.1
Total Drainage Area	15458
Percent Impervious	56%

Areas taken from model space drawing.

APPENDIX C

**POND DESIGN SHEET
STORMWATER MANAGEMENT PLAN
WOOLWICH BIO-EN INC.
ELMIRA, ONTARIO**

Task: Design pond for the site

Stage/Storage					
Dead Storage Elevation =		356.80			
<i>Elevation</i>	<i>Area</i>	<i>Depth</i>	<i>Total Storage</i>	<i>Live Storage</i>	
<i>(m)</i>	<i>(m²)</i>	<i>(m)</i>	<i>(m³)</i>	<i>(m³)</i>	<i>(ha-m)</i>
354.8	0	0.00	0	0	0.0000
355	0	0.20	0	0	0.0000
355.5	88.66	0.70	22	0	0.0000
356	203.47	1.20	95	0	0.0000
356.5	256.94	1.70	210	0	0.0000
356.8	344.06	2.00	300	0	0.0000
356.9	437.26	2.10	340	39	0.0039
357	505.5	2.20	385	85	0.0085
357.1	535.8	2.30	437	137	0.0137
357.2	566.2	2.40	493	192	0.0192
357.3	596.5	2.50	551	250	0.0250
357.4	646	2.60	613	312	0.0312
357.5	695.5	2.70	680	379	0.0379
357.6	718.7	2.80	751	450	0.0450
357.7	741.8	2.90	824	523	0.0523
357.8	765	3.00	899	599	0.0599

POND OUTLET PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

October 5, 2011

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PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (m).....	0.4
FHWA Chart Number.....	1
FHWA Scale Number (Type of Culvert Entrance).....	1
Manning's Roughness Coefficient (n-value).....	0.013
Entrance Loss Coefficient of Culvert Opening.....	0.5
Culvert Length (m).....	3.45
Invert Elevation at Downstream end of Culvert (m).....	356.76
Invert Elevation at Upstream end of Culvert (m).....	356.8
Culvert Slope (m/m).....	0.0116
Starting Flow Rate (cu m/s).....	0.01
Incremental Flow Rate (cu m/s).....	0.01
Ending Flow Rate (cu m/s).....	0.41
Starting Tailwater Depth (m).....	356.5
Incremental Tailwater Depth (m).....	0.0
Ending Tailwater Depth (m).....	356.5

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COMPUTATION RESULTS

Flow Rate (cu m/s)	Tailwater Depth (m)	Headwater (m)		Normal Depth (m)	Critical Depth (m)	Depth at Outlet (m)	Outlet Velocity (m/s)
		Inlet Control	Outlet Control				
0.01	356.5	0.09	356.46	0.06	0.07	0.4	0.08
0.02	356.5	0.13	356.46	0.08	0.1	0.4	0.16
0.03	356.5	0.17	356.47	0.1	0.12	0.4	0.24
0.04	356.5	0.19	356.47	0.12	0.14	0.4	0.32
0.05	356.5	0.22	356.47	0.13	0.16	0.4	0.4
0.06	356.5	0.25	356.48	0.14	0.17	0.4	0.48
0.07	356.5	0.27	356.49	0.15	0.19	0.4	0.56
0.08	356.5	0.29	356.5	0.16	0.2	0.4	0.64
0.09	356.5	0.32	356.51	0.18	0.22	0.4	0.72
0.1	356.5	0.34	356.52	0.19	0.23	0.4	0.8
0.11	356.5	0.36	356.53	0.2	0.24	0.4	0.88
0.12	356.5	0.38	356.54	0.21	0.25	0.4	0.95
0.13	356.5	0.41	356.56	0.22	0.26	0.4	1.03
0.14	356.5	0.43	356.57	0.23	0.27	0.4	1.11
0.15	356.5	0.45	356.59	0.24	0.28	0.4	1.19

0.16	356.5	0.49	356.6	0.25	0.29	0.4	1.27
0.17	356.5	0.51	356.62	0.26	0.3	0.4	1.35
0.18	356.5	0.53	356.64	0.27	0.31	0.4	1.43
0.19	356.5	0.56	356.66	0.28	0.32	0.4	1.51
0.2	356.5	0.6	356.69	0.29	0.32	0.4	1.59
0.21	356.5	0.63	356.71	0.31	0.33	0.4	1.67
0.22	356.5	0.67	356.73	0.32	0.34	0.4	1.75
0.23	356.5	0.7	356.76	0.34	0.34	0.4	1.83
0.24	356.5	0.74	356.78	0.36	0.35	0.4	1.91
0.25	356.5	0.78	356.81	0.4	0.35	0.4	1.99
0.26	356.5	0.82	356.84	0.4	0.36	0.4	2.07
0.27	356.5	0.87	356.87	0.4	0.36	0.4	2.15
0.28	356.5	0.91	356.9	0.4	0.37	0.4	2.23
0.29	356.5	0.96	356.93	0.4	0.37	0.4	2.31
0.3	356.5	1.01	356.97	0.4	0.37	0.4	2.39
0.31	356.5	1.06	357.0	0.4	0.38	0.4	2.47
0.32	356.5	1.11	357.04	0.4	0.38	0.4	2.55
0.33	356.5	1.17	357.07	0.4	0.38	0.4	2.63
0.34	356.5	1.22	357.11	0.4	0.38	0.4	2.71
0.35	356.5	1.28	357.15	0.4	0.38	0.4	2.79
0.36	356.5	1.34	357.19	0.4	0.39	0.4	2.86
0.37	356.5	1.4	357.23	0.4	0.39	0.4	2.94
0.38	356.5	1.46	357.27	0.4	0.39	0.4	3.02
0.39	356.5	1.52	357.32	0.4	0.39	0.4	3.1
0.4	356.5	1.59	357.36	0.4	0.39	0.4	3.18
0.41	356.5	1.66	357.41	0.4	0.39	0.4	3.26

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APPENDIX D

Sample Sediment and Erosion Control Inspection Report

**APPENDIX D
SAMPLE SEDIMENT AND EROSION CONTROL INSPECTION REPORT
WOOLWICH BIO-EN INC
MARTIN LANE, ELMIRA, ONTARIO**

Inspector: _____

Date: _____

Site Conditions:

BIWEEKLY RAIN EVENT OTHER

Measures & Controls	In Conformance with Design Standards	Effective Pollutant Control Practice
Construction Entrance	YES / NO	YES / NO
Silt Fence	YES / NO	YES / NO
Soil Stabilization	YES / NO	YES / NO
Coir Logs	YES / NO	YES / NO
Solid Waste Disposal	YES / NO	YES / NO
Equipment Fueling/Storage	YES / NO	YES / NO
Hazardous Materials Storage	YES / NO	YES / NO
Hazardous Waste	YES / NO	YES / NO
Sanitary / Septic	YES / NO	YES / NO
Offsite Storage Erosion Controls	YES / NO	YES / NO

RECOMMENDED REMEDIAL ACTIONS:

Signature: _____ Telephone: _____

Printed Name: _____

DRAWINGS

Drawings

Drawing C1-1	Existing Conditions Plan
Drawing C1-2	Site Plan
Drawing C2-1	Site Grading and SWM Plan
Drawing C3-1	Site Servicing Plan
Drawing C4-1	Erosion Sediment Control Plan