



# EMISSION SUMMARY AND DISPERSION MODELLING REPORT

WOOLWICH BIO-EN INC.  
ELMIRA, ONTARIO

**DISCLAIMER:**  
SOME FORMATTING CHANGES MAY HAVE OCCURRED WHEN  
THE ORIGINAL DOCUMENT WAS PRINTED TO PDF; HOWEVER,  
THE ORIGINAL CONTENT REMAINS UNCHANGED.

DECEMBER 2011  
REF. NO. 046254 (3)

**Prepared by:**  
**Conestoga-Rovers  
& Associates**

651 Colby Drive  
Waterloo, Ontario  
Canada N2V 1C2

Office: (519) 884-0510  
Fax: (519) 884-0525

web: <http://www.CRAworld.com>

## EXECUTIVE SUMMARY

This Emission Summary and Dispersion Modelling (ESDM) Report was prepared to support an Application for Renewable Energy Approval (REA). The ESDM Report was prepared in accordance with s.26 of Ontario Regulation 419/05 (O. Reg. 419/05) to support the Application for REA. In addition, guidance in the ministry publication "Procedure for Preparing an Emission Summary and Dispersion Modelling Report" dated March 2009 (ESDM Procedure Document) was followed as appropriate.

Woolwich Bio-En Inc. (Bio-En) plans to construct and operate a biogas-fired power plant fuelled by biogas generated through the anaerobic digestion of various forms of biomass. The facility is to be located at 40 Martin's Lane (Plan 58R-14363, Lot 18, Part 9) in Elmira, Ontario (Facility). The Facility is located in an area zoned for industrial use. Bio-En will produce biogas from the anaerobic digestion of organic material at the Facility and will use that biogas to generate electricity.

The Facility is subject to s.19 of O. Reg. 419/05; therefore, the modelled impact of contaminant emissions can be assessed as half-hour maximum point of impingement (POI) concentration. The appropriate model to assess the half-hour maximum POI impact is the model in the Appendix to Regulation 346. The Facility has made a request under O. Reg. 419/05 s.20(4) to have Schedule 3 standards apply in advance of the date specified by the regulation. This request has been made for all emissions. The appropriate model to assess the maximum POI impact for these contaminants is the United States Environmental Protection Agency (USEPA) SCREEN3 or AERMOD models. The Ontario Ministry of the Environment (MOE) has approved this request (see Appendix C-2) and requested that all contaminants be modelled using the AERMOD dispersion model.

The Facility is expected to emit volatile organic compounds (VOCs), sulphur compounds, products of combustion and odour. Some of the sources and contaminants were considered negligible in accordance with s.8 of O. Reg. 419/05.

The maximum POI concentrations were calculated based on the Operating Conditions where all significant sources are operating simultaneously at their individual maximum rates of production. The maximum emission rates for each significant contaminant emitted from the significant sources were calculated in accordance with s.11 of O. Reg. 419/05 and the data quality assessment follows the process outlined in the requirements of the ESDM Procedure Document.

A POI concentration for each significant contaminant emitted from the Facility was calculated based on the estimated emission rates and the output from the approved dispersion model; the results are presented in the following Emission Summary Table in accordance with s.26 of O. Reg. 419/05.

The POI concentrations listed in the Emission Summary Table were compared against criteria listed in the Ministry publication "Summary of O. Reg. 419 Standards and Guidelines to support Ontario Regulation 419: Air Pollution - Local Air Quality" and "Jurisdictional Screening Levels (JSL) List" dated February 2008.

**EMISSION SUMMARY TABLE**  
**ELMIRA BIOGAS PLANT**  
**WOOLWICH BIO-EN INC.**

<i>Contaminant</i>	<i>CAS No.</i>	<i>Total Facility Emission Rate (g/s) or (OU/s)</i>	<i>Air Dispersion Model Used</i>	<i>Max. Ground Level Conc. ug/m3 / (OU) (1)</i>	<i>Averaging Period (hours)</i>	<i>MOE POI Limit (ug/m3)</i>	<i>Limiting Effect</i>	<i>Regulation Schedule #</i>	<i>Percentage of MOE POI Limit</i>
Carbon Monoxide	630-08-0	8.25	AERMOD	1.72E+03	0.5	6000	Health	3	28.61%
Nitrogen Oxides	10102-44-0	1.91	AERMOD	2.57E+02	1	400	Health	3	64.14%
		1.91	AERMOD	1.50E+02	24	200	Health	3	74.98%
NMHC	NA	0.68	AERMOD	2.76E+02	1	NA	NA	NA	NA
				2.13E+02	24	NA	NA	NA	NA
Particulate Matter	NA	0.26	AERMOD	2.69E+01	24	120	Visibility	3	22.38%
Odour	NA	1.19E+04	AERMOD	0.46 See Modelling Memorandum	10 min	1 OU	Odour	G	NA
Ammonia	7664-41-7	4.84E-02	AERMOD	7.79E-01	24	100	Health	3	<1%
Trimethylamine	75-50-3	2.08E-03	AERMOD	1.03E-01	1	0.5	Odour	3 (G)	20.63%
Triethylamine	121-44-8	1.94E-03	AERMOD	3.13E-02	24	7	NA	JSL	<1%
Hydrogen Sulfide	7783-06-4	3.87E-03	AERMOD	INCLUDED IN TRS					
Methyl Mercaptan	74-93-1	1.10E-03	AERMOD	INCLUDED IN TRS					
Ethyl Mercaptan	75-08-1	2.56E-03	AERMOD	INCLUDED IN TRS					
Dimethyl Sulphide	77-78-1	1.00E-02	AERMOD	INCLUDED IN TRS					
Dimethyl disulphide	624-92-0	5.99E-03	AERMOD	INCLUDED IN TRS					
Total Reduced Sulfur (2)	NA	2.35E-02	AERMOD	3.79E-01	24	7	Health	3	5.42%
				1.92E+00	10 min	13	Odour	3	14.80%
Butanol	71-36-3	1.67E-02	AERMOD	2.68E-01	24	920	Health	3	<1%
				1.36E+00	10 min	2100	Odour	G (S.20)	<1%
Alpha-pinene	80-56-8	1.24E-02	AERMOD	1.99E-01	24	270	NA	JSL	<1%
Limonene	5989-27-5	2.33E-02	AERMOD	3.76E-01	24	625	NA	JSL	<1%
Acetic Acid	64-19-7	8.33E-03	AERMOD	1.34E-01	24	2500	Odour	G (S.20)	<1%



TABLE OF CONTENTS

	<u>Page</u>
1.0 INTRODUCTION AND FACILITY DESCRIPTION .....	1
1.1 PURPOSE AND SCOPE OF ESDM REPORT .....	1
1.2 DESCRIPTION OF PROCESSES AND NAICS CODES.....	2
1.3 DESCRIPTION OF PRODUCTS AND RAW MATERIALS .....	4
1.4 PROCESS FLOW DIAGRAM .....	5
1.5 OPERATING SCHEDULE .....	5
1.6 FACILITY PRODUCTION LIMIT .....	5
2.0 INITIAL IDENTIFICATION OF SOURCES AND CONTAMINANTS .....	6
2.1 SOURCES AND CONTAMINANTS IDENTIFICATION TABLE .....	6
3.0 ASSESSMENT OF SIGNIFICANCE OF SOURCES AND CONTAMINANTS.....	7
3.1 IDENTIFICATION OF NEGLIGIBLE CONTAMINANTS AND SOURCES .....	7
3.2 RATIONALE FOR ASSESSMENT .....	7
4.0 OPERATING CONDITIONS, EMISSIONS ESTIMATING AND DATA QUALITY .....	8
4.1 DESCRIPTION OF OPERATING CONDITIONS.....	8
4.2 EXPLANATION OF THE METHODS USED TO CALCULATE EMISSION RATES .....	8
4.3 SAMPLE CALCULATIONS .....	9
4.4 ASSESSMENT OF DATA QUALITY .....	9
5.0 SOURCE SUMMARY TABLE AND SITE PLAN .....	10
5.1 SOURCE SUMMARY TABLE.....	10
5.2 SITE PLAN .....	10
6.0 DISPERSION MODELLING .....	11
6.1 DISPERSION MODELLING INPUT SUMMARY TABLE .....	12
6.2 COORDINATE SYSTEM.....	13
6.3 METEOROLOGY AND LAND USE DATA.....	13
6.4 TERRAIN.....	14
6.5 RECEPTORS.....	14
6.6 BUILDING DOWNWASH.....	15
6.7 DEPOSITION .....	15
6.8 AVERAGING TIME AND CONVERSIONS .....	15
6.9 DISPERSION MODELLING OPTIONS .....	16
6.10 DISPERSION MODELLING INPUT AND OUTPUT FILES.....	16

TABLE OF CONTENTS

	<u>Page</u>
7.0 EMISSION SUMMARY TABLE AND CONCLUSIONS.....	17
7.1 EMISSION SUMMARY TABLE .....	17
7.2 ASSESSMENT OF CONTAMINANTS WITH NO MOE POI LIMITS .....	17
7.3 CONCLUSIONS .....	18


## EMISSION SUMMARY AND DISPERSION MODELLING REPORT CHECKLIST

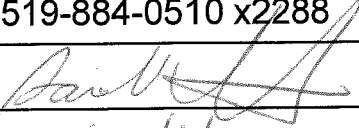
Company Name: Woolwich Bio-En Inc.

Company Address: 4 Arthur St. N  
Elmira, ON, N3B 3A2

Location of Facility: 40 Martin's Lane  
Elmira, ON, N3B 3A1

The attached Emission Summary and Dispersion Modeling Report was prepared in accordance with s.26 of O. Reg. 419/05 and the guidance in the MOE document "Procedure for Preparing an Emission Summary and Dispersion Modelling Report" dated July, 2005 and "Air Dispersion Modelling Guideline for Ontario" dated July 2005 and the minimum required information identified in the check-list on the reverse of this sheet has been submitted.

Company Contact:	<u>Woolwich Bio-En Inc.</u>
Name:	<u>Chuck Martin</u>
Title:	<u>President</u>
Phone Number:	<u>519-669-5171</u>
Signature:	
Date:	<u>Feb. 3 / 2011</u>

Technical Contact:	_____
Name:	<u>Sarah Tebbutt, P.Eng., MBA</u>
Representing:	<u>Conestoga-Rovers &amp; Associates Ltd.</u>
Phone Number:	<u>519-884-0510 x2288</u>
Signature:	
Date:	<u>Feb 11/11</u>

## EMISSION SUMMARY AND DISPERSION MODELLING REPORT CHECKLIST

Required Information		Submitted	Explanation/Reference
<b>Executive Summary and Emission Summary Table</b>			
1.1	Overview of ESDM Report	<input checked="" type="checkbox"/> Yes	Executive Summary
1.2	Emission Summary Table	<input checked="" type="checkbox"/> Yes	Table 4
<b>1.0</b>	<b>Introduction and Facility Description</b>		
1.1	Purpose and Scope of ESDM Report (when report only represents a portion of facility)	<input checked="" type="checkbox"/> Yes	Section 1.1
1.2	Description of Processes and NAICS code(s)	<input checked="" type="checkbox"/> Yes	Section 1.2
1.3	Description of Products and Raw Materials	<input checked="" type="checkbox"/> Yes	Section 1.3
1.4	Process Flow Diagram	<input checked="" type="checkbox"/> Yes	Figure 4
1.5	Operating Schedule	<input checked="" type="checkbox"/> Yes	Section 1.5
<b>2.0</b>	<b>Initial Identification of Sources and Contaminants</b>		
2.1	Sources and Contaminants Identification Table	<input checked="" type="checkbox"/> Yes	Table 1
<b>3.0</b>	<b>Assessment of the Significance of Contaminants and Sources</b>	<input checked="" type="checkbox"/> Yes	
3.1	Identification of Negligible Contaminants and Sources	<input checked="" type="checkbox"/> Yes	Section 3.1
3.2	Rationale for Assessment	<input checked="" type="checkbox"/> Yes	Section 3.2
<b>4.0</b>	<b>Operating Conditions, Emission Estimating and Data Quality</b>		
4.1	Description of operating conditions, for each significant contaminant that results in the maximum POI concentration for that contaminant	<input checked="" type="checkbox"/> Yes	Section 4.1
4.2	Explanation of Method used to calculate the emission rate for each contaminant	<input checked="" type="checkbox"/> Yes	Section 4.2
4.3	Sample calculation for each method	<input checked="" type="checkbox"/> Yes	Section 4.3
4.4	Assessment of Data Quality for each emission rate	<input checked="" type="checkbox"/> Yes	Section 4.4
<b>5.0</b>	<b>Source Summary Table and Property Plan</b>		
5.1	Source Summary Table	<input checked="" type="checkbox"/> Yes	Table 2
5.2	Site Plan (scalable)	<input checked="" type="checkbox"/> Yes	Figure 1
<b>6.0</b>	<b>Dispersion Modelling</b>		
6.1	Dispersion Modelling Input Summary Table	<input checked="" type="checkbox"/> Yes	Table 3
6.2	Land Use Zoning Designation Plan	<input checked="" type="checkbox"/> Yes	Figure 2
6.3	Dispersion Modelling Input and Output Files	<input checked="" type="checkbox"/> Yes	Appendix D
<b>7.0</b>	<b>Emission Summary Table and Conclusions</b>		
7.1	Emission Summary Table	<input checked="" type="checkbox"/> Yes	Table 4
7.2	Assessment of Contaminants with no MOE POI Limits	<input checked="" type="checkbox"/> Yes	Section 7.2
7.3	Conclusions	<input checked="" type="checkbox"/> Yes	Section 7.3
<b>Appendices (Provide supporting information or details such as...)</b>			
Supporting Calculations		<input checked="" type="checkbox"/> Yes	Appendix A
Supporting Information for Assessment of Negligibility		<input checked="" type="checkbox"/> Yes	Appendix B
Air Dispersion Modelling Memo		<input checked="" type="checkbox"/> Yes	Appendix C
Air Dispersion Modelling Input/Output		<input checked="" type="checkbox"/> Yes	Appendix D
Manufacturer Data		<input checked="" type="checkbox"/> Yes	Appendix E
Lease Agreement		<input checked="" type="checkbox"/> Yes	Appendix F
Start Up and Commissioning Protocol		<input checked="" type="checkbox"/> Yes	Appendix G

LIST OF FIGURES  
(Following Text)

FIGURE 1	SITE LOCATION PLAN
FIGURE 2A	LAND USE ZONING DESIGNATION PLAN
FIGURE 2B	LAND USE ZONING DESIGNATION PLAN
FIGURE 3A	SITE LAYOUT AND ROOF LAYOUT
FIGURE 3B	CONCEPTUAL FACILITY LAYOUT
FIGURE 3C	EAST AND WEST BUILDING ELEVATIONS
FIGURE 3D	NORTH AND SOUTH BUILDING ELEVATIONS
FIGURE 4	PROCESS FLOW DIAGRAM

LIST OF TABLES  
(Following Text)

TABLE 1	SOURCES AND CONTAMINANTS IDENTIFICATION TABLE
TABLE 2	SOURCE SUMMARY TABLE
TABLE 3	DISPERSION MODELLING INPUT SUMMARY TABLE
TABLE 4	EMISSION SUMMARY TABLE

## LIST OF APPENDICES

APPENDIX A	SUPPORTING CALCULATIONS
APPENDIX B	SUPPORTING INFORMATION FOR ASSESSMENT OF NEGLIGIBILITY
APPENDIX C-1	AERMOD AIR DISPERSION MODELLING MEMO FOR ODOUR
APPENDIX C-2	MOE LETTER APPROVING MET DATA AND SPEED UP REQUEST FORM
APPENDIX D	AERMOD AIR DISPERSION MODELLING FILES
APPENDIX E	MANUFACTURER DATA SHEETS
APPENDIX F	LEASE AGREEMENT
APPENDIX G	START UP AND COMMISSIONING PROTOCOL
APPENDIX H	ELECTRONIC TABLES

## **1.0 INTRODUCTION AND FACILITY DESCRIPTION**

This Emission Summary and Dispersion Modelling (ESDM) Report was prepared in accordance with s.26 of O. Reg. 419/05. In addition, guidance in the Ministry publication "Procedure for Preparing an Emission Summary and Dispersion Modelling Report" dated March 2009 (ESDM Procedure Document) PIBS 3614e02 was followed as appropriate.

For ease of review and to promote clarity, this ESDM Report is structured to correspond to each of the items listed in the Ministry publication "2005 Emission Summary and Dispersion Modelling Check-List" PIBS 5357e.

The section provides a description of the facility as required by subparagraph 1 of s.26(1) of O. Reg. 419/05.

### **1.1 PURPOSE AND SCOPE OF ESDM REPORT**

This ESDM Report was prepared to support an Application for a Renewable Energy Approval (REA) for all sources at the facility. The ESDM Report was prepared in accordance with s.26 of O. Reg. 419/05 to support the REA Application.

Woolwich Bio-En Inc. (Bio-En) plans to operate an anaerobic digestion (AD) and power generation facility to be located at 40 Martin's Lane (Plan 58R-14363, Lot 18, Part 9) in Elmira, Ontario (Facility).

The location of the Facility is presented in Figure 1 and the land use designation of the site and surrounding area is presented on Figures 2A and 2B. The location of the discharges from each of the sources is presented in Figure 3A; the location of each of the sources is specified with the source reference number. The conceptual facility layout is provided in Figure 3B and the elevations of the structures on the site are provided in Figures 3C and 3D.

## 1.2 DESCRIPTION OF PROCESSES AND NAICS CODES

An overall process schematic is included on Figure 4.

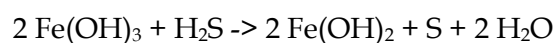
The AD process to be employed at the Facility can be summarized as follows:

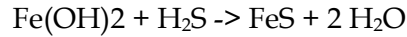
- Incoming renewable energy crops and other solid wastes are unloaded into a covered receiving pit in the Solids Receiving area in the Process Building.
- Liquid or slurry manure is unloaded from tankers into the first pretreatment tank or into one of the liquid storage tanks.
- Incoming liquid feedstock materials are unloaded into 175 m<sup>3</sup> storage tanks located inside the Process Building. Trucks carrying liquid feedstock materials will enter the Liquids Receiving Area in the Process Building and will pump materials from the trucks directly into the storage tanks. The Liquids Receiving Area will have an area of approximately 123.2 m<sup>2</sup>. The liquid materials are pumped from the storage tanks to a Liquid Organics Mixing Unit in the Process Building. The Liquid Organics Mixing Unit will be located in an area with a footprint of approximately 21.5 m<sup>2</sup>. The incoming feedstock storage tanks are contained by a concrete barrier wall for secondary containment.
- Incoming glycerine is unloaded into a 20 m<sup>3</sup> storage container and fed into the Liquid Organics Mixing Unit to be combined with the other feedstock materials.
- Incoming solid organic materials will be unloaded in the Solids Receiving Area into a covered 130 m<sup>3</sup> receiving pit. The Solids Receiving Area is located in the Process Building and has a footprint of approximately 263.1 m<sup>2</sup> (including the receiving pit). The solid feedstocks are processed in the Solid Organics Pre-processing and Mixing Unit and are mixed with the other organic materials and recycled process water so they can be pumped to a storage tank or pretreatment tank. The Solid Organics Pre-processing and Mixing Unit is located in the Process Building in an area that has a footprint of approximately 24.2 m<sup>2</sup>. Materials are pumped from the storage tank and/or the Solid Organics Pre-processing and Mixing Unit to the Pretreatment Tanks.
- Residual material that is not suitable for AD is sorted from incoming SSO, kitchen and food processing waste, stored in the Process Building in a dedicated area with a footprint of approximately 51.3 m<sup>2</sup> and is transported off Site when the 40 m<sup>3</sup> bin has reached capacity. The residual waste will be removed from the Site in dedicated containers. Once the storage capacity of a container is reached, the container will be removed from the Site and a new container will be moved into the contrary bin storage area. The proposed storage area meets the needs of the facility to manage the residuals. Two containers are on-site at all times, with a volume of 40 m<sup>3</sup> per

container for a total capacity of 80 m<sup>3</sup>. When a full container is taken off-site, it is returned empty within a few hours, ensuring that there is always available space for residual waste disposal.

- Fresh municipal water, off-Site water, or water from the SWM pond is used to supplement the recycled process water as required to balance water losses in the AD process.
- The organic materials are pumped from the Mixing Units to a Pretreatment Tank with a footprint of 74.6 m<sup>2</sup> each, equipped with two mixers to further homogenize the materials and increase the temperature of the organics to approximately 50 to 60°C. Pretreatment tanks are equipped with level sensors to prevent overflowing of liquids.
- The mixed organic materials are then pumped to one of the two other Pretreatment Tanks with a foot print of 74.6 m<sup>2</sup> each, equipped with only one mixer each, for a hydraulic retention time (HRT) of approximately 20 hours. The Pretreatment Tanks are operated in batches. While the material in one of the tanks is undergoing pretreatment, the other tank is being emptied and filled with new material.
- After pretreatment, the organic material is periodically pumped to one of two Main Digestion Tanks, each with a footprint of 483.6m<sup>2</sup>, to complete the AD process and generate the desired biogas. Unlike the Pretreatment Tanks, the Main Digestion Tanks are operated under continuous mix conditions and the material from the Pretreatment Tanks is intermittently dosed in to the Main Digestion Tanks. The digesters are insulated and heated to maintain a temperature of approximately 35 to 45°C and have a HRT of approximately 15 to 25 days. During the AD process, the digester conditions and the resulting biogas is continuously monitored as part of an overall control process to optimize biogas yields and energy production.

The hydrogen sulfide concentration must be reduced to less than 200 parts per million (ppm) using a chemical-physical process involving air injection and the addition of ferric-hydroxide or another suitable chemical as needed before being fed into the internal combustion engine to minimize damage to the engine. The oxygen content is maintained between 0 and 2 percent by volume. Excess moisture in the biogas is also damaging to the engines. The process occurs in the tanks themselves (hydrolysis and digester tanks) by controlling the oxygen content in the gas and by adding the ferric-hydroxide to the liquid. The ferric-hydroxide reacts with sulphur compounds to form iron-sulfide (FeS). The ferric-hydroxide reacts with H<sub>2</sub>S and binds the sulphur in a form that is not available to be made back into H<sub>2</sub>S, thereby reducing the amount in the biogas. The following chemical reaction takes place:





In addition, by controlling the oxygen content in the gas storage/top of the tank promotes sulphide-oxidizing bugs, which again reduces the amount of H<sub>2</sub>S.

- The biogas from the Main Digestion Tanks and the Secondary Digestion and Repository Tank is collected in biogas storage membranes and is piped to a Combined Heat and Power (CHP) cogeneration unit, or to a flare if the CHP unit is not operational and the biogas storage is full.
- Electrical and thermal energy are generated by the CHP units, which are specifically designed for the combustion of biogas. Thermal energy is recovered from the CHP unit using a heat exchanger.
- The digestate is pumped from the Main Digestion Tanks through a solids separator to remove the solids (approximately 4 percent dry matter) for recycle water or directly to the Secondary Digester and Repository Tank with an approximate footprint of 647.3 m<sup>2</sup> to await off-Site transport and eventual land application on agricultural fields. The liquid portion of the digestate is either recirculated back to the Mixing Unit as an inoculant for the AD process or pumped to the Secondary Digester and Repository Tank. The Secondary Digester and Repository Tank will have approximately 30 days storage capacity. The capacity of the solid/liquid separator equipment is 800 m<sup>3</sup>/day. The intention is that all digestate material from the main digester tanks will pass through the solid/liquid separator equipment if it is appropriate. There may be instances where the material does not need to be passed through the solid/liquid separator. The solids/liquid separator is a non-essential part of the process. The intention will be to use the separator unless it is broken. It should be noted that it does not need to be used at all. It is used to decrease the percent solids before the material being put into the repository. The solids will be sold separately. The solids/liquids separator is used to increase profits.
- The solid portion of the digestate (approximately 27 percent dry matter) is stored in a bin in the Process Building and transported off-Site when the bin reaches capacity. The digestate solids are land-applied as a nutrient source and soil conditioning agent (fertilizer), similar to the digestate liquids.

The North American Industry Classification System (NAICS) Codes that apply to this Facility are 221119 Other Electricity Generation and 562219 Other Nonhazardous Waste Treatment and Disposal.

### 1.3 DESCRIPTION OF PRODUCTS AND RAW MATERIALS

The Facility will receive a maximum 70,000 tonnes per year (on average, 1,346 tonnes per week to a maximum of 750 tonnes per day) of feedstocks from a variety of sources. The average weekly requirement of materials will vary depending on the dry matter content (DM) and calorie density of the feedstock.

Organics to be processed at the Facility include, but are not limited to:

Organics from food processing facilities, grocery stores, food distribution companies, bakeries, confectionary processing facilities, dairies and facilities that process dairy products, fruit and vegetable processing facilities, cereal and grain processing facilities, oil seed processing facilities, snack food processing facilities, snack food manufacturing facilities, breweries and distillers grain, wineries, alcoholic and non-alcoholic beverage manufacturing facilities, fruit and vegetable packing facilities, milling facilities, kitchen waste, livestock, aquaculture, and paunch manure, glycerol and by-products from ethanol, biodiesel, breweries, and distillery plants, fats, oil, and grease (FOG), of plant and animal origin, and accompanying food residuals collected from grease interceptors and / or grease traps at food production, food processing and/or food wholesale and retail facilities, renewable energy crops (i.e., corn silage), herbaceous plant waste from greenhouse, nurseries, garden centers & flower shops, and aquatic plants, organic solids skimmed from a dissolved air flotation (DAF) tank from wastewater for the production of animal or plant-based materials or from the production of any other food for human or animal consumption, spent grain soluble (SGS) from ethanol, breweries and distillers plant and source separated organics (SSO). These feedstocks may be received as a liquid or a solid.

The recipe will consist of any combination of the above organic feedstocks depending on availability to optimize gas production and anaerobic digester performance and will change from time to time.

The facility shall not accept any waste that is classified as hazardous waste in accordance with O.Reg. 347 and any waste that is classified as: "Specified Risk Materials" as defined by the Canadian Food Inspection Agency Feed Act 1993.

The incoming organics will be of sufficient quality with respect to heavy metals and other contaminants to be acceptable under the Nutrient Management Act.

Product usages and process information are provided in detail in Appendix A - Supporting Calculations. Refer to Table 1 - Sources and Contaminants Identification Table, which tabulates the individual sources of emissions at the Facility.

#### **1.4 PROCESS FLOW DIAGRAM**

Refer to Figure 4 - Process Flow Diagram for a graphical representation of the processes at the Facility.

#### **1.5 OPERATING SCHEDULE**

The Facility will generate electrical and thermal energy 24 hours per day, 7 days per week.

The receiving of organics will occur from 6:00 a.m. to 11:00 p.m., Monday through Saturday. The bulk of this truck traffic will be limited to the hours of 7:00 a.m. to 7:00 p.m. with few trucks on-Site outside of those hours. Trained personnel will be available on Site at all times when organics are being received at the Facility.

#### **1.6 FACILITY PRODUCTION LIMIT**

The projected production capacity of the Facility is a maximum of 2,852 kW of electricity and 3,020 kW of heat.

## **2.0 INITIAL IDENTIFICATION OF SOURCES AND CONTAMINANTS**

This section provides an initial identification of all of the sources and contaminants emitted at the Facility, as required by subparagraphs 2 to 4 of s.26(1) of O. Reg. 419/05.

There may be general ventilation from the Facility that only discharges uncontaminated air from the workspaces or air from the workspace that may include contaminants that come from commercial office supplies, building maintenance products or supplies and activities; these types of ventilation sources are considered to be negligible and were not identified as sources at the Facility.

It should be noted that general ventilation located in the process area that does not vent process emissions is also considered negligible.

### **2.1 SOURCES AND CONTAMINANTS IDENTIFICATION TABLE**

Table 1 - Sources and Contaminants Identification Table tabulates all the emission sources at the Facility. Table 1 provides the information required for subparagraphs 2 to 4 of s.26(1) of O. Reg. 419/05.

The expected contaminants emitted from each source are also identified in Table 1. Each of the identified sources has been assigned a source reference number.

The location of the discharges from each of the sources is presented on Figure 3A - Site Layout and Roof Layout; the location of each of the sources is specified with the source reference number.

### **3.0 ASSESSMENT OF SIGNIFICANCE OF SOURCES AND CONTAMINANTS**

This section provides an explanation for each source and contaminant identified as negligible in Table 1, as requested by subparagraph 5 of s.26(1) of O. Reg. 419/05.

In accordance with s.8 of O. Reg. 419/05 emission rate calculations and dispersion modelling does not have to be performed for emissions from negligible sources or for the emission of negligible contaminants from significant sources.

#### **3.1 IDENTIFICATION OF NEGLIGIBLE CONTAMINANTS AND SOURCES**

Of all the sources listed in Table 1, two have been identified as negligible.

The remaining sources are significant. These sources will be included in the dispersion modelling for the site.

#### **3.2 RATIONALE FOR ASSESSMENT**

For each source in Table 1 that has been identified as being negligible, there is an accompanying documented rationale. The technical information required to substantiate the argument that each of the identified sources is negligible is presented in Appendix B – Supporting Information for Assessment of Negligibility.

#### **4.0 OPERATING CONDITIONS, EMISSIONS ESTIMATING AND DATA QUALITY**

---

This section provides a description of the operating conditions used in the calculation of the emission estimates and an assessment of the data quality of the emission estimates for each significant contaminant from the facility as required by subparagraphs 6 and 7 of s.26(1) of O. Reg. 419/05. In accordance with s.8 of O. Reg. 419/05, emission rate calculations and dispersion modelling do not have to be performed for emissions from negligible sources.

##### **4.1 DESCRIPTION OF OPERATING CONDITIONS**

Section 10 of O. Reg. 419/05 states that an acceptable operating condition is a scenario that assumes operating conditions for the Facility that would result, for the relevant contaminant, in the highest concentration of the contaminant at a POI that the Facility is capable of. The operating condition described in this ESDM Report meets this requirement.

The averaging time for the operating condition is one hour. The operating condition used for this Facility that results in the maximum concentration at a POI is the scenario where all significant sources are operating simultaneously at their individual maximum rates of production. The individual maximum rates of production for each significant source of emissions correspond to the maximum emission rate during any hour period. The individual maximum rates of production for each significant source of emissions are explicitly described in Appendix A.

##### **4.2 EXPLANATION OF THE METHODS USED TO CALCULATE EMISSION RATES**

---

The maximum one-hour emission rates for each significant contaminant emitted from the significant sources were calculated in accordance with requirements of the ESDM Procedure Document.

The emission rate for each significant contaminant emitted from a significant source was estimated and the methodology for the calculation is documented in Table 2.

### **4.3 SAMPLE CALCULATIONS**

The technical rationale, including sample calculations, required to substantiate the emission rates presented in Table 2 is documented in Appendix A.

### **4.4 ASSESSMENT OF DATA QUALITY**

This section provides an assessment of the data quality of the emission estimates for each significant contaminant from the facility.

The assessment of the data quality of the emission rate estimates for each significant contaminant emitted from the significant sources was performed in accordance with the requirements of subparagraph 7iii of s.26(1) of O. Reg. 419/05.

For each contaminant the emission rate was estimated and the data quality of the estimate is documented in Table 2. The assessment of data quality for each source is listed in Table 2 and is documented in Appendix A.

All the emission rates listed in Table 2 were evaluated using the highest data quality available and correspond to the operating scenario where all significant sources are operating simultaneously at their individual maximum rates of production. Therefore, emission rate estimates listed in Table 2 are not likely to be an underestimate of the actual emission rates and use of these emission rates will result in a calculated concentration at POI greater than the actual concentrations.

## 5.0 SOURCE SUMMARY TABLE AND SITE PLAN

This section provides the table required by subparagraph 8 and the site plan required by subparagraph 9 of s.26(1) of O. Reg. 419/05.

### 5.1 SOURCE SUMMARY TABLE

For each source of significant contaminants the following parameters are referenced:

- Contaminant
- Chemical Abstract Service (CAS) reference number
- Source reference number
- Source description
- Stack parameters (flow rate, exhaust temperature, diameter, height above grade, height above roof)
- Location referenced to a UTM coordinate system presented in Figure 3A
- Maximum emission rate
- Averaging period
- Emission estimating technique
- Estimation data quality
- Percentage of overall emission

### 5.2 SITE PLAN

The locations of the emission sources listed in Table 2 are presented on Figure 3A; the location of each of the sources is specified with the source reference number. The location of the property-line is indicated on Figure 3A, with the endpoints of each section of the property-line clearly referenced in a UTM coordinate system. The location of each source is referenced in a UTM coordinate system under a column in Table 2.

The heights of the structures that are part of the Facility are labeled on Figure 3A.

## 6.0 DISPERSION MODELLING

This section provides a description of how the dispersion modelling was conducted at the Facility to calculate the maximum concentration at a POI.

The dispersion modelling was conducted in accordance with the Ministry publication "Air Dispersion Modelling Guideline for Ontario" PIBS 5165e (ADMGO).

The site has submitted a request under s.20(4) to have Schedule 3 of O. Reg. 419/05 apply for all contaminants at the Facility. Therefore, the modelled impact of contaminant emissions are assessed as 1-hour and 24-hour maximum POI concentrations. The appropriate model to assess 1-hour and 24-hour maximum POI impact is the United States Environmental Protection Agency (USEPA) SCREEN3 or AERMOD models. The Ontario Ministry of the Environment requested that each contaminant be modelled using the USEPA AERMOD model; therefore, this approach was taken.

The AERMOD modelling system has been identified by the MOE as one of the approved dispersion models under O.Reg. 419/05, and currently includes the Plume Rise Model Enhancements (PRIME) algorithms for assessing the effects of buildings on air dispersion.

The AERMOD modelling system is made up of the AERMOD dispersion model, the AERMET meteorological pre-processor and the AERMAP terrain pre-processor. The following approved dispersion model and pre-processors were used in the assessment:

- AERMOD dispersion model (v. 09292)
- AERMAP surface pre-processor (v. 09040)
- BPIP building downwash pre-processor (v. 04274)

AERMET was not used in this assessment, as a pre-processed MOE meteorological dataset was used.

The emission rates used in the dispersion model meet the requirements of Section 11(1)1 of O. Reg. 419/05, which requires that the emission rate used in the dispersion model is at least as high as the maximum emission rate that the source of contaminant is reasonably capable of for the relevant contaminant. These emission rates are further described in Appendix A.

Regulation 419 regulates the exposure of air contaminants emitted from a source through the use of POIs. POIs are the maximum allowable concentrations, over a particular averaging period, at a receptor. Receptors may be defined as an off-site location where a person may be exposed to an air contaminant.

For each air contaminant, the highest predicted concentration for each averaging period was determined and used to assess against the MOE published Schedule 3 standards. Note that high concentrations resulting from meteorological anomalies were eliminated from consideration for all contaminants. The maximum GLC, as predicted by the AERMOD model, and the MOE Schedule 3 standard for each contaminant are summarized in Table 4. Table 4 shows that the maximum predicted ground level concentrations for each contaminant emitted from the Facility are below the MOE standards.

There is no childcare facility, health care facility, senior's residence, long-term care facility, or education facility located at the Facility. Furthermore, the nearest POI is located greater than five (5) metres from the building on which the points of emission are located. As such, same structure contamination was not considered.

A number of air contaminants are only emitted from the biofilter (S-2) shown on Figure 3A. Therefore, source S-2 was modelled using an emission rate of 1 g/s. The result was a predicted maximum concentration at the property line for each 1 g/s emission of a contaminant. This ratio is known as a Dispersion Factor. For the 1-hour averaging period, the maximum predicted Dispersion Factor was 49.52  $\mu\text{g}/\text{m}^3$ . For the 24-hour averaging period, the maximum predicted Dispersion Factor was 16.10  $\mu\text{g}/\text{m}^3$ . Air contaminants that are emitted from multiple sources were modelled using compound-specific models.

To calculate the maximum concentrations at the property line POI for those air contaminants emitted from source S-2, the point source Dispersion Factor was multiplied by the emission rate for that substance.

The emissions of odour have been modelled using the AERMOD dispersion model, details of this modelling are provided in Appendix C-1.

## **6.1 DISPERSION MODELLING INPUT SUMMARY TABLE**

A description of the way in which the approved dispersion modelling was performed is included in Table 3. This table meets both the requirements of s.26(1)11 and Sections 8

to 17 of O. Reg. 419/05 and follows the format provided in the ESDM Procedure Document.

## **6.2 COORDINATE SYSTEM**

The Universal Transverse Mercator (UTM) coordinate system, as per Section 5.2.2 of the ADMGO, was used to specify source locations, model object sources, buildings and receptors. All coordinates were defined in the North American Datum of 1983 (NAD83).

All sources, buildings, and property line coordinates are provided in Figure 3A.

## **6.3 METEOROLOGY AND LAND USE DATA**

Five years of local meteorological data was obtained from the MOE for use in the assessment. The meteorological data is from the Elora Research Climate Station, and was processed by MOE with land-use classifications for the Facility locale. The meteorology covers the dates from January 1, 2004 to December 31, 2008. The hourly data included many factors which affect the dispersion of air contaminants including wind speed, wind direction, temperature, ceiling height, and atmospheric stability. The maximum hour or averaging period out of 43,800 hours of data would not occur at each grid point simultaneously since the wind can only blow in one direction during one hour. This meteorological data was approved by the MOE in letter dated June 12, 2009 as provided in Appendix C-2.

Subparagraph 10 of s.26(1) of O. Reg. 419/05 requires a description of the local land use conditions if meteorological data described in paragraph 2 of s.13(1) of O.Reg. 419/05 was used.

A land-use zoning plan is provided on Figures 2A and 2B. Figure 2A also illustrates the extents of the site property boundary and provides the zoning of adjacent land uses. The site is located in a predominantly agricultural area. Land surrounding the site is zoned for industrial (M1) and agricultural (A) usage.

As previously noted, there are no sensitive land uses on the property, such as childcare facilities, senior citizen's residences, long-term care, or educational facilities.

## **6.4**      **TERRAIN**

The dispersion models were developed and geographically sited using UTM coordinates to allow for the inclusion of publicly available MOE digital terrain data. Digital Elevation Model (DEM) (7.5 minute format) data from the Elmira terrain tile set was used.

AERMAP utilizes terrain data, or Digital Elevation Model (DEM) data in conjunction with a layout of receptors and sources to height scale factors that can be directly used in AERMOD.

AERMOD captures the essential physics of dispersion in complex terrain though the use of a separate height scale factor for each receptor (USEPA, 1998 – AERMAP UG). The highest scale factor represents the terrain that would dominate flow in the vicinity of the receptor.

## **6.5**      **RECEPTORS**

Receptors were chosen based on recommendations provided in Section 7.1 of the ADMGO, which is in accordance with s.14 of O.Reg. 419/05. A tiered receptor grid was defined starting with a rectangular boundary that encloses all the modelled sources (bounding box). A tiered grid was then defined starting from the edge of the bounding box with a fine resolution, to coarser resolutions further away. All tiered distances were defined relative to the bounding box. The receptor grid used is described as follows:

- 20 m spacing within 200 m of the edge of the bounding box
- 50 m spacing from 200 to 500 m
- 100 m spacing from 500 to 1,000 m
- 200 m spacing from 1,000 to 2,000 m
- 500 m spacing from 2,000 to 5,000 m

A property line ground level receptor grid with 10 m spacing was used to evaluate the maximum property boundary concentration. No receptors were placed inside the Site's property line.

## **6.6 BUILDING DOWNWASH**

The Facility buildings were entered into the model using the USEPA Building Profile Input Program (BPIP-PRIME). The inputs into this pre-processor include the co-ordinates and heights of the buildings and stacks. The BPIP program was executed to evaluate any building cavity downwash effects. Cavity downwash can result in air contaminants being forced to ground level prematurely under certain meteorological conditions. The on-site buildings and structures were modelled with their respective average roof heights.

The PRIME plume rise algorithms include vertical wind shear calculations (important for buoyant releases from short stacks (i.e., stacks at release heights within the recirculation zones of the buildings). The PRIME algorithm also allows for the wind speed deficit factors to improve the accuracy of predicted concentrations within building wake zones that form in the lee of buildings. The BPIP input file is provided in Appendix D.

## **6.7 DEPOSITION**

AERMOD has the ability to account for wet and dry deposition of substances that would reduce ground level concentrations at POIs. However, the deposition algorithm has not been implemented in this assessment and therefore, the predicted POI concentrations are considered to be more conservative.

## **6.8 AVERAGING TIME AND CONVERSIONS**

The shortest time scale that AERMOD predicts is a 1-hour average value. Schedule 3 standards of O.Reg. 419/05 apply to this Facility; many of these standards are based on 1-hour and 24-hour averaging times, which are averaging times that are provided by AERMOD. In cases where a standard has an averaging period less than 1-hour (e.g., 10-minute), a conversion to the appropriate averaging period was completed using the MOE recommended conversion factors, as documented in the ADMGO.

## 6.9 DISPERSION MODELLING OPTIONS

The options used in the AERMOD dispersion model are summarized in the table below.

<i>Modelling Parameter</i>	<i>Description</i>	<i>Used in the Assessment?</i>
DFAULT	Specifies that regulatory default options will be used	Yes
CONC	Specifies that concentration values will be calculated	Yes
DDPLETE	Specifies that dry deposition will be calculated	No
WDPLETE	Specifies that wet deposition will be calculated	No
FLAT	Specifies that the non-default option of assuming flat terrain will be used	No, the model will use elevated terrain as detailed in the AERMAP output
NOSTD	Specifies that the non-default option of no stack-tip downwash will be used	No
AVERTIME	Time averaging periods calculated	1-hr, 24-hr
URBANOPT	Allows model to incorporate the effects of increased surface heating from an urban area on pollutant dispersion under stable atmospheric conditions	No
URBANROUGHNESS	Specifies the urban roughness length (m)	No; not applicable
FLAGPOLE	Specifies that receptor heights above local ground level are allowed on the receptors	No

## 6.10 DISPERSION MODELLING INPUT AND OUTPUT FILES

Appendix D includes the input and output files from the AERMOD model in electronic form.

## 7.0 EMISSION SUMMARY TABLE AND CONCLUSIONS

This section provides the table required by subparagraph 14 of s.26(1) of O. Reg. 419/05 and provides an interpretation of the results as required by the ESDM Procedure Report.

### 7.1 EMISSION SUMMARY TABLE

A POI concentration for each significant contaminant emitted from the Facility was calculated based on the emission rates listed in Table 2 and the output from the approved dispersion model presented in Appendix D. The results are presented in Table 4. This Table follows the format provided in the ESDM Procedure Document. For each source of significant contaminants the following parameters are referenced:

- Contaminant name
- CAS number
- Total facility emission rate
- Approved dispersion model used
- Maximum POI concentration
- Averaging period for the dispersion modelling
- MOE POI limit
- Indication of limiting effect
- Schedule in Regulation 419/05
- The percentage of standard

The POI concentration listed in Table 4 were compared against criteria listed in the publication "Summary of Standards and Guidelines to support Ontario Regulation 419: Air Pollution – Local Air Quality" dated February 2008 and "Jurisdictional Screening Level (JSL) List" dated February 2008.

### 7.2 ASSESSMENT OF CONTAMINANTS WITH NO MOE POI LIMITS

Subparagraph 14 subsection viii of s.26(1) of O. Reg. 419/05 requires an indication of the likelihood, nature, and location of any adverse effect if the contaminant is not listed in any of Schedules 1, 2, and 3.

Two contaminants, Non - Methane Hydrocarbons and Propyl butyrate do not have corresponding criteria limits in the List of MOE POI Limits nor JSLs and are considered to be Contaminants with No Ministry POI Limits.

### 7.3 CONCLUSIONS

This ESDM Report was prepared in accordance with s.26 of O. Reg. 419/05. In addition guidance in the ESDM Procedure Document was followed as appropriate.

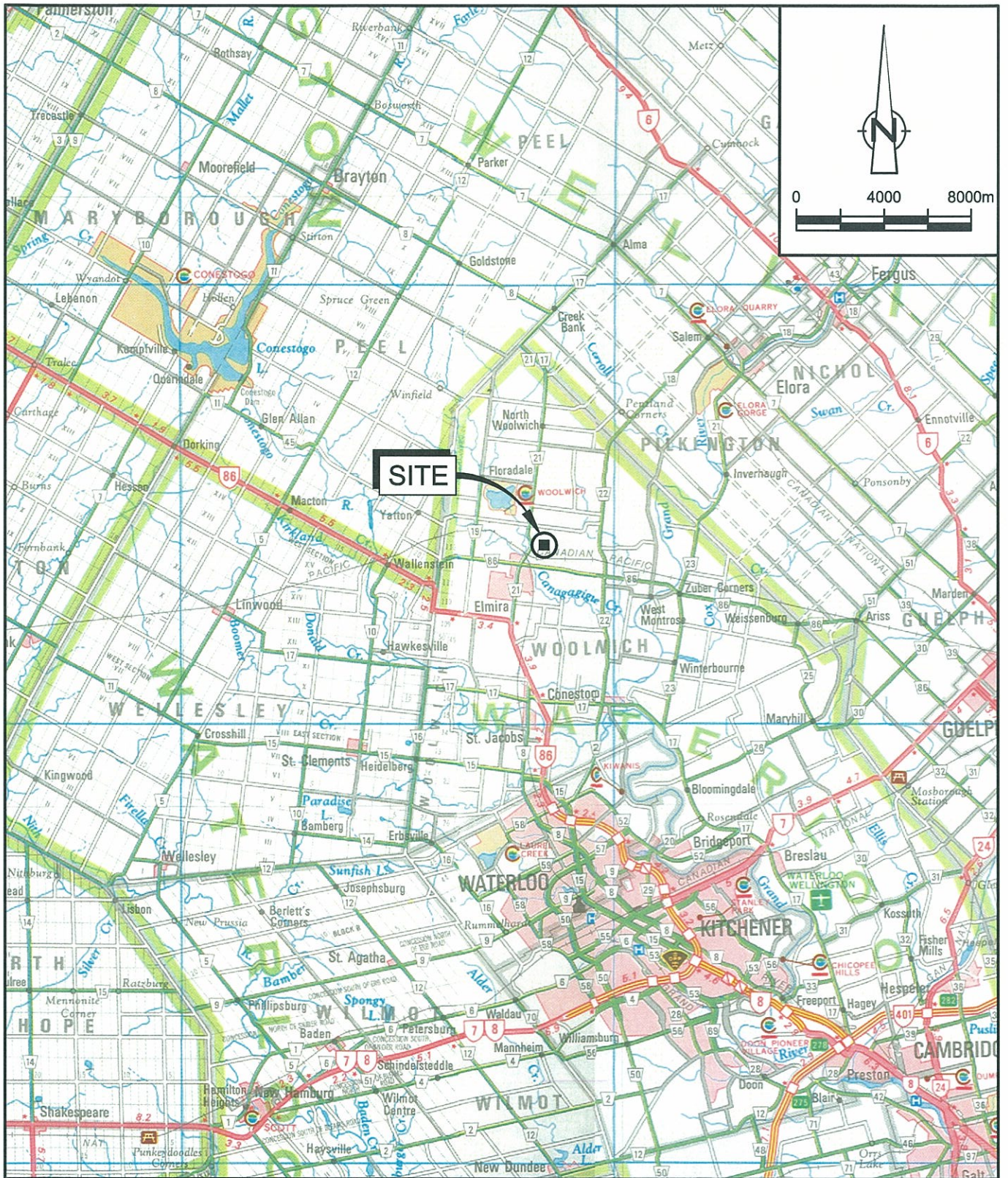
The emission rate estimates for each source of significant contaminants are documented in Table 2. All the emission rates listed in Table 2 have been estimated using the highest data quality available and correspond to the operating scenario where all significant sources are operating simultaneously at their individual maximum rates of production. Therefore the emission rate estimates listed in Table 2 are not likely to be an underestimate of the actual emission rates.

A POI concentration for each significant contaminant emitted from the Facility was calculated based on the calculated emission rates and the output from the AERMOD model, odour was modelled in AERMOD; the results are presented in Table 4.

The POI concentrations listed in Table 4 were compared against criteria listed in the "Summary of Standards and Guidelines to support Ontario Regulation 419: Air Pollution - Local Air Quality" and "Jurisdictional Screening Level (JSL) List" dated February 2008.

Of all the contaminants listed in Table 4 that have limits in the list of MOE POI Limits or JSLs all the predicted POI concentrations are below the corresponding limits.

This ESDM Report demonstrates that the Facility can operate in compliance with O. Reg. 419/05.



SOURCE: RAND MCNALLY ROAD ATLAS

figure 1

**SITE LOCATION PLAN**  
**EMISSIONS SUMMARY AND DISPERSION MODELLING REPORT**  
**WOOLWICH BIO-EN FACILITY**  
*Elmira, Ontario*



MAP SYMBOL CLASSIFICATION

- A AGRICULTURAL
- R-1 RESIDENTIAL - SETTLEMENT
- R-4 RESIDENTIAL - MIXED MEDIUM DENSITY
- R-6 RESIDENTIAL - COMMERCIAL
- C-1 CORE COMMERCIAL - URBAN
- M-1 GENERAL INDUSTRIAL - DRY
- O-1 OPEN SPACE
- P INSTITUTIONAL

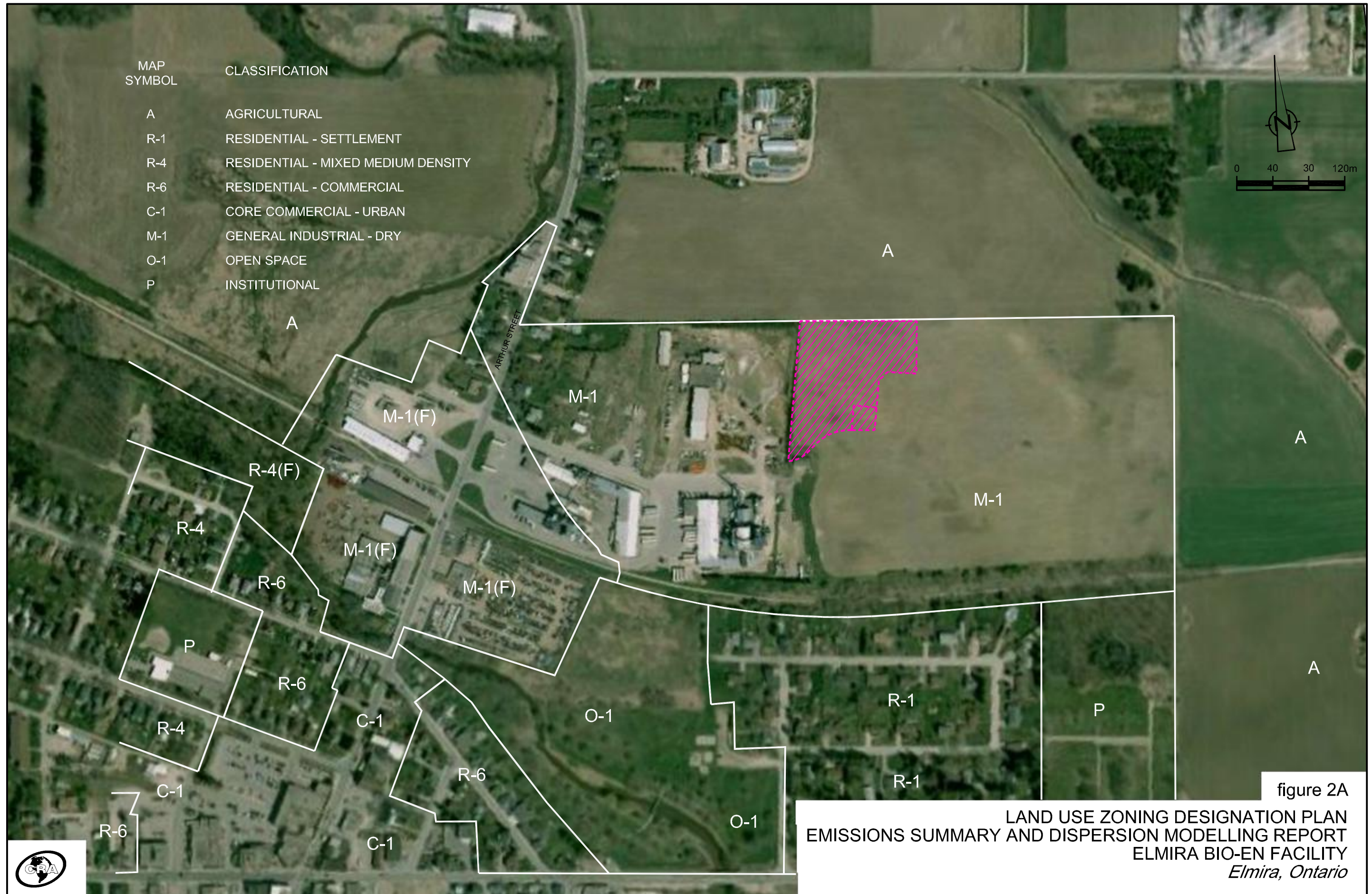
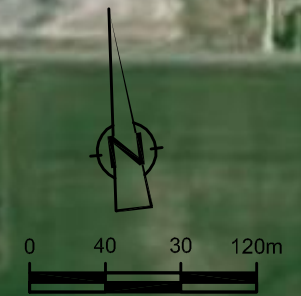


figure 2A

LAND USE ZONING DESIGNATION PLAN  
EMISSIONS SUMMARY AND DISPERSION MODELLING REPORT  
ELMIRA BIO-EN FACILITY  
Elmira, Ontario



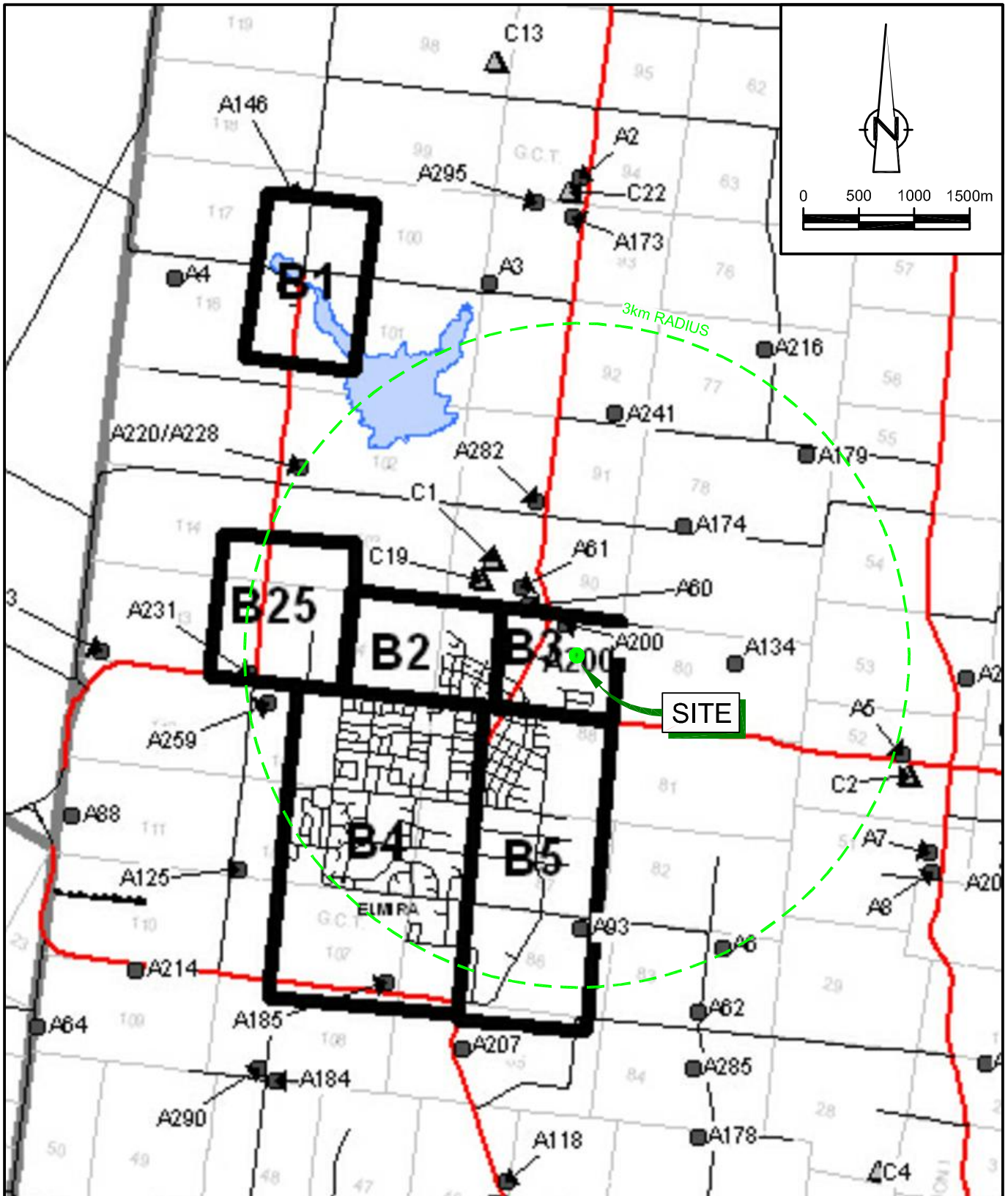


figure 2B

LAND USE ZONING DESIGNATION PLAN  
 EMISSIONS SUMMARY AND DISPERSION MODELLING REPORT  
 WOOLWICH BIO-EN FACILITY  
 Elmira, Ontario



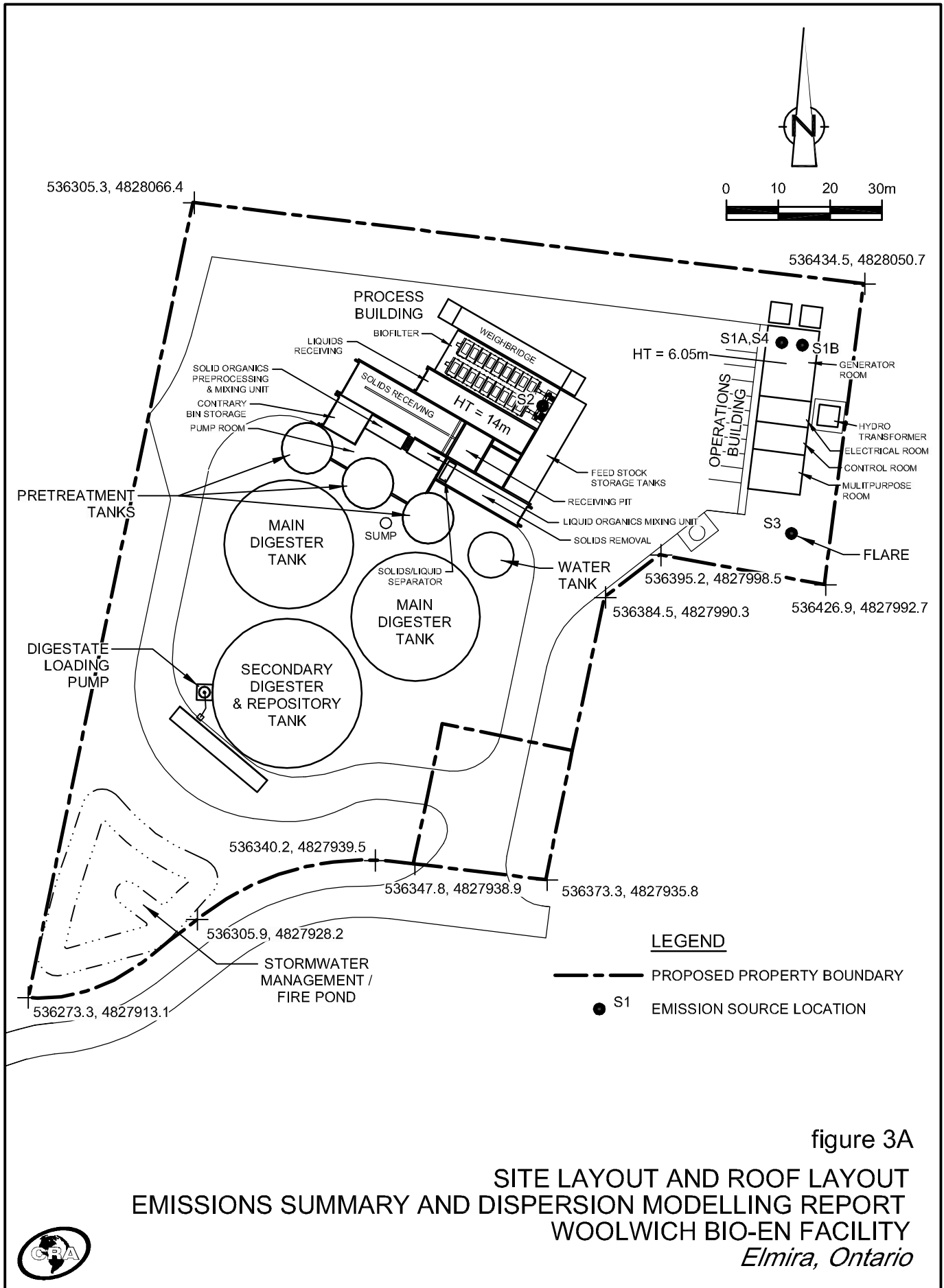
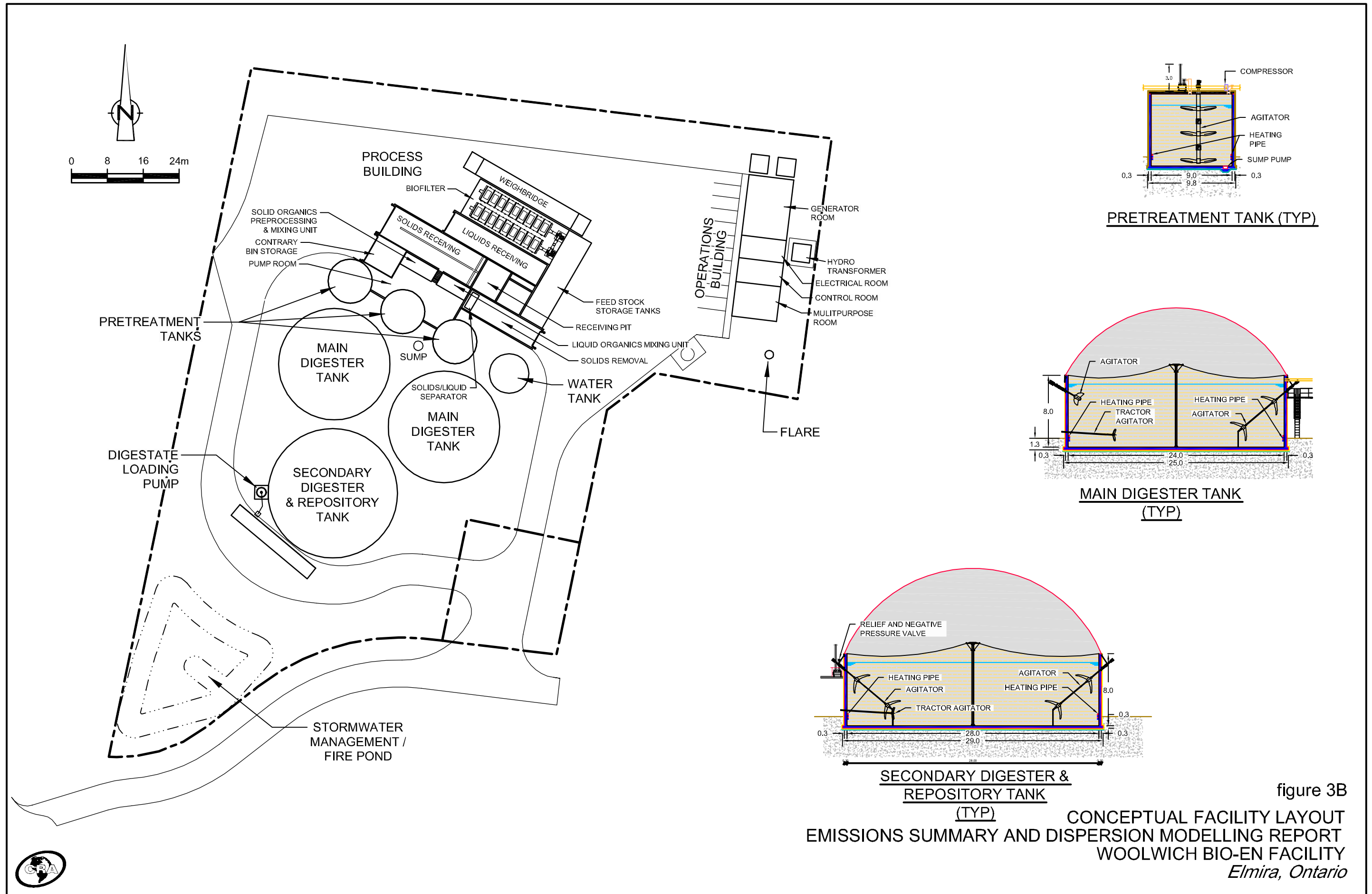
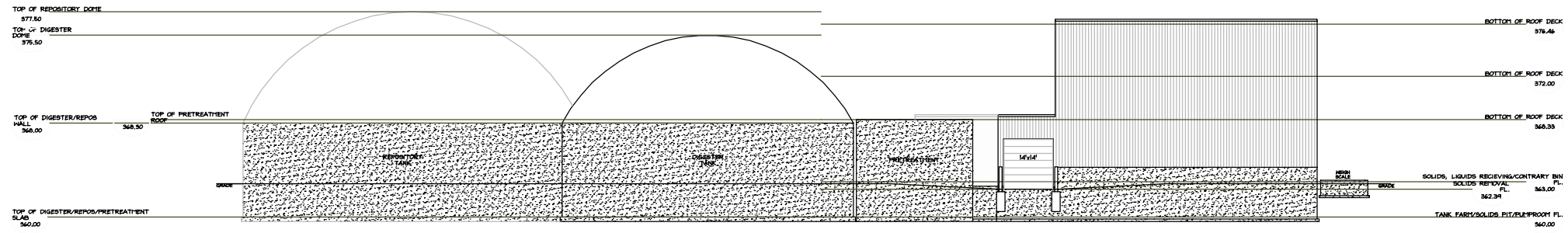


figure 3A

SITE LAYOUT AND ROOF LAYOUT  
 EMISSIONS SUMMARY AND DISPERSION MODELLING REPORT  
 WOOLWICH BIO-EN FACILITY  
 Elmira, Ontario

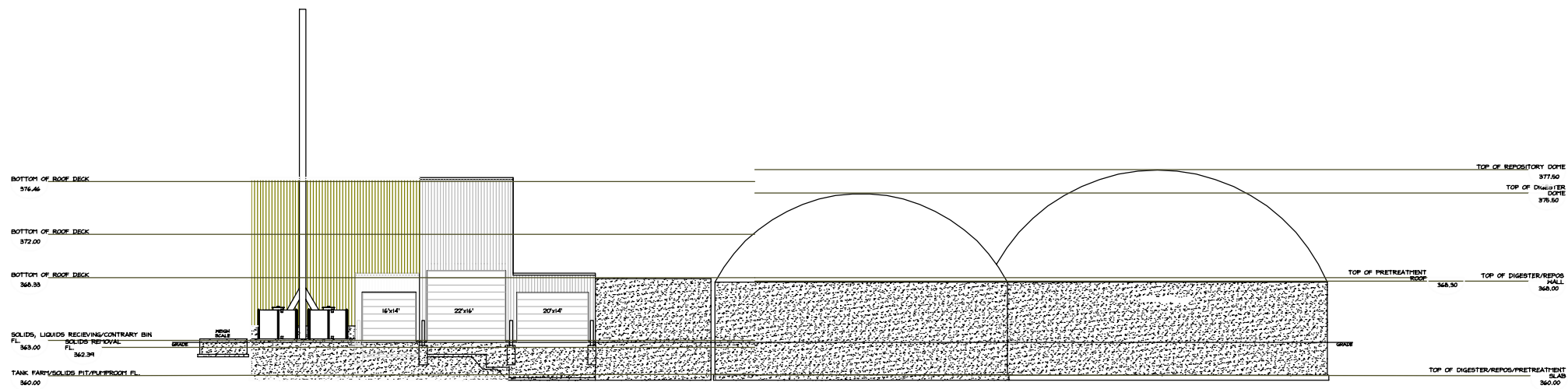






**EAST ELEVATION**

SCALE = 1:500

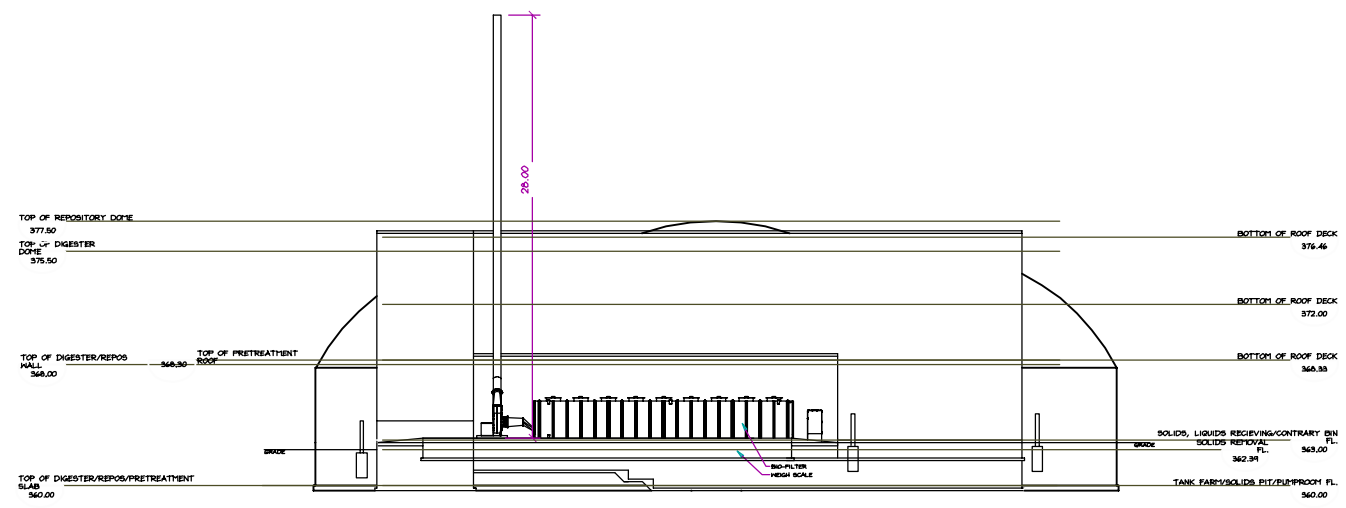


**WEST ELEVATION**

SCALE = 1:500

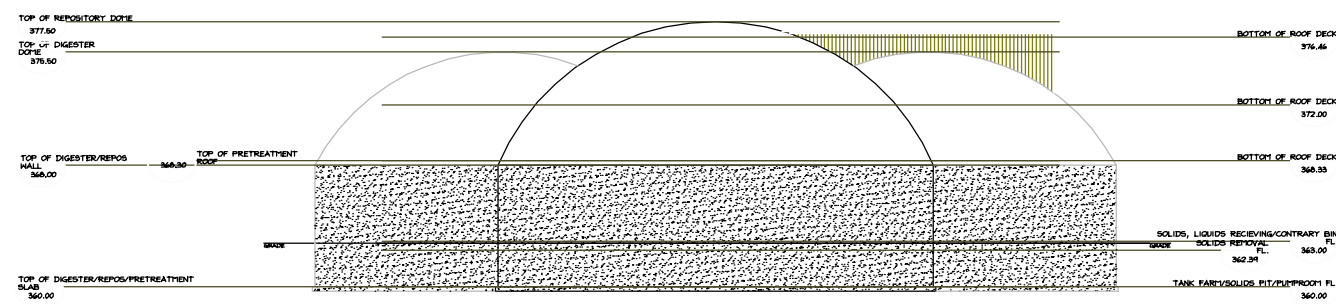
figure 3C  
 EAST AND WEST BUILDING ELEVATIONS  
 EMISSIONS SUMMARY AND DISPERSION MODELLING REPORT  
 WOOLWICH BIO-EN FACILITY  
 Elmira, Ontario





**NORTH ELEVATION**

SCALE = 1:500



**SOUTH ELEVATION**

SCALE = 1:500

figure 3D

NORTH AND SOUTH BUILDING ELEVATIONS  
 EMISSIONS SUMMARY AND DISPERSION MODELLING REPORT  
 WOOLWICH BIO-EN FACILITY  
 Elmira, Ontario



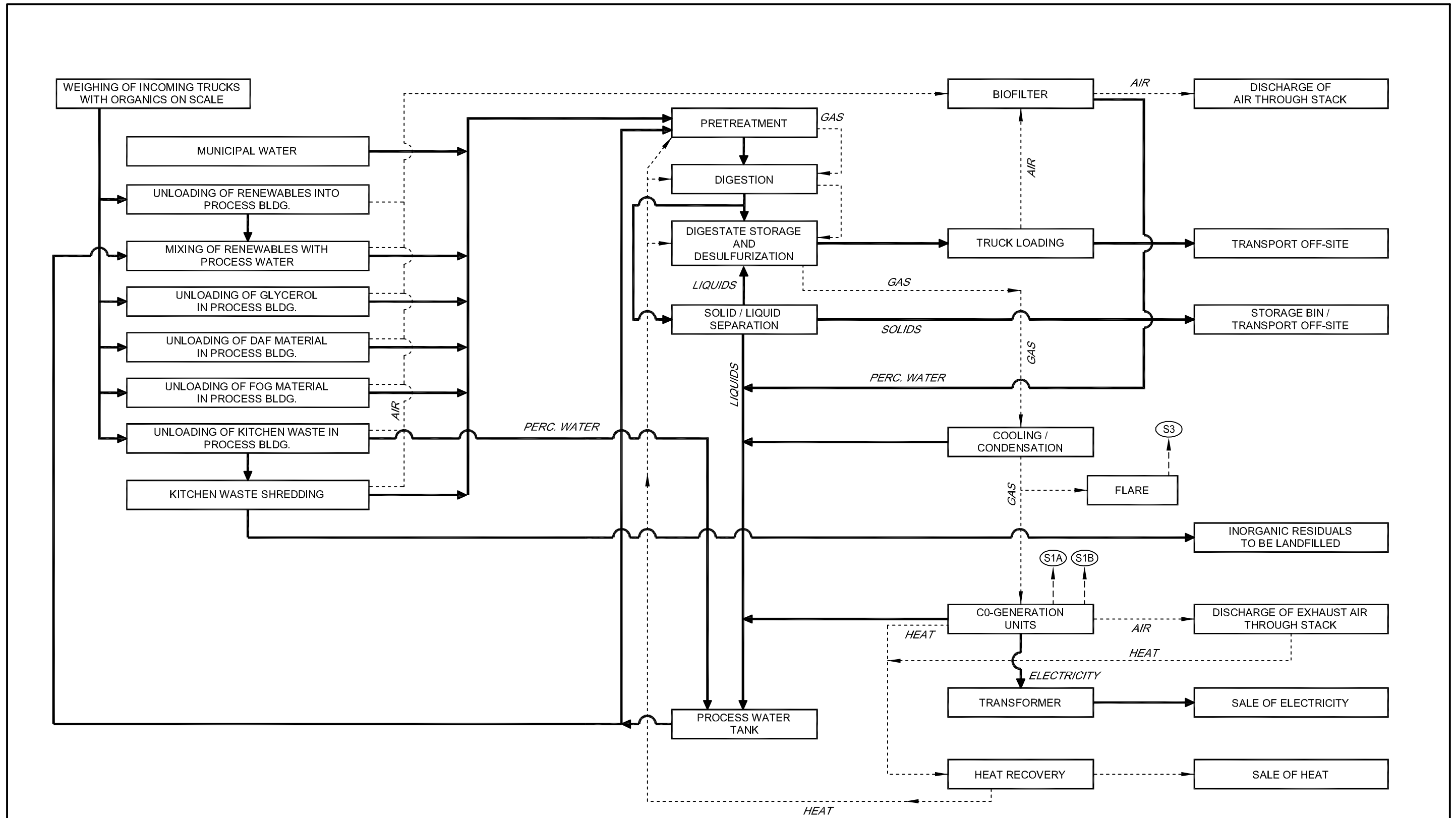


figure 4

PROCESS FLOW DIAGRAM  
 EMISSIONS SUMMARY AND DISPERSION MODELLING REPORT  
 WOOLWICH BIO-EN FACILITY  
 Elmira, Ontario



TABLE 1

SOURCES AND CONTAMINANTS IDENTIFICATION TABLE  
 ELMIRA BIOGAS PLANT  
 WOOLWICH BIO-EN INC.

<i>Source Information</i>		<i>Location</i>	<i>Expected Contaminants</i>	<i>Significant (Y/N)</i>	<i>Rationale</i>
<i>Source ID</i>	<i>Source Description</i>				
S-1a and S-1b	Digester Gas Engines	Operations Building	Products of Combustion Odour	Y N	<5% of facility total, see ESDM Procedure Document
S-2	Biofilter	Adjacent to Process Building	VOCs Odour Total Reduced Sulfur	Y Y Y	
S-3	Flare	Adjacent to Operations Building	Products of Combustion Odour	Y Y	
S-4	Startup Boiler	Operations Building	Products of Combustion	N	Listed in Table B-3 of ESDM Procedure Document
	Roads, Parking Lot		Dust	N	Not listed in Table 7-2 or 7-3 of Section 7.4 of the ESDM Procedure Document

**TABLE 2**  
**SOURCE SUMMARY TABLE**  
**ELMIRA BIOGAS PLANT**  
**WOOLWICH BIO-EN INC.**

Contaminant	CAS No.	Source Data								Emission Data				
		Source ID	Source Description	Stack Flow Rate (Am <sup>3</sup> /s)	Stack Exit Gas Temperature (C)	Stack Inner Diameter (m)	Stack Height Above Grade (m)	Stack Height Above Roof (m)	Source Coordinates (x,y) (UTM) (m)	Maximum Emission Rate (g/s)or (OU/s)	Averaging Period (hours)	Emission Estimation Technique	Emission Data Quality	% of Overall Emissions (%)
Carbon Monoxide	630-08-0	S-1a	Digester Gas Engine -1	4.36	470	0.3	12	5.95	536,419.21, 4,828,039.51	2.62E+00	0.5	EC	Above Average	32%
		S-1b	Digester Gas Engine -2	4.36	470	0.3	12	5.95	536,422.88, 4,828,039.07	2.62E+00	0.5	EC	Above Average	32%
		S-3	Flare	4.17	850	0.5	8	NA	536,420.67, 4,828,002.55	3.00E+00	0.5	EF	Average	36%
Nitrogen Oxides	10102-44-0	S-1a	Digester Gas Engine -1	4.36	470	0.3	12	5.95	536,419.21, 4,828,039.51	8.74E-01	1, 24	EC	Above Average	46%
		S-1b	Digester Gas Engine -2	4.36	470	0.3	12	5.95	536,422.88, 4,828,039.07	8.74E-01	1, 24	EC	Above Average	46%
		S-3	Flare	4.17	850	0.5	8	NA	536,420.67, 4,828,002.55	1.63E-01	1, 24	EF	Average	9%
NMHC	NA	S-1a	Digester Gas Engine -1	4.36	470	0.3	12	5.95	536,419.21, 4,828,039.51	3.41E-01	24	EC	Above Average	50%
		S-1b	Digester Gas Engine -2	4.36	470	0.3	12	5.95	536,422.88, 4,828,039.07	3.41E-01	24	EC	Above Average	50%
Particulate	NA	S-1a	Digester Gas Engine -1	4.36	470	0.3	12	5.95	536,419.21, 4,828,039.51	9.62E-02	24	EC	Above Average	37%
		S-1b	Digester Gas Engine -2	4.36	470	0.3	12	5.95	536,422.88, 4,828,039.07	9.62E-02	24	EC	Above Average	37%
		S-3	Flare	4.17	850	0.5	8	NA	536,420.67, 4,828,002.55	6.75E-02	24	EF	Uncertain	26%
Odour	NA	S-2	Biofilter	5.56	Ambient (1)	0.54	28	14	536,372.73, 4,828,027.10	1.11E+04	10 min	EF	Average	93%
		S-4	Flare	4.17	850	0.5	8	NA	536,420.67, 4,828,002.55	8.33E+02	10 min	EF	Average	7%
Ammonia	7664-41-7	S-2	Biofilter	5.56	Ambient (1)	0.54	28	14	536,372.73, 4,828,027.10	4.84E-02	24	EC	Average	100%
Trimethylamine	75-50-3	S-2	Biofilter	5.56	Ambient (1)	0.54	28	14	536,372.73, 4,828,027.10	2.08E-03	1	EC	Average	100%
Triethylamine	121-44-8	S-2	Biofilter	5.56	Ambient (1)	0.54	28	14	536,372.73, 4,828,027.10	1.94E-03	24	EC	Average	100%
Hydrogen Sulfide	7783-06-4	S-2	Biofilter	5.56	Ambient (1)	0.54	28	14	536,372.73, 4,828,027.10	3.87E-03	10 min, 24	EC	Average	100%
Methyl Mercaptan	74-93-1	S-2	Biofilter	5.56	Ambient (1)	0.54	28	14	536,372.73, 4,828,027.10	1.10E-03	10 min	EC	Average	100%
Ethyl Mercaptan	75-08-1	S-2	Biofilter	5.56	Ambient (1)	0.54	28	14	536,372.73, 4,828,027.10	2.56E-03	10 min	EC	Average	100%
Dimethyl Sulphide	77-78-1	S-2	Biofilter	5.56	Ambient (1)	0.54	28	14	536,372.73, 4,828,027.10	1.00E-02	NA	EC	Average	100%
Dimethyl disulphide	624-92-0	S-2	Biofilter	5.56	Ambient (1)	0.54	28	14	536,372.73, 4,828,027.10	5.99E-03	10 min	EC	Average	100%
Butanol	71-36-3	S-2	Biofilter	5.56	Ambient (1)	0.54	28	14	536,372.73, 4,828,027.10	1.67E-02	10min,24	EC	Average	100%
Alpha-piene	80-56-8	S-2	Biofilter	5.56	Ambient (1)	0.54	28	14	536,372.73, 4,828,027.10	1.24E-02	24	EC	Average	100%
Limonene	5989-27-5	S-2	Biofilter	5.56	Ambient (1)	0.54	28	14	536,372.73, 4,828,027.10	2.33E-02	24	EC	Average	100%
Acetic Acid	64-19-7	S-2	Biofilter	5.56	Ambient (1)	0.54	28	14	536,372.73, 4,828,027.10	8.33E-03	24	EC	Average	100%
Oleic Acid	112-80-1	S-2	Biofilter	5.56	Ambient (1)	0.54	28	14	536,372.73, 4,828,027.10	9.63E-03	1	EC	Average	100%

**TABLE 2**  
**SOURCE SUMMARY TABLE**  
**ELMIRA BIOGAS PLANT**  
**WOOLWICH BIO-EN INC.**

Contaminant	CAS No.	Source ID	Source Description	Source Data					Emission Data					
				Stack Flow Rate (Am <sup>3</sup> /s)	Stack Exit Gas Temperature (C)	Stack Inner Diameter (m)	Stack Height Above Grade (m)	Stack Height Above Roof (m)	Source Coordinates (x,y) (UTM) (m)	Maximum Emission Rate (g/s)or (OU/s)	Averaging Period (hours)	Emission Estimation Technique	Emission Data Quality	% of Overall Emissions (%)
Butyric Acid	107-92-6	S-2	Biofilter	5.56	Ambient (1)	0.54	28	14	536,372.73, 4,828,027.10	3.00E-03	24	EC	Average	100%
Cyclopentanol	96-41-3	S-2	Biofilter	5.56	Ambient (1)	0.54	28	14	536,372.73, 4,828,027.10	1.78E-02	24	EC	Average	100%
Propyl acetate	109-60-4	S-2	Biofilter	5.56	Ambient (1)	0.54	28	14	536,372.73, 4,828,027.10	1.11E-02	24	EC	Average	100%
Propyl butyrate	105-66-8	S-2	Biofilter	5.56	Ambient (1)	0.54	28	14	536,372.73, 4,828,027.10	1.78E-02	NA	EC	Average	100%
Pentanone	107-87-9	S-2	Biofilter	5.56	Ambient (1)	0.54	28	14	536,372.73, 4,828,027.10	4.44E-03	24	EC	Average	100%
Me-isobutyl ketone	108-10-1	S-2	Biofilter	5.56	Ambient (1)	0.54	28	14	536,372.73, 4,828,027.10	2.22E-02	24	EC	Average	100%
Nonanal	124-19-6	S-2	Biofilter	5.56	Ambient (1)	0.54	28	14	536,372.73, 4,828,027.10	1.11E-02	24	EC	Average	100%
Total Reduced Sulfur	NA	S-2	Biofilter	5.56	Ambient (1)	0.54	28	14	536,372.73, 4,828,027.10	2.35E-02	10min, 24	EC	Average	100%

Notes:

EF-Emission Factor

(1) Temperature was assumed to be 14 degrees C in order to be conservative. It is expected that during winter months, the exit temperature of the biofilter will be between 21 and 25 degrees C.

**TABLE 3**

**DISPERSION MODELLING INPUT SUMMARY TABLE  
ELMIRA BIOGAS PLANT  
WOOLWICH BIO-EN INC.**

<i>Relevant Section of the Regulation</i>	<i>Section Title</i>	<i>Description of How the Approved Dispersion Model was Used</i>
Section 8	Negligible Sources	Sources and contaminants that were considered negligible were explicitly identified, and therefore were not modelled, in accordance with s.8 of O. Reg. 419. See Table 1 - Sources and Contaminants Identification Table and Appendix B of the ESDM Report for more information
Section 9	Same Structure Contamination	Not applicable as Bio-En is the only tenant occupying the building, and does not have a child care facility, health care facility, senior's residence, long-term care facility or an educational facility located at the Facility
Section 10	Operating Conditions	All equipment was assumed to be operating at the maximum production rates at the same time. See Section 4.1 and Appendix A of the ESDM Report.
Section 11	Source of Contaminant Emission Rate	The emission rate for each significant contaminant emitted from a significant source was estimated, the methodology for the calculation is documented in Table 2 - Source Summary Table. See Section 4.1 and Section 4.2 and Appendix A of the ESDM Report for more information.
Section 12	Combined Effect of Assumptions for Operating Conditions and Emission Rates	The operating conditions were estimated in accordance with s.10(1) and 1 and S.11 (1) 1 of O. Reg. 419 and are therefore considered to result in the highest concentrations at POI that the Facility is capable of for the contaminants emitted. See Section 4.1 and Section 4.2 of the ESDM Report.
Section 13	Meteorological Conditions	MOE localized meteorological data obtained from Elora, Ontario was used for the AERMOD model.
Section 14	Area of Modelling Coverage	Completed in compliance with MOE Modelling Guidance
Section 15	Stack Height	Documented in accordance with MOE Modelling Guidance
Section 16	Terrain Data	MOE available data sets were used.
Section 17	Averaging Periods	The Averaging Periods summarized in Table 2 were used.

TABLE 4

**EMISSION SUMMARY TABLE  
ELMIRA BIOGAS PLANT  
WOOLWICH BIO-EN INC.**

<i>Contaminant</i>	<i>CAS No.</i>	<i>Total Facility Emission Rate</i>	<i>Air Dispersion Model Used</i>	<i>Max. Ground Level Conc.</i>	<i>Averaging Period</i>	<i>MOE POI Limit</i>	<i>Limiting Effect</i>	<i>Regulation Schedule #</i>	<i>Percentage of MOE POI Limit</i>
		<i>(g/s) or (OU/s)</i>		<i>ug/m3 / (OU) (1)</i>	<i>(hours)</i>	<i>(ug/m3)</i>			
Carbon Monoxide	630-08-0	8.25	AERMOD	1.72E+03	0.5	6000	Health	3	28.61%
Nitrogen Oxides	10102-44-0	1.91	AERMOD	2.57E+02	1	400	Health	3	64.14%
		1.91	AERMOD	1.50E+02	24	200	Health	3	74.98%
NMHC	NA	0.68	AERMOD	2.76E+02	1	NA	NA	NA	NA
				2.13E+02	24	NA	NA	NA	NA
Particulate Matter	NA	0.26	AERMOD	2.69E+01	24	120	Visibility	3	22.38%
Odour	NA	1.19E+04	AERMOD	0.46 See Modelling Memorandum	10 min	1 OU	Odour	G	NA
Ammonia	7664-41-7	4.84E-02	AERMOD	7.79E-01	24	100	Health	3	<1%
Trimethylamine	75-50-3	2.08E-03	AERMOD	1.03E-01	1	0.5	Odour	3 (G)	20.63%
Triethylamine	121-44-8	1.94E-03	AERMOD	3.13E-02	24	7	NA	JSL	<1%
Hydrogen Sulfide	7783-06-4	3.87E-03	AERMOD	INCLUDED IN TRS					
Methyl Mercaptan	74-93-1	1.10E-03	AERMOD	INCLUDED IN TRS					
Ethyl Mercaptan	75-08-1	2.56E-03	AERMOD	INCLUDED IN TRS					
Dimethyl Sulphide	77-78-1	1.00E-02	AERMOD	INCLUDED IN TRS					
Dimethyl disulphide	624-92-0	5.99E-03	AERMOD	INCLUDED IN TRS					
Total Reduced Sulfur (2)	NA	2.35E-02	AERMOD	3.79E-01	24	7	Health	3	5.42%
				1.92E+00	10 min	13	Odour	3	14.80%



APPENDIX A

SUPPORTING CALCULATIONS

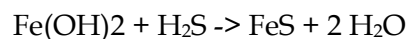
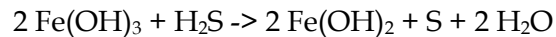
**APPENDIX A**  
**SUPPORTING CALCULATIONS**  
**WOOLWICH BIO-EN INC.**

EMISSION CALCULATIONS

Source S-1a and S-1b: BioGas Combustion Sources (Cogeneration Units)

The Facility will produce heat and power using two 1426kW Jenbacher Digester Gas Engines (Combined Heat and Power (CHP) units). The biogas obtained from the digesters and stored in the gas storage membranes is utilized by the CHP units and converted to thermal and electrical energy. The electricity produced will be fed to the power grid and the thermal energy will be captured with a heat exchanger to produce usable heat. A portion of the sulphur is removed from the biogas prior to combustion in the engines.

The hydrogen sulfide concentration must be reduced to less than 200 parts per million (ppm) using a chemical-physical process involving air injection and the addition of ferric-hydroxide or another suitable chemical as needed before being fed into the internal combustion engine to minimize damage to the engine. The oxygen content is maintained between 0 and 2 percent by volume. Excess moisture in the biogas is also damaging to the engines. The process occurs in the tanks themselves (hydrolysis and digester tanks) by controlling the oxygen content in the gas and by adding the ferric-hydroxide to the liquid. The ferric-hydroxide reacts with sulphur compounds to form iron-sulfide (FeS). The ferric-hydroxide reacts with H<sub>2</sub>S and binds the sulphur in a form that is not available to be made back into H<sub>2</sub>S, thereby reducing the amount in the biogas. The following chemical reaction takes place:



In addition, by controlling the oxygen content in the gas storage/top of the tank promotes sulphide-oxidizing bugs, which again reduces the amount of H<sub>2</sub>S.

The moisture content of the biogas will be reduced prior to combustion by lowering the temperature of the biogas prior to combustion. The emissions estimated from these sources are provided in Table A.2A.

**Methodology:** Mass Balance (MB)

The emissions from the CHP units have been estimated using emissions and exhaust information provided by the engine manufacturer and are provided in Appendix E.

**Sample Calculation:** Nitrogen Oxides (S-1a)

ER = Contaminant Concentration × Normalized Flowrate

$$\text{ER} \left( \frac{\text{g}}{\text{s}} \right) = 500 \frac{\text{mg}}{\text{Nm}^3} \times 6,295 \frac{\text{Nm}^3}{\text{hr}} \times \frac{\text{hr}}{3600\text{s}} \times \frac{\text{g}}{1000\text{mg}}$$
$$\text{ER} \left( \frac{\text{g}}{\text{s}} \right) = 8.74 \times 10^{-1} \frac{\text{g}}{\text{s}}$$

**Data Quality:** Above Average

Section 8.3.2 of the ESDM Procedure Document titled "Above-Average Data Quality" Emission Estimating Techniques includes mass balance techniques that accounts for 100 percent (%) of the material balance.

**Operating Condition, Individual Maximum Rates of Production:**

The emission rate calculations for these sources are based on the engines being fired at their full capacity. Based on information provided in the manufacturer's specification, CO emissions will be lower at start-up than at full operating capacity. Based on information from the manufacturer, the NO<sub>x</sub> levels will be maintained below the guaranteed level at full or partial load. These engines may be fuelled with Natural Gas during start-up of the Facility. The Engine supplier has confirmed that the emissions of this piece of equipment when operated using Natural Gas will be less than or equal to emissions generated when the equipment is operated using biogas, with the exception of NO<sub>x</sub>, which has been calculated using the natural gas emission rate.

**Source S4:** Start-up Boiler

Anaerobic Digestion requires the fermentation process to operate at approximately 40°C for optimal gas production. Once the plant is in operation, the heat required to bring the feedstock to fermentation temperature is supplied by the heat generated by the engines. On plant start-up, there is no gas to run the engines, so start-up heat (start-up boiler) must be supplied until there is sufficient gas production to run the engines. At this

point, the system would be self-sustaining with no further need for the start-up boiler. This start-up period ranges from 4-8 weeks. The emissions estimated from the start-up boiler are provided in Table A-2B.

**Methodology:** Emission Factor (EF)

The USEPA AP-42 emission factors from Chapter 1.4 "Natural Gas Combustion" for low-NO<sub>x</sub> small natural gas-fired boilers <100 MMBtu have been used for this source. The AP-42 emission factors are expressed in units of lb/10<sup>6</sup> scf and a conversion factor of 1,020 to convert to lb/MMBtu is provided. These emission factors have data quality ratings of "Above Average" for carbon monoxide, "Average" for VOC, and "Uncertain" for NO<sub>x</sub> and particulate matter. The emissions from the start-up boiler have been calculated on the basis of 2.4 MMBtu/hr thermal input.

**Sample Calculation:** Nitrogen Oxides (S-4)

$$ER = EF \times \text{MMBtu} / \text{hr}$$

$$ER = 50 \frac{\text{lb}}{10^6 \text{ scf}} \times \frac{10^6 \text{ scf}}{1020 \text{ MMBtu}} \times 2.400 \frac{\text{MMBtu}}{\text{hr}} \times \frac{1 \text{ hour}}{3600 \text{ s}} \times \frac{453.59237 \text{ g}}{\text{lb}}$$

$$ER = 1.48 \cdot 10^{-2} \text{ g/s}$$

**Data Quality:** Above Average for carbon monoxide, Average for VOC, and Uncertain for NO<sub>x</sub> and particulate matter

Section 8.3.2 of the ESDM Procedure Document titled "Above-Average Data Quality" Emission Estimating Techniques includes USEPA AP-42 emission factors with an emission factor quality rating of A or B.

Section 8.3.3 of the ESDM Procedure Document titled "Average Data Quality" Emission Estimating Techniques includes USEPA AP-42 emission factors with an emission factor quality rating of C.

Section 8.3.3 of the ESDM Procedure Document titled "Marginal or Uncertain Data Quality" Emission Estimating Techniques includes USEPA AP-42 emission factors with an emission factor quality rating of D or E.

## **Operating Condition, Individual Maximum Rates of Production:**

The emission rate calculations for this source are based on the boiler firing at its full capacity, 2.4 MMBtu/hr.

### **Source 2: Biofilter**

The biofilter is used to treat air from the process building and storage tanks that may contain potentially odorous emissions originating from organics storage or other operations in the solids and liquid organics unloading areas, processing areas and digestate loading. The air from inside the process building will be vented to the biofilter. The air is treated by a microbial inoculated mineral filter medium. The humidity of the biofilter will be regulated by a water sprinkler system. According to the biofilter manufacturer, odours are guaranteed to be reduced by 85% using this filter as indicated in Section 3 of the manufacturer's specification provided in Appendix E. The odour concentration has been estimated based on an odour inlet concentration to the biofilter of 10,000 OU and an odour removal efficiency of 80%, which is conservative as the manufacturer states that a higher efficiency is guaranteed. The biofilter will have an empty bed residence time of approximately 34.3s. The biofilter is configured to provide redundancy to allow maintenance and servicing on one module while still providing treatment capacity on remaining modules by maintaining an inventory of parts, altering the flow rate to the biofilter, or by using the air as combustion intake air for the engines.

This odour inlet loading has been estimated based on discussions with BIOREM and CRA's experience with organic processing facilities. 10,000 OU/m<sup>3</sup> is a reasonable worst-case inlet concentration to the biofilter from an AD facility since most AD facilities look for fresh organic waste, which has not had the opportunity to decompose to a high degree. Bio-En wishes to obtain as fresh organic material as possible, as this feedstock has the greatest biogas potential. The data presented in Appendix E shows a range of odour levels at the inlet of a biofilter from a rendering and municipal source separated organics facilities. Considering the material that Bio-En will receive is fresher and is not significantly processed in the Process Building, 10,000 OU/m<sup>3</sup> is a reasonable worst case. The flow rate of exhaust to the biofilter has been estimated based on the number of air changes in the building and the number of tanks that may be filled in an hour. Information pertaining to the flow rate of air to the biofilter is provided in Section 4.6.2 of the Odour Study Report. Additional information on the inlet odour loading of the air is provided in Appendix E.

Emissions of contaminants treated by the biofilter are based on contaminant concentrations provided by senior BIOREM process engineers based on some actual

sampling (e.g., hydrogen sulphide), literature presented at conferences and professional estimates. To estimate conservative emissions from this source, the maximum of the concentration ranges measured has been used. Additionally, BIOREM-provided destruction efficiencies for the contaminants are listed in Table A.3. The Total Reduced Sulphur (TRS) emissions were calculated in accordance with MOE Guidance as the aggregate emission of hydrogen sulphide, mercaptans, dimethyl sulfide, and dimethyl disulphide. Equipment specifications are provided in Appendix E.

**Methodology:** Engineering Calculation (EC)

The estimated maximum emission rates of contaminants and odour from the biofilter were calculated based on engineering estimates.

**Sample Calculation:** Ammonia (g/s)

$$\text{Concentration} \left( \frac{\text{mg}}{\text{m}^3} \right) = \frac{25 \text{ ppm} \times 17.03 \frac{\text{g}}{\text{mol}}}{24.45} = 17.4 \frac{\text{mg}}{\text{m}^3}$$

$$ER \left( \frac{\text{g}}{\text{s}} \right) = 5.56 \frac{\text{m}^3}{\text{s}} \times \frac{17.4 \text{ mg}}{\text{m}^3} \times (100\% - 50\%) \times \frac{\text{g}}{1000 \text{ mg}}$$

$$ER \left( \frac{\text{g}}{\text{s}} \right) = 4.84 \times 10^{-2} \frac{\text{g}}{\text{s}}$$

**Sample Calculation:** Total Reduced Sulphur (g/s)

$$ER_{\text{TRS}} = ER_{\text{H}_2\text{S}} + ER_{\text{METHYL MERCAPTAN}} + ER_{\text{ETHYL MERCAPTAN}} + ER_{\text{DIMETHYLSULFIDE}} + ER_{\text{DIMETHYLDISULFIDE}}$$

$$ER_{\text{TRS}} \left( \frac{\text{g}}{\text{s}} \right) = 3.87 \times 10^{-3} + 1.10 \times 10^{-3} + 2.56 \times 10^{-3} + 1.00 \times 10^{-2} + 5.99 \times 10^{-3}$$

$$ER_{\text{TRS}} \left( \frac{\text{g}}{\text{s}} \right) = 2.35 \times 10^{-2} \frac{\text{g}}{\text{s}}$$

**Sample Calculation:** Odour (OU/s)

$$ER \left( \frac{\text{OU}}{\text{s}} \right) = 5.56 \frac{\text{m}^3}{\text{s}} \times 10,000 \text{ OU} \times (100\% - 80\%)$$

$$ER \left( \frac{\text{OU}}{\text{s}} \right) = 1.11 \times 10^4 \frac{\text{OU}}{\text{s}}$$

**Data Quality:** Average

Section 8.3.3 of the ESDM Procedure Document titled "Average Data Quality" Emission Estimating Techniques, includes engineering calculations and judgement. Emission estimates derived from fundamental scientific and engineering principles, and/or relevant empirical data can be considered average data quality.

**Operating Condition, Individual Maximum Rates of Production:**

The emission of odour and contaminants from the biofilter is based on the maximum exhaust flow rate of the biofilter and the maximum concentration provided in Appendix E for each contaminant.

**Source S-3:** Flare

A candlestick-type gas flare will be operated at the Facility designed to accommodate 100% of the generated gas if the CHP units are not operational or if the gas production exceeds the CHP capacity. Manufacturer's specifications are provided in Appendix E.

**Methodology:** Emission Factor (EF)

The composition of biogas from anaerobic digestion is similar to that of landfill gas; therefore, the USEPA AP-42 emission factors for landfill gas flares in Chapter 2.4 "Solid Waste Management" have been used to estimate the emissions from this source. The AP-42 Chapter 2.4 emission factors are expressed in the units of kilogram per million cubic meters of methane. It has been estimated that the methane content of the biogas is 60% for the purposes of these emission estimate calculations. These AP-42 emission factors have data quality ratings of "Average" and "Uncertain". The emissions from the flare have been calculated using these emission factors and a maximum biogas flaring rate of 1,500 m<sup>3</sup>/hr as per the flare design. Emission estimates from this source are provided in Table A.4.

**Sample Calculation:** Nitrogen Oxides

$$ER\left(\frac{g}{s}\right) = \frac{1,500 Nm^3_{biogas}}{hr} \times \frac{6.5 \times 10^2 kg}{10^6 m^3_{methane}} \times \frac{0.6 m^3_{methane}}{m^3_{biogas}} \times \frac{1000 g}{kg} \times \frac{hr}{3600s}$$

$$ER\left(\frac{g}{s}\right) = 1.63 \times 10^{-1} \frac{g}{s}$$

**Data Quality:** Average and Uncertain

Section 8.3.3 of the ESDM Procedure Document titled "Average Data Quality" Emission Estimating Techniques includes emission factor calculations using USEPA emission factors with data quality ratings of "C".

Section 8.3.4 of the ESDM Procedure Document titled "Marginal" or "Uncertain Data Quality" Emission Estimating Techniques includes emission factor calculations using USEPA emission factors with data quality ratings of "D" or "E".

**Methodology:** Engineering Calculation (EC)

CRA has assumed an inlet odour concentration of 10,000 OU as defined in the MOE Landfill Gas Interim Guideline (1992), and a conservative destruction efficiency of 80% for the flare. The emissions from the flare have been calculated using these emission factors and a maximum biogas flaring rate of 1,500 m<sup>3</sup>/hr as per the flare design. Emission estimates from this source are provided in Table A.4.

**Sample Calculation:** Odour (OU/s)

$$ER\left(\frac{OU}{s}\right) = 0.42 \frac{m^3}{s} \times 10,000 OU \times (100\% - 80\%)$$

$$ER\left(\frac{OU}{s}\right) = 8.33 \cdot 10^2 \frac{OU}{s}$$

**Data Quality:** Average

Section 8.3.3 of the ESDM Procedure Document titled "Average Data Quality" Emission Estimating Techniques, includes engineering calculations and judgement. Emission estimates derived from fundamental scientific and engineering principles, and/or relevant empirical data can be considered average data quality.

**Operating Condition, Individual Maximum Rates of Production:**

The emission rate estimates for this source have been estimated using a biogas flow rate to the flare of 1,500 m<sup>3</sup> per hour with 60% methane content.

TABLE A.1

LIST OF COMBUSTION EQUIPMENT  
ELMIRA BIOGAS PLANT  
WOOLWICH BIO-EN INC.

<i>Equipment Identification</i>	<i>Ratings (kW Energy Input)</i>
S-1a biogas engine	3,538
S-1b biogas engine	3,538
<b>Total</b>	<b>7,076</b>

TABLE A.2A

ESTIMATED MAXIMUM BIOGAS COMBUSTION EMISSIONS  
ELMIRA BIOGAS PLANT  
WOOLWICH BIO-EN INC.

Normalized Exhaust Flow Rate		6,295	Nm <sup>3</sup> /hr (1)	per engine
<i>Compound</i>	<i>CAS No.</i>	<i>Mfr Guaranteed Emission Values (mg/Nm<sup>3</sup>) (2)</i>	<i>Estimated Maximum Emission Rate for Engine 1 (S-1a) (g/s)</i>	<i>Estimated Maximum Emission Rate for Engine 2 (S-1b) (g/s)</i>
Carbon Monoxide	630-08-0	1500	2.62E+00	2.62E+00
Nitrogen Oxides	10102-44-0	500	8.74E-01	8.74E-01
NMHC	NA	195(3)	3.41E-01	3.41E-01
Particulate	NA	55	9.62E-02	9.62E-02

Notes:

(1) Based on Dry Normalized Exhaust flow rate of each engine.

(2) Based on GE guaranteed emission limits.

(3) This concentration is reflective of the emissions from Natural Gas that would be used during start-up conditions. The concentration of NMHC from the engines when firing biogas is 100 mg/Nm<sup>3</sup>.

**TABLE A.2B**

**ESTIMATED MAXIMUM NATURAL GAS COMBUSTION EMISSIONS  
ELMIRA BIOGAS PLANT  
WOOLWICH BIO-EN INC.**

<i>Compound</i>	<i>CAS No.</i>	<i>Emission Factor (lb/MMBtu) (1)</i>	<i>Estimated Maximum Emission Rate Boiler (g/s)</i>
Carbon Monoxide	630-08-0	0.082	2.49E-02
Nitrogen Oxides	10102-44-0	0.049	1.48E-02
VOC	NA	0.00539	1.63E-03
Particulate	NA	0.00745	2.25E-03

Notes:

(1) From USEPA AP-42 - Table 1.4-1 and 1.4-2. Natural gas combustion in low-NOx small boilers.

TABLE A.3

**ESTIMATED MAXIMUM EMISSIONS FROM BIOFILTER  
ELMIRA BIOGAS PLANT  
WOOLWICH BIO-EN INC.**

Exhaust flow rate(m <sup>3</sup> /s)		5.56		
<i>Contaminant</i>	<i>CAS No.</i>	<i>Concentration (mg/m<sup>3</sup>) or (OU/m<sup>3</sup>) (1)</i>	<i>Destruction Efficiency (%) (2)</i>	<i>Emission (g/s) or (OU/s)</i>
Ammonia	7664-41-7	17.4	50%	4.84E-02
Trimethylamine	75-50-3	1.5	75%	2.08E-03
Triethylamine	121-44-8	1.0	65%	1.94E-03
Hydrogen Sulfide	7783-06-4	13.9	95%	3.87E-03
Methyl Mercaptan	74-93-1	2.0	90%	1.10E-03 (3)
Ethyl Mercaptan	75-08-1	1.0	65%	2.56E-03 (3)
Dimethyl Sulphide	77-78-1	5.2	65%	1.00E-02
Dimethyl disulphide	624-92-0	3.1	65%	5.99E-03
Butanol	71-36-3	10.0	70%	1.67E-02
Alpha-pinene	80-56-8	5.6	60%	1.24E-02
Limonene	5989-27-5	10.5	60%	2.33E-02
Acetic Acid	64-19-7	5.0	70%	8.33E-03
Oleic Acid	112-80-1	5.8	70%	9.63E-03
Butyric Acid	107-92-6	1.8	70%	3.00E-03
Cyclopentanol	91-41-3	8.0	60%	1.78E-02
Propyl acetate	109-60-4	5.0	60%	1.11E-02
Propyl butyrate	105-66-8	8.0	60%	1.78E-02
Pentanone	107-87-9	2.0	60%	4.44E-03
Me-isobutyl ketone	108-10-1	10.0	60%	2.22E-02
Nonanal	124-19-6	5.0	60%	1.11E-02
Total Reduced Sulfur	NA			2.35E-02
Odour	NA	2000 (4)		1.11E+04

## Notes:

- (1) Concentrations have been provide by BioRem for biofilter inlet concentrations based on data collected at organics processing and rendering facilities. To produce conservative emission estimates, the highest value in the range of concentrations, as provided in Appendix E has been used in this calculation.
- (2) Biofilter removal efficiency has been provided by BioRem for individual compounds.
- (3) Amount of Mercaptans calculated according to Note 15 on page 20 of Summary of O. Reg. 419/05 Standards and Point of Impingement Guidelines and Ambient Air Quality Criteria (AAQCs)<sup>11</sup> date December 2005.
- (4) Based on conservative odour removal efficiency of 80% provided by manufacturer. Assuming 10,000 OU inlet.

TABLE A.4

ESTIMATED MAXIMUM EMISSIONS FROM BIOGAS FLARE  
ELMIRA BIOGAS PLANT  
WOOLWICH BIO-EN INC.

Maximum Biogas Flow Rate		1,500	Nm <sup>3</sup> /hr (1)
<i>Compound</i>	<i>CAS No.</i>	<i>Emission Factor (kg/10<sup>6</sup>m<sup>3</sup> methane) (2)</i>	<i>Estimated Maximum Emission Rate for Flare (S-3) (g/s) (3)</i>
Carbon Monoxide	630-08-0	1.20E+04	3.00E+00
Nitrogen Oxides	10102-44-0	6.50E+02	1.63E-01
PM	NA	2.70E+02	6.75E-02
Odour	NA	2.00E+03 OU/m <sup>3</sup> (4)	8.33E+02 OU/s

Notes:

- (1) Based on the flare capacity provided by Bio-En.
- (2) Emission factors provided in Table 2.4-4 of Chapter 2.4 AP-42 1998 using emission factors as provided for landfill gas flares as these are the factors with the highest data quality available
- (3) The emission rates have been determined based on an estimated 60% methane in biogas
- (4) Based on 10,000 OU inlet loading and 80% destruction efficiency

APPENDIX B

SUPPORTING INFORMATION FOR ASSESSMENT OF NEGLIGENCE

## APPENDIX B

### SUPPORTING INFORMATION FOR ASSESSMENT OF NEGLIGIBILITY WOOLWICH BIO-EN INC.

Sources were screened for negligibility using the following screening protocols listed in the ESDS Procedure Document:

- Generalized Guidance to Identifying Insignificant or Significant Sources and Contaminants (Section 7.3)
- Fugitive dust from on-site roadways (Section 7.4)
- Specific Examples of Sources that Emit Contaminants in Negligible Amounts (Table B-3)

The results of the screening are discussed in detail in the following text.

#### Fugitive Road Dust:

The Facility is not listed in Table 7-2 or 7-3 of Section 7.4 of the ESDM Procedure Document and accordingly dust emissions from these sources (parking lot, paved roads) can be considered as insignificant.

#### Start-up Boiler (Source S-4):

The start-up boiler is a natural gas fired boiler. The total facility-wide heat input usage for the natural gas boiler is 2.4 MMBtu/hr (2.5 million kJ/hr) which is less than 20 million kJ/hour. This meets the requirements listed in Table B-3 of the ESDM Procedure Document and accordingly emissions from this source can be considered as insignificant.

#### Engines (Sources S-1a and S-1b) odour:

The engine destruction efficiency, according to the manufacturer, is between 94 and 98%. This would leave an insignificant amount of odour in the exhaust compared to the biofilter stack and flare. An email from the manufacturer confirming this destruction percentage is included in Appendix E. This would result in the engines contributing less than 5% of the total odour emissions; therefore, in accordance with Section 7.2.2 of the ESDM Procedure Document, the engines have been considered a negligible source of odour.

APPENDIX C-1

AERMOD AIR DISPERSION MODELLING MEMO FOR ODOUR




---

## MEMORANDUM

---

TO: Sarah Tebbutt REF. NO.: 046254

FROM: Stephen Koo/ca/6  DATE: December 9, 2011

RE: **AERMOD Odour Modelling Assessment  
Woolwich Bio-En Inc., Elmira, Ontario**

---

### 1.0 INTRODUCTION

This memorandum has been prepared to summarize the methodology and results of the air dispersion modelling performed for the determination of odour compliance of the proposed Woolwich Bio-En Inc. (Bio-En) Anaerobic Digestion (AD) facility to be located at 40 Martin's Lane in Elmira, Ontario (Facility). The dispersion modelling considered all significant odour-related air emission sources that have the potential to release odour at the Facility. The results of the dispersion modelling will be used to evaluate the Facility's compliance with acceptable odour limits, as prescribed by the Ontario Ministry of the Environment (MOE).

Dispersion modelling for the concentration of odour was performed using the United States Environmental Protection Agency (USEPA) multi-source dispersion model AERMOD, as prescribed by Ontario Regulation 419/05 (O.Reg. 419). AERMOD is an advanced steady-state plume model that has the ability to incorporate building cavity downwash, actual source parameters, emission rates, terrain and historical meteorological information to predict ground level concentrations (GLCs) at specified locations.

Odour-based dispersion modelling was performed for both a tiered receptor grid and discrete sensitive receptors, as described by O.Reg. 419, and the MOE technical bulletin entitled, "Methodology for Modelling Assessments with 10-Minute Average Standards and Guidelines under O.Reg. 419/05" dated April 2008.

### 2.0 MODELLING METHODOLOGY

#### 2.1 GENERAL MODELLING APPROACH

As per the April 2008 technical bulletin, a series of models were performed to determine odour compliance, as described below.

- Step 1: An air dispersion model, constructed as prescribed by O.Reg. 419/05, using a tiered receptor grid, is modelled for a 1-hour averaging period at ground level. All modelled results are then converted to a 10-minute averaging period. The removal of meteorological anomalies is allowed to determine the maximum compliance odour value. After this is done, if the odour-based guideline of 1 odour unit

(OU) is not exceeded at any modelled point, no further modelling is required. If the odour-based guideline is exceeded, further modelling is required.

- Step 2: An air dispersion model, with discrete receptors located at all locations where human activities may occur, is modelled for a 1-hour averaging period. All modelled results are then converted to a 10-minute averaging period. After this is done, if the odour-based guideline of 1 OU is not exceeded at any discrete receptor, no further modelling is required. If the odour-based guideline is exceeded, further modelling is required.
- Step 3: An air dispersion model, with a discrete receptor located where human activities may occur, is modelled for a 1-hour averaging period. All modelled results are then converted to a 10-minute averaging period. A frequency analysis by year, based on the 99.5<sup>th</sup> percentile, is then performed to determine the maximum compliance odour value. The 99.5<sup>th</sup> percentile is equivalent to removing the highest 44 modelled concentrations per year.

## **2.2 MODEL EXECUTABLES**

The following USEPA executables were used in the assessment:

- AERMOD meteorological pre-processor (AERMET), version 06341
- AERMOD digital terrain pre-processor (AERMAP), version 09040
- AERMIC air dispersion model (AERMOD), version 09292
- Building Profile Input Program (BPIP), version 04274

## **2.3 METEOROLOGICAL DATA**

Five years of local meteorological data was obtained from the MOE for use in the assessment. The meteorological data is from the Elora Research Climate Station, and was processed by MOE with land-use classifications for the Facility locale. The meteorology covers the dates from January 1, 2004 to December 31, 2008. The hourly data included many factors which affect the dispersion of air contaminants including wind speed, wind direction, temperature, ceiling height, and atmospheric stability.

## **2.4 AVERAGING PERIODS AND TIME-BASED CONCENTRATION CONVERSION**

Odour levels are based on 10-minute peak concentrations of 1 odour unit (OU). An OU for a compound is defined as a threshold where 50 percent of the population would detect, but not identify, the odiferous compound. This definition is normally applied at sensitive receptors. Sensitive receptors may include residences, camping grounds, schools, community centres, day care centres, recreational centres and outdoor public recreational areas, or any other locations as specified by MOE.

All concentrations at the receptors were modelled. As AERMOD cannot model averaging periods less than 1 hour, the 1-hour averaging period was used with the resulting predicted concentrations converted to the shorter 10-minute averaging period using the MOE conversion factor of 1.65.

## 2.5 DIGITAL ELEVATION MODEL DATA

Digital elevation model (DEM) data was obtained from the MOE. The DEM data was used to include the effects of terrain in the modelling. The terrain used is from the DEM dataset tile085.

DEM data was preprocessed with AERMAP for use with AERMOD.

## 2.6 SOURCE INPUT PARAMETERS

Sources at the Facility were modelled as point sources based on their physical description. Point source parameters and locations were based on information provided by Facility personnel and site drawings. All sources were conservatively assumed to be operating simultaneously, continuously, and at maximum emission rates.

Based on Facility provided information, the biofilter and flare stacks were identified as the only significant sources at the Facility that would emit odour.

A summary of the AERMOD source input parameters and odour emission rates are provided in Table 1. The Facility property boundary and the locations of the modelled sources are shown on Figure 1.

## 2.7 TIERED RECEPTORS AND DISCRETE SENSITIVE RECEPTORS

Two sets of receptors were used in the assessment:

- A tiered receptor grid, located at ground level, for use with the Step 1 model
- A series of discrete sensitive receptors for use with the Step 2 and Step 3 models

The tiered receptor grid was defined based on a bounding box that encapsulates all the modelled sources. The grid was then tiered starting from the edge of the bounding box with a fine resolution, and progressing to coarser resolutions at further distances. All tiered distances were defined relative to the bounding box. The receptor grid used is described as follows:

- Bounding box origin (SW corner)(X,Y): 536,372.5, 4,828,001.5 (m)
- Size (width, height): 50.4, 38.1 (m)
- 20 m spacing within 200 m of the edge of the bounding box
- 50 m spacing from 200 m to 500 m
- 100 m spacing from 500 to 1,000 m
- 200 m spacing from 1,000 to 2,000 m
- 500 m spacing from 2,000 to 5,000 m

A property line ground level receptor grid with 10 m spacing was used to evaluate the maximum property boundary concentration. No receptors were placed inside the Facility's property line. A total of 1,976 receptors were used in the receptor grid and along the property line.

For the discrete sensitive receptors, a series of receptors were sited at locations of human activities. The locations for each receptor was selected based on the MOE's definition of a sensitive receptor, as follows:

*"...any location where routine or normal activities occurring at reasonably expected times would experience adverse effect(s) from odour discharges from the Facility, including one or a combination of:*

- (a) private residences or public facilities where people sleep...*
- (b) institutional facilities ...*
- (c) outdoor public recreational areas ...*
- (d) commercial areas where there are continuous public activities.."*

A total of four sensitive receptors were identified that may be adversely affected by odour from the Facility. All receptors are residential. The locations of these receptors are presented in Figure 2.

## **2.8 ON-SITE BUILDING DATA**

All on-site Facility buildings were modelled in AERMOD to account for building cavity downwash. Cavity downwash can result in air contaminants being forced to ground level prematurely under certain meteorological conditions, which can result in higher than expected near-field odour levels.

The USEPA Building Profile Input Program (BPIP) was used to calculate downwash effects for use with the AERMOD. All modelled buildings are presented in Figure 1.

## **2.9 FREQUENCY ANALYSIS**

Step 3 models were not required to assess frequency impacts. However, they were still conducted in order to provide a complete overview. The frequency analysis was performed using the POSTFILE output option in AERMOD to calculate the 1-hour concentrations at the sensitive receptors for each single hour across the entire five year meteorological period. The concentrations calculated were then converted to a 10-minute averaging period and aggregated for each year to determine the frequency distribution and compliance odour concentration at each receptor.

## **3.0 DISPERSION MODELLING RESULTS**

All odour models were developed and executed following the methodology described above.

The five years of meteorological data included over 43,800 hours of data. The AERMOD model was run to calculate the maximum 1-hour ground level concentration (GLC) for odour. The meteorological conditions, which would result in the maximum odour concentrations, would typically be stable atmospheric conditions such as an inversion with low wind speed. The maximum hour out of 43,800 hours of data would not occur at each grid point simultaneously since the wind can only blow in one direction during one hour.

### 3.1 STEP 1 ANALYSIS

As per Step 1 of the technical bulletin, a tiered receptor grid was used to calculate the maximum 1-hour odour concentrations at each receptor location. The 1-hour concentrations were converted to 10-minute concentrations using the MOE time-based conversion factor of 1.65. As per MOE guidelines, for each modelled year the eight meteorological 1-hour periods that resulted in the highest eight GLCs were identified and removed. This resulted in the removal of a total of 40 hours from evaluation. After the removal of meteorological anomalies, the maximum odour GLC was calculated to be 0.91 OU.

The Step 1 maximum 10-minute odour concentration isopleths are presented in Figure 3. A summary of the hours removed from the analysis is provided in Table 2. A Step 2 analysis was still performed in order to show the Facility's compliance with the 1 OU guideline.

### 3.2 STEP 2 ANALYSIS

As per Step 2 of the technical bulletin, elevated receptors were used to calculate the maximum 1-hour odour concentration at each sensitive receptor location. The 1-hour concentrations were converted to 10-minute concentrations using the MOE time-based conversion factor of 1.65. The maximum odour concentration at any sensitive receptor was calculated to be 0.93 OU. As this odour concentration meets the 1 OU odour guideline at all sensitive receptors, a Step 3 analysis is not required for any of the sensitive receptors.

Based on the Step 2 analysis, the maximum odour concentrations for each of the discrete receptors are as follows:

- Township Road 14 Residence, 0.91 OU
- Arthur Street N. Residence, 0.93 OU
- High Street East Residence, 0.80 OU
- High Street West Residence, 0.84 OU

A Step 3 analysis was still performed in order to show the Facility's compliance with the 1 OU guideline.

### 3.3 STEP 3 ANALYSIS

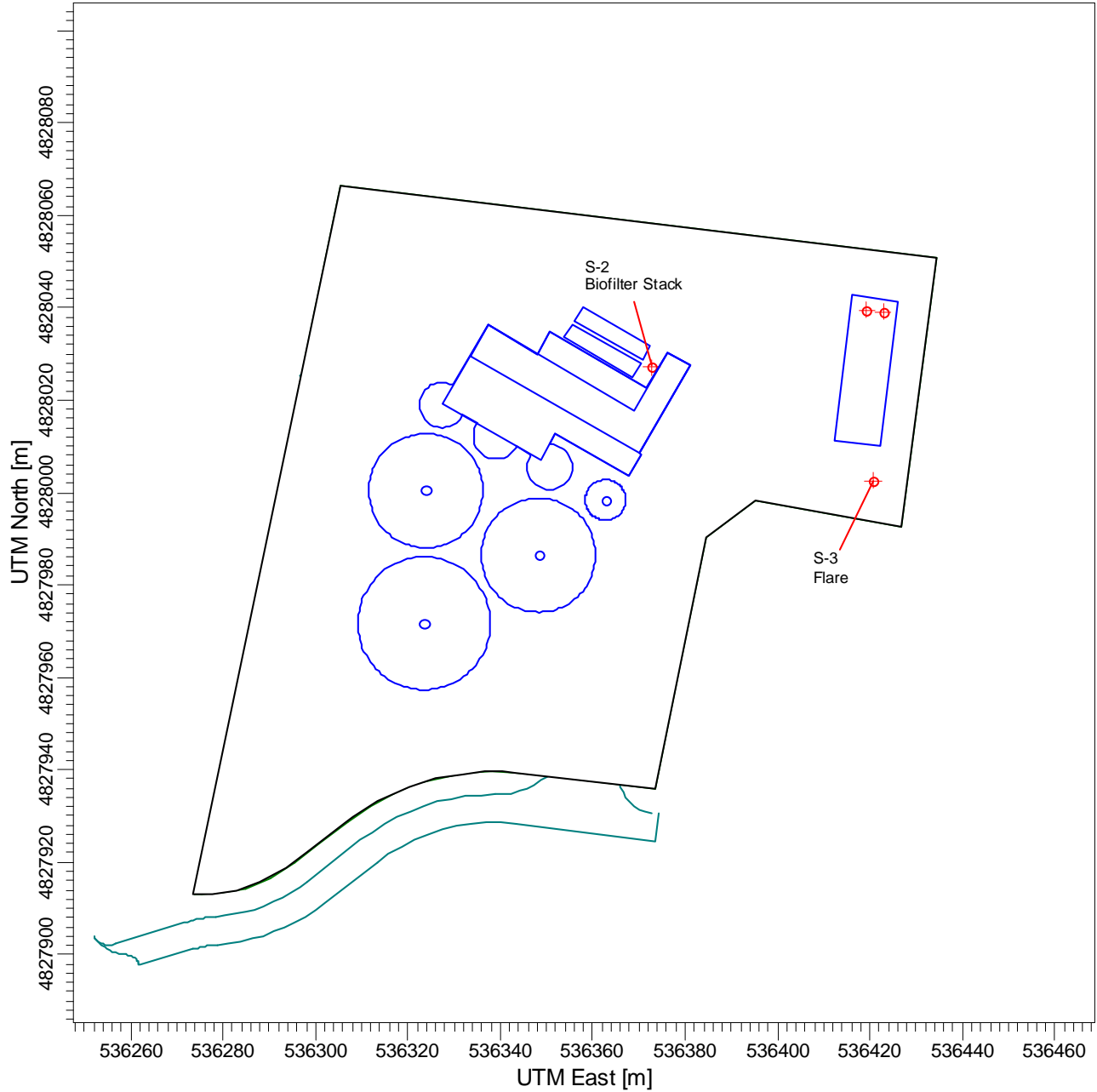
As per Step 3 of the technical bulletin, the maximum 1-hour odour concentrations for all hours in the meteorological dataset for each sensitive receptor were modelled for frequency. The 1-hour concentrations were recorded using the POSTFILE option in AERMOD. The resulting 1-hour concentrations were converted to 10-minute concentrations using the MOE time-based conversion factor of 1.65. The 10-minute concentrations were then sorted into odour bins of 0.1 OU increments to evaluate for frequency. In addition, the compliance odour value was determined for each discrete receptor by removing the highest 44 concentrations per year (equivalent to the 99.5<sup>th</sup> percentile), as per the guidance presented in the technical bulletin.



The compliance OU for each of the sensitive receptors is summarized in Table 3 and presented in Figure 4. The frequency distribution for each receptor is also summarized in Table 3.

Should you have any questions on the above, please do not hesitate to contact us.

PROJECT TITLE:

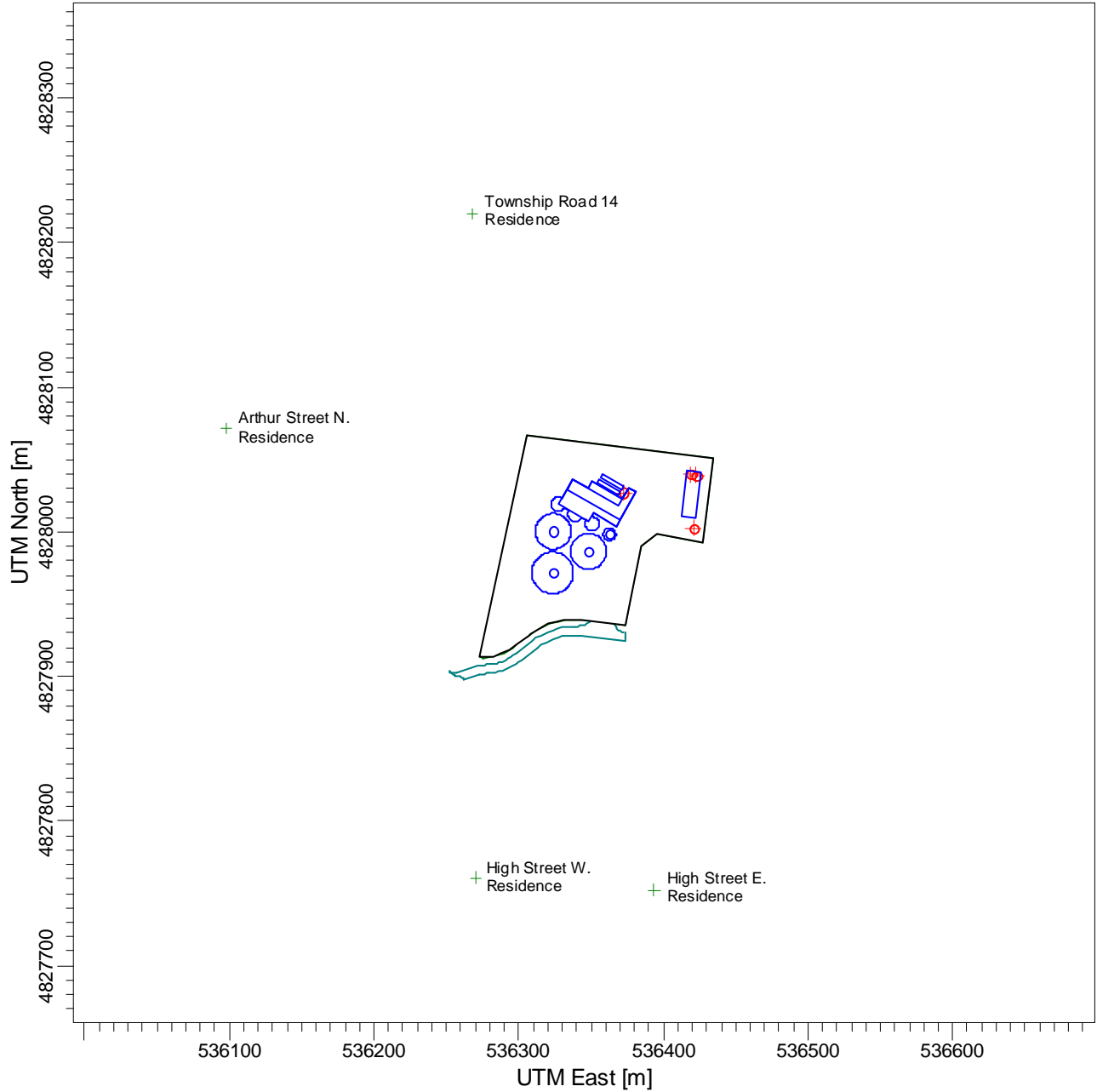
**FIGURE 1  
FACILITY PROPERTY BOUNDARY, BUILDINGS, AND ODOUR SOURCES**



COMMENTS:	SOURCES:	COMPANY NAME:	
	<b>4</b>	<b>WOOLWICH BIO-EN INC., ELMIRA, ONTARIO</b>	
	RECEPTORS:	MODELER:	 <b>CONESTOGA-ROVERS &amp; ASSOCIATES</b>
	<b>2000</b>	<b>CRA</b>	
	SCALE:	1:1,388	
		 0 0.05 km	
	DATE:	PROJECT NO.:	
	<b>11/11/2011</b>	<b>046254</b>	

PROJECT TITLE:

**FIGURE 2  
DISCRETE SENSITIVE RECEPTOR LOCATIONS**



COMMENTS:

SOURCES:

**4**

COMPANY NAME:

**WOOLWICH BIO-EN INC., ELMIRA, ONTARIO**

RECEPTORS:

**2000**

MODELER:

**CRA**

SCALE:

1:4,434

0 0.1 km



**CONESTOGA-ROVERS  
& ASSOCIATES**

DATE:

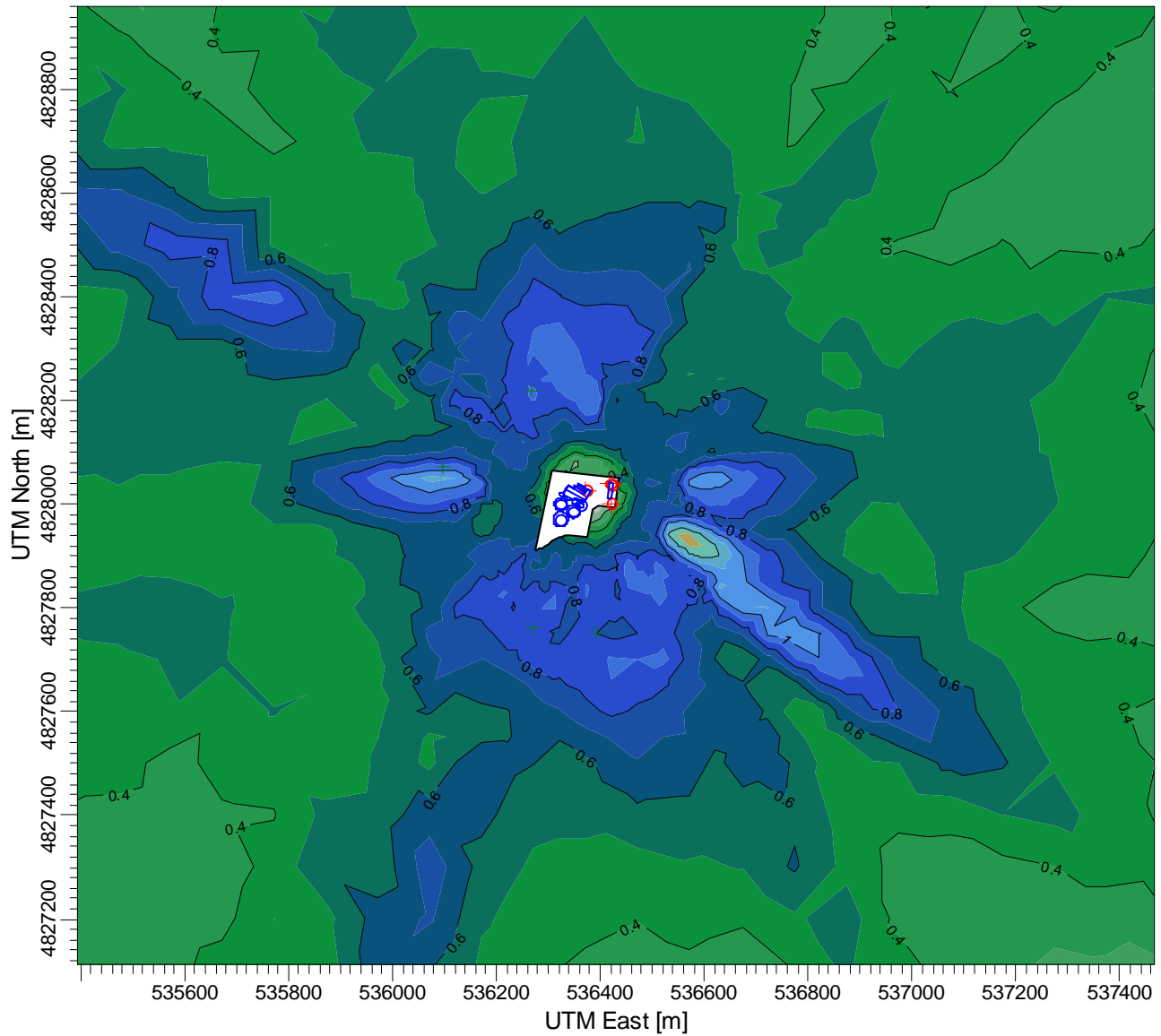
**11/11/2011**

PROJECT NO.:

**046254**

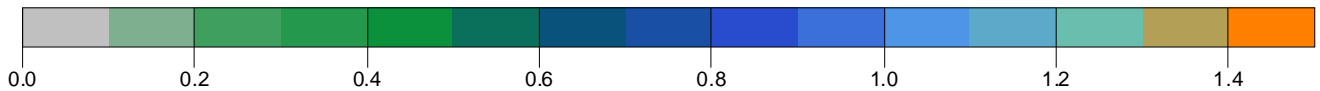
PROJECT TITLE:

**FIGURE 3  
STEP 1 MAXIMUM 10-MINUTE GROUND LEVEL ODOUR CONCENTRATIONS**



PLOT FILE OF HIGH 1ST HIGH 10.0-MIN VALUES FOR SOURCE GROUP: ALL

OU



COMMENTS:

Maximum predicted odour concentrations after removal of meteorological outliers is 0.91 OU.

Meteorological dataset for Elora CRS processed for local land use by MOE Modelling Division.

SOURCES:

**4**

RECEPTORS:

**2000**

OUTPUT TYPE:

**Concentration**

MAX:

**1.3285 OU**

COMPANY NAME:

**WOOLWICH BIO-EN INC., ELMIRA, ONTARIO**

MODELER:

**CRA**

SCALE:

1:13,016



DATE:

**12/9/2011**



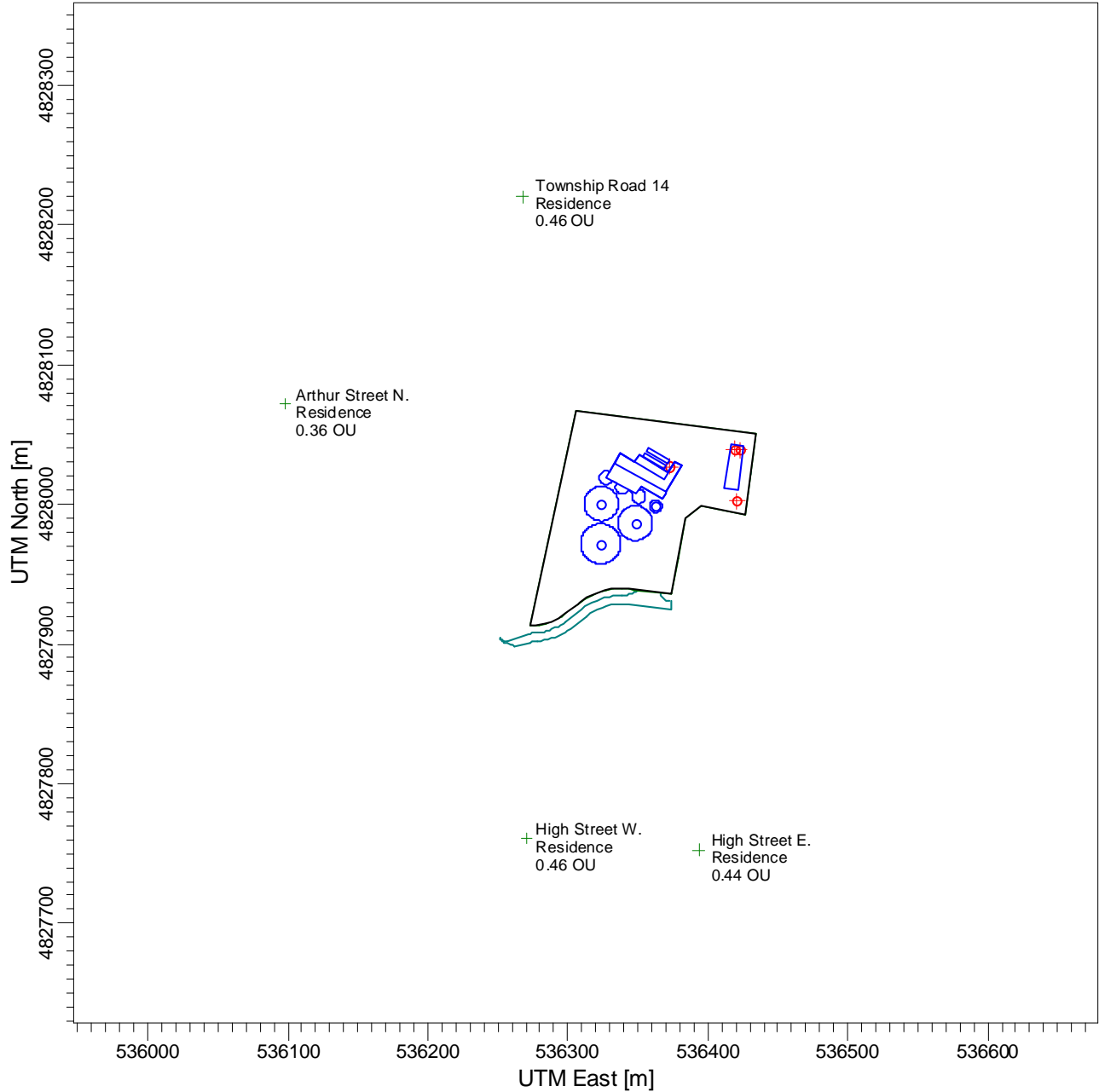
**CONESTOGA-ROVERS  
& ASSOCIATES**

PROJECT NO.:

**046254**

PROJECT TITLE:

**FIGURE 4**  
**STEP 3 COMPLIANCE 10-MINUTE ODOUR CONCENTRATIONS AT SENSITIVE RECEPTORS**





<p>COMMENTS:</p> <p>Predicted odour concentrations at sensitive receptors after removal of the highest 44 odour hours per year.</p>	<p>SOURCES:</p> <p><b>4</b></p>	<p>COMPANY NAME:</p> <p><b>WOOLWICH BIO-EN INC., ELMIRA, ONTARIO</b></p>	
	<p>RECEPTORS:</p> <p><b>2000</b></p>	<p>MODELER:</p> <p><b>CRA</b></p>	 <p><b>CONESTOGA-ROVERS &amp; ASSOCIATES</b></p>
		<p>SCALE:</p> <p>1:4,596</p> <p>0  0.1 km</p>	
		<p>DATE:</p> <p><b>12/9/2011</b></p>	<p>PROJECT NO.:</p> <p><b>046254</b></p>

TABLE 1

AERMOD ODOUR DISPERSION MODELLING SOURCE PARAMETERS  
 WOOLWICH BIO-EN INC.  
 ELMIRA, ONTARIO

<i>Source Identifier</i>	<i>Description</i>	<i>Source Type</i>	<i>UTM Coordinates</i>		<i>Exit Height (m)</i>	<i>Exit Diameter (m)</i>	<i>Exit Temperature (K)</i>	<i>Exit Velocity (m/s)</i>	<i>Maximum Modelled Emission Rate (ou/m<sup>3</sup>/s)<sup>-6</sup></i>
			<i>X (m)</i>	<i>Y (m)</i>					
S-2	Biofilter Stack	point	536,421.53	4,828,041.89	28.00	0.54	288.15	24.02	1.11E+04
S-3	Flare	point	536,420.67	4,828,002.55	8.00	0.50	1123.15	21.22	8.33E+03

TABLE 2

STEP 1 IDENTIFIED METEOROLOGICAL OUTLIER HOURS  
 WOOLWICH BIO-EN INCORPORATED  
 ELMIRA, ONTARIO

<i>Summary of Hours by Model Year</i>									
2004		2005		2006		2007		2008	
<i>Rank</i>	<i>Date</i> <i>(ymmddhh)</i>	<i>Rank</i>	<i>Date</i> <i>(ymmddhh)</i>	<i>Rank</i>	<i>Date</i> <i>(ymmddhh)</i>	<i>Rank</i>	<i>Date</i> <i>(ymmddhh)</i>	<i>Rank</i>	<i>Date</i> <i>(ymmddhh)</i>
1	4082512	2	5011903	8	6092710	5	7081417	3	8050712
6	4070416	7	5092812	10	6070918	20	7030214	4	8090508
12	4062405	9	5092813	24	6121307	21	7072614	11	8010901
15	4051415	13	5042611	50	6112920	45	7100113	14	8061401
18	4051713	16	5051016	53	6052815	52	7100114	22	8010815
19	4100822	17	5051017	58	6012407	63	7100308	28	8010820
23	4010302	25	5111213	60	6121309	65	7050715	29	8070810
27	4012119	26	5111212	72	6013010	68	7100117	32	8101514

TABLE 3

**10-MINUTE COMPLIANCE ODOUR CONCENTRATION AND  
FREQUENCY DISTRIBUTION AT SENSITIVE RECEPTORS  
WOOLWICH BIO-EN INCORPORATED  
ELMIRA, ONTARIO**

	<i>Sensitive Receptors</i>											
	<i>Township Road 14 Residence</i>			<i>Arthur Street N. Residence</i>			<i>High Street E. Residence</i>			<i>High Street W. Residence</i>		
	<i>Odour Value (ou)</i>	<i>Total Hours (hours)</i>	<i>Frequency (%)</i>	<i>Odour Value (ou)</i>	<i>Total Hours (hours)</i>	<i>Frequency (%)</i>	<i>Odour Value (ou)</i>	<i>Total Hours (hours)</i>	<i>Frequency (%)</i>	<i>Odour Value (ou)</i>	<i>Total Hours (hours)</i>	<i>Frequency (%)</i>
Maximum OU	0.91	--	--	0.93	--	--	0.80	--	--	0.84	--	--
Compliance OU	0.46 (1)	--	--	0.36 (1)	--	--	0.46 (1)	--	--	0.44 (1)	--	--
<i>Odour Bins (ou)</i>												
less than 0.1	--	41,913	95.59%	--	41,120	93.78%	--	41,656	95.00%	--	41,423	94.47%
0.1-0.2	--	663	1.51%	--	1469	3.35%	--	903	2.06%	--	942	2.15%
0.2-0.3	--	565	1.29%	--	892	2.03%	--	583	1.33%	--	712	1.62%
0.3-0.4	--	416	0.95%	--	286	0.65%	--	406	0.93%	--	468	1.07%
0.4-0.5	--	187	0.43%	--	67	0.15%	--	201	0.46%	--	198	0.45%
0.5-0.6	--	75	0.17%	--	10	0.02%	--	56	0.13%	--	71	0.16%
0.6-0.7	--	21	0.05%	--	3	0.01%	--	29	0.07%	--	27	0.06%
0.7-0.8	--	6	0.01%	--	0	0.00%	--	13	0.03%	--	5	0.01%
0.8-0.9	--	1	0.00%	--	0	0.00%	--	1	0.00%	--	2	0.00%
0.9-1.0	--	1	0.00%	--	1	0.00%	--	0	0.00%	--	0	0.00%
greater than 1.0	--	0	0.00%	--	0	0.00%	--	0	0.00%	--	0	0.00%

**Notes:**

- (1) Compliance odour value is determined after removal of the highest 44 odour values per year.  
The maximum of the remaining 45th values for each of the five modelled meteorological years represents the compliance odour value.

APPENDIX C-2

MOE LETTER APPROVING MET DATA AND SPEED UP REQUEST FORM

Ministry of the Environment

Environmental Monitoring and  
Reporting Branch

125 Resources Road  
Toronto ON M9P 3V6  
Tel: 416 235-6300  
Fax: 416 235-6235

Ministère de l'Environnement

Direction de la surveillance  
environnementale

125, chemin Resources  
Toronto ON M9P 3V6  
Tél. : 416 235-6300  
Télééc. : 416 235-6235



June 12, 2009

Stephen Koo, Conestoga-Rovers & Associates  
On behalf of  
Woolwich Bio-En  
40 Martin's Lane  
Elmira, Ontario N3B 2A1

Dear Sir:

**Re: Request for Approval under Paragraph 3 of section 13(1) of Regulation 419/05  
For use of Site Specific Meteorological Data  
Woolwich Bio-En, Elmira  
MOE Reference Number IDS reference no.**

This letter provides approval under paragraph 3 of section 13(1) of Regulation 419/05 for use of site specific meteorological data. I am approving the use of site specific data to use in preparing an Emission Summary Dispersion Modelling (ESDM) report pursuant to the request submitted on behalf of Woolwich Bio-En signed by you and dated June 02, 2009. I am of the opinion that the site specific meteorological data referenced as the Elora data is an accurate reflection of the meteorological conditions for the following reasons:

The Elora station is operated by the Environment Canada for wind and temperature measurements. Other variables (cloud coverage/opacity and ceiling heights) are from the Waterloo Airport also operated by Environment Canada. Waterloo Airport wind data were also used to fill the few missing hours in Elora wind data. Given the similar proximity of the Elora station to the facility's location at 40 Martin's Lane, it is my opinion that this site provides good meteorological data for the modelling assessment.

A fully processed meteorological data set for the 5 years from 2004 to 2008 has been prepared by the Ministry of the Environment using the above data sets with wind-sector dependent land use specific to the application area. This data can be used to run the AERMOD model. This meteorological data has been prepared only for this ESDM assessment.

Please note that in accordance with the above-referenced request, the site specific meteorological data can only be used to model discharges from the Woolwich Bio-En Facility, 40 Martin's Lane, Elmira, Ontario N3B 2A1.

This request for notice was submitted with an application for a Certificate of Approval under Section 9 of the Environmental Protection Act (EPA) as part of an ESDM assessment and is subsequently approved for use in the Certificate of Approval application corresponding to this project.

Yours truly,

Dr. Robert Bloxam  
Senior Leader, Modelling

cc: District Manager, Guleph District Office  
Director, Section 9, Environmental Protection Act  
Environmental Assessment and Approvals Branch

## REQUEST UNDER s. 20(4) TO HAVE THE SCHEDULE 3 STANDARDS APPLY IN ADVANCE OF THE DATE REQUIRED BY REGULATION 419/05

### General Information

Information requested in this form is collected under the authority of the *Environmental Protection Act*, R.S.O. 1990 (EPA) and the *Environmental Bill of Rights*, C. 28, Statutes of Ontario, 1993, (EBR) and will be used to evaluate requests to have the Schedule 3 Standards of Air Pollution – Local Air Quality Regulation (O. Reg. 419/05) in advance of the date required by the regulation. **INCOMPLETE FORMS WILL BE RETURNED TO THE APPLICANT.** Even if the form is accepted as complete the Ministry of the Environment may request additional information during the review of this request.

1. Questions regarding completion and submission of this request should be directed to the Environmental Assessment and Approvals Branch (EAAB) of the Ministry of the Environment at the address below or to the local Ministry of the Environment (MOE) District Office which has jurisdiction over the area in which the facility is located. A list of these District Offices is available on the Ministry of the Environment Internet site at <http://www.ene.gov.on.ca/envision/org/op.htm#Reg/Dist>.

2. Two copies of this form must be submitted to the Ministry of the Environment. The original should be sent to:

Ministry of the Environment,  
 Director, O.Reg. 419/05 s.20(4),  
 Environmental Assessment and Approvals Branch  
 2 St. Clair Avenue West, Floor 12A  
 Toronto, Ontario, M4V 1L5  
 Phone: 416-314-8001  
 Toll Free: 1-800-461-6290  
 Email: [EAABGen@ene.gov.on.ca](mailto:EAABGen@ene.gov.on.ca)

A copy of this form should be sent to the local District Office which has jurisdiction over the area where the facility is located.

3. Information contained in this application form is not considered confidential and will be made available to the public upon request. Information submitted as supporting information may be claimed as confidential but will be subject to the *Freedom of Information and Protection of Privacy Act* (FOIPPA) and the *EBR*. If you do not claim confidentiality at the time of submitting the information, the Ministry of the Environment may make the information available to the public without further notice to you.

### Instructions

This form should be used to request to have Schedule 3 standards from O. Reg. 419/05 apply in advance of the date required by the regulation and should be accompanied by a description of the circumstances surrounding this request. In accordance with s.20(4) a person who discharges or causes or permits the discharge of a contaminant from a property may request the Director to consider issuing a written notice under s. 20(4) requiring that s.20 apply to the facility on a date specified in the notice. This request may be made for all of the contaminants at the facility or for specified contaminants.

The Director will not consider a request under s. 20(4) unless the person making the request provides the concentration at point of impingement using an approved dispersion model acceptable under s. 20 for the contaminants that are the subject of this request. This information should be summarized on the table included in this form or indicated in an application for a Certificate of Approval.

If the request is limited to specific contaminants (the request is not for all contaminants at a facility) then the person making the request must also include the concentration at point of impingement using an approved dispersion model acceptable under s. 20 for all contaminants that are not included in the request but are associated with the contaminants that are the subject of the request. For example, if the request is for only particulate, and metals or semi-volatile contaminants are associated with the particulate, then the concentration at point of impingement for the associated metals or semi-volatile contaminants should also be provided on the table included in this form.

Note – your compliance limit remains Schedule 1 or 2 (whichever applies) until a date specified in the Notice.

### Regulatory Authority

*Section 20(4) The Director may give a person who discharges or causes or permits discharges of contaminants from a facility notice requiring the person to comply with this section, beginning on a date specified in the notice that is not later than January 31, 2020, if the notice is requested in writing by the person.*

*Section 20(6) A notice or order under subsection (4) or (5) applies in respect of all contaminants unless the notice or order provides that it applies only in respect of contaminants specified in the notice or order.*

#### 1. Requestor Information (Owner of works/facility)

Requestor Name (legal name of individual or organization as evidenced by legal documents)

Woolwich Bio-En Inc.

Business Identification Number

221119

Business Name (the name under which the entity is operating or trading if different from the Applicant Name - also referred to as trade name)

Woolwich Bio-En

Requestor Type:

- |   |  |
|---|--|
| <input checked="" type="checkbox"/> Corporation | <input type="checkbox"/> Federal Government      |
| <input type="checkbox"/> Individual             | <input type="checkbox"/> Municipal Government    |
| <input type="checkbox"/> Partnership            | <input type="checkbox"/> Provincial Government   |
| <input type="checkbox"/> Sole Proprietor        | <input type="checkbox"/> Other (describe): _____ |

North American Industry Classification System (NAICS) Code

Business Activity Description (a narrative description of the business endeavour, this may include products sold, services provided or machinery/equipment used, etc.)

Processing of organic material to produce biogas for use in electricity generation.

**2. Project Technical Information Contact**

Name <b>Sarah Tebbutt</b>		Company <b>Conestoga-Rovers&amp;Associates</b>		
Civic Address - Street information (address that has civic numbering and street information includes street number, name, type and direction) <b>651 Colby Drive</b>				Unit Identifier (i.e. suite or apartment number)
Delivery Designator: If signing authority mailing address is a Rural Route, Suburban Service, Mobile Route or General Delivery (i.e., RR#3)				
Municipality <b>Waterloo</b>	Postal Station	Province/State <b>ON</b>	Country <b>Waterloo</b>	Postal Code <b>N2V 1C2</b>
Telephone Number (including area code & extension) <b>(519) 884-0510 ext 2288</b>		Fax Number (including area code) <b>(519) 884-0525</b>		E-mail Address <b>smtebbutt@craworld.com</b>


**3. Ontario Regulation 419/05 Information**

1. Does this request apply to all contaminants? (please complete the attached table for all applicable contaminants) <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
2. How does the applied for change affect your compliance? <input type="checkbox"/> Remain Compliant <input type="checkbox"/> Remain Non-Complaint <input checked="" type="checkbox"/> Move Into Compliance <input type="checkbox"/> Move Into Non-Compliance	
3. a) Which section of O. Reg. 419/05 currently applies to your facility? <input type="checkbox"/> s.18 (Schedule 1) <input checked="" type="checkbox"/> s. 19 (Schedule 2)	b) Without this notice, when would O. Reg. 419/05 require s. 20 (Schedule 3) standards apply to your facility (dd/mm/yyyy)? <b>2013</b>
4. Is this form submitted with an Application for Certificate of Approval under Section 9 of the EPA? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No if yes, is the application dependant on granting of notice? <input type="checkbox"/> Yes <input type="checkbox"/> No	
5. Does this application relate to an Application for Certificate of Approval under Section 9 of the EPA that has already been made to the Ministry of the Environment or an existing Certificate of Approval? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No if yes, please provide the application reference number or current Certificate of Approval Number: _____	
6. Will this change affect any limits or conditions in your existing Certificate(s) of Approval under Section 9 of the EPA? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No if yes, please provide additional supporting information: _____	
7. Is your facility currently subject to an approved abatement plan (e.g. Order) that would be affected by this change? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No if yes, have you discussed this change with MOE District Office representatives? <input type="checkbox"/> Yes <input type="checkbox"/> No	
8. Has a request for approval for an alteration of a Schedule 3 standard under s. 32 of O. Reg. 419/05 been made for this facility? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No if yes, please attach a copy of ministry acknowledgement letter (if available) or an overview of the request	

**4. Statement of Requestor**

**I, the undersigned hereby declare that, to the best of my knowledge:**

- The information contained herein and the information submitted in support of this application is complete and accurate in every way and I am aware of the penalties against providing false information as per s.184(2) of the Environmental Protection Act.
- The Project Technical Information Contact identified in section 2 of this form is authorized to act on my behalf for the purpose of obtaining a notice to have the Schedule 3 standards of O. Reg. 419/05 apply in advance of the date required by the regulation.
- I have used the most recent request form (as obtained from the Ministry of the Environment Internet site at <http://www.ene.gov.on.ca/envision/gp/index.htm#PartAir> or the Environmental Assessment and Approvals Branch at 1-800-451-6290) and I have included all necessary information required by O. Reg. 419/05 and identified on this form.

Name of Signing Authority (please print) <b>Chuck Martin</b>		Title <b>President</b>	
Telephone Number (including area code & extension) <b>(519) 669-5171</b>		Fax Number (including area code) <b>(519) 669-5982</b>	
E-mail Address <b>chuckm@marbro.com</b>			
Signature 		Date (dd/mm/yyyy) <b>03/02/2011</b>	
<b>Address Information:</b>			
Civic Address - Street information (address that has civic numbering and street information includes street number, name, type and direction) <b>4 Arthur Street N</b>			Unit Identifier (i.e. suite or apartment number)
Delivery Designator: If signing authority mailing address is a Rural Route, Suburban Service, Mobile Route or General Delivery (i.e., RR#3)			
Municipality <b>Waterloo</b>	Postal Station	Province/State <b>ON</b>	Country <b>Waterloo</b>
			Postal Code <b>N3B 3A2</b>

# Contaminants Requested Under Section 20(4)

For Office Use Only		
Reference #	Reviewer	Contact #

## Instructions

Please complete the following table providing the concentration at point of impingement using an approved dispersion model acceptable under the current section of O. Reg. 419/05 that applies to your facility as well as s. 20 for the contaminants that are the subject of this request.

If the request is limited to specific contaminants discharged from the facility (the request is not for all contaminants at a facility) then please include the concentration at point of impingement using an approved dispersion model for all contaminants that are not included in the request but are associated with the contaminants that are the subject of the request. For example, if the request is for only particulate, and metals or semi-volatile contaminants are associated with the particulate they should also be provided on the table. Indicate with a check mark on the left hand column which contaminants are the subject of the request or leave the column blank if all contaminants are subject.

If you are applying for a Certificate of Approval for a facility under Section 9 of the EPA and this request is accompanying the application for approval, information regarding compliance with s. 18 or s. 19 compliance is not necessary (information may be included with the application for a Certificate of Approval)

### Site Information

Site Name Woolwich Bio-En	NAICS Code 221119	<b>Notes for Table:</b> a) Proper Chemical Name should be given (Abbreviations, acronyms, numeric codes, trade names and mixtures NOT ACCEPTABLE). b) CAS Number : Chemical Abstracts Services Number (UNIQUE Identifier for a chemical) c) POI Concentration : Point of Impingement Concentration
Site Address 40 Martin's Drive, Elmira, Ontario	Postal Code N3B 3A1	
County / District Waterloo		
District Office Guelph District Office		

Do you require more space than offered in the table below?  Yes  No

If yes, please attach a separate table

Is this request being submitted with an application for a Certificate of Approval (s.9) that includes an ESDM Report?  Yes  No

If yes, the table below does not need to be completed

Contaminant (a)	CAS (b)	Total Facility Emission Rate (g/s)	Schedule		Air Dispersion Model Used (if Sch. 3 please specify)	Maximum POI (c) Concentration (µg/m <sup>3</sup> )	Averaging Period (hours)	MOE POI Limit (µg/m <sup>3</sup> )	Limiting Effect	Percentage of MOE POI Limit
			<input checked="" type="checkbox"/> 1	<input type="checkbox"/> 2						
1			<input checked="" type="checkbox"/>	<input type="checkbox"/>	O. Reg. 346					
2			<input checked="" type="checkbox"/>	<input type="checkbox"/>	O. Reg. 346					
3			<input checked="" type="checkbox"/>	<input type="checkbox"/>	O. Reg. 346					
4			<input type="checkbox"/>	<input type="checkbox"/>	O. Reg. 346					
5			<input type="checkbox"/>	<input type="checkbox"/>	O. Reg. 346					
6			<input type="checkbox"/>	<input type="checkbox"/>	O. Reg. 346					

APPENDIX D

AERMOD AIR DISPERSION MODELLING FILES

APPENDIX E  
MANUFACTURER DATA SHEETS

ENGINE MANUFACTURER DATA



**Technical Description**  
**Cogeneration Unit-Container**  
**JMS 420 GS-B.L**

---

**Bio-En Elmira Pet Products**

---

<b>Electrical output</b>	<b>1426 kW el.</b>
<b>Thermal output</b>	<b>1510 kW</b>

**Emission values**  
NOx < 500 mg/Nm<sup>3</sup> (5% O<sub>2</sub>)



## 0.01 Technical Data (module)

Data at:			Full	Part Load	
			load		
Fuel gas LHV		kWh/Nm <sup>3</sup>	6.5		
			100%	75%	50%
Energy input		kW [2]	3,538	2,743	1,948
Gas volume		Nm <sup>3</sup> /h *)	544	422	300
Mechanical output		kW [1]	1,466	1,100	733
Electrical output		kW el. [4]	1,426	1,068	706
Recoverable thermal output					
~ Intercooler 1st stage		kW	208	40	3
~ Lube oil		kW	165	152	114
~ Jacket water		kW	400	387	296
~ Exhaust gas cooled to 180 °C		kW	737	616	471
Total recoverable thermal output		kW [5]	1,510	1,195	884
Total output generated		kW total	2,936	2,263	1,590
Heat to be dissipated					
~ Intercooler 2nd stage		kW	78	67	38
~ Surface heat	ca.	kW [7]	111	106	108
~ Balance heat		kW	35	27	19
Spec. fuel consumption of engine		kWh/kWh [2]	2.41	2.49	2.66
Lube oil consumption	ca.	kg/h [3]	0.44	~	~
Electrical efficiency		%	40.3%	38.9%	36.2%
Thermal efficiency		%	42.6%	43.5%	45.3%
Total efficiency		% [6]	82.9%	82.4%	81.5%
Hot water circuit:					
Forward temperature		°C	90.0	85.8	81.7
Return temperature		°C	70.0	70.0	70.0
Hot water flow rate		m <sup>3</sup> /h	64.9	64.9	64.9

\*) approximate value for pipework dimensioning  
 [ ] Explanations: see 0.10 - Technical parameters

All heat data is based on standard conditions according to attachment 0.10. Deviations from the standard conditions can result in a change of values within the heat balance, and must be taken into consideration in the layout of the cooling circuit/equipment (intercooler; emergency cooling; ...). In the specifications in addition to the general tolerance of +/- 8% on the thermal output a further reserve of 10% is recommended for the dimensioning of the cooling requirements.



### Main dimensions and weights (container)

Length	mm	~ 12,200
Width	mm	~ 3,000
Height	mm	~ 2,600
Weight empty	kg	~ 35,600
Weight filled	kg	~ 37,500

### Connections

Jacket water inlet and outlet	DN/PN	100/10
Exhaust gas outlet	DN/PN	300/10
Fuel gas connection (container)	mm	150/16
Fresh oil connection	G	28x2"
Waste oil connection	G	28x2"
Cable outlet	mm	800x400
Condensate drain	mm	18

### Output / fuel consumption

ISO standard fuel stop power ICFN	kW	1,466
Mean effe. press. at stand. power and nom. speed	bar	16.00
Fuel gas type		Biogas
Based on methane number	MZ d)	100
Compression ratio	Epsilon	12.50
Min./Max. fuel gas pressure at inlet to gas train	mbar	120 - 200 c)
Allowed Fluctuation of fuel gas pressure	%	± 10
Max. rate of gas pressure fluctuation	mbar/sec	10
Maximum Intercooler 2nd stage inlet water temperature	°C	55
Spec. fuel consumption of engine	kWh/kWh	2.41
Specific lube oil consumption	g/kWh	0.30
Max. Oil temperature	°C	85
Jacket-water temperature max.	°C	90
Filling capacity lube oil (refill)	lit	~ 437

c) Lower gas pressures upon inquiry

d) based on methane number calculation software AVL 3.1



## 0.02 Technical data of engine

Manufacturer		GE Jenbacher
Engine type		J 420 GS-A81
Working principle		4-Stroke
Configuration		V 70°
No. of cylinders		20
Bore	mm	145
Stroke	mm	185
Piston displacement	lit	61.10
Nominal speed	rpm	1,800
Mean piston speed	m/s	11.10
Length	mm	3,750
Width	mm	1,580
Height	mm	2,033
Weight dry	kg	6,600
Weight filled	kg	7,300
Moment of inertia	kgm <sup>2</sup>	11.64
Direction of rotation (from flywheel view)		left
Flywheel connection		SAE 18"
Radio interference level to VDE 0875		N
Starter motor output	kW	9
Starter motor voltage	V	24

### Thermal energy balance

Energy input	kW	3,538
Intercooler	kW	286
Lube oil	kW	165
Jacket water	kW	400
Exhaust gas total	kW	1,110
Exhaust gas cooled to 180 °C	kW	737
Exhaust gas cooled to 100 °C	kW	931
Surface heat	kW	71
Balance heat	kW	35

### Exhaust gas data

Exhaust gas temperature at full load	°C [8]	470
Exhaust gas mass flow rate, wet	kg/h	8,098
Exhaust gas mass flow rate, dry	kg/h	7,526
Exhaust gas volume, wet	Nm <sup>3</sup> /h	6,295
Exhaust gas volume, dry	Nm <sup>3</sup> /h	5,609
Max. admissible exhaust back pressure after engine	mbar	60

### Combustion air data

Combustion air mass flow rate	kg/h	7,466
Combustion air volume	Nm <sup>3</sup> /h	5,775
Max. admissible pressure drop in front of intake-air filter	mbar	10

basis for exhaust gas data: natural gas: 100% CH<sub>4</sub>; biogas 65% CH<sub>4</sub>, 35% CO<sub>2</sub>



### Sound pressure level

<b>Aggregate b)</b>		<b>dB(A) re 20<math>\mu</math>Pa</b>	<b>97</b>
31,5 Hz		dB	79
63 Hz		dB	87
125 Hz		dB	98
250 Hz		dB	95
500 Hz		dB	91
1000 Hz		dB	86
2000 Hz		dB	88
4000 Hz		dB	92
8000 Hz		dB	89
<b>Exhaust gas a)</b>		<b>dB(A) re 20<math>\mu</math>Pa</b>	<b>115</b>
31,5 Hz		dB	95
63 Hz		dB	117
125 Hz		dB	115
250 Hz		dB	113
500 Hz		dB	108
1000 Hz		dB	105
2000 Hz		dB	108
4000 Hz		dB	109
8000 Hz		dB	107

### Sound power level

<b>Aggregate</b>		<b>dB(A) re 1pW</b>	<b>117</b>
<b>Measurement surface</b>		<b>m<sup>2</sup></b>	<b>107</b>
<b>Exhaust gas</b>		<b>dB(A) re 1pW</b>	<b>123</b>
<b>Measurement surface</b>		<b>m<sup>2</sup></b>	<b>6.28</b>

a) average sound pressure level on measurement surface in a distance of 1m according to DIN 45635, precision class 2.  
 b) average sound pressure level on measurement surface in a distance of 1m (converted to free field) according to DIN 45635, precision class 3.  
 Operation with 1200 rpm see upper values, operation with 1800 rpm add 3 dB to upper values.  
 Engine tolerance  $\pm$  3 dB



**STANDARD VALUES for exhaust gas emissions**

**GE Jenbacher gas engines 2007**

		J420	
		C81	C82
		bio	bio
bhp		1966	1966
kWeI		1426	1426
Minimum MIN			
NOx	mg/m3	500	250
	g/bhp.hr	1.1	0.6
	ppm (15%O2)	92	46
	lbs/hr	4.77	2.60
	tons/yr	20.9	11.4
CO	mg/m3	1500	1500
	g/bhp.hr	3.4	3.4
	ppm (15%O2)	450	450
	lbs/hr	14.7	14.7
	tons/yr	64.6	64.6
NMHC	mg/m3	100	100
	g/bhp.hr	0.2	0.2
	ppm (15%O2)	25	25
NMNEHC	mg/m3	50	50
	g/bhp.hr	0.1	0.1
	ppm (15%O2)	10	10
PM10	mg/m3	55	55
	g/bhp.hr	0.15	0.15
	lbs/hr	0.65	0.65

- Remarks:
- These are standard values. Specific emission values may vary with fuel gas analysis and engine adjustment.
  - CO emissions are long time values provided engine maintenance according factory schedule; CO emissions at startup are lower
  - Standard conditions 60 degF, 14.696 psia
  - tons/yr are based on 8760 hrs/ yr and 907.2 kg/ton
  - mg/m3 are at normal conditions of 0 deg C and 1.013 bar and at 5% O2
  - Natural gas composition used: 95% Methane (CH4), 2% Ethane (C2H6), 1% Propane (C3H8), 1% CO2, 1% others
  - Biogas composition used: 65% Methane (CH4), 35% CO2
  - NMHC: Ethane density used; NMNEHC: Propane density used
  - MN means Methane Number which is 100 for Methane and 33 for Propane (MN is not the CH4 contents!)

**BIOFILTER MANUFACTURER DATA**



# BIOREM

## BIO-EN Proposal – Two Modular Units

### 1.0 Product Description

The BASYS<sup>®</sup> modular system extracts foul air for subsequent preconditioning in the humidification stage and oxidation through the BIOSORBENS<sup>®</sup> media bed prior to atmospheric discharge.

Odourous compounds in the air entering the biofilter are solubilized into the moisture layer surrounding the individual media particles or are adsorbed directly to their surface. Bacteria present within this moisture film utilize the compounds as substrate. The compounds are biologically oxidized to CO<sub>2</sub>, H<sub>2</sub>O and inorganic salts and clean air is discharged to atmosphere. It is critical that the filter creates an optimal environment to enhance microbial development. Maintaining proper air temperature, pH, moisture and nutrient levels are essential for favorable biofilter performance and removal efficiency.

### 2.0 Project Details

The biofilter system shall be designed to remove odourous constituents from a process air stream under the following operating conditions:

<u>Process Parameter</u>	<u>Value</u>
Flow Rate	20,000 m <sup>3</sup> /hr
Inlet Air Temperature:	18 C – 40 C
Average Inlet RH:	Min 30 %
Average Inlet Particulate Conc.:	Clean Air
<b>Type of Contaminant:</b>	<b>Average / Peak Concentration Levels</b>
H <sub>2</sub> S (ppm)	<10                      <15
NH <sub>3</sub> (ppm)	< 5                         < 15
Organic Sulfides	< 2
Odour (Odour Units)	< 10,000

The biofilter system will conform to the following specified parameters:

<u>Design Parameter</u>	<u>Value</u>
Model of Modular Biofilter:	BASYS <sup>®</sup> 50X
Material of Construction:	FRP
Media Depth:	1.83 m
Media Volume:	94 m <sup>3</sup>
Internal Biofilter Dimensions (L:W:H):	15.2 m : 3.4 m : 2.4 m
Footprint Dimensions (L:W):	16.7 m : 3.7 m
Water Consumption (Humidification):	3.34 m <sup>3</sup> /day
Water Consumption (Irrigation):	2.3 m <sup>3</sup> /day
Electrical (V):	575V, 120V
Empty Weight Biofilter Unit (kg):	10120 kg
Full Weight Biofilter Unit (kg):	153,735 kg



# BIOREM

## BIO-EN Proposal – Two Modular Units

### 3.0 System Performance

- A. When loaded under average and peak conditions the biofilter system shall provide at least 99 percent removal of H<sub>2</sub>S when operated at a maximum, equal to the design air flow rate.
- B. Odour Removal Requirements: The biofilter system shall provide 85% removal for average inlet concentration levels of less than 10,000 and greater than or equal to 5000 OU. For inlet concentration levels less than 5000 OU, the outlet concentration levels shall be less than 500 D/T. (Odor D/T concentrations to be determined using ASTM-E679 with a 20 liter/minute odor panel presentation rate).
- C. The system shall be operated under positive pressure.

### 4.0 Warranties

- A. The Manufacturer warrants that the biofilter media will not compact, degrade or decompose for a period of 10 years from the date of Substantial Completion, provided that the system is operated in accordance with the Manufacturer's printed Operation and Maintenance Manuals.
- B. All mechanical components shall be warranted free of manufacturing defects for a period of 12 months from substantial completion.

### 5.0 Scope of Supply

- A. The following components are provided with each BASYS 50X unit:
  - 1. Modular biofilter tank with integral humidification and removable covers. Material of Construction to be UV and H<sub>2</sub>S resistant FRP.
  - 2. 94 m<sup>3</sup> of BIOSORBENS<sup>®</sup> biofilter media provided in bulk.
  - 3. Media surface irrigation systems. Composed of 25 mm, schedule 80 PVC pipe, with unions, tees and spray nozzles for full surface coverage of the Biofilter media bed.
  - 4. Humidification system, integral to the biofilter vessel. Complete with humidification packing and spraying system
  - 5. 25 HP Centrifugal FRP exhaust fan, TEFC, Class 1, Division 2 motor.
  - 6. Level 1 Instrumentation and controls.
    - i. NEMA 12 steel control panel (Compact Logix AB PLC with HMI) , complete with fused disconnect. Includes all system controls, pilot and alarm lights, motor starters, and (2) dry contacts for transmitting signals



# BIOREM

## BIO-EN Proposal – Two Modular Units

- to remote location [To be mounted inside – 1 Control Panel for Two Biofilter Units].
- ii. 25 HP VFD with dial speed control.
  - iii. Timer and normally closed solenoid valve for irrigation control
  - iv. Flow indicating totalizer to record irrigation system water usage.
  - v. Flow indicator/switch, to display humidification water flow rate and signal alarm in case of reduced water flow.
  - vi. Local pressure gauge on humidification line.
  - vii. Media temperature gauge.
  - viii. Static pressure gauges before and after system fan.
  - ix. Static pressure gauge to measure pressure drop across media bed.
  - x. 3 HP Recirculation Pump
7. Winterization system: consisting of a 95.3 KW immersion heater with integral thermostat for temperature control.
  8. 5 Submittal packages
  9. Operation and Maintenance Manuals – CD form.
  10. A 1-year BIOSERVE service support package. Includes site visit and system inspection within the first 6 months of system commissioning, media sampling and analysis, system spot performance testing.
  11. Commissions will consist of 1 trip and a maximum of 3 days for system commissioning & operator training.
- B. The following items listed are to be supplied by the Contractor and are not in the Manufacturer's Scope of Supply.
1. All equipment offloading, temporary storage and placement.
  2. Installation and assembly of all equipment and instrumentation components required for a complete system including labor, equipment and materials. Equipment installation to include biofilter vessel, fan, control panel and all associated instrumentation and components, where applicable.
  3. Installation site including site preparation and clearing of materials.
  4. Design and provide an appropriately sized reinforced concrete slab to handle full load of the biofilter vessel and fan.
  5. Supply and install all required protective coatings.



# BIOREM

## **BIO-EN Proposal – Two Modular Units**

6. Supply and install all external water piping and drain piping to and from the biofilter vessel and humidification equipment including heat tracing, insulation, piping supports, drainage traps where necessary and / or UV protective paint.
7. Supply and install air ductwork to and from the biofilter system including exhaust stack, interconnecting ducting, manual or actuated dampers, filters, insulation and piping supports.
8. Supply and install all hardware, supports, guide wires, duct gaskets, expansion joints and connectors needed for a complete and operational system.
9. Media onsite storage and installation. The OTHER party shall be required to remove biofilter cover, install and distribute media evenly across the biofilter, assemble media irrigation system and reinstall cover. Media to be shipped in bulk (end dump truck), unless otherwise requested in writing.
10. Utility requirements including main electrical service and system field wiring outside the main biofilter control panel, water supply at minimum pressure of 40psi. All electrical requirements for heat tracing and equipment not specifically provide by BIOREM® to be provided by others.
11. Duct balancing, and system functional, hydrostatic, vibration and performance testing to be conducted by OTHERS as specified.



**Potential Contaminants in inlet ducting before biofilter from organic waste facilities**

<b>Compound</b>	<b>Range</b>
Ammonia	5 - 25 ppm
Trimethylamine	0.005 – 1.5 mg/m <sup>3</sup>
Triethylamine	0.02 – 1.0 mg/m <sup>3</sup>
Hydrogen Sulphide	ND – 10 ppm
Methyl Mercaptan	0.05 – 1.0 ppm
Ethyl Mercaptan	0.05 - 0.4 ppm
Dimethyl Sulphide	0.05 – 1.0 ppm
Dimethyl Disulphide	0.1 – 0.8 ppm
Butanol	0.002 – 10 mg/m <sup>3</sup>
Alpha-pinene	ND – 1ppm
Limonene	ND – 10.5 mg/m <sup>3</sup>
Acetic Acid	0.3 – 5.0 mg/m <sup>3</sup>
Oleic Acid	ND – 0.5 ppm
Butyric Acid	ND – 0.5 ppm

Cyclopentanol	ND – 8 mg/m <sup>3</sup>
Propylacetate	ND – 5 mg/m <sup>3</sup>
Propylbutyrate	ND – 8 mg/m <sup>3</sup>
Pentanone	0.05 – 2 mg/m <sup>3</sup>
Me-isobutylketone	0.003 – 10 mg/m <sup>3</sup>
Nonanal	ND – 5 mg/m <sup>3</sup>

**NOTES:**

- 1) This summary data is provided by Senior BIOREM Process Engineers based on some actual sampling (ex. hydrogen sulfide, TRS compounds), literature presented at conferences and professional estimates. Normally in applications where odour removal is the primary requirement very little data is collected on the individual chemicals compounds except perhaps for hydrogen sulfide or possibly some reduced sulfur compounds.
- 2) None of this data would include the impacts of manure as BIOREM has not yet installed any animal manure applications; however, BIOREM has many installations in municipal wastewater treatment plants.

## Summary of Odour Levels Going into the Biofilter from Organics Management Facilities

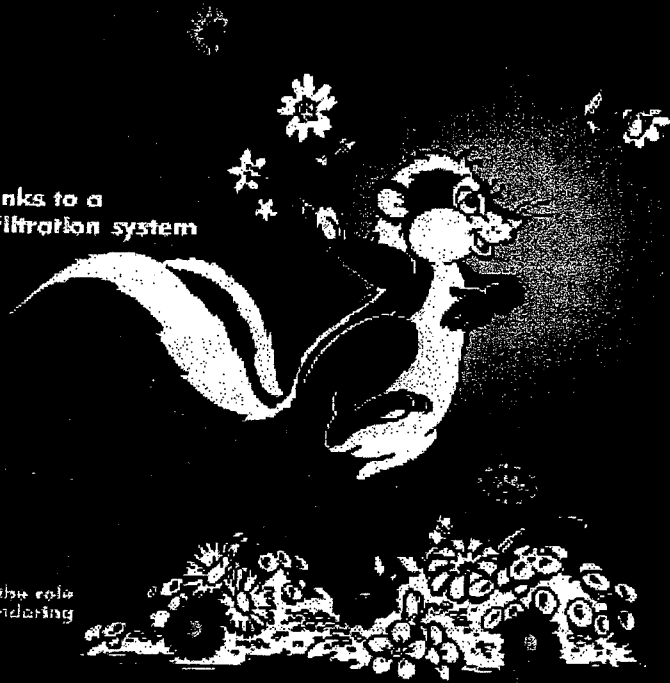
Location / Source	Odour Levels	Comments
Rendering Plants Odours	10,200 OU/m <sup>3</sup> (Max.) 6,275 OU/m <sup>3</sup> (Avg.)	Article in Render Magazine June 2005 about Rothsay Dundas Pg 10, 11, 21. About 75% of the air volume at this facility is from plant air (tipping floor etc) and about 25% is from Process Air (cookers, dryers etc) so it probably overstates the odour levels vs an AD facility that does not include much processing or elevated temperatures.
Source Separated Organics (Region of Peel)	6,150 OU/m <sup>3</sup>	See Paper, <i>Advanced Odour Management Program for Municipal Composting</i> . Odours are from both the tipping floor and composting tunnels so odour levels are probably higher than what an AD process would experience.
Source Separated Organics & Biosolids (Cape Breton Regional Municipality)	13, 085 OU/m <sup>3</sup>	See Paper, <i>Advanced Odour Management Program for Municipal Composting</i> . Odours are from both the tipping floor and composting tunnels so odour levels are probably higher than what an AD process would experience.

The National Magazine of Rendering June 2009

# Render

Thanks to a  
biofiltration system

And the role  
of rendering



# Odor Problem Solved

By Clifford Seth  
Indumark

Engineering management at Rothsay, a rendering facility in Canada, reports it has all but eliminated odor complaints by installing a 250,000 cubic feet per minute (cfm) biofiltration system, replacing a scrubber system that could no longer provide sufficient removal efficiencies.

Tests conducted soon after startup in August 2003, with triplicate samples collected on three occasions over a two-week period, revealed an overall removal of greater than 94 percent. Preliminary results of Ontario's Ministry of the Environment (MOE) compliance testing that began in the spring of 2004 indicated average odor removal of 92 percent. Recent testing by a third-party consulting firm confirmed average removal efficiencies of 94 percent, with highs of 97 percent.

The new system was designed, manufactured, and installed by Biorem Technologies of Guelph, ON, Canada, who used their Biosorbens inorganic biofilter media. The company's technology was selected following extensive study and consideration of alternatives by Rothsay's corporate environmental engineering group and their consulting firm. The team established a 90 percent odor removal at all times as the primary design criterion.

"The scrubber system did its job for a long time, but increased residential development around the facility resulted in odor issues," recalled Amar Aulkh, Rothsay's chief engineer at their Dundas, ON, plant. "Performance testing on the scrubber system conducted in 2002 showed that odor removal efficiency was below our 90 percent target.

"We've seen a big difference since we installed the new system, with four or five tests since startup all

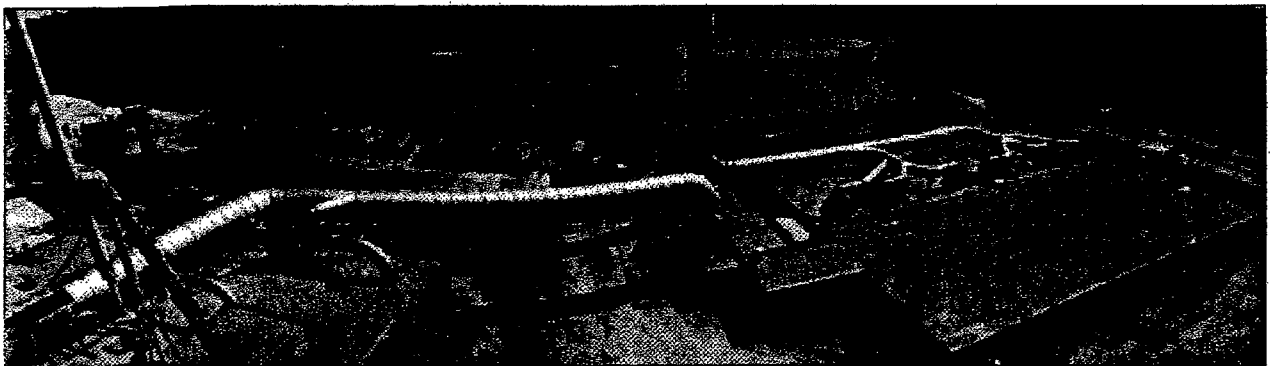
showing 90 percent removal, and community concerns have significantly decreased," Aulkh commented. "This has helped us fulfill our environmental commitment, which includes assuring sound environmental management by requiring visible technology accountability at every level."

In addition to the technology accountability requirement, Rothsay's mission statement includes setting specific environmental performance goals as part of strategic planning and designing for the future. Environmental performance of the facility has been incorporated into the operation of the plant since its startup in the mid-1950s, and continues to be an integral aspect of operations.

The plant started with one scrubber, increasing to six by 2002 as the treated odorous gas stream increased from 50,000 cfm to 250,000 cfm. Its odor control system main collection duct receives input from multiple areas in two main buildings, with input from each area ranging from 60 cfm to 10,000 cfm. The scrubbers, two including primary with venturi, one with venturi only, and the other three air-through, had utilized sodium hypochlorite at 12 percent to remove odor, and potassium hydroxide to maintain pH.

"When we tested the scrubbers' performance in 2002, we found their performance no longer met our standard," Aulkh said. "To solve the problem, we tested alternative scrubbers that utilized chlorine dioxide, ozone, chlorine dioxide and ozone simultaneously, and a neutralizer, but could not get the 90 percent removal efficiency we needed.

"At the same time," he continued, "we had learned about biofiltration and incineration as part of a broad alternative methodology search that we also conducted. We determined that incineration was a cost-prohibitive alter-



*A multiple-port duct collection network from the original scrubber system was incorporated into the replacement biofiltration system. Input from ports in two main buildings ranges from 60 cfm to 10,000 cfm for each port.*



# Thanks to a biofiltration system



native for our operations at [one] point in time, and that this technology relies on long-term dependence on fuels.

"That moved the focus to biofiltration, and we spent a month testing odor removal efficiencies from airstreams from different areas of the plant, using media supplied by Biorem that they claimed had important differences compared to standard wood chip media," Aulkh stated. "The other biofiltration technology providers claimed to achieve similar effectiveness with their wood chip media, but their wood chips needed replacement every two or three years, which was a big job we wanted to avoid. Biorem claimed theirs would last 10 years.

"We evaluated all of the biofiltration technology providers, and chose Biorem because they had a combination of better warranty, closer proximity to our operations, and fair pricing. They also had a willingness to help us solve the problem as quickly as possible, which was important because MOE wanted quick action on the concerns we were receiving from the local community."

The odor control project decision was finalized in November 2002, following a one-month pilot-testing program with a proportional flow taken from each area of the plant.

"It did considerably better than the scrubbers right away, and we quickly got the removal efficiency over 90 percent," Aulkh noted. "The pilot was important, because while we had visited four or five biofiltration installations and were impressed with the performance of all of them – you could stand on the filtration bed and not smell anything offensive – we didn't know if they would work for our plant."

Construction of the final system began in January 2003, with both the plant's consulting firm and Biorem on site until completion in August. The multiple-port duct collection network from the original scrubber system was incorporated into the biofiltration system, but the main duct now leads into the Biorem system. This new system begins with its three-chamber preconditioning unit, where water from plant recycling and fresh water sources is sprayed into the gas stream at 500 gallons per minute in each chamber to achieve 98 percent relative humidity within the stream – above the 95 percent minimum Biorem recommends.

The gas stream then moves to a mist eliminator for water drop removal, followed by an inlet plenum common to the two banks of three biofiltration cells. Each of the six cells contains a five-and-a-half-foot bed of the Biosorbens media, and has a fan to draw the stream from the top of the bed and out the bottom to the outlet plenum. Individual cells can be isolated for work if needed, with the other five still in operation. As part of the contract, media

## Test Day 1. Media Temp 18-20°C

	Inlet odor units/m <sup>3</sup>	Inlet odor units/m <sup>3</sup>	% Removal
Sample 1	2,856	364	
Sample 2	3,152	357	
Sample 3	2,664	282	
Average	2,901	328	89

## Test Day 2. Media Temp 16°C

	Inlet odor units/m <sup>3</sup>	Inlet odor units/m <sup>3</sup>	% Removal
Sample 1	10,168	164	
Sample 2	10,212	173	
Sample 3	10,212	164	
Average	10,197	167	98

## Test Day 3. Media Temp 14°C

	Inlet odor units/m <sup>3</sup>	Inlet odor units/m <sup>3</sup>	% Removal
Sample 1	4,218	237	
Sample 2	5,905	228	
Sample 3	7,060	182	
Average	5,728	215	95

m<sup>3</sup> = cubic meter

*As shown above, the first few tests for the biofiltration system showed average odor removal greater than 94 percent, exceeding the 90 percent design criterion. Later testing by Ontario's regulatory agency indicated average odor removal of 92 percent, and recent tests by a third-party consulting firm showed 94 percent.*

samples are sent to Biorem every four months for checking on the effectiveness of the odor-removing microbes.

Each cell handles an equivalent amount of captured plant and process air, with each 150 horsepower fan working with a variable frequency drive (VFD) and controlled by a programmable logic controller (PLC). Rothsay has recently completed installation of a similar size biofiltration system at their Moorefield, ON, plant.

"The VFDs are good to have," Aulkh noted. "With the extremes of heat and cold we have, we can vary the horsepower accordingly, knocking it down to as low as 25 percent of capacity when there is no processing going on during a winter weekend.

"It is a good, environmentally-friendly system that works," he concluded. "There are no chemicals. It is easy

*Continued on page 21*

**Biofilter** *Continued from page 11*

to operate, all automatic, with our stationary engineers having PLC panels for routine monitoring of temperatures, pressures, and flows. There haven't been any problems with the process, we've just had to clean out the mist eliminator and the preconditioning chamber sump every couple of months."

Biorem describes its Biosorbens media as designed to handle a wide range of odor-causing compounds, and also suitable for removal of volatile organic compounds. Compound classes successfully treated include aldehydes, ketones, alcohols, volatile fatty acids, and aliphatic and aromatic hydrocarbons.

The media is said to maintain a balance between optimal growing conditions for the microbes, while offering ideal pressure drop through the media, high moisture retention, long operating life, and resistance to decomposition and compaction, while providing a surface on which the biomass film can flourish.

It is described as consisting of inert, uniformly shaped hydrophilic cores that are produced with nutrient-rich organic and inorganic adsorbents. These characteristics are said to decrease residence time, and increase serviceable life to more than 10 years. Its high surface area-to-volume ratio is said to result in requiring only one-third the space needed by organic medias.

Biorem, established in 1994, offers a comprehensive monitoring and support program for its biofilters and media. Its resources include experienced engineers, chemists, and industrial microbiologists, and state-of-the-art laboratory and research facilities. ♦

**FLARE MANUFACTURER DATA**

## BIOGAS CONTROL AND SAFETY SYSTEM



WASTE GAS BURNERS

# MODEL 8391B

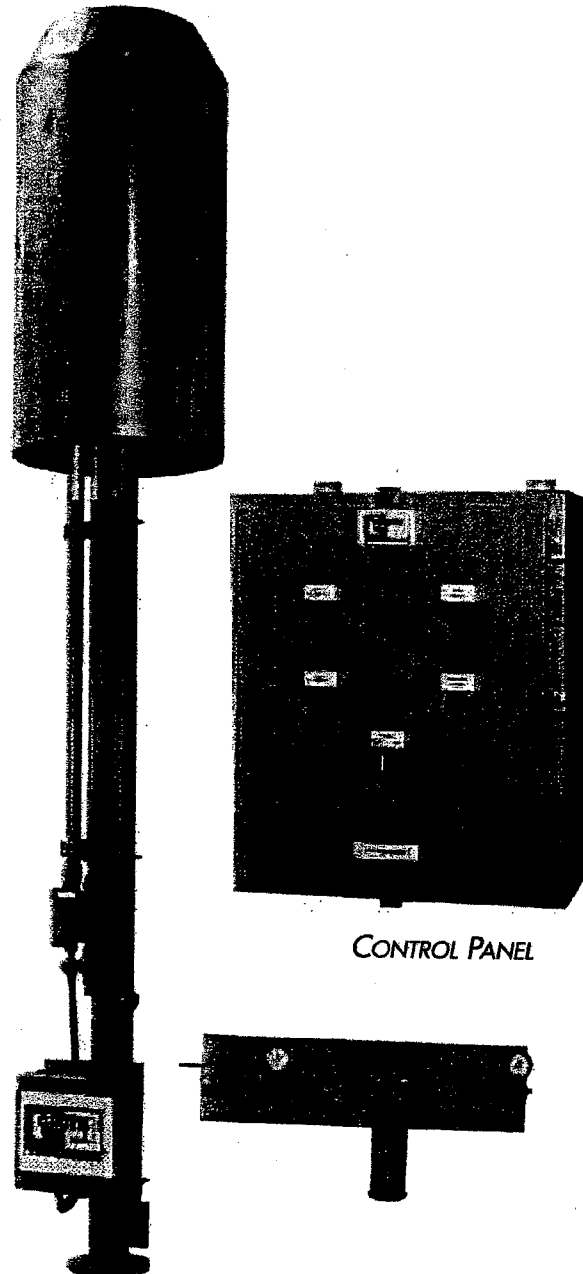
- Sizes 2" through 12"
- All stainless steel construction in flame area
- Automatic ignition and re-ignition
- Stoichiometric pilot on all burners
- Efficient combustion with biogas BTU value as low as 300/cu. ft.
- Reliable "downdraft prevention" for wind protection
- Flame retention vortex vanes vastly improve burning efficiency
- Pilot system operates as low as 4" WC
- Quick, easy maintenance
- Flame front generator (FFG) pilot ignition system available
- Fully enclosed flare (FEF) configuration available for high destruction rate efficiency

### WASTE GAS IGNITION & BURNER SYSTEM

The Model 8391B includes an ignition system with all of the best features available in a waste gas burner. The burner wind shield contains the unique "downdraft prevention" with a bevel design which virtually eliminates the possibility of the flame being blown out. The design also provides the proper air/fuel mixture to ensure an efficient burn. The wind shield will control outside winds, up to 150 MPH, and operates efficiently in heavy rains. This will prevent smoke and odors from permeating the neighborhood.

### FEATURES

The automatic ignition option provides extra high reliability coupled with "state-of-the-art" positive pilot ignition. When gas is to flow, a signal to the control panel causes the solenoid to open providing gas to the pilot. The ignitor then sparks until the pilot is lit. The system does not require compressed air,



CONTROL PANEL

MODEL 8391B

adjustments for various gases, or separate ignition line. You may choose to locate the control panel close to the burner or at some remote distance.

The unique burning system of the Groth gas flares contain flame retention vortex vanes in the tip of the burners and when coupled with the "downdraft prevention" in the shield, the result is an updraft and an air mixing action that will provide excellent high efficiency, smokeless and odorless burning. With the prevention of "flame licking", the requirement for a remote ignition source (flame front) and associated piping and other problems are eliminated. Trouble-free start-up is assured. All adjustments and maintenance can be performed safely at ground level. An additional benefit to the "downdraft prevention" in the main burner is the fact that winds up to 150 MPH or heavy rain will not take out the flame.

The control system provides contacts for remote indication of "Pilot flame failure" and "Pilot flame on", as well as panel lights for "Pilot flame on", "Pilot flame failure", "Thermocouple OK" and "Pilot gas on". All Groth pilot systems are provided with an inspirating venturi to insure a stoichiometric mixture of the pilot gas. A solenoid valve is included with each automatic pilot system. Fuel consumption of the pilot is only 22-150 SCFH. Normal operating pressure range of the pilot is 4" WC to 10 psig. The reduced fuel consumption at a manageable waste gas pressure means that it might be possible to utilize biogas for the operation of the pilot system. However, natural gas with a supply pressure of 5 to 10 psig (specify exact pressure when ordering) is recommended for optimum pilot operation.

The Groth Model 8391B offers several options to meet your specific requirements. For example, the burner can be provided with (1) Manual Electric Ignitor which will provide manual start-up ignition

from a remote location. A switch in a remote weatherproof enclosure will be provided to operate a sparking electrode at the pilot tip. (Flame sensing is not included in this system). (2) Automatic Electric Pilot Ignition System which provides a fully automatic start-up, flame monitoring, re-ignition and alarming system. This automatically operated system will provide auto-ignition from a contact closure (usually a pressure switch), sense pilot flame status, provide automatic re-ignition sequencing and flame failure alarm, and provide status lights on the control panel and contacts for remote monitoring. A manual mode override will be provided on the control panel. Additionally, the pilot solenoid valve is included in the fully automatic system manifold. (3) Dual Flame Sensing which provides pilot shut down while main burner flame is burning and re-ignition if main burner flame fails, conserving pilot fuel. (4) Flame front generator which meters and combines fuel gas and air creating a combustible air/gas mixture (fireball) in the ignition line. An automatic self-inspirated control system for ignition and re-ignition provided.

### OPERATION

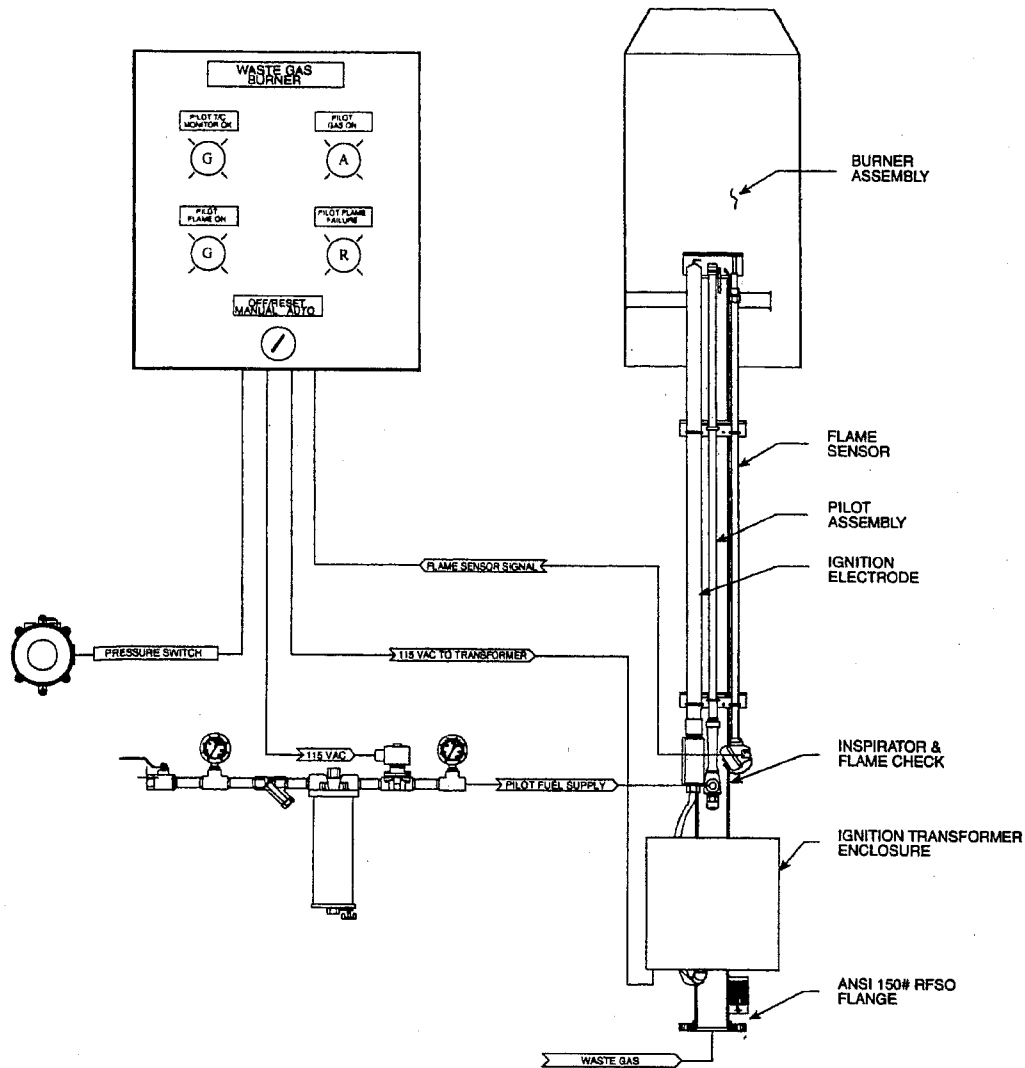
When gas is to flow to the burner, a signal to the control panel (normally, a contact closure) causes the solenoid to open, providing a stoichiometric air/fuel mixture to the pilot. The ignitor begins sparking and continues until the pilot is lit. The flame sensor will signal "flame on" and the sparking will cease.

When the biogas arrives at the burner tip, ignition immediately takes place and the burn is continuous until the gas supply is removed. The pilot will continue to be ignited until the signal is received (contact is opened). The pilot start signal may be provided by a Groth supplied pressure switch. When flaring of the gas is required again, the above sequence will be repeated.

SPECIFICATION TABLE \* MODEL 8391B

Specifications subject to change without notice.  
Certified dimensions available upon request.

Nominal Diameter of Burner D <sub>B</sub> (mm)	Flow Rate SCFH SG = 0.8 CF = 50" WC Temp = 60°F	Minimum Recommended Overall Height Above Grade H <sub>S</sub> (mm)	Minimum Recommended Safe Distance To Control Panel D <sub>C</sub> (mm)	Diameter of Shield D (mm)	Burner Weight Lbs (kg)
2" (50 mm)	4,040 (114)	10' (3.0 mm)	8' (2.4 mm)	18" (457 mm)	176 (80 kg)
3" (80 mm)	9,090 (257)	12' (3.7 mm)	10' (3.0 mm)	18" (457 mm)	212 (97 kg)
4" (100 mm)	16,200 (459)	12' (3.7 mm)	15' (4.6 mm)	24" (610 mm)	272 (124 kg)
6" (150 mm)	36,400 (1021)	12' (3.7 mm)	22' (6.7 mm)	24" (610 mm)	363 (165 kg)
8" (200 mm)	64,600 (1794)	16' (4.9 mm)	28' (8.5 mm)	30" (762 mm)	512 (233 kg)
10" (250 mm)	100,930 (2808)	20' (6.1 mm)	36' (11.0 mm)	36" (914 mm)	572 (260 kg)
12" (300 mm)	144,600 (4020)	25' (7.6 mm)	42' (12.8 mm)	36" (914 mm)	619 (282 kg)



## MAINTENANCE

All components and controls for the pilot system are easily accessible at ground level. No components that would require adjustment or periodic maintenance are located in the flame area. Most maintenance checks can be made safely while the burner is in operation.

## BURNER CAPACITY

Digester gas containing methane, see page 41.

## BURNER CONSTRUCTION

Carbon Steel lower burner pipe with 150# flange mounting. Stainless steel upper burner pipe and windshield. Alloy pilot nozzle and cast iron venturi. Self supporting on 150# flange with 150 mph winds and zone 4 seismic coefficient. Other mounting plates optional. Control panel may be remotely installed from burner.

## SPECIFICATIONS

### Electrical

115V, 1PH, 60 Hz, 10 AMP, grounded neutral  
 Contacts for remote monitoring — (1) NO, 3 AMP, "Flame On" — (1) NO, 3 AMP, "Flame Failure"

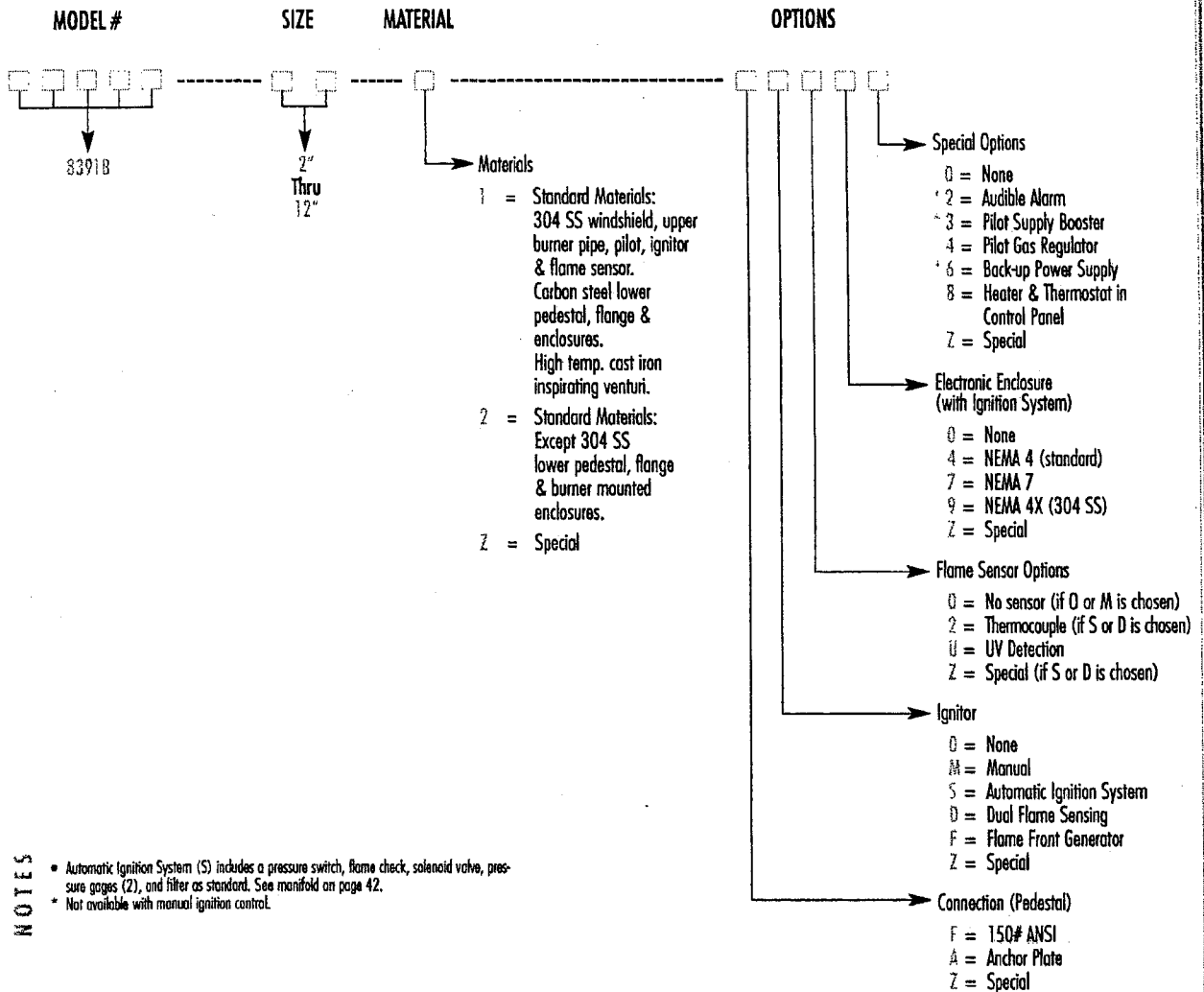
### Enclosures

Standard: Nema 4, Weatherproof  
 Optional: Nema 4X, Nema 7, etc.  
 Pressure Switch — Explosion Proof; 4" - 20" WC  
 Range; 0.4" - 0.6" WC Deadband

### Pilot Fuel for stoichiometric pilot

- \* Natural Gas — 4" WC to 10 psig Supply Pressure
  - \* LPG — 1 psig to 10 psig Supply Pressure
  - \* Digester Gas 4" WC to 10 psig Supply Pressure
- Pilot Consumption: 22-150 SCFH

**HOW TO ORDER  
FOR EASY ORDERING, SELECT PROPER MODEL NUMBER**



**NOTES**

- Automatic Ignition System (S) includes a pressure switch, flame check, solenoid valve, pressure gages (2), and filter as standard. See manifold on page 42.
- \* Not available with manual ignition control.

**EXAMPLE**

8 3 9 1 B - 1 0 - 2 - F S 2 4 0

Indicates a 10" Model 8391B constructed with standard materials except stainless steel lower pedestal. Options include 150# ANSI connection, automatic ignition system using a thermocouple sensor in a standard NEMA 4 electronic enclosure.

# **HIGH EFFICIENCY, COMPACT**

## **CLEARFIRE®-W COMMERCIAL HOT WATER BOILER**



**ClearFire® - W**  
400 - 2,400 MBH

# ClearFire, the New Standard in Commercial High-Efficiency Firetube Boilers

## CLEARFIRE BOILERS

The ClearFire-W non-condensing commercial hot water boiler offers high efficiency, low NOx technology

and as such satisfies demands for economy and environmental protection. It features the C-B ClearFire combustion system with pre-mix down firing burner. This advanced burner is fundamental to the boiler achieving efficiencies up to 88% and NOx levels to less than 20 PPM. The pre-mix burner is suitable for use with natural gas. ClearFire boilers are available in 7 sizes with maximum inputs between 400 - 2,400 MBTU. They are suitable for central heating for working pressures up to 125 psig.

### Key Design features:

- ASME Section IV carbon steel construction, 125# design
- 400 - 2,400 MBTU
- Up to 88% efficiency
- Up to 5:1 turndown
- Low NOx at < 20 PPM
- Advanced Falcon controls seamlessly integrates up to 8 boilers
- Uses the patented AluFer® tube
- Compact footprint
- Easy maintenance
- Single pass design
- Thermal shock resistance

## CONTROLS

### C-B Falcon Controls

The C-B Falcon is a total boiler control that provides our customers with the integrated functionality needed to efficiently and economically operate their boiler system, while providing necessary safety and reliability.

- A single source solution for total Boiler control
- Touch screen graphics with trending
- Three configurable relays (pump/ valve)
- Post shutdown pump delay
- Outdoor temperature reset
- Supply & return water sensor
- High limit cut-out with manual reset
- Integrated Burner sequencing, alarming and lockout
- Date/time stamping of lockouts and alerts
- First out expanded annunciation, firing rate limiting, time of day (setback) and PID loops.
- ModBus (RS485) Communications
- Frost protection
- Modulation VSD combustion control
- UL Recognized



User-friendly Touch Screen Graphics

## ENHANCED EFFICIENCY

### Enhanced efficiency with single pass heat exchanger

The single pass ClearFire boiler has a premix burner downfiring into a vertical water surrounded tube nest made up of high efficiency AluFer® tubes.

The extended heating surface and corrosion resistant properties of the AluFer® tube ensure enhancing heat transfer and peak performance.

### AluFer® Tubes

The internationally patented AluFer® tube is the latest innovation in advanced heat transfer technology.

The tube is constructed from an inner (fireside) aluminum alloy finned surface, die fitted within an outer steel tube providing exceptional heat exchange characteristics.

The efficiency of the heat transfer is attributable to the following factors:

- Heat conductivity of the AluFer® insert is ten times greater than that of carbon steel.
- Internal finned surface of the AluFer® tube enlarges the heat exchange surface fivefold.
- Inner surface of the tube is divided into eight flow channels to create maximum turbulence and heat transfer.



# The ClearFire-W Advantage

## COMBUSTION CONTROL

### Premix modulating burner operation

The premix burner controls automatically adjust the air/gas mixture to the correct proportions before it enters the burner.

A symmetrical 360° even temperature heat output is achieved from the burner, giving consistent high efficiency combustion with low NOx emissions. Turndown is 5:1 with standard emissions of < 20 ppm.

### Burner Gas Train

Standard components meet the requirements of cULus, ASME CSD-1, XL-GAP, and FM. These items include:

- Low Gas Pressure manual reset.
- High Gas Pressure manual reset.
- CSD-1 Test Cocks
- Manual Test Valve

Gas Train is factory piped and wired on the burner. Gas supply connection should be made at the side of the boiler and include a drip leg.

### Boiler Trim and Controls

Boiler trim is in accordance with cUL and ASME CSD-1 which includes:

- High Limit Temperature Control — Manual Reset
- Combustion Air Proving Switch
- Manual Reset Probe Type Low Water Cutoff
- ASME Safety Relief Valve set @ 125 psig.

### Quality Assurance

Each ClearFire Boiler is manufactured in accordance with ASME Section IV requirements and appropriately stamped. Manufacturing process is according to ISO 9001 standards. The complete package is cULus certified, listed, and labeled.



Modulating low NOx Burner Assembly for Maximum Operating Efficiency

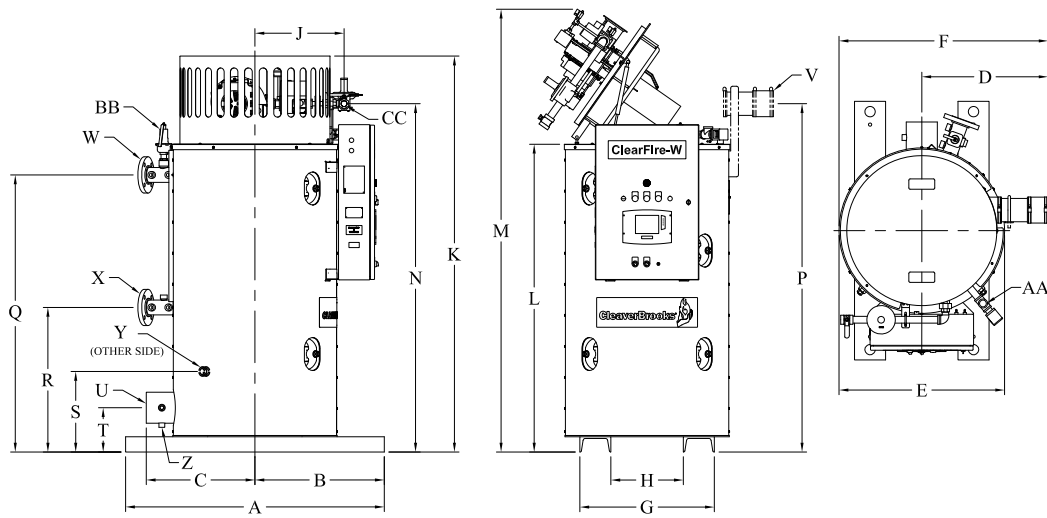
Fiber Mesh Fecralloy Burner Designed to Premix Air and Fuel for Optimal Combustion

Thermal Insulation with Steel Casing

Single Power Point for Electrical and Controls

Patented Alufer® Tubes for Increased Heat Transfer

Handhole(s) for Cleaning



## ClearFire®-W Boiler Dimensions and Ratings

ITEM	DIMENSIONS	BOILER SIZE						
		400	500	750	1000	1500	2000	2400
A	OVERALL LENGTH	50"	50"	55"	55"	56"	68"	68"
B	CENTERLINE TO BOILER FRONT	25"	25"	29"	29"	28"	35"	35"
C	CENTERLINE TO STACK OUTLET	21"	21"	24 ¾"	24 ¾"	25 ½"	28 ½"	28 ½"
D	CENTERLINE COMBUSTION AIR INLET	24 ½"	24 ½"	24 ½"	24 ½"	27"	37 ¼"	37 ¼"
E	BOILER O.D.	32"	32"	39"	39"	41"	47"	47"
F	OVERALL WIDTH	40 ½"	40 ½"	44"	44"	47 ½"	60 ¾"	60 ¾"
G	OUTSIDE WIDTH OF CHANNEL	26"	26"	28"	28"	30"	36"	36"
H	INSIDE WIDTH OF CHANNEL	14"	14"	16"	16"	18"	24"	24"
J	CENTERLINE TO GAS INLET	17 ¼"	17 ¼"	19 ¼"	19 ¼"	20 ¼"	22"	22"
K	OVERALL HEIGHT	76 ½"	82 ½"	76 ½"	82 ½"	88"	88"	94"
L	VESSEL HEIGHT	59 ½"	65 ½"	59 ½"	65 ½"	70"	67"	73"
M	BURNER DOOR CLEARANCE (OPEN)	85 ½"	91 ½"	84 ¾"	90 ¾"	99 ¾"	101"	107"
N	FLOOR TO GAS INLET	67 ½"	73 ½"	67 ½"	73 ½"	79 ½"	79 ¼"	85 ¼"
P	FLOOR TO AIR INLET	67 ¼"	73 ½"	67 ¼"	73 ½"	79 ½"	78"	84"
Q	FLOOR TO SUPPLY CONNECTION	53 ½"	59 ½"	54 ½"	60 ½"	64 ¾"	61 ¼"	67 ¼"
R	FLOOR TO RETURN CONNECTION	28"	31"	25 ¾"	25 ¾"	32 ¼"	31 ½"	34 ½"
S	FLOOR TO DRAIN	15 ½"	15 ½"	14 ½"	14 ½"	17 ¼"	19 ½"	19 ½"
T	FLOOR TO STACK OUTLET	8 ½"	8 ½"	8"	8"	9"	9 ¾"	9 ¾"
<b>CONNECTIONS</b>								
U	FLUE/STACK, NOMINAL OD	6"	6"	6"	6"	8"	10"	10"
V	SEALED COMBUSTION, AIR	4"	4"	4"	4"	6"	8"	8"
W	SUPPLY WATER, FLANGE	2 ½"	2 ½"	2 ½"	2 ½"	3"	4"	4"
X	RETURN WATER, FLANGE	2 ½"	2 ½"	2 ½"	2 ½"	3"	4"	4"
Y	BOILER DRAIN	1"	1"	1"	1"	1"	1 ¼"	1 ¼"
Z	CONDENSATE DRAIN	½"	½"	½"	½"	½"	½"	½"
AA	AIR VENT	1"	1"	1"	1"	1"	1"	1"
BB	SAFETY VALVE, 125 PSIG	1"	1"	1"	1"	1"	1"	1"
CC	GAS TRAIN	1"	1"	1"	1"	1 ½"	1 ½"	1 ½"
<b>WEIGHTS-LBS</b>								
	SHIPPING WEIGHT (125#)	1550	1700	2100	2300	2900	3400	3800
	OPERATING WEIGHT (125#)	2205	2460	3260	3630	4330	5105	5780
<b>RATINGS</b>								
	BTU/HR MAXIMUM INPUT @ SEA LEVEL TO 2000'	400,000	500,000	750,000	1,000,000	1,500,000	2,000,000	2,400,000
	*BTU/HR OUTPUT @ SEA LEVEL TO 2000'	344,000	430,000	645,000	860,000	1,290,000	1,720,000	2,064,000
	MAX. AMP DRAW FAN @ 115/1/60	4.0	4.0	4.0	4.0	8.5	12.0	12.0
	BLOWER MOTOR SIZE (WATTS)	335	335	335	335	750	1,200	1,200
	FIRESIDE HEATING SURFACE (FT²)	86	105	133	164	263	319	395

\*Note: Output based on 86% efficiency with 140°F return and 180°F supply water temperature



221 Law Street • Thomasville, GA 31792  
 414-359-0600 • 800-250-5883  
 info@cleverbrooks.com • cleverbrooks.com

## Kopylovski, Yuri

---

**From:** Tebbutt, Sarah  
**Sent:** December 8, 2011 12:24  
**To:** Kopylovski, Yuri  
**Subject:** FW: Engine Destruction Efficiency ~COR-046254~

-----Original Message-----

**From:** Tebbutt, Sarah  
**Sent:** Monday, November 07, 2011 11:08 AM  
**To:** Sylvestre-Williams, Barbara (ENE)  
**Cc:** Project Email Hold  
**Subject:** Engine Destruction Efficiency ~COR-046254~

Hi Barbara,

Please see below for the manufacturer response for destruction efficiency from the engines. As described below, the destruction efficiency is between 94% - 98%.

Thanks,  
Sarah

-----Original Message-----

**From:** Mike Savel [mailto:SavelMike@ddace.com]  
**Sent:** Thursday, October 27, 2011 11:51 AM  
**To:** Tebbutt, Sarah  
**Subject:** FW: 420 Destruction Efficiency?

Sarah,

Please see response below from GEJ.

Regards,

Mike

---

**From:** Poovathoor, Joseph (GE Power & Water) [joseph.poovathoor@ge.com]  
**Sent:** Thursday, October 27, 2011 11:23 AM  
**To:** Mike Savel  
**Subject:** RE: 420 Destruction Efficiency?

Mike,

GE Jenbacher Gas Engines confirms that the methane (CH4) destruction efficiency for biogas, are confirmed to be 97 - 98% at start up and an average of 94% between overhauls (destruction rate between overhauls is an indicator only and

the values depend on maintenance and overall condition of the engines), these values are based on standard landfill gas quality in accordance with GE Jenbacher TI1000-0300 and TI1400-0091

Best regards:

Joseph P. Koshy

Commercial Operations

T: +1 832 295 5633 | C: +1 713 855 2591

E: [joseph.poovathoor@ge.com](mailto:joseph.poovathoor@ge.com)

g GE Energy - Jenbacher Gas Engines

**Tebbutt, Sarah**

---

**From:** Bill Mullin [bmullin@biorem.biz]  
**Sent:** Friday, June 12, 2009 6:32 AM  
**To:** Tebbutt, Sarah  
**Subject:** Bio-En Biofilter Removal Eff. Revised  
Sarah:

TMA removal efficiency increased to 75% / <.15.

I hope this helps.

Regards,  
Bill

Bill Mullin  
BIOREM Technologies Inc.  
7496 Wellington Rd. 34, R.R.#3  
Guelph ON Canada N1H-6H9  
Direct: 519-341-2996

TABLE A.4

ESTIMATED MAXIMUM EMISSIONS FROM BIOFILTER  
ELIMIRA BIOGAS PLANT  
WOOLWICH BIO-EN INC.

Exhaust flow rate(m<sup>3</sup>/s)                      5.56

<i>Contaminant</i>	<i>CAS No.</i>	<i>Concentration (mg/m<sup>3</sup>) or (OU/m<sup>3</sup>)</i>	<i>Est DRE</i>
Ammonia	7664-41-7	17.4	50%
Trimethylamine	75-50-3	1.5	75% / <.15
Triethylamine	121-44-8	1.0	65%
Hydrogen Sulfide	7783-06-4	13.9	95%
Methyl Mercaptan	74-93-1	2.0	90% / <.1
Ethyl Mercaptan	75-08-1	1.0	65% / <.1
Dimethyl Sulphide	77-78-1	5.2	65% / <.1
Dimethyl disulphide	624-92-0	3.1	65% / <.1
Butanol	35296-72-1	10.0	70%
Alpha-piene	80-56-8	5.6	60%
Limonene	5989-27-5	10.5	60%
Acetic Acid	64-19-7	5.0	70%
Oleic Acid	112-80-1	5.8	70% / <.1
Butyric Acid	107-92-6	1.8	70% / <.1
Cyclopentanol	91-41-3	8.0	60%
Propyl acetate	109-60-4	5.0	60%
Propyl butyrate	105-66-8	8.0	60%
Pentanone	107-87-9	2.0	60%
Me-isobutyl ketone	108-10-1	10.0	60%
Nonanal	124-19-6	5.0	60%
Odour	NA	2000 (1)	NA

## Notes:

(1)Based on conservative odour removal efficiency of 80% provided by manufacturer. Assuming 10,000OU inlet.

(2) Amount of Mercaptans calculated according to Note 15 on page 20 of Summary of O. Reg. 419/05 Standards and Point of Impingement Guidelines and Ambient Air Quality Criteria (AAQCs)" date December 2005.

APPENDIX F  
LEASE AGREEMENT

**OFFER TO LEASE**

THIS OFFER is dated the 20 day of May, 2008,

BETWEEN:

**MARBRO CAPITAL LIMITED**

("Landlord")

-and-

**WOOLWICH BIO-EN INC.**

(Tenant")

The Tenant hereby offers to lease from the Landlord, the premises known as 42 Martin's Lane, Elmira, Ontario ("Leased Lands"), on terms and conditions set out below:

- 1. **Term**                      An initial term of twenty (20) years, commencing on the Commencement Date, as hereinafter defined.
  
- 2. **Minimum Rent**            Rent shall be payable to the Landlord at its head office or at any other place designated by the Landlord, without deduction, abatement, set-off or compensation, as set out in Schedule "B" hereto.  
  
    Rent is due in monthly installments payable in advance on or before the first of each month.
  
- 3. **Utilities**                    The Tenant shall pay all charges for utilities used by the Tenant at the Leased Lands.
  
- 4. **Maintenance**              From and after the date the Tenant is required to commence paying rent the tenant shall pay to the Landlord all business taxes and other taxes assessed and billed in respect of the Tenant's business assets and improvements at the Leased Lands and real property taxes assessed against the Leased Lands.
  
- 5. **Alterations**                The Tenant will be entitled to construct such buildings, lagoons, alterations and/or improvements at the Leased Lands as it may deem necessary or advisable for its business purposes.

6. Lease                    The Tenant and the Landlord will execute and deliver a standard form of land lease ("Lease") for the Leased Lands, to be prepared by the Landlord, and subject to such changes as may be reasonably required by the Tenant's solicitors.
7. Assignments            This offer shall not be assigned, sublet or transferred by the Tenant without the Landlord's prior written consent, which shall not be unreasonably withheld or delayed.
8. Conditions            (a)    This offer shall be subject to the following
- (i)    the Tenant obtaining such approvals as it considers necessary on terms satisfactory to it from the Ontario Ministry of the Environment and other Regulatory agencies having jurisdiction over the proposed business of the Tenant at the Leased lands; and,
- (ii)   the Tenant having entered into a standard offer contract under the auspices of the Ontario Power Authority on such terms satisfactory to the Tenant relative to the connection of the Tenant's proposed generation project to the Ontario Electricity distribution system,
- failing which this offer shall be rendered null and void, at the sole option of the Tenant.
- (b)    Upon fulfillment or waiver of the foregoing conditions, the Tenant shall advise the Landlord of the date of commencement for the Lease (the "Commencement Date").
9. Extension              The Tenant shall have the option to extend this Lease for a further period of up to six (6) years, on similar terms and conditions, save and except any further right of renewal. The Tenant shall notify the Landlord in writing at least six months prior to the expiry of the Term of its intention to exercise this option. Rental shall be at the rate in effect as at the final year of the Term.
10. Time of the Essence    Time shall be of the essence of this offer.

**11. Acceptance**

The execution of this agreement by the Tenant shall constitute an offer for acceptance by the Landlord. The Tenant and Landlord recognize that in order to expedite amongst other matters, transmission of offers, counter offers, condition clauses, waiver of conditions, and acceptance, it may be essential that said documents be communicated by means of facsimile transmission and these shall be considered legal and binding in the absence of originals. If the Landlord fails to execute and deliver this agreement on or before the 31<sup>st</sup> day of May, 2008, this agreement shall be null and void and neither party shall be responsible to the other for any loss, cost, expense or damage.

DATED at Elmira this 20 day of MAY, 2008.

**WOOLWICH BIO-EN INC.**

Per:  c/s  
Harold Wideman

I have the authority to bind the Corporation.

THE LANDLORD hereby accepts the above offer this 20 day of May, 2008.

**MARBRO CAPITAL LIMITED**

Per:  c/s  
I have the authority to bind the Corporation.

APPENDIX G

START UP AND COMMISSIONING PROTOCOL

**Start up and commissioning protocol**

**Woolwich Bio-En**

**Elmira Anaerobic Digestion Facility**

**Elmira, ON**

**January 2010**

# 1 INTRODUCTION

This start up protocol provides an overview of the start up operations of the proposed 2.85 MW biogas plant to be located in Elmira, Ontario, Canada.

The start up of the biogas plant takes place in four (4) different steps:

1. Filling the tanks
2. Heating up to process temperature
3. Constantly increasing load to full power
4. Operating plant on full power

In order to minimize the environmental impact during these stages, several measures are in place to prevent possible releases to the air, groundwater and soil.

## 2.0 DIGESTER SYSTEM START UP PROTOCOL

### 2.1 TANK FILLING STAGE

Before the digesters are filled all electrical and mechanical systems are tested for proper function and availability. The piping and heating system will be tested to ensure that they are waterproof and free of leaks.

After the piping waterproof test Digester 1 will be filled with manure and water to its maximum level. The manure is pumped from the truck into the tank ensuring that there are no open manure storage tanks on the site. The tanks are gas proof to inhibit odour emissions. This procedure will take about 1 week.

<b>Impact on:</b>	<b>extent</b>	<b>Measurement in place</b>
ground water	none	Waterproof tanks are used
soil	none	Waterproof tanks are used
air	none	no gas production at this point

## 2.2 TANK HEATING STAGE

The first main digester is heated up to approximately 40°C using an external heat source (portable boiler or CHP operated using Natural Gas). To protect the concrete structure the increase in temperature will be approximately 1.5°C per day. During this procedure the first biogas is formed. The productivity of the digester is very low and the biogas has low methane concentrations. The formed biogas is stored in the biogas storage membrane and flared when full capacity of the buffer is reached. This procedure will take about two weeks.

<b>Impact on:</b>	<b>extent</b>	<b>Measurement in place</b>
ground water	none	Waterproof tanks are used
soil	none	Waterproof tanks are used
air	minimum	Gas proof tanks with biogas storage membrane are used. Excess biogas is flared.

## 2.3 INCREASING BIOGAS PRODUCTION STAGE

During this stage of the startup procedure the first input material is processed in the plant. Liquid input material like DAF and FOG are transported to the process building and stored in the liquid input storage tanks. The transfer from truck to tank is a pipe on pipe system. From the liquid storage tank the material is pumped in the pretreatment tank and heated to approximately 50 to 60°C. This organic material stays in the pretreatment tank for at least 20hrs at that temperature to reach a sufficient sanitation effect. Discharge air from the liquid storage tanks is processed by the biofilter. Biogas formed in the pretreatment tanks is stored in the biogas storage membrane. The main digesters are nearly constantly fed with input material from the pretreatment tanks.

Biological control of the process is maintained by periodic measurement of VOC (volatile organic compounds) and TAC (total alkalinity).

The loading rate of kg organic dry matter/ m<sup>3</sup> digester volume is increased over a period of about 6 weeks until full capacity is reached. As the capacity of gas production reaches 25% of full capacity the first of the two CHPs (combined heat and power plant) is operated at 50%. At this point all the biogas produced is used in the CHP and not flared.

Biogas residue overflows into the secondary digester and repository tank that is a waterproof concrete tank covered with a biogas storage membrane. When the amount of biogas residue reaches 3700 m<sup>3</sup> all this material is used to fill the second main digester to maximum level. With the second main digester in operation the gas production will be further increased until full capacity of both CHPs is reached.

<b>Impact on:</b>	<b>extent</b>	<b>Measurement in place</b>
ground water	none	Waterproof storage tanks are used
soil	none	Waterproof storage tanks are used, sanitation is done on the input material.
air	minimum	Gas proof tanks with biogas storage membrane are used. Excess biogas is flared or processed in CHP. Reduced amounts of discharge air need to be treated because less ventilation of the receiving hall is required due to smaller quantities of organics being processed during start up.

## 2.4 FULL PLANT OPERATION STAGE

After the second main digester reaches full gas production capacity the plant is in full power operation. At this point the biofilter will be able to handle larger amounts of discharge air as the biofilter biological activity will have increased as the quantity of organics processed increases over the start up period.

<b>Impact on:</b>	<b>extent</b>	<b>Measurement in place</b>
ground water	none	Waterproof storage tanks are used
soil	none	Waterproof storage tanks are used, sanitation is done on the input material.
air	minimum	Gas proof tanks with biogas storage membrane are used

### 3.0 BIOFILTER START UP

The BIOREM BASYS modular biofilter system extracts foul air for subsequent preconditioning in the humidification stage and oxidation through the BIOSORBENS media bed prior to atmospheric discharge.

Odourous compounds in the air entering the biofilter are solubilized into the moisture layer surrounding the individual media particles or are adsorbed directly to their surface. Bacteria present within this moisture film utilize the compounds as substrate. The compounds are biologically oxidized to CO<sub>2</sub>, H<sub>2</sub>O and inorganic salts and clean air is discharged to atmosphere. Maintaining proper air temperature, pH, moisture and nutrient levels are essential for favorable biofilter performance and removal efficiency.

The BIOSORBENS® media has significant adsorptive capacity. BioRem believes that this media will provide at least a 70% odour removal in less than 2 weeks of installation. This removal should be obtained assuming that the biofilter media temperature is in the appropriate operating range and that the media has been properly moistened at least 2 weeks before system start up.

In order to build the microbial population as quickly as possible in the inorganic media, it is desirable to treat an odour load as soon as possible after the filter is installed and operational. This initial odour load will come from the organic materials that will be processed during the first stages of the anaerobic digestion process start up.

In order to ensure that odour levels are not excessive during the start up process, the Facility will operate the plant at reduced airflow. During start up of the process, the Facility will process less waste than during normal operation. As a result, the Facility will have less odour loading to the biofilter.

For planning purposes a 50% odour removal will be achieved in the first week of operation (assuming that the media is in the temperature range of approximately 20°C to 40°C). Operations at the Facility will preliminarily include the processing of

less odourous materials while operating a minimum of 12 hours per day. The second week of operations, the Facility will achieve a 60% odour reduction while operating a minimum of 12 hours per day. The odour removal efficiency will increase to 70% during the third week with the Facility operating a minimum of 16 hours per day. The guaranteed 80% removal efficiency will be reached by the end of the fourth week when the Facility will be operating a minimum of 20 hours per day.

All removal efficiencies and start up times are based on the time following the complete installation and commissioning with all the water and power connections made to the biofilter system.

APPENDIX H

ELECTRONIC TABLES