Report No. 25918-1

ORTECH

Report:

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

Date: October 10, 2013



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Report No.: 25918-1 (Revision 2)
20 pages

Odour Study Report

Part 1: Emission Estimates

Grimsby Energy Inc.

Table of Contents

1. INTRODUCTION

Grimsby Energy Inc. is planning to install and operate an Anaerobic Digester facility on rural land at 442 Sobie Road in the Town of Grimsby, Ontario, to generate about 1 MW of electrical energy from surplus material available in the local farming community and, perhaps, other renewable sources. The facility will be constructed in two phases (Phase 1 and Phase 2) commencing in 2014 with completion of the first phase expected about 6 months later. Each phase will generate about 500 kW. The facility will produce thermal energy, some of which will be used to heat the Anaerobic Digester equipment and the remainder will be surplus.

The project has received a Feed in Tariff (FIT) contract, F-000610-BIG-130-302, from the Ontario Government to supply the surplus energy as electricity to the local grid.

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. This part of the study, Part 1, includes emission estimates.

Some of the other reports required for a Class 3 Anaerobic Digester are a *Project Description Report* and a *Design and Operations Report*. These two reports have already been prepared by Riepma Consultants Inc. and were used as a basis for preparing this Odour Study Report.

3. ANAEROBIC DIGESTER DESCRIPTION

A site plan for the Anaerobic Digester facility is shown in Figure 1 and a process flow schematic of the Anaerobic Digester process is shown in Figure 2. The purpose of this Anaerobic Digester is to decompose organic farm material 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 an engine or turbine to generate electricity. A decision on whether to use an engine or a turbine has not yet been made.

As described in the Project Description Report, dated August 21, 2012, the facility during Phase 2 will consist of a weigh scale for the trucks (Solid Feed Trucks and Liquid Feed Trucks) bringing feed material into the facility. There are six Receiving Bunkers for solid material upon completion of Phase 2. There will also be an Inground Storage Tank for liquid manure and other materials. A Front End Loader will convey solid material from the bunkers to two Gravity Feeders which feed two Plug Flow Digesters, followed by two Secondary and two Tertiary Digesters. Liquid manure and other materials in the Inground Storage Tank will be piped to the Plug Flow Digesters.

The Anaerobic Digester liquid fraction from the Tertiary Digester effluents will be stored in two Digestate Storage Tanks. The solid fraction of the Tertiary Digesters effluents will be obtained using a Separator and a Slurry Pit. The solid fraction will be transferred to a Concrete Floor (Loading Plate) for transport from the facility using Solid Product Trucks and the liquid fraction will be removed from the Digestate Storage Tanks for transport from the facility in sealed tanks.

Biogas from the Anaerobic Digester process will be stored in two Biogas Storage gas bladders prior to processing, which includes a Gas Cooler and a Carbon Adsorber, before the biogas is combusted in an engine or turbine to produce thermal energy for generating electricity and for heating purposes in the Anaerobic Digester process. Then there will be a Transformer and a transmission line connection. Excess or sub-standard biogas will be combusted by a Flare.

Figure 1: Site Plan

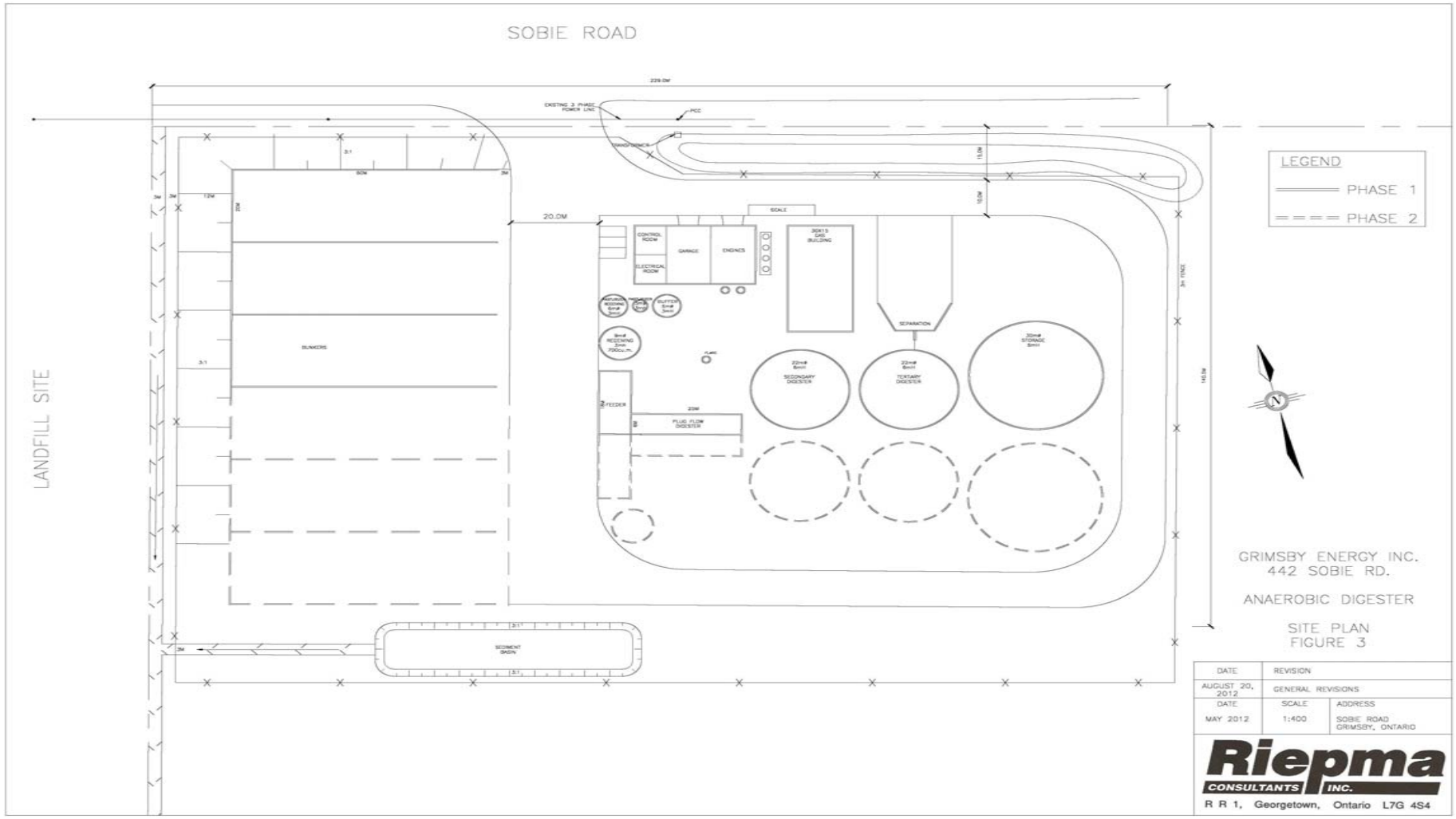
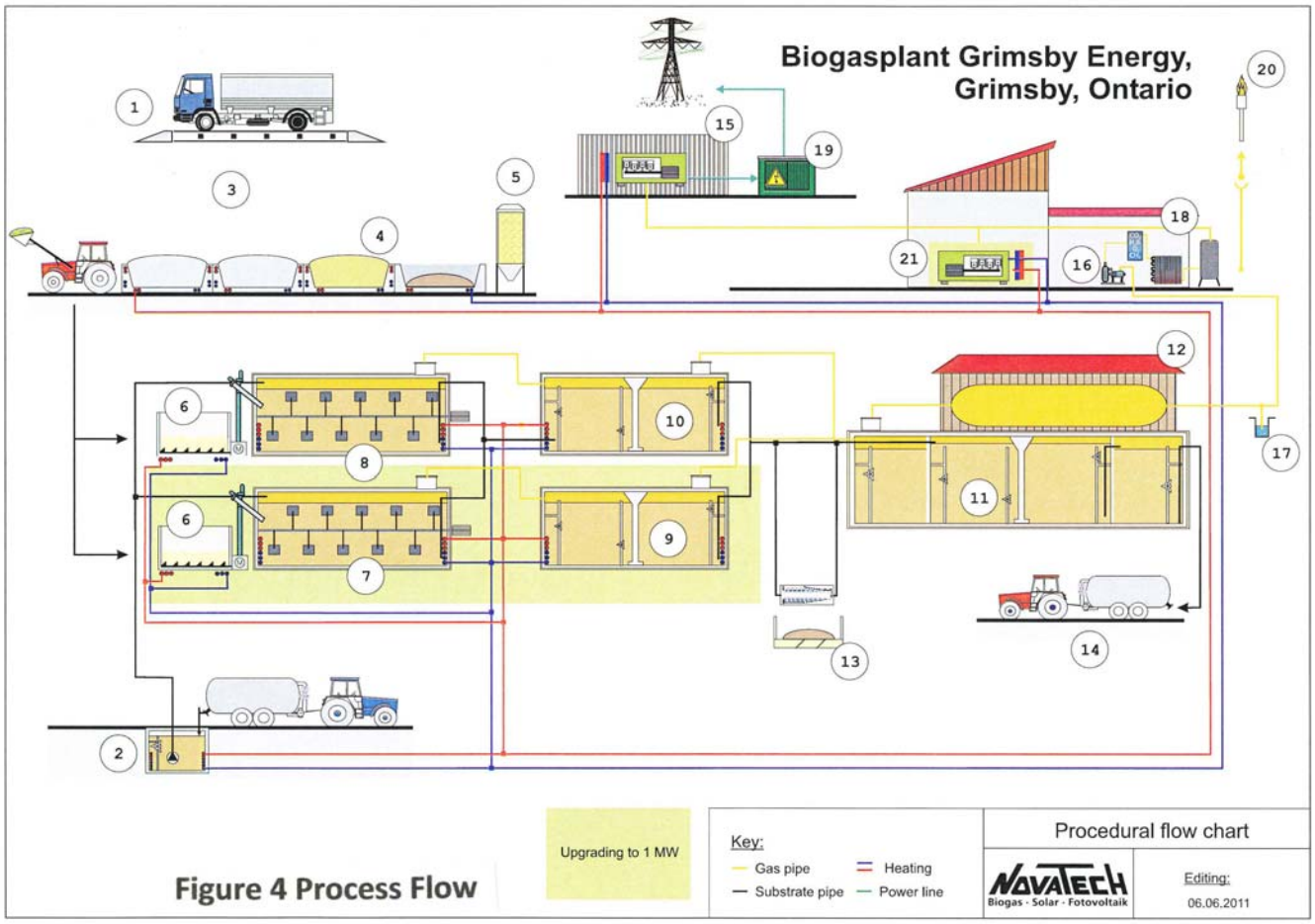


Figure 2: Process Flow



4. ANAEROBIC DIGESTER OPERATIONS

Feedstock materials will be delivered to the Anaerobic Digester facility in specific amounts at specific times of the year, as detailed in the *Project Description Report* and the *Design and Operations Report*. These materials will consist of crop residues, grass cuttings, grape pomace, other materials and manure in both liquid and dry solid states. The materials will be weighed and stored in six covered Receiving Bunkers for the solid materials and in an Inground Storage Tank for the liquid manure and other materials. A Front End Loader will move the solid Receiving Bunker material to the two Gravity Feeders daily as required, and thence to the two Plug Flow Digesters. Material in the Inground Storage Tank will be transferred via a closed system to the Plug Flow Digesters.

After a period of 22 days in the two Plug Flow Digesters at a mesophylic temperature range of 38 to 43°C, the material will be moved to the Secondary and Tertiary Digesters for a period of 66 days. The Tertiary Digesters output material will be separated into solid and liquid fractions. The solid fraction will be loaded from a Concrete Floor onto the Solid Product Trucks and transported off-site to local farms for use as a soil supplement. The liquid fraction will be stored in the Digestate Storage Tanks, and moved off-site by tanker truck for use at local farms as a soil nutrient.

Biogas from the Anaerobic Digester process will be stored in two Biogas Storage bladders enclosed in a building which is expected to have a roof vent. Sub-standard or excess amounts of biogas will be combusted in a Flare system. Otherwise, the biogas will be processed to remove moisture by the Gas Cooler and reduced sulphur compounds by the Carbon Adsorber prior to combustion in an Engine or Turbine to produce thermal energy and generate electricity which will be delivered to a local transmission line via a Transformer. The facility will be operated from a Control Room.

5. POTENTIAL SOURCES OF ODOUR EMISSIONS

There are many potential sources of odour emissions from the Anaerobic Digester facility 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 facility property.

For the actual Anaerobic Digester process alone, any odour emissions are expected to be insignificant fugitive emissions since this is a sealed process. Equipment for this process includes the two Plug Flow Digesters, the Secondary and Tertiary Digesters, and the Digestate Storage Tanks.

Trucks for liquid feed delivery to the facility and the trucks for the liquid product removal are not expected to have significant odour emissions although there may be slight odour emissions as air is displaced from the liquid fraction product trucks when they are filled.

The Inground Storage Tank for liquid dairy cattle manure and liquid swine manure is not expected to have significant odour emissions although there will be slight odour emissions as air is displaced from the tank when it is filled. In addition, the Inground Storage Tank will receive other materials such as fats, oil and grease (FOG) which are also expected to have only slight odours.

No odour emissions are expected from the building which will contain the Gas Cooler, moisture removal and Carbon Adsorber equipment since these are sealed units. Similarly, no significant odour emissions are expected to occur from the Control Room, Engine or Turbine and Transformer. There may be a slight odour from unburnt hydrocarbons in the Engine or Turbine combustion products.

Sources which may have relatively significant odour emissions compared with the sources mentioned above are described below.

Solid Feed Truck: Trucks will be used to deliver solid feed to the facility, including corn silage, grass silage, grape pomace and dry solid manure (poultry manure and cattle manure). These will be open trucks which will discharge odours when they drive around the facility 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 product from the facility for use as a soil conditioner by local farmers. These will be open trucks which will discharge odours as they drive from the facility and are stationary while they are on the weigh scale or being loaded from the Concrete Floor. Covered trucks will be used if necessary to reduce odour emissions.

Receiving Bunkers: The six Receiving Bunkers will be covered. These covers will not allow odours to be discharged from the solid feed. However, odours will be discharged from the sections of the bunkers which are uncovered to allow the Solid Feed Trucks to dump their solid feed loads and for the Front End Loader to transfer material from the Receiving Bunkers to the two Gravity Feeders.

Front End Loader: A Front End Loader with an open bucket will transfer material from the Receiving Bunkers to the two Gravity Feeders. Odour emissions will occur from the bucket during the transfer operations.

Flare: The Flare will be activated to burn biogas which does not meet quality standards for the Engine or Turbine, or is produced in an excessive quantity that cannot be used by the Engine or Turbine. Odour emissions will occur when the Flare is in operation due to the combustion products.

Biogas Storage: Biogas will be stored in two separate Biogas Storage bladders prior to clean up and combustion in the Engine or Turbine, or Flare. The bladders are slightly porous which will cause biogas to leak from the bladders into the room containing the bladders and then through an assumed roof vent which is located on the room. Slight odour emissions from the vent will occur.

Separator: The Separator is a sealed unit but slight odour emissions will occur as the relatively dry solids are discharged from the base of the Separator.

Slurry Pit: The dry solid fraction from the Separator will fall into a Slurry Pit and some odour emissions will be discharged from the open top of the pit.

Concrete Floor: Dry solids from the Slurry Pit will be stored on a concrete floor (Loading Plate) until it is loaded onto Solid Product Trucks and some odour emissions from the solids will occur.

6. ODOUR EMISSION ESTIMATES

In preparation for determining the impact of odour emissions from the facility on the odour receptors beyond the facility property, odour emission rates were estimated for those sources in the facility where there is a potential for significant odour emissions to occur. These sources 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 1 MW. Some assumptions have been made in order to calculate the odour emission rates.

Receiving Bunkers: The six Receiving Bunkers are assumed to contain corn silage, grass silage, dry solid manure and poultry manure. Laboratory and field studies have determined odour emission factors for these types of materials using standard flux chamber techniques to collect odour samples which were then evaluated for the odour detection threshold value expressed as odour units (ou). These techniques are approved by the Ontario Ministry of the Environment for compliance odour testing programs. The emission factor results are expressed as the number of odour units discharged from one square meter of the material surface per second ($ou/m^2/s$).

Test results obtained for corn silage, grass silage, dry solid manure and poultry manure gave estimated emission factors of 0.45 $ou/m^2/s$, 0.50 $ou/m^2/s$, 0.49 $ou/m^2/s$ and 15.6 $ou/m^2/s$, respectively. These emission factors are typical but will vary depending on the type and condition of the material. No emission factor is available for grape pomace so an estimated emission factor of 0.48 $ou/m^2/s$, based on an average of the above emission factors, except for the poultry manure emission factor.

Test results from laboratory studies obtained for chicken manure gave estimated emission factors of up to 15.6 $ou/m^2/s$. This emission factor will vary depending on the type and condition of the material but may be much lower than this value for other types of chicken waste. For example, a test result for chicken litter was an emission factor of 4.20 $ou/m^2/s$.

If it is assumed that the extent of coverage in the Receiving Bunkers is typically 80% when material is being delivered to or removed from a bunker, then the uncovered area per bunker is 240 m^2. The odour emission rates from the uncovered potions of the bunkers are the products of the uncovered area (m^2) and the corresponding emission factor (ou/m^2/s), expressed as odour units per second (ou/s).

Inground Storage Tank: The liquid swine and liquid dairy manure which will be delivered to the Inground Storage Tank will cause a high odour threshold value for the air inside the tank. For example, test results indicate that emission factors are 27 ou/m^2/s for liquid swine manure and 24 ou/m^2/s for liquid dairy manure. Any air which is displaced from the tank during loading operations will be vented to the atmosphere, but there will be a carbon adsorber to remove odours and the Inground Storage Tank is not expected to be a significant source of odour emissions although there could be fugitive odour emissions. These fugitive odour emissions are expected to be minor and, therefore, an odour emission rate has not been calculated.

Front End Loader and Gravity Feeders: A Front End Loader will transfer material from the Receiving Bunkers to the two Gravity Feeders which feed the two Plug Flow Digesters. It is assumed that the emission factors used for the Receiving Bunker odour emission rate calculations are equally applicable to the open areas of the Front End Loader and Gravity Feeders. If these areas are assumed to be 6 m^2 for the Front End Loader and 16 m^2 for the Gravity Feeders, the corresponding odour emission rates are 3 ou/s for the Front End Loader and 8 ou/s for each Gravity Feeder, although they will be higher during the transfer of Poultry Manure but appropriately mature manure only will be delivered to the Anaerobic Digester facility.

These emission rates will only occur during material transfer operations provided the equipment is kept clean during other time periods.

Flare: Biogas will be combusted by the Flare during periods of substandard or excess biogas production, with the combustion products released to the atmosphere. The maximum biogas combustion rate will be 0.135 m^3/s. The biogas will have a very high odour concentration which will be caused primarily by hydrogen sulfide and any release of this biogas to the atmosphere will be avoided. Laboratory analysis of a biogas sample from an operating Anaerobic Digester gave a hydrogen sulfide concentration of 1320 parts per million (ppm) by volume. The odour threshold value for hydrogen sulfide is about 0.07 parts per billion (ppb).

Therefore, the maximum odour emission rate is 18,857,000 ou/s at a biogas flow rate of 0.135 m^3/s. During combustion, the hydrogen sulfide is converted into sulfur dioxide which has a much lower odour threshold value of about 5 ppm. Therefore, the odour emission rate from the Flare is estimated to be 36 ou/s based on the sulfur dioxide emission rate. The Flare will be maintained at a sufficient temperature to ensure that all the hydrogen sulfide and other odorous compounds are essentially converted into sulfur dioxide and non-odorous combustion products.

Biogas Storage: The two cylindrical Biogas Storage bladders will have a pressure of less than 5 mbar and will be encased in a sealed building which is assumed to have an exhaust vent. They will have a maximum porosity of 500 cm^3/m^2/day/bar (as permitted by Regulation 359). At this porosity and a combined surface area of 1178 m for the two bladders, the leakage rate of biogas from the assumed roof vent will be 0.034 cm^3/s. Using the odour threshold value for hydrogen sulfide, the corresponding odour emission rate will be 0.64 ou/s for each bladder.

Separator, Slurry Pit and Concrete Floor: Digestate from the Tertiary Digester process will be separated into liquid and solid fractions by the Separator process. The dry solids will be stored in the Slurry Pit and loaded onto trucks from the Concrete Floor.

A study has shown that up to 90% of the odour in liquid manure feed to an Anaerobic Digester is removed in the solid fraction product and another study showed that the reduction is typically 70% to 80%. To determine an emission factor for the solid product, the liquid manure feed is assumed to have an emission factor of 27 $ou/m^2/s$, based on tests for liquid swine manure, and the odour reduction is 75% to give an emission factor for the solid product of 6.8 $ou/m^2/s$. This emission factor of 6.8 $ou/m^2/s$ represents a worst case situation since the emission factor of 27 $ou/m^2/s$ for liquid swine manure feed is far higher than the emission factors for the other feed materials except for the poultry manure. The liquid farm manure will be blended with these other feed materials in the anaerobic digester and, therefore, the solid product emission factor is expected to be far lower than 6.8 $ou/m^2/s$. But, for the purpose of this Odour Study Report, this emission factor has been used since the combination of feed materials which will be used in the digester has not yet been established.

If the exposed surface area of the Slurry Pit and Concrete Floor are 28 m^2 and 15 m^2, respectively, the odour emission rates are 190 ou/s and 102 ou/s, respectively.

Solid Feed Trucks and Solid Product Trucks: Emission factors for these trucks were assumed to be the same as those for the Poultry Manure Bunker (15.6 $ou/m^2/s$) and the Concrete Floor (6.8 $ou/m^2/s$), respectively, with a truck bed area of $15m^2$. The odour emission rates are then 234 ou/s for the Solid Feed Truck and 102 ou/s for the Solid Product Truck.

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)
Solid Feed Trucks	Solid Feed	15.6	15	234
Solid Product Trucks	Solid Product	6.8	15	102
Receiving Bunker 1	Corn & Grass Silage	0.45	240	108
Receiving Bunker 2	Poultry Manure & Pomace	3.58	240	859
Receiving Bunker 3	Dry Solid Manure	0.49	240	118
Receiving Bunkers 4 to 6	Silage, Manure & Pomace	-	0	0
Inground Storage Tank	Dairy & Swine Liquid Manure	-	0	0
Front End Loader	Solid Feed	0.50	6	3
Gravity Feeder 1	Solid Feed	0.50	16	8
Gravity Feeder 2	Solid Feed	0.50	16	8
Biogas Storage 1	Biogas	-	-	1
Biogas Storage 2	Biogas	-	-	1
Separator	Filtrate/Digestate	0.00	25	0
Slurry Pit	Solid Digestate	6.8	28	190
Concrete Floor	Solid Digestate	6.8	15	102
Flare	Combustion Products	-	-	36
Estimated Total				1770

In this table it is assumed that Receiving Bunker 1 will contain corn and grass silage with an estimated combined odour emission factor of 0.45 $ou/m^2/s$. Receiving Bunker 2 will contain poultry manure and grape pomace with an estimated combined emission factor of 3.58 $ou/m^2/s$, which is prorated based on the amounts of these materials which will be delivered to the facility each year (1500 t of poultry manure and 6000 t of grape pomace). It is further assumed that three of the receiving bunkers, in this case Receiving Bunker 4 to Receiving Bunker 6, will be completely covered at all times and have no odour emissions.

Based on this table, the estimated odour emission rate for Receiving Bunker 2, which contains some poultry manure, accounts for 48.5% of the total estimated odour emission rate. Therefore, to significantly reduce the total estimated odour emission rate, only appropriately mature poultry manure will be delivered to the facility and the uncovered areas of the receiving bunkers containing poultry manure will be kept to a minimum during the delivery and removal of the manure.

The estimated total odour emission rate of 1770 ou/s in Table 1 is based on the theoretical assumption that all of the sources are emitting odour at the same time. This will not occur. The estimated total odour emission rate will be much lower for each actual process operating condition in combination with various odour mitigation measures.

7. MITIGATION OF ODOUR EFFECTS

A number of measures can be undertaken, when necessary, to reduce the amount of odour discharged from the facility 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 for Feed Delivery and Product Removal: Trucks which deliver solid feed to the facility are likely to have open tops but odour emission can be reduced if the tops have closed tops which are removed during unloading and loading. Solid Feed Truck loads can be inspected to assess the condition of the load and determine if there are anaerobic decomposition conditions present which may lead to odour complaints. Movements of trucks within the plant and during loading and unloading activities can be coordinated so that these movements are optimized to control odour emissions.

Wind speed and wind direction may need to be considered when there are truck movements in the facility. If feasible, loading operations should be avoided when the wind is blowing towards the nearest sensitive receptors if a load is particularly odorous. A wind rose for the Anaerobic Digester facility area is shown in Figure 3, based on regional meteorological data from London, Ontario, and in Figure 4, based on local meteorological data.

The odour emission rates for the Solid Feed Trucks (234 ou/s) and Solid Product Trucks (102 ou/s) will be reduced if the trucks are covered, particularly when delivering poultry manure to the facility. When the trucks are covered it is assumed that these emission rates will be reduced to 10% of these rates when the trucks are uncovered, equivalent to 23 ou/s for the Solid Feed Trucks, except for poultry manure deliveries, and 10 ou/s for the Solid Product Trucks. For poultry manure deliveries it is assumed that the Solid Feed Truck odour emission rate can be reduced to 117 ou/s when the trucks are covered.

Figure 3: Wind Rose for the Anaerobic Digester Facility (based on London Met. Data)

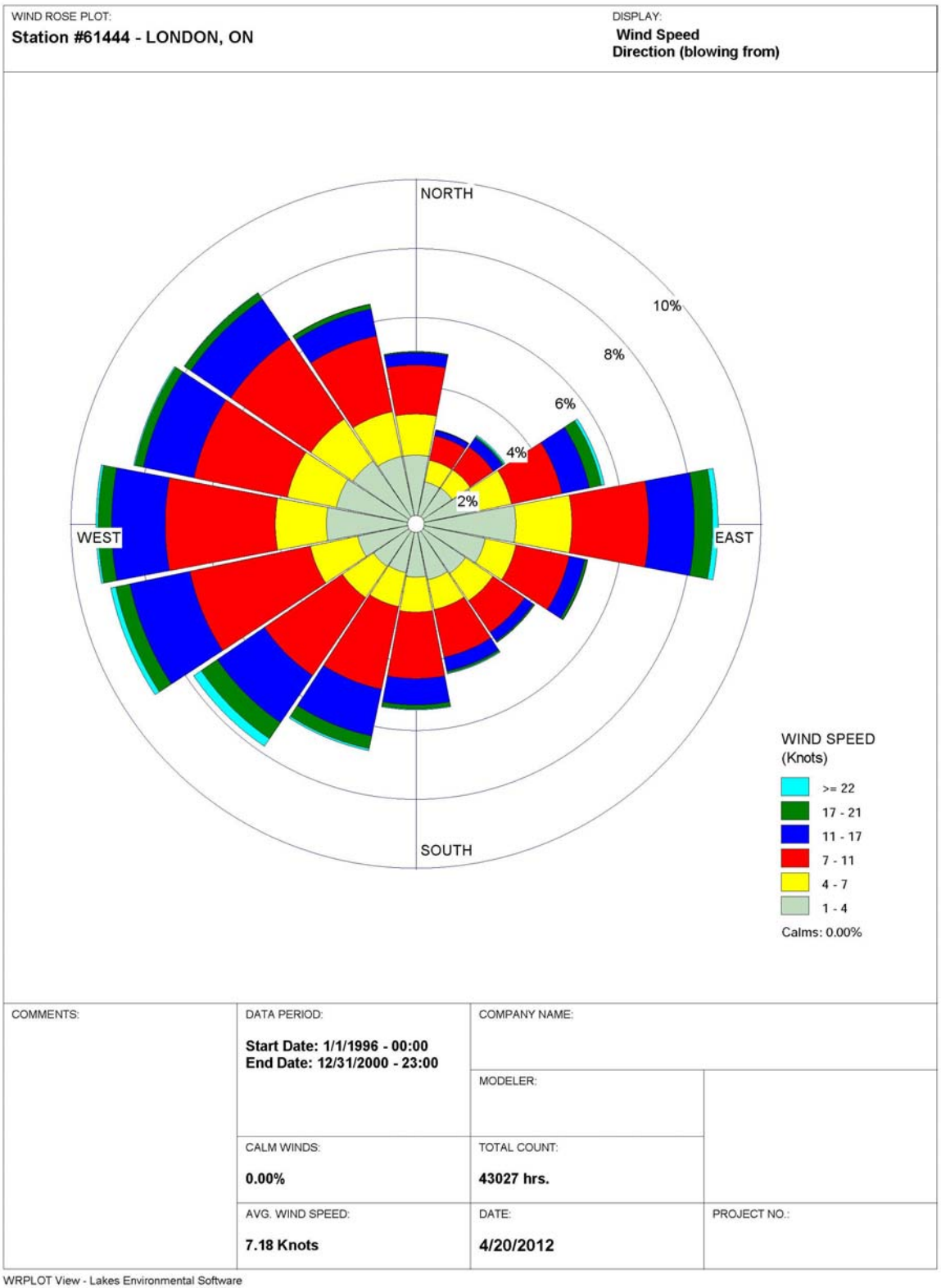
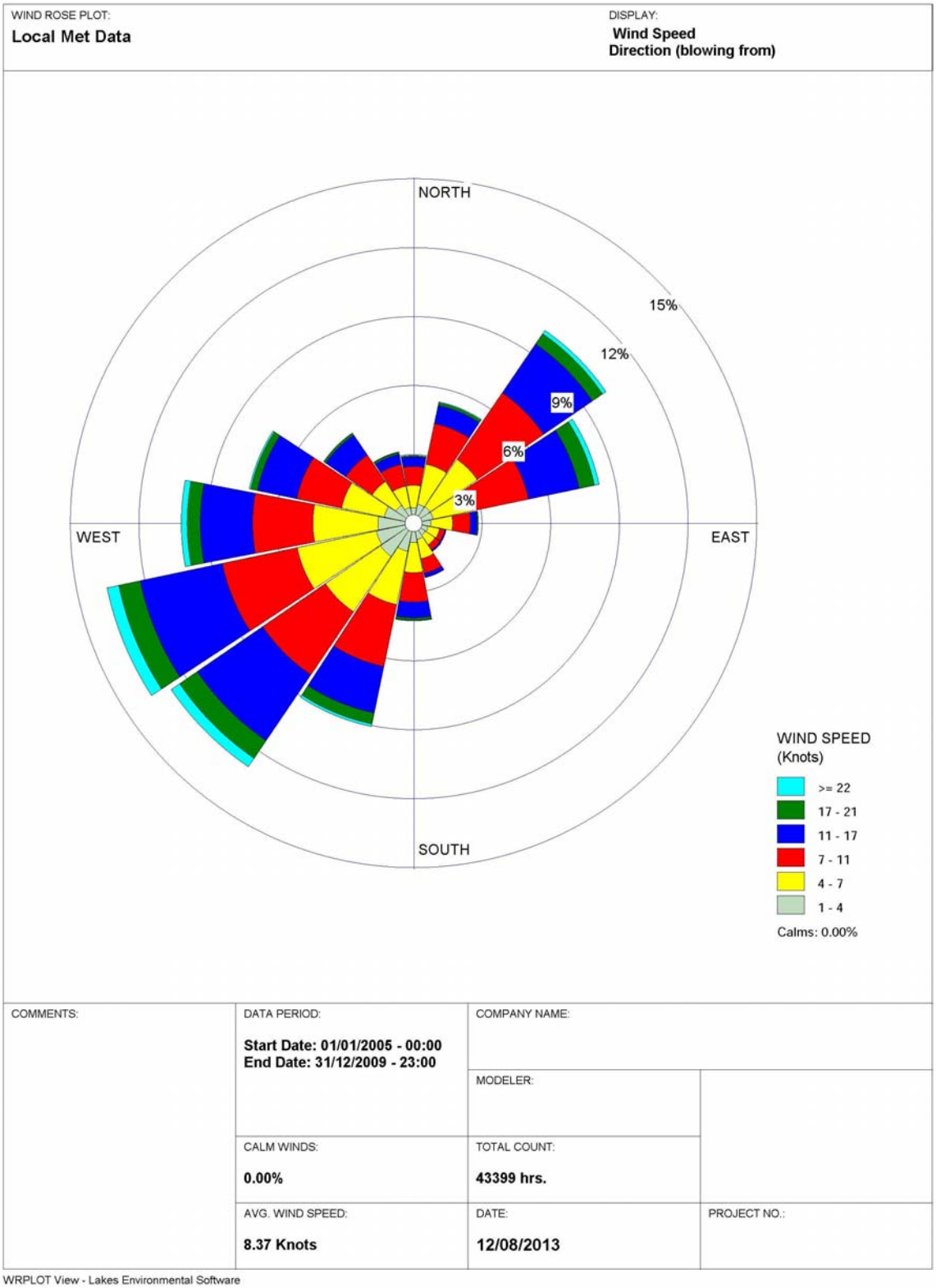


Figure 4: Wind Rose for the Anaerobic Digester Facility (based on Local Met. Data)



Bunkers and Material Loading: The Receiving Bunkers, especially the Receiving Bunkers containing poultry manure, will be covered entirely except for uncovered areas to allow material delivery and removal. Liquid run off from the bunkers will be recycled in the facility.

Since the Receiving Bunker containing Poultry Manure is estimated to account for 48.5% of the total estimated odour emission rate from the Anaerobic Digester facility, as shown in Table 1, there should be provisions to store the poultry manure at its place of origin until it matures and the odour emission rate is significantly reduced.

As a target, the odour emission rate for the Receiving Bunkers containing poultry manure should be reduced from 859 ou/s to 113 ou/s, which is equivalent to an expected odour emission rate for the other Receiving Bunkers.

The time for material loading operations by the front end loader when the bunker covers are partially removed, should be minimized, especially for the Receiving Bunker containing poultry manure. Gravity Feeders may need to be covered except when material is being added to the feeders by the Front End Loader.

A Carbon Adsorber could be placed on the Inground Storage Tank for liquid manure to reduce odour emissions in the displaced air as the tank is filled, although this is a relatively minor source of odour emissions.

Flare: 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 which has a high odour threshold value compared with reduced sulphur compounds.

Separator, Slurry Pit and Plate Loading: Digestate separation and loading are predicted to be the most critical sources of odour emissions based on their off-property odour impact. These sources will be covered as much as possible to minimize the surface area of digestate which is open to the atmosphere. It may be necessary to conduct digestate separation and loading operations under specific wind directions or other meteorological conditions.

The total estimated odour emission rate of 1770 ou/s shown in Table 1 is based on all the odour emission sources emitting odour at the same time (Condition A) and none of these mitigation measures in place. In practice, all of the sources will only be emitting odour periodically and this odour emission rate will never occur. The total odour emission rate will vary constantly depending on the process conditions operating at the time. The following Table 2 provides estimated odour emission rates for these different combinations of process conditions.

Table 2: Estimated Odour Emission Rates for Combinations of Process Conditions

Source	Material	All Processes Operating (ou/s)	Front End Loader & Gravity Feeder (ou/s)	Solid Feed Delivery (ou/s)	Solid Product Removal (ou/s)	Flare Operating (ou/s)	Poultry Manure Delivery (ou/s)
		A	B	C	D	E	F
Solid Feed Trucks	Solid Feed	234		23			117
Solid Product Trucks	Solid Product	102			10		
Receiving Bunker 1	Corn & Grass Silage	108		108			
Receiving Bunker 2	Poultry Manure, Pomace	859	113	113			113
Receiving Bunker 3	Dry Solid Manure	118	118				
Receiving Bunkers 4 to 6	Silage, Manure, Pomace	0					
Inground Storage Tank	Liquid Manure	0					
Front End Loader	Solid Feed	3	3				
Gravity Feeder 1	Solid Feed	8	8				
Gravity Feeder 2	Solid Feed	8	8				
Biogas Storage 1	Biogas	1	1	1	1	1	1
Biogas Storage 2	Biogas	1	1	1	1	1	1
Separator	Filtrate/Digestate	0					
Slurry Pit	Solid Digestate	190			190		
Loading Plate	Solid Digestate	102			102		
Flare	Combustion Products	36				36	
Estimated Total		1770	252	246	304	38	231

Six combinations of operating conditions are considered (Condition A to Condition F).

Condition A is the theoretical condition when all of the sources are emitting odours and none of the mitigating measures are in place. The remaining conditions are representative of five combinations of operating conditions with some of the mitigating measures in place, including covers on the Solid Feed Trucks and Solid Product Trucks, as well as ensuing that poultry manure odour emissions are minimized by reducing the uncovered area of any Receiving Bunker which contains poultry manure and ensuring that only mature poultry manure is received at the facility. These mitigation measures assume that covers on the trucks will reduce the odour emission rate by 90%, except for the poultry manure feed trucks. The poultry manure feed truck odour emission rate (117 ou/s) is assumed to be reduced by 50% of the uncovered Solid Feed Truck odour emission rate (234 ou/s) when truck covers are used. For Condition B and Condition C, it is assumed that two uncovered Receiving Bunkers will be involved.

The odour emission rate for Receiving Bunker 2, containing a mixture of poultry manure and pomace, is 859 ou/s. It is assumed this odour emission rate can be reduced to 113 ou/s, which is similar to the other Receiving Bunkers, by storing only mature poultry manure in the Receiving Bunker and minimizing the uncovered portion.

It is expected that the facility can generally operate without any overlap in the five representative operating conditions. The above mitigation measures can be implemented, as appropriate, if there are odour complaints or there is a potential for odour complaints about the facility.

8. ODOUR AND OTHER ENVIRONMENTAL BENEFITS

The principal odour environmental benefit from the Anaerobic Digester operations is that odour discharged from the facility will be much lower than the odours which will be discharged if the feed materials were to be spread on fields as a nutrient. 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 from the biogas in a Carbon Adsorber and are not released to the atmosphere.

Other environmental benefits include the generation of electrical power and the concomitant reduction in the use of fuels such as coal or natural gas which would otherwise be combusted to produce this power. These fuels discharge toxic components in the combustion gases and contribute to global warming. The facility also provides a means for farmers to dispose of unwanted crop residues and manure, as well as grass cuttings.

9. CONCLUSIONS

In this Odour Study Report, Part 1, designs for the Grimsby Energy Anaerobic Digester facility 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 will be taken to reduce these odour emission rates. These measures include covering the Solid Feed Trucks and Solid Product Trucks, and ensuring that only mature poultry manure is delivered to the facility.

If there are situations in the facility when odour complaints may or do occur, such as delivery of feed material which has decomposed or displacement of air in tanks as they are being filled, then a number of other mitigation measures will be taken to eliminate these complaints. These measures may include inspection of Solid Feed Trucks upon arrival at the facility, basing truck movements on meteorological conditions and placing a carbon filter on the Inground Storage Tank. An experimental odour testing program may be required after the facility is operating to optimize the process operating conditions to ensure that odour complaints do not occur.

10. REFERENCES

"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.