Report No. 26049

Report:

An Odour Study Report for an Anaerobic Digester at the Toronto Zoo under Ontario Regulation 359/09

Date: November 28, 2013



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An Odour Study Report for an Anaerobic Digester at the Toronto Zoo under Ontario Regulation 359/09
Part 1: Emission Estimates

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Odour Study Report

Toronto Zoo

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1. INTRODUCTION

The Toronto Zoo is planning to install and operate an Anaerobic Digester facility at a biogas plant in Toronto, Ontario, on land which is currently used by the zoo for composting purposes. The Anaerobic Digester will replace the composting operations and produce biogas which will be used to generate about 500 kW of electrical energy and 500 kW of thermal energy. The project will require a Feed in Tariff (FIT) contract from the Ontario Government to supply the surplus energy as electricity to the local grid. The thermal energy will be used to operate the Anaerobic Digester and any surplus energy will be available for use in the zoo.

The biogas plant will occupy approximately 5000 m^2 of the current composting operations site at the east side of Meadowvale Road, south of the access road to the former Beare landfill site. The land is owned by the Toronto Region Conservation Authority.

Annual input materials to the Anaerobic Digester are estimated to be 3000 tonnes of manure supplied by the zoo and 12000 tonnes of organic grocery store waste which will be supplied by a Toronto grocery retailer. This waste will consist of vegetables, as well as fats, oils and greases (FOG). Other liquid wastes may also be available from the local area.

Under Regulation 359 of the Ontario Environmental Protection Act, a Renewable Energy Approval (REA), based on Part V.0.1 of the Act, is required for the facility. Since the facility will be a non-farm operation, it is a Class 3 Anaerobic Digester as defined by Regulation 359.

2. REQUIREMENTS OF ONTARIO REGULATION 359/09

The section *Supporting Documents 13.* of Regulation 359 specifies that certain documents need to be filed to support a REA and *TABLE 1 (REPORTS)* of Regulation 359 lists the various reports which need to be prepared and submitted with each type of REA. A REA for a Class 3 Anaerobic Digester facility requires an *Odour Study Report* with the following components, as specified in *TABLE 1 (REPORTS):*

1. *The significant process and fugitive sources of odour discharge from the renewable energy generation facility.*
2. *Any negative environmental effects that may result from the odour discharge mentioned in paragraph 1 at all odour receptors.*
3. *The technical methods that are expected to be employed to mitigate any negative environmental effects mentioned in paragraph 2 and the negative environmental effects that are expected to result if the technical methods are employed.*

This Odour Study Report was prepared by ORTECH Environmental (ORTECH) to address these components. The study includes the determination of estimated odour emission rates from the biogas plant and atmospheric dispersion modeling to assess the effects of these emissions.

One of the other reports required for a Class 3 Anaerobic Digester is a *Project Description Report*. This report has already been prepared by Riepma Consultants Inc. and was used as a basis for preparing this Odour Study Report.

3. BIOGAS PLANT DESCRIPTION

A site plan for the biogas plant is shown in Figure 1 and a process flow diagram of the biogas plant process is shown in Figure 2. The purpose of the Anaerobic Digester in the biogas plant is to decompose organic zoo manure and organic grocery store waste using microbes in the absence of oxygen to obtain a gaseous product (biogas) which contains mostly methane and carbon dioxide, but also small amounts of other gases, some of which are highly odorous. The biogas will be combusted in a 500 kW engine to generate electricity.

As described in the *Project Description Report*, there will be a weigh scale for the trucks bringing feed material into the biogas plant. These trucks will dump their loads into a 9.2 m diameter Hydrolysis Receiving Tank where they will be mixed together. The mixture will be pumped to a Hydrolysis Tank, then to the Hydrolysis Buffer Tank (both 9.2 m diameter) and the Anaerobic Digester, as needed.

Any material which requires pasteurization will be dumped into a Pasteurizing Receiving Tank (7.4 m diameter) and pumped to the Pasteurizer where it is heated to 50°C for 20 h. The material will be pumped from the Pasteurizer to the Pasteurizing Buffer Tank (both 6.0 m diameter) and then to the Anaerobic Digester, as needed.

There will be a single sealed concrete Anaerobic Digester facility with a double membrane roof. The dimensions are 21 m in diameter and 6 m high. The total volume is 2077 m^3 and the operating volume is 1731 m^3. The retention time in the Anaerobic Digester is designed to be 38 days.

The Anaerobic Digester liquid output fraction will be stored in two Digestate Storage Tanks. One of these tanks will have the same dimensions as the Anaerobic Digester and can be converted to a digester at a later date. The second Digestate Storage Tank will be 39 m in diameter and 4.3 m high with a volume of 4700 m^3. The total liquid digestate storage period is 180 days before it is applied to local farm fields as a nutrient.

The Anaerobic Digester solid output fraction will be transferred to a Separator where a liquid fraction will be obtained and stored in the two Digestate Storage Tanks. After removal of this liquid fraction, the solid fraction will be stored on a concrete pad in an open container. It will then be bagged and sold as a soil conditioner. If there is no market for the bagged solid fraction, the solid fraction will not be separated from the liquid fraction, but will be sold directly for field application.

Figure 1: Biogas Plant Site Plan

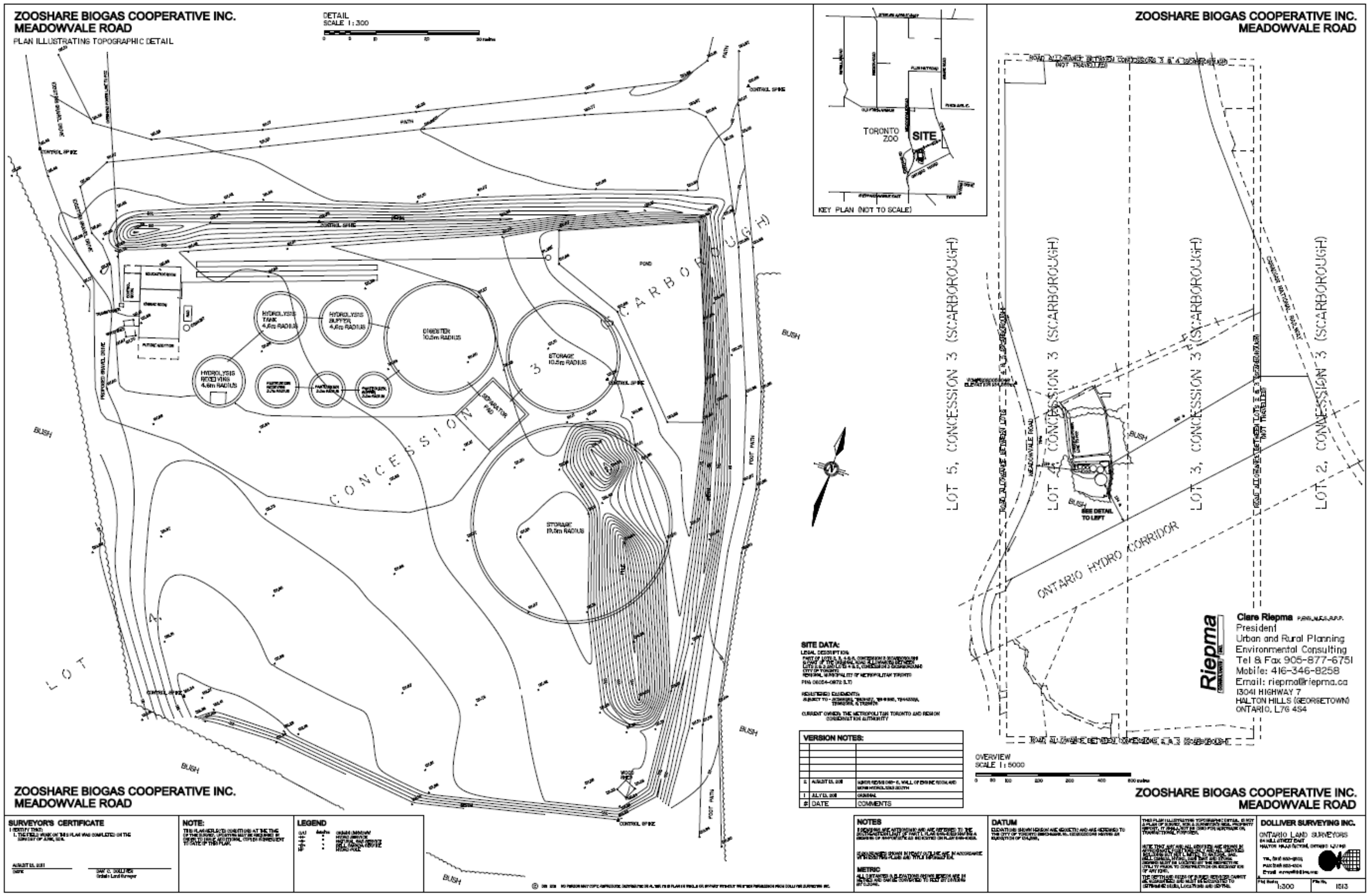
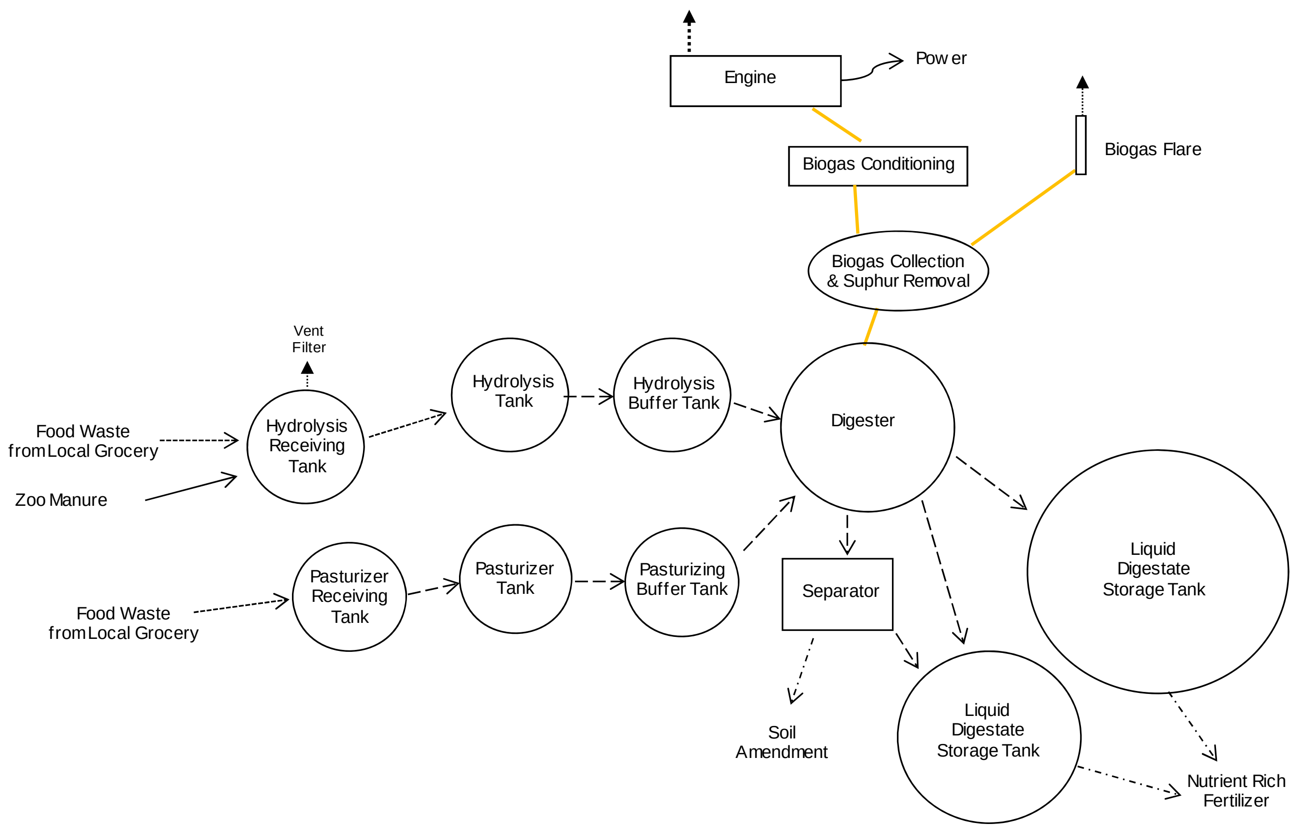


Figure 2: Biogas Plant Process Flow Diagram



Biogas from the Anaerobic Digester process will be stored in the upper part of the Anaerobic Digester facility and the volume is expected to be about 1000 m³. It will then be cooled underground and any condensed moisture from the cooling process will be recycled to the Hydrolysis Tank.

The cooled biogas will be combusted in an Engine to produce thermal energy for generating electricity (500 kW) and for heating purposes in the Anaerobic Digester process (100 kW to 150 kW). Surplus thermal energy (350 kW to 400 kW) will be available for use by the Toronto Zoo or others. Hydrogen sulphide is removed from the biogas by bacterial action which is promoted by injection of a small amount of oxygen near a wooden floor at the roof of the Anaerobic Digester facility. The hydrogen sulphide concentration should be reduced to below 200 ppm in order to prevent Engine damage. The Engine combustion gases will discharge minor amounts of sulphur dioxide and nitrogen oxides which are odorous. Then, there will be electrical switchgear, a transformer and a transmission line connection.

When the engine is not operating or excess biogas is produced, it will be combusted by a Flare. The Flare capacity is 400 m³/h of biogas, equivalent to 150% of the biogas generation capacity.

4. ANAEROBIC DIGESTER OPERATIONS

Solid zoo manure will be delivered to the biogas plant each day by zoo truck at a rate of 13.6 m^3 per day. It will be dumped into the Receiving Tank and mixed with liquid manure. Material requiring pasteurization will be dumped into the Pasteurizer Receiving Tank. Liquid grocery store waste will also be dumped into the Hydrolysis Receiving Tank and the Pasteurizer Receiving Tank. From the Hydrolysis Receiving Tank, the feed material will be pumped to the Hydrolysis Tank and then to the Hydrolysis Buffer Tank. From the Pasteurizer Receiving Tank, the material will be pumped to the Pasteurizer and then the Pasteurizer Buffer Tank. The two buffer tanks will provide the feed to the Anaerobic Digester facility.

After a period of 38 days in the Anaerobic Digester at a mesophylic temperature range of 38 to 52°C, the biogas produced will be treated to remove hydrogen sulphide and stored in the roof of the Anaerobic Digester structure. This will be followed by cooling of the biogas to remove moisture and combustion in the Engine of Flare, as appropriate. Apart from the biogas, the Anaerobic Digester output material will be separated into solid and liquid fractions.

Solid material from the Anaerobic Digester facility will be dewatered using a screw press. The solid fraction from the screw press will be piled onto the concrete pad or in a box. From there it will be further processed, bagged, shipped by truck and sold as a soil amendment. Liquid residue from the screw press will be pumped to the Digestate Storage Tanks.

Liquid material in the Digestate Storage Tanks will be delivered by tanker truck to local farms or to the Toronto Zoo twice per year, in the spring and fall, for use as a soil nutrient.

Other output operations are the biogas combustion gases from the Engine or from the Flare which will be used to combust excess biogas or all of the biogas when the Engine is not operating.

5. POTENTIAL SOURCES OF ODOUR EMISSIONS

There are many potential sources of odour emissions from the biogas plant when it is in operation, including point sources, area sources and fugitive sources, but few of these sources are likely to be significant with regard to their impact beyond the plant property.

For the actual Anaerobic Digester facility alone, any odour emissions are expected to be insignificant fugitive emissions since this is a sealed process. Equipment for this process includes the Anaerobic Digester with a combined solid/liquid fraction and a biogas generation/storage fraction above.

Zoo trucks will deliver solid manure from the Toronto Zoo to the biogas plant. These are assumed to be open top trucks which may have significant odour emissions, but they can be covered if necessary to reduce these emissions.

Tanker trucks for liquid manure and liquid grocery store waste deliveries to the biogas plant and the tanker trucks for the liquid digestate fraction removal are not expected to have significant odour emissions although there may be slight odour emissions as air is displaced from the liquid digestate fraction trucks as they are filled, but a carbon filter can be used to remove odours from these emissions, if necessary.

The Hydrolysis Receiving Tank may have significant odour emissions as the solid manure is transferred from the solid feed trucks but odour emissions from the delivery of liquid material to the Hydrolysis Receiving Tank and the Pasteurizer Receiving Tank are expected to be insignificant since this is a closed system. There may be some odours emitted as air is displaced from the tanks during filling operations, but a carbon filter can be used to remove odours from these emissions if necessary.

There may be an odour from unburnt hydrocarbons and combustion gases in the Engine or Flare combustion products.

Sources which may have relatively significant odour emissions are described below.

Solid Feed Truck: Trucks will be used to deliver solid Toronto Zoo manure to the biogas plant. These will be open trucks which will discharge odours when they drive around the plant and are stationary while they are on the weigh scale or being unloaded. Covered trucks will be used if necessary to reduce odour emissions.

Solid Product Trucks: Trucks will be used to remove solid digestate product from the plant for use as a soil conditioner by local farmers or the Toronto Zoo. These will be open trucks containing either bulk or bagged solid digestate, which will discharge odours as they drive from the plant and are stationary while they are on the weigh scale or being loaded from the concrete pad. Covered trucks will be used if necessary to reduce odour emissions.

Flare: The Flare will be activated to burn biogas when the Engine is shut down or biogas is produced in an excessive quantity that cannot all be used by the Engine. Odour emissions will occur when the Engine and Flare are in operation due to the combustion products. Odour emission calculations in this report are based on all of the biogas produced being combusted by the Flare.

Biogas Storage: Biogas will be stored in a gas storage membrane at the upper portion of the Anaerobic Digester facility prior to cooling and combustion in the Engine or Flare. The membrane will be slightly porous which will cause biogas to leak from the membrane to the atmosphere.

Separator: The Separator is a sealed unit but slight odour emissions will occur as the relatively dry solids are discharged from the Separator screw press. Dry solids from Separator screw press will be stored as a pile in an open container on a concrete pad until the container is removed. Some odour emissions from the solid pile in the container will occur.

6. ODOUR EMISSION ESTIMATES

In preparation for determining the impact of odour emissions from the biogas plant on the odour receptors beyond the plant property, odour emission rates were estimated for those sources in the plant where there is a potential for significant odour emissions to occur. These sources may include point sources, area sources and fugitive sources. Methods for determining the odour emissions from these sources and the estimated odour emission rates are described below for the various sources. The emission rates assume that the facility is fully operating at its nominal electrical generating capacity of 500 kW and thermal heat generating capacity of 500 kW. Some assumptions have been made in order to calculate the odour emission rates.

Solid Feed Trucks: Three times per week open Toronto Zoo trucks will deliver solid zoo manure to the biogas plant. The annual amount of zoo manure to be treated by the biogas plant is estimated to be 3000 tonnes, equivalent to about 20 tonnes or 20 m^3 per delivery. The exposed surface area of manure in the trucks is assumed to be 10 m^2, based on a manure height of 2 m. It is not known if there will be one truck or more than one truck per delivery but the exposed surface area is assumed to be constant at 10 m^2.

Without conducting odour emission tests for the manure which will be used at the biogas plant, it is assumed that the zoo manure will have a similar overall odour emission factor to manure odour emission factors for various farm animals.

During an experimental laboratory program conducted by ORTECH Environmental for OCETA in 2004 and an emission testing program conducted by Pinchin Environmental at a mushroom composting plant in 2004, the following solid manure odour emission factors were obtained:

- Dairy cow manure ....0.49 ou/s/m^2
- Beef cattle manure ....0.58 ou/s/m^2
- Horse manure ....0.70 ou/s/m^2
- Poultry manure ....15.60 ou/s/m^2

The poultry manure emission factor is much higher than the other emission factors. If it is assumed that the zoo manure will contain some bird manure with a similar odour emission factor to poultry manure but bird manure is only a small fraction of the total zoo manure, than a reasonable overall odour emission factor for the zoo manure is 0.60 ou/s/m^2.

Therefore, the odour emission rate for a zoo manure truck delivery will be 6 ou/s, calculated as the product of the surface area of 10 m^2 and the odour emission factor of 0.60 ou/s/m^2. The same odour emission factor will apply to the Hydrolysis Receiving Tank but the odour emission rate will increase to 33.6 ou/s based on a surface area in the Hydrolysis Receiving Tank of 56 m^2 of the total area of 66 m^2. Therefore, the total odour emission rate for the manure delivery truck and Hydrolysis Receiving Tank combined will be 39.6 ou/s.

Various scientific papers have indicated that the odour emissions from farm animal manure will decrease by 90% or more when the manure is treated by an anaerobic digester. For the purpose of this study, it is assumed that the Toronto Zoo manure odour emission factor will decrease by 70% when the manure is treated by the proposed Anaerobic Digester facility. Therefore, the odour emission factor will decrease from 0.60 ou/s/m² for the untreated manure to 0.18 ou/s/m² for the digested manure. If the surface area of the digested manure is assumed to be the same as for the untreated manure, then the odour emission rate for the treated manure is 11.9 ou/s, which is the product of 0.18 ou/s/m² for the emission factor and 66 m² for the surface area. The assumed surface area of 66 m² will include the Separator, the Concrete Pad with open container and any trucks which may transport the container of digested manure off-site or to the bagging operations.

Flare: Biogas will be combusted by the Flare during periods of excess biogas production or when the Engine is not operating, with the combustion products released to the atmosphere. The Flare stack will be 10.0 m high but have an equivalent release height of 12.1 m when the flame height is included.

The maximum design biogas combustion rate in the Flare when the Engine is not operating will be 0.111 m^3/s (400 m³/h), which is about 150% of the expected maximum biogas production rate. The Flare gas temperature is expected to be 977°C and the total actual volumetric flow rate of combustion gas products will be 2.6 m³/s, when the combustion gases from the biogas and the natural gas required to maintain the gas temperature are taken into consideration.

The biogas will have a very high odour concentration which will be caused primarily by hydrogen sulfide and any release of this biogas directly to the atmosphere will be avoided. After removal of most of the hydrogen sulphide in the Anaerobic Digester facility, the maximum residual concentration of hydrogen sulphide in the biogas should be below 200 ppm, equivalent to 278 mg/m³ at reference conditions (25°C and 1 atmosphere). Therefore, the maximum amount of hydrogen sulphide which will be flared is 30.9 mg/s, calculated as the product of the concentration (278 mg/m³) and the volumetric flow rate (0.111 m^3/s). During combustion, all of the hydrogen sulphide will be converted into sulfur dioxide on a molecule per molecule basis. Based on molecular weights, 34 g of hydrogen sulphide will be converted into 64 g of hydrogen sulphide. Therefore, combustion of 30.9 mg/s of hydrogen sulphide in the flare will yield 61.8 mg/s of sulphur dioxide in the combustion gases. The sulphur dioxide equivalent concentration in the biogas would be 557 mg/m³ (61.8 mg/s divided by 0.111m³/s).

Several literature references have indicated that the odour threshold value of sulphur dioxide is about 3 ppm (7.8 mg/m³). The odour concentration in the biogas due to the equivalent concentration of sulphur dioxide is 67.1 ou (200 ppm maximum concentration in the biogas divided by the odour threshold value of 3 ppm) and the odour emission rate in the flare due to the sulphur dioxide is then 7.4 ou/s (67.1 ou odour concentration multiplied by the biogas emission rate of 0.111 m³/s). This odour emission rate is based on 150% of the biogas generation capacity.

These estimated odour emission rates are summarized in Table 1.

Table 1: Estimated Odour Emission Rates for all Emission Sources Operating

Source	Material	Odour Emission Factor (ou/s/m^3)	Area (m^2)	Odour Emission Rate (ou/s)
Hydrolysis Receiving Tank	Zoo Manure	0.60	66	39.6
Separator	Solid Digestate	0.18	66	11.9
Flare	Sulphur Dioxide	-	-	7.4
Total				58.9

The estimated total odour emission rate of 58.9 ou/s in Table 1 is based on the assumption that all of the three sources are emitting odour at the same time. This is unlikely to occur often.

7. MITIGATION OF ODOUR EFFECTS

A number of measures can be undertaken, if necessary, to reduce the amount of odour discharged from the biogas plant while it is in operation and minimize the impact of odour at off-site receptors. The measures will be relatively easy to implement. These measures which can be undertaken are described as follows:

Trucks which deliver solid zoo manure to the facility are likely to have open tops but odour emission can be reduced if they have closed tops which are removed during unloading. Similarly, closed tops can be used on the trucks which remove solid digestate from the facility. Movements of these trucks within the plant and during loading and unloading activities can be coordinated so that these movements are optimized to control odour emissions. Tanker trucks will be used to deliver liquid waste to the facility and remove liquid digestate. Odour emissions from these trucks will be low but a carbon adsorber can be used to remove odours as the liquid digestate trucks are being loaded, if necessary.

Wind speed and wind direction may need to be considered when there are truck movements in the biogas plant. If feasible, loading operations should be avoided when the wind is blowing towards the nearest sensitive receptors, if a load is particularly odorous.

The combustion temperature and residence time at the Flare will be sufficient to ensure that essentially all hydrocarbons are destroyed and any reduced sulphur compounds are converted to sulphur dioxide.

8. ODOUR AND OTHER ENVIRONMENTAL BENEFITS

The principal odour environmental benefit from the Anaerobic Digester facility operations is that odour discharged from the biogas will be much lower than the odours which will be discharged if the Toronto Zoo manure and organic grocery store waste materials were to be composted and the compost spread directly on fields as a nutrient. Therefore, there will be no net negative environmental effects due to odour emissions from the biogas plant. The filtrate and digestate will still be available as nutrients but will have a much lower odour concentrations since the very odorous reduced sulphur compounds in the feed material will be removed as components of the biogas. These compounds are removed primarily from the biogas in the Anaerobic Digester and the remainder is removed in the Engine or Flare where they are converted to sulphur dioxide.

Other environmental benefits include the generation of electrical and thermal energy with the concomitant reduction in the use of fuels such as coal or natural gas which would otherwise be combusted to produce this energy. These fuels discharge toxic components in the combustion gases and contribute to global warming. The facility also provides a means for grocery stores to dispose of unwanted biodegradable wastes.

9. AERMOD ODOUR DISPERSION MODELLING

Modelling Options: The United States Environmental Protection Agency (US EPA) AERMOD atmospheric dispersion model (Version 11103) was used to determine the impact of odour emissions from the biogas at off-site receptors, including specific sensitive receptors. The dispersion modelling was conducted using the default regulatory options in accordance with the Air Dispersion Modelling Guideline for Ontario (ADMGO), March 2009.

Since the Toronto Zoo biogas plant will be located in an area which is at least 50% rural, the modelling was run using rural dispersion coefficients. The site location is shown in Figure 3. The Universal Transverse Mercator (UTM) projection, NAD 83, Zone 17, was used as the coordinate system for defining all model objects.

Figure 3: Site Location

Source Information: The Flare was modelled as a point source and the remaining two sources of odour emissions were modelled as area sources. The source input parameters which were used for the modelling are shown in Table 2.

Table 2: Source Input Parameters

Emission Source	Odour Emission Rate (ou/s)	Release Height (m)	Location	
			Easting (m)	Northing (m)
Hydrolysis Receiving Tank	39.6	0.0	647098	4853124
Separator	11.9	0.0	647151	4853136
Flare	7.4	12.1	647150	4853170

The Flare combustion gas temperature was assumed to be 977°C. The Flare stack height will be 10 m above grade and the diameter will be 0.41 m. The actual combustion gas volumetric flow rate will be 2.6 m^3/s and the effective flame height will be 12.1 m above grade.

Building Downwash: For US EPA regulatory applications, a building or structure is considered to be sufficiently close to a stack to cause wake effects when the distance between the stack and the nearest part of the building is less than or equal to five (5) times the lesser of the building height or the projected width of the building. All buildings and structures within the Area of Influence were input into the current version of the Building Profile Input Program for PRIME (BPIP-PRIME) for calculating any building downwash effects.

Receptor Information and Terrain Conditions: The following receptor grid layout was used in the dispersion modelling:

- 10 m spacing along the property lines;
- 20 m spacing within 200 m of the emission source;
- 50 m spacing from 200 m to 500 m;
- 100 m spacing from 500 m to 1,000 m;
- 200 m spacing from 1,000 m to 2,000 m;
- 500 m spacing from 2,000 m to 5,000 m;
- 1000 m spacing from 5,000 m to 10,000 m

In addition, the nearest residences and other sensitive receptors around the biogas plant were modelled as a set of discrete receptors, representing the sensitive receptors. The actual plant property was used to determine the property lines.

The coordinates for the most impacted sensitive receptors are listed in Table 3.

Table 3: Sensitive Receptor Locations

Sensitive Receptor	Direction for the Facility	Elevation (m)	Location	
			Easting (m)	Northing (m)
Park	South	126	646953	4852281
Church	South	126	647319	4852337
Residence	East	128	648449	4853541
Residence	South	128	646960	4852386
Residence	North	150	647227	4854547
Toronto Zoo	North-west	135	646365	4853413
Residence	North-west	134	646358	4852650

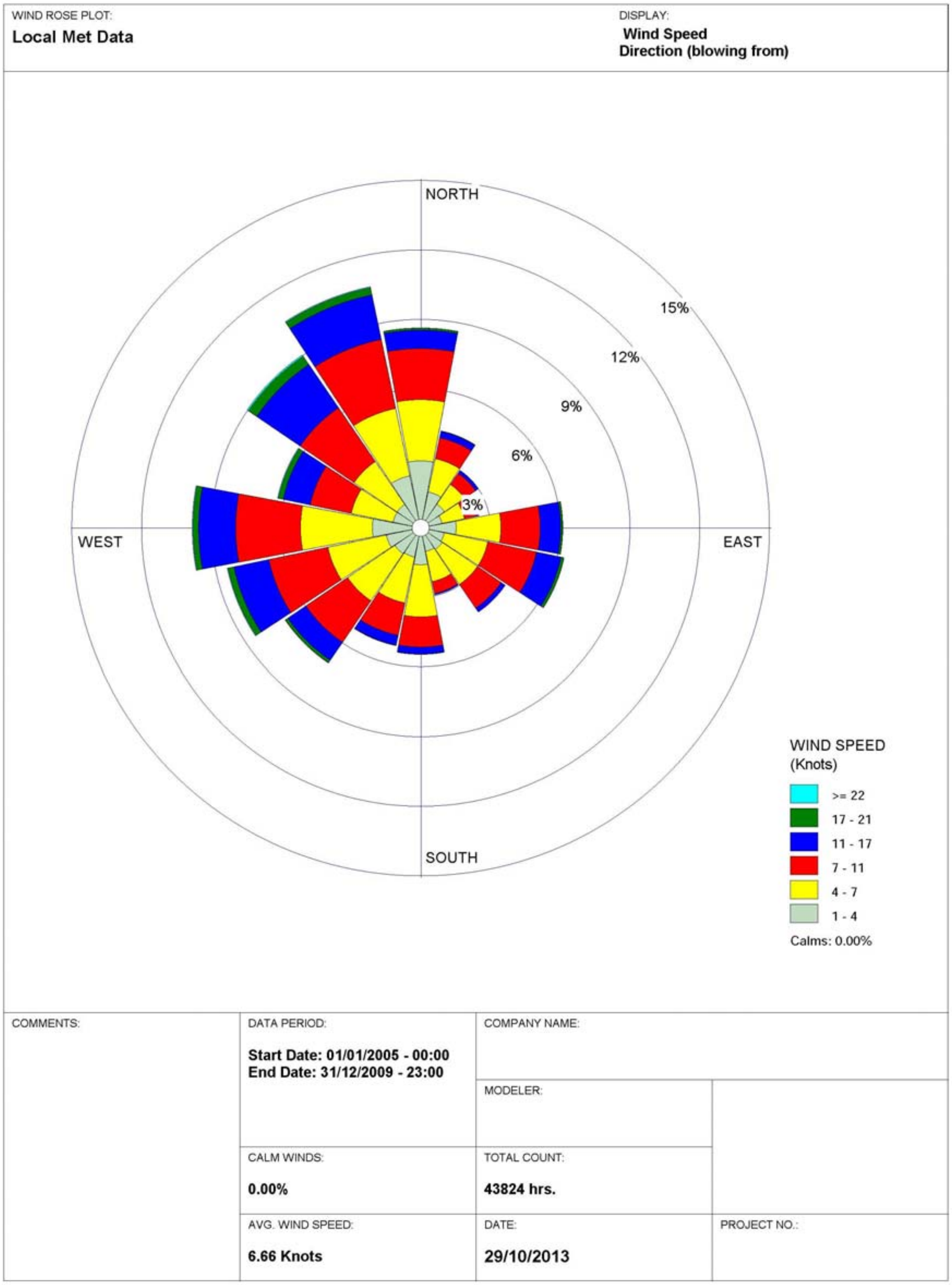
The United States Geological Survey (USGS) 7.5-minute Ontario data set was used as digital terrain input to the AERMAP. The US EPA recommended elevation data import technique was used to import the elevations for receptors, sources and buildings.

Meteorological Data and Concentration Conversion: The dispersion modelling was conducted using a local meteorological data set which was supplied by the Ontario Ministry of the Environment (Ministry). The dispersion modeling results based on this local meteorological data set are provided in this report. Copies of an application form to the Ministry requesting approval to use the local meteorological data and a letter from the Ministry confirming the approval are shown in Appendix 1. A wind rose for the area surrounding the biogas plant is shown in Figure 4.

The shortest averaging period that can be calculated by the AERMOD model is 1 hour. For odour, the Ministry point of impingement calculations are based on a 10-minute averaging time period. Therefore, the 1-hour averaging time period results obtained from the AERMOD modelling have to be converted to 10-minute averaging time periods. As detailed in the ADMGO, the 1-hour concentrations predicted by the AERMOD model were multiplied by a factor of 1.65 to derive the 10-minute concentrations.

Meteorological Outliers: As indicated in the ADMGO, for 1-hour concentrations, the eight hours with the highest 1-hour average predicted concentrations in each single meteorological year may be discarded. For compliance assessment The Ministry will consider the highest concentration after elimination of these forty hours over the five-year period from the modelling results. As a consequence, the highest 8 hours per year were discarded for the combined odour emission sources.

Figure 4: Wind Rose



WRPLOT View - Lakes Environmental Software

10. EFFECTS AT ODOUR RECEPTORS

The dispersion modelling results based on the local meteorological data set are summarized in Table 4 which shows the maximum 10-minute average odour concentration which is predicted to occur at any off-property receptor for any hour over the 5-year modelling period for the combined emission sources. This concentration is 0.999 ou over a 10-minute averaging period, which will be at a receptor located near the property boundary since most of the odour emission sources are relatively low level sources.

Table 4: Sensitive Receptor Predicted Odour Concentrations (10-Minute Averages)

Sensitive Receptor	Direction from the Facility	Maximum Odour Concentration at a Sensitive Receptor (ou)	Frequency Above 1 ou Concentration (%)
All receptors		0.999	0
Park	North-east	0.014	0
Church	South	0.015	0
Residence	East	0.006	0
Residence	South	0.017	0
Residence	North	0.015	0
Toronto Zoo	North-west	0.007	0
Residence	North-west	0.010	0

All of the above predicted receptor odour concentrations are calculated on the assumption that all the processes at the biogas plant which generate significant odour emissions are operating, as shown in Table 1.

At an odour concentration of 1 ou, 50 % of a population with a normal olfactory response can detect an odour and at a concentration of about 5 ou all of a population with a normal olfactory response can usually detect an odour. The odour concentration at which there may be an odour complaint depends on many factors and might typically be 10 ou to 15 ou but could be significantly higher or lower under specific circumstances. The odours which will be discharged from the biogas plant will have a typical rural character and, therefore, any odour complaints are very unlikely to occur at any of the seven most impacted sensitive receptors since the maximum predicted 10-minute odour concentration in any hour over the 5-year modelling period is only 0.999 ou and this is based on odour being emitted from all the significant sources in the facility at the same time. The areas of trees which surround the biogas plant will assist in reducing the predicted odour concentrations at the sensitive receptors.

Table 4 also shows the frequency for each specific sensitive receptor when the 10-minute average odour concentration is predicted to exceed 1 ou during any hour over the 5-year modelling period, assuming that all the processes at the biogas plant which discharge significant odours are operating continuously during this period. At none of the receptors was the 1 ou concentration exceeded and, therefore, the frequency of exceeding 1 ou was 0.00 %.

11. CONCLUSIONS

In this Odour Study Report designs for the Toronto Zoo biogas plant were used to identify the processes which may be significant sources of odour emissions and odour emission rates were estimated for these sources.

Several mitigation measures can be taken to reduce these odour emission rates if there are situations at the plant when odour complaints may or do occur, such as inspection and rejection of feed material which has decomposed, using a carbon filter during displacement of air in tanks as they are being filled, basing truck movements on meteorological conditions and sealing equipment to prevent leakage of fugitive odours.

To determine the effect of the Anaerobic Digester emissions on nearby sensitive receptors, atmospheric dispersion modelling was used to predict odour concentrations at these receptors assuming that all the processes in the biogas plant are operating at the same time. At the request of the Ministry, the AERMOD model used for the modeling with local meteorological data

Using 5-years of hourly meteorological data in conjunction with the dispersion modelling, the highest 10-minute odour concentration at any off-site receptor is predicted to be 0.999 ou with the local meteorological data. This is a theoretical concentration which assumes that all of the sources in the plant are discharging odour at the same time, as shown by the odour emission rates in Table 1, and that there are no odour mitigation measures in place. The highest 10-minute odour concentration at the most impacted sensitive receptor is predicted to be less than 0.999 ou with the local meteorological data.

At these predicted odour concentrations of 0.999 ou or less, some people might just be able to detect the biogas odours in the absence of other odour sources in the vicinity of a receptor, but it is very unlikely that anyone would complain about the odour, particularly since it will have the same odour character as normal rural odours and odours from the nearby Toronto Zoo.

12. REFERENCES

"Project Description Report, Toronto Zoo Anaerobic Digester", Riepma Consultants Inc., August 15, 2001.

"Odour Classification of Land-Applied Materials", ORTECH Environmental Report No. 25242, December 1, 2004.

"Odour Assessment at Greenwood Mushroom Farm", Pinchin Environmental Report No. 23033, September 22, 2004.

"Farm-Based Anaerobic Digesters", Michigan State University Extension.

APPENDIX 1

Application and Approval to Use Local Meteorological Data
(3 pages)

1. Requestor Information

Requestor Name	Business Identification Number
Toronto Zoo Biogas Project	1613588

Business Name

Requestor Type:

- [X] Corporation
- [ ] Individual
- [ ] Partnership
- [ ] Sole Proprietor
- [ ] Federal Government
- [ ] Municipal Government
- [ ] Provincial Government
- [ ] Other

North American Industry Classification System (NAICS) Code: 5622

Business Activity Description

Zoo manure & grocery organic waste treatment facility with recovery of biogas for energy generation

2. Site Information

Site Name	MOE District Office
Toronto Zoo Biogas Project	Metro Toronto District Office

Address Information:

Site Address - Street information	Unit Identifier

Survey Address

Lot and Conc.: used to indicate location within a subdivided township and consists of a lot number and a concession number		Part and Reference: used to indicate location within an unsubdivided township or unsurveyed territory, and consists of a part and a reference plan number indicating the location within that plan. Attach copy of the plan	
Lot	Conc.	Part	Reference Plan
4	3		

Non Address Information

East of Meadowvale Road & south of Zoo Road in Toronto, Ontario

Municipality/Unorganized Township	County/District	Postal Code
Scarborough	Ontario	

Geo Reference(mandatory)

Map Datum	Zone	Accuracy Estimate	Geo Referencing Method	UTM Easting	UTM Northing
UTM NAD 83	17	+/- 2m	google earth	647143	4853124

Which of the following section of O. Reg. 419/05 currently applies to your facility?

- [ ] s.18 (Schedule 1)
- [ ] s.19 (Schedule 2)
- [X] s.20 (Schedule 3)

3. Project Technical Information Contact

Name	Company
Steve Thorndyke	ORTECH Consulting Inc

Civic Address - Street information	Unit Identifier
804 Southdown Road	

Delivery Designator:
If signing authority mailing address is a Rural Route, Suburban Service, Mobile Route or General Delivery

Municipality	Postal Station	Province/State	Country	Postal Code
Mississauga		Ontario	Canada	L5J2Y4

Telephone Number	Fax Number	E-mail Address
915-822-4120 x345		sthorndyke@ortech.ca

4. Reason(s) for Request

The use of a specified model is being requested in regards to (check all that apply):

- [ ] An application for a Certificate of Approval ( ):
- [ ] A submission under s.23, s.24 or s.25 of O. Reg. 419/05 (to prepare an Emission Summary and Dispersion Modelling (ESDM) Report)
- [ ] An ESDM Report required by s.30 (exceedence of Upper Risk Thresholds)
- [ ] A request for approval of an alteration of a Schedule 3 standard under s. 32 of O. Reg. 419/05
- [ ] Abatement activity
- [X] Other ( ): Renewable Energy Approval submission

5. Information about the Specified Model(s)

☐	This is a request to use a specified model in combination with a currently approved model					
	Are the following attached or submitted?					
	Name of Specified Model being requested for use in combination with currently approved model	☐	Yes	☐	No (if no, reason?)	
	Site Specific Circumstance that warrant the use of the specified model	☐	Yes	☐	No (if no, reason?)	
	Scenarios under which the combination of models would be used	☐	Yes	☐	No (if no, reason?)	
☒	This is a request to use a specified model listed in the Air Dispersion Modelling Guideline for Ontario					
	Are the following attached or submitted?					
	Name of Specified Model being requested	☐	Yes	☒	No (if no, reason?)	AERMOD
	Site Specific Circumstance that warrant the use of the specified model	☐	Yes	☒	No (if no, reason?)	Version 12345
☐	This is a request to use a specified model not listed in the Air Dispersion Modelling Guideline for Ontario					
	Are the following attached or submitted?					
	Name of Specified Model being requested	☐	Yes	☐	No (if no, reason?)	
	An executable copy of the specified model (or reference to where it can be obtained)	☐	Yes	☐	No (if no, reason?)	
	Site specific circumstance that warrant the use of the specified model	☐	Yes	☐	No (if no, reason?)	
	A copy of the user guide specific to the dispersion model named above	☐	Yes	☐	No (if no, reason?)	
	A copy of any technical guidance available on the dispersion model named above	☐	Yes	☐	No (if no, reason?)	
	A copy of any evaluation (e.g. comparison with monitoring studies, beta testing results) pertaining to the dispersion model named above	☐	Yes	☐	No (if no, reason?)	
☐	This is a request to use a specified model in combination with monitoring					
	Contact the Environmental Monitoring and Reporting Branch for pre-submission consultation					

6. Additional Facility Information

General Supporting Information Required	Attached or Submitted?	If No, reason?
Site Plan	☐ Yes ☐ No	
Location of Stacks & Buildings Identified	☐ Yes ☐ No	
Elevation Plan	☐ Yes ☐ No	
Physical Location Information	☐ Yes ☐ No	
Surrounding Building Information	☐ Yes ☐ No	
Local Terrain Information	☐ Yes ☐ No	
Downwash Effect Described (if applicable)	☐ Yes ☐ No	

7. 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
- The Project Technical Information Contact identified this form is authorized to act on my behalf for the purpose of obtaining approval for use of a specified dispersion model under Section 7 of O. Reg. 419/05 for the equipment/processes identified herein.
- 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 1-800-461-6290) and I have included all necessary information required by O. Reg. 419/05 or identified on this form.

Name of Signing Authority: Clare Riepma	Title: President	
Telephone Number: 905-877-6751	Fax Number:	E-mail Address: riepma@riepma.ca
Signature: [signature]	Date: Nov 12/13	

Address Information:

Civic Address - Street Information: c/o Riepma Consultants Inc., 13041 Highway 7	Unit Identifier:

Delivery Designator:
If signing authority mailing address is a Rural Route, Suburban Service, Mobile Route or General Delivery

Municipality	Postal Station	Province/State	Country	Postal Code
Georgetown		Ontario	Canada	L7G 4S4

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
Téléc. : 416 235-6235

Ontario

November 22, 2013

Clare Riepma, President
Riepma Consultants Inc.
Acting for Toronto Zoo Biogas Project
13041 Highway 7
Georgetown, ON L7G 4S4

Dear Madam/Sir:

Re: Request for Approval under Paragraph 3 of section 13(1) of Regulation 419/05
For use of Site Specific Meteorological Data at
Toronto Zoo Biogas Project, Scarborough, Ontario

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 Toronto Zoo Biogas Project signed by you and dated November 12, 2013. I am of the opinion that the site specific meteorological data referenced as the Buttonville Airport data is the most representative meteorological conditions for the proposed modelling assessment, given the proximity of the Toronto Pearson Airport to the facility's location.

A fully processed meteorological data set for the 5 years from 2005 to 2009 has been prepared by the Ministry of the Environment with wind-sector dependent land use specific to the application area, using surface data from Buttonville Airport. Missing hours were filled by data from Toronto Pearson Airport station. Both stations are operated by Environment Canada. This meteorological dataset can be used to run the AERMOD model and has been prepared only for this specific ESDM assessment to model discharges from the above-referenced facility.

The data were prepared in reply to a request submitted for preparation of an ESDM report under O. Reg. 419 and is subsequently approved for use in Environmental Compliance Approval (ECA) applications for this specific facility provided there are no significant land use changes in vicinity of the facility.

Yours truly,

Robert Bloxam

Dr. Robert Bloxam
Director, Section 13, O. Reg. 419/05

cc: District Manager, Metro Toronto District Office
Environmental Approvals Branch