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ODOUR AND GAS MONITORING OF TWO BIOFILTERS LOCATED IN ORMONDE ORGANICS COMPOSTING FACILITY, PORTLAW, CO. WATERFORD.

PERFORMED BY ODOUR MONITORING IRELAND ON BEHALF OF ORMONDE ORGANICS LTD

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1. Introduction and scope

1.1 Introduction

Odour Monitoring Ireland was commissioned by Ormonde Organics Ltd to perform an odour, hydrogen sulphide, ammonia, amines and mercaptan test of the exhaust treated air from the biofiltration system located in their Composting facility in Portlaw, Co. Waterford. The monitoring scope included:

- Inlet and exhaust odour sampling and analysis of the exhaust treated air from the biofiltration system in accordance with the EN13725:2003,
- Exhaust Ammonia, Hydrogen sulphide, Amines and Mercaptans sampling and analysis of the exhaust treated air from the biofiltration system.

Sampling and analysis of Odour is easily performed using established sampling and analysis methodologies. Odour sampling and analysis was performed in accordance with the EN13725:2003. All materials in contact with the inlet sample air stream were either stainless steel, Teflon or Nalophan. Hydrogen sulphide, Amines, Ammonia and Mercaptans sampling and analysis was performed indirectly in accordance with EN13649:2002, NIOSH 2010, gold leaf analyser and MDHS 72 and 75.

Materials and methods, results and discussion and conclusions are presented within the document.

1.1 Scope of the work

The main objectives of this study include:

- Inlet and exhaust odour sampling and analysis of the exhaust treated air from the biofiltration systems in accordance with the EN13725:2003,
- Exhaust Ammonia, Hydrogen sulphide, Amines and Mercaptans sampling and analysis of the exhaust treated air from the biofiltration systems.

2. Materials and methods

This section describes the materials and methods used throughout the monitoring on the 04th November 2010.

2.1 Volume flow rate measurement

Airflow rate measurement was performed in accordance with EN13284-1:2002. The following equipment was used through the airflow rate assessment. These included:

- Testo 400 and 350/454 MXL handheld and differential pressure sensors,
- L type pitot probe,
- PT100 temperature probe,

The following control procedure was used through the measurement sequence:

1. Measurement was performed at two diameters at right angles to each other,
2. The internal diameter of the ductwork was measured and verified,
3. Approximately 5 duct diameters were available between the measurement point and the outlet of the carbon vessel,
4. The temperature profile across the stack was verified and did not differ by more than 5% from the average absolute temperature of the duct cross section,
5. Since the duct was small in diameter, only three individual samples points was used to determine the average flow at specified locations across the duct diameter.
6. The difference in the average airflow velocity across each diameter did not exceed 5% of the mean for all the diameters (2 in total).
7. The number of sample points across the 2 diameters was determined in accordance with Table 7.1.4 of ISO10780:1994. The sample locations were marked upon the L type pitot using a water resistant marker.
8. The L type pitot was checked for any burrs and obstructions in the pitot orifices,
9. The absence of swirling flow was determined in accordance with EN13284-1:2002.
10. The measurement sequence was performed in accordance with the procedure described in EN13284-1:2002.

The airflow rate measurement was used to ascertain the volumetric airflow through the biofiltration system.

2.2 Odour sampling and analysis

2.2.1 Odour sampling

In order to obtain air samples for odour assessment, a static sampling method was used where air samples were collected in 40 to 60 litre pre-conditioned Nalophan^{NA} bags using a vacuum sampling device over a 15 minute period. The sampler operates on the 'lung principle', whereby the air is removed from a rigid container around the bag by a battery powered SKC vacuum pump at a rate of 4 *l* min^{-1}. This caused the bag to fill through a stainless steel and PTFE tube whose inlet is placed in ambient air, with the volume of sample equal to the volume of air evacuated from the rigid container. All odour-sampling bags were pre-conditioned and flushed with odourous air to remove any interference from the sample material.

Since the exhaust of the biofiltration systems are open beds, a hood technique was used to allow for capture of the odourous air stream to facilitate sampling. The hood was constructed from 304L SS and has a surface area of 1 m^2 which is coned down to a circular duct of 0.075 m diameter. This also facilitates the measurement of total volumetric airflow rate per m^2 of biofilter surface. The inlet of the biofiltration system was samples as a point source over a time period of 25 to 30 minutes.

In term of the sampling regime, a total of between 4 and 6 individual sample locations were chosen randomly for each odour sample bag. The hood fixed to the surface of the biofilter bed and the presence of positively displaced air was verified through the use of a 73mm vane anemometer. A total of 3 to 4 minutes was allowed between sample acquisition to ensure in excess of 12 AC/hr within the hood before sampling commenced.

Inlet odour samples were taken in the inlet pipework using traditional point sampling techniques. A total of 2 inlet and 4 outlet odour samples were taken on the day of sampling.

2.2.2 Olfactometry

Olfactometry using the human sense of smell is the most valid means of measuring odour (Dravniek et al, 1986) and at present is the most commonly used method to measure the concentration of odour in air (Hobbs et al, 1996). Olfactometry is carried out using an instrument called an olfactometer. Three different types of dynamic dilution olfactometers exist:

- Yes/No Olfactometer
- Forced Choice Olfactometer
- Triangular Forced Choice Olfactometer.

In the dynamic dilution olfactometer, the odour is first diluted and is then presented to a panel of screened panellists of no less than four (CEN, 2003) Panellists are previously screened to ensure that they have a normal sense of smell (Casey et al., 2003). According to the CEN standard this screening must be performed using a certified reference gas *n*-butanol. This screening is applied to eliminate anosmia (low sensitivity) and super-noses (high sensitivity). The odour analysis has to be undertaken in a low odour environment such as an air-conditioned odour free laboratory. Analysis should be performed preferably within 8 to 12 hours of sampling.

2.2.3 Odour measurement in accordance with the EN13725:2003

An ECOMA TO8 dynamic yes/no olfactometer was used throughout the measurement period to determine the odour threshold concentration of the sample air. The odour threshold concentration is defined as the dilution factor at which 50% of the panel can just detect the odour. Only those panel members who pass screening tests with n-butanol (certified reference gas, CAS 72-36-3) and who adhered to the code of behaviour were selected as panellists for olfactometry measurements (CEN, 2003). Odour measurement was carried out in an odour free laboratory in accordance with EN13725:2003. The analyses were carried out in the laboratory of Odour Monitoring Ireland in Trim Co. Meath.

2.2.4 What is an odour unit?

The odour concentration of a gaseous sample of odourant is determined by presenting a panel of selected screened human panellists with a sample of odourous air and varying the concentration by diluting with odourless gas, in order to determine the dilution factor at the 50% detection threshold. The Z_{50} value (threshold concentration) is expressed in odour units ($Ou_E\ m^{-3}$).

The European odour unit is that amount of odourant(s) that, when evaporated into one cubic metre of neutral gas (nitrogen), at standard conditions elicits a physiological response from a panel (detection threshold) equivalent to that elicited by one European Reference Odour Mass (EROM) evaporated in one cubic meter of neutral gas at standard conditions. One EROM is that mass of a substance (n-butanol) that will elicit the Z_{50} physiological response assessed by an odour panel in accordance with this standard. *n*-Butanol is one such reference standard and is equivalent to 123µg of n-butanol evaporated in one cubic meter of neutral gas at standard conditions (CEN, 2003).

2.3 Exhaust Hydrogen sulphide sampling and analysis

H_2S is commonly associated with composting operations. It is used as an indicator gas for the assessment of significant odour nuisance in the vicinity of such operations. The Jerome 631-X utilises a patented gold film sensor. The sensor's selectivity to hydrogen sulphide eliminates interferences from sulphur dioxide, carbon dioxide, carbon monoxide, and water vapour. When the sample button is pressed, an internal pump draws air into the instrument. Any hydrogen sulphide in the sample is adsorbed by the sensor, which registers a proportional change in electrical resistance. The hydrogen sulphide concentration is displayed on the LCD, where it remains until the next sample is taken.

Triplicate H_2S measurement was performed on each odour sampling bag as detailed in *Section 2.2.1*. The odour-sampling bag was directly sampled for H_2S concentration in order to assess the exhaust concentration from the outlet of the biofilter. The Jerome metre is the only instrument capable of measurement H_2S in real time over the measurement range 3 ppb to 50 ppm in 1 ppb increments.

2.4 Exhaust Amines sampling and analysis

A specific sorbent was chosen to efficiently bind and pre-concentrate Amines for analysis by HPLC in accordance with established and accredited methodologies (methodology based on principles contained within BS EN13649:2002 and NIOSH 2010). Sealed sorbent tubes were used throughout the study to maintain repeatability and integrity.

In order to pre-concentrate Amines upon each sorbent, a pre-calibrated controlled volume of sample air was drawn through each tube by a SKC pump for a period of up to 40 minutes (Static sampling/pumped sampling as per *Section 2.2.1*). The SKC pump was pre-calibrated with the specific sorbent using a Bios Primary flow calibrator (NIST traceable certified). The pump was calibrated to a flow rate of 100 ml/min. The sorbent tube was connected to the odour sample bag. When sampling was complete the sorbent tubes were sealed and stored in flexible air tight containers and transported to the gas chromatography laboratory and analysed by means of HPLC in a UKAS accredited laboratory (UKAS (NAMAS) for compliance with ISO-IEC (17025).

2.5 Exhaust Ammonia, Mercaptans sampling and analysis

In order to obtain air samples for Ammonia, methyl and butyl mercaptan assessment, an active sampling method was used where air samples were directly collected into a specific sampling system. The system is based on Dräger's 60+ years of dry chemical reaction technology used in Dräger-Tubes®. The CMS advanced electronics and sampling system delivers accuracies of +/- 4 to 10% of measured values for most gases and vapours. CMS does not require gas calibration. All measurement and calibration information is stored on a bar code on the CMS Chip. An electronics and leak check is performed before each measurement so you are assured of accurate readings every time.

3. Results

This section will present the results from the monitoring assessment.

2.1 Volume flow rate results

Table 3.1 presents the specific details about air flow treatment capacity of the two biofiltration system and also the total air loading volumes on each biofilter cell. Biofiltration system 1 has an inorganic bed medium while biofiltration system 2 has a wood chip medium.

Table 3.1. Airflow rate characteristics on each biofiltration system – 1 and 2.

Parameter	Value	Notes
Biofilter 1		
Extraction location	Process bays and headspace of building	-
Diameter of pipework	1,200 mm	-
Airflow rate treatment value (m^3/hr)	**46,829**	-
Biofilter 2		
Extraction location	Process bays and headspace of building	-
Diameter of pipework	1,200 mm	-
Airflow rate treatment value (m^3/hr)	**27,282**	-
Total treatment capacity on site (m^3/hr)	**74,111**	Airflow rate is split between the LECA and Woodchip biofilter

3.2 Odour results from inlet and exhaust of biofiltration system 1 and 2

Table 3.2 presents the results of the testing of the inlet and exhaust of the biofiltration system located in Ormonde Organics Composting facility. As can be observed, two composite samples were taken on the inlet (one for each system) and four composite samples were taken on the exhaust of the biofilter beds (duplicate samples on the exhaust of each biofilter) in line with the description contained in *Section 2.2.1*.

Table 3.2. Odour threshold concentrations recorded on inlet and exhaust of biofiltration system 1 and 2.

Sample identity	Inlet odour conc. ($Ou_E/.m^3$)	Exhaust odour conc (Ou_E/m^3)
Biofiltration system 1 (LECA)		
S1041110	-	724
S2041110	-	1,341
S5041110	39,721	--
Average Odour conc (Ou_E/m^3)	**39,721**	**1,032**
Average odour removal efficiency (%)	-	**97**
Biofiltration system 2 (Woodchip)		
S3041110	-	2,299
S4270910	-	2,128
S6041110	46,336	-
Average Odour conc (Ou_E/m^3)	**46,336**	**2,213**
Average odour removal efficiency (%)	**--**	**95**

As can be observed in *Table 3.2*, the average inlet and exhaust odour threshold concentrations for biofiltration system 1 was 39,721 and 1,032 Ou_E/m^3. The average inlet and exhaust odour threshold concentrations for biofiltration system 2 was 46,336 and 2,213 Ou_E/m^3. The average odour removal efficiency for biofiltration system 1 was 97% and for biofiltration system 2 was 95%.

3.3 Exhaust Ammonia, Amines, Hydrogen sulphide and Mercaptans results for biofiltration system 1 and 2

Table 3.3 presents the results of the testing of biofiltration system 1 and 2 located in Ormonde Organics facility. As can be observed sampling was performed on the exhaust of the biofiltration system for Total aliphatic amines, Hydrogen sulphide, Ammonia and Mercaptans. The biofiltration system for biofiltration system 1 and 2 located in Ormonde Organics composting facility is made up of a LECA and woodchip bed medium, respectively.

Table 3.3. Compound specific concentrations recorded from biofiltration system 1 and 2 located in Ormonde Organics Composting Facility.

Sample identity	Exhaust air stream conc (mg/Nm^3)
Biofiltration system 1 - LECA	**--**
Total aliphatic amines	1.12
Hydrogen sulphide	0.023
Ammonia	8.80
Total Mercaptans	<0.10
Biofiltration system 2 – Wood chip	**--**
Total aliphatic amines	1.48
Hydrogen sulphide	0.015
Ammonia	14.60
Total Mercaptans	<0.10

As can be observed in *Table 3.3*, the overall exhaust Total aliphatic amines, Hydrogen sulphide, Ammonia and Mercaptans concentration were low with values of 1.12, 0.023, 8.80 and <0.10 mg/Nm^3 recorded on the exhaust of biofiltration system 1. The overall exhaust Total aliphatic amines, Hydrogen sulphide, Ammonia and Mercaptans concentration for biofiltration system 2 were low with values of 1.48, 0.015, 14.60 and <0.10 mg/Nm^3 recorded on the exhaust of biofiltration system 2. The exhaust concentrations of Hydrogen sulphide, Ammonia and Total Mercaptans and Amines were in compliance with typical licence limits contained in Waste permits.

4. Conclusions

The following conclusions are drawn from the study:

1. All odour sampling and analysis was performed in accordance with the EN13725:2003.
2. All compound sampling and analysis was performed in accordance with prescribed techniques including indirect sampling in line with EN13649:2002, NIOSH 2010 and MDHS 72 and 75 requirements.
3. The average inlet odour threshold concentration for biofiltration system 1 was 39,721 Ou_E/m^3.
4. The average inlet odour threshold concentration for biofiltration system 2 was 46,336 Ou_E/m^3.
5. The average exhaust odour threshold concentration for biofiltration system 1 was 1,032 Ou_E/m^3.
6. The average exhaust odour threshold concentration for biofiltration system 2 was 2,213 Ou_E/m^3.
7. The overall odour removal efficiency of the biofiltration system 1 was 97%.
8. The overall odour removal efficiency of the biofiltration system 2 was 95%.
9. The overall exhaust Total aliphatic amines, Hydrogen sulphide, Ammonia and Mercaptans concentration for biofiltration system 1 were low with values of 1.12, 0.023, 8.80 and <0.10 mg/Nm^3 recorded on the exhaust of biofiltration system 1.
10. The overall exhaust Total aliphatic amines, Hydrogen sulphide, Ammonia and Mercaptans concentration for biofiltration system were low with values of 1.48, 0.015, 14.60 and <0.10 mg/Nm^3 recorded on the exhaust of biofiltration system 2.
11. The exhaust concentrations of Hydrogen sulphide, Ammonia and Total Mercaptans and Amines were in compliance with typical licence limits contained in Waste permits.

Analysing
Testing
Consulting
Calibrating

TEST REPORT

Client:
Ormonde Organics
Killowen
Portlaw
Co.Waterford

BHP Ref No.: 95287
Order No.:
Date Received: 15th October 2010
Date Tested: 15th October 2010
Test Specification:
Issue 2

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Item: Report on PM_{10} Dust Monitoring and Dust Deposition at Ormonde Organics, Killowen, Portlaw, Co.Waterford.

For and on behalf of BHP Ltd.

Pat O'Sullivan
Date Issued: 14th December 2010
Supplement to report No. N/A

Contents

Section 1: Baseline PM_{10} Study

1.0 Scope of Survey

At the request of Ormonde Organics, Killowen, Portlaw, Co.Waterford, BHP undertook to perform PM_{10} dust monitoring at the current facility. PM_{10} dust levels (10μm Particulate Matter or PM_{10}) were measured using a calibrated Aerosol Monitor at the current Bergerhoff Dust Monitoring locations.

2.0 Survey Approach

A TSI Dust Trak Aerosol Monitor, Model 8530, was used to monitor dust levels at the Site. In all 4 locations were monitored using the Dust Trak. The monitor was set up to sample PM_{10} particles. The 4 locations are illustrated on the site map in appendix 1. Sampling for PM_{10} particles was limited to 45 minutes at each of the monitoring locations.

3.0 Date of Sampling

Sampling was carried out on the 15th October 2010.

4.0 Results

4.1 PM_{10} Dust levels:

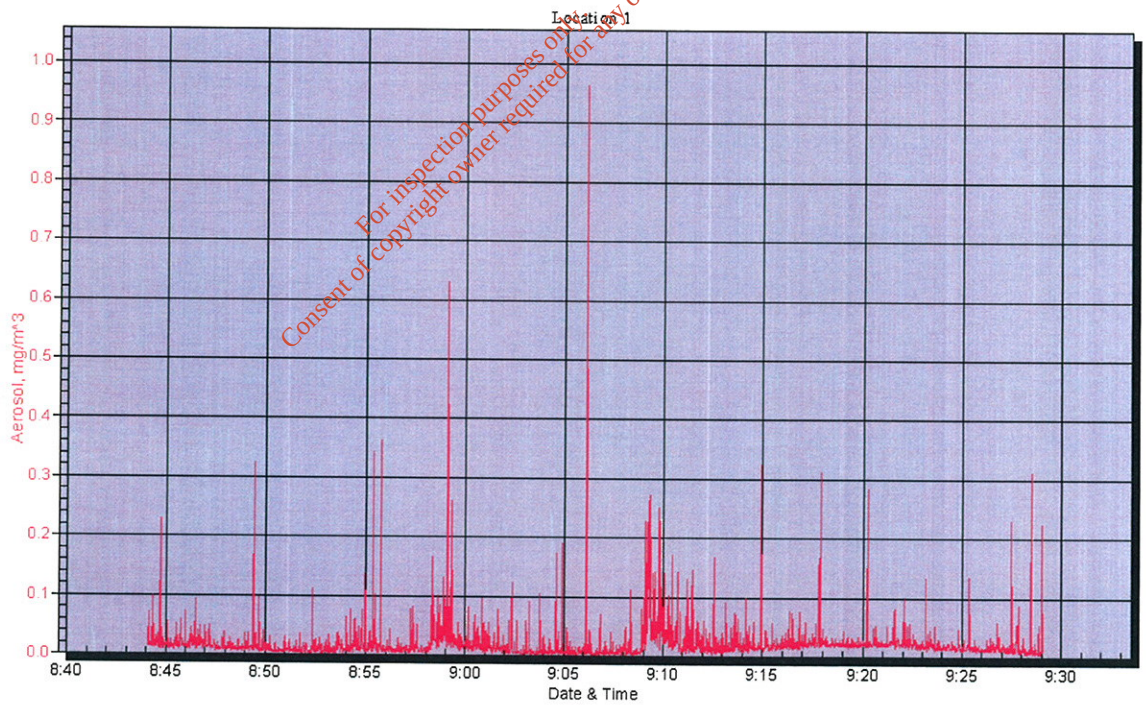
Levels are presented in table 4.1 below. Actual PM_{10} levels recorded for the duration of the sampling are presented in the subsequent graphs.

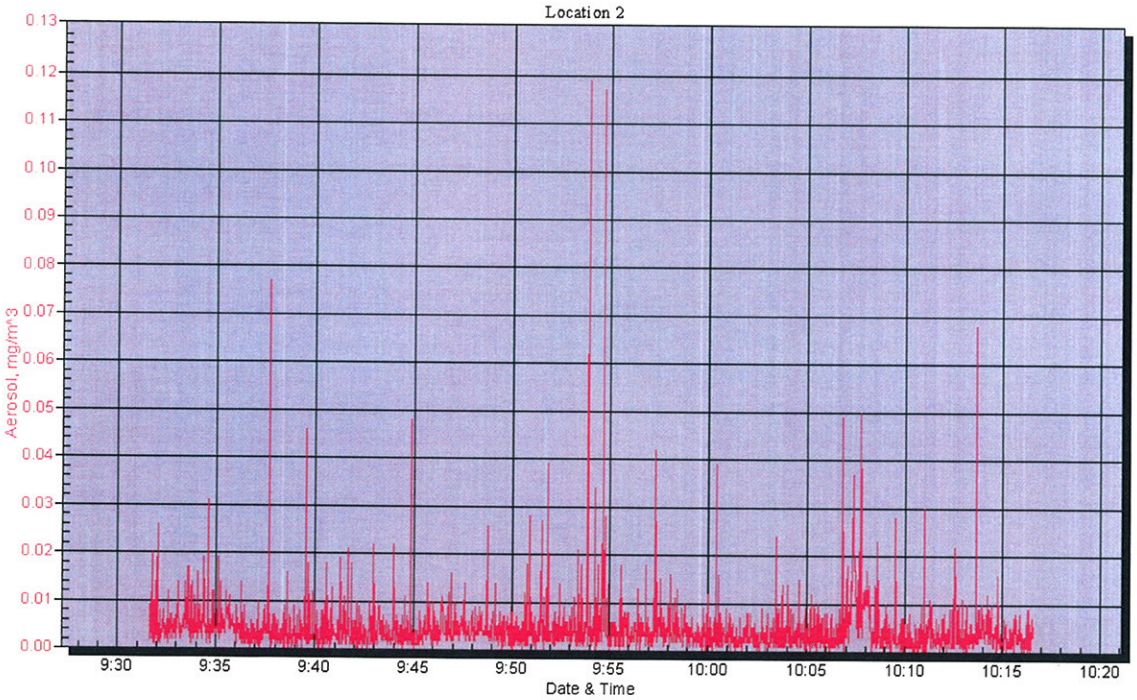
Table 4.1 Summary of PM_{10} levels at the monitoring locations

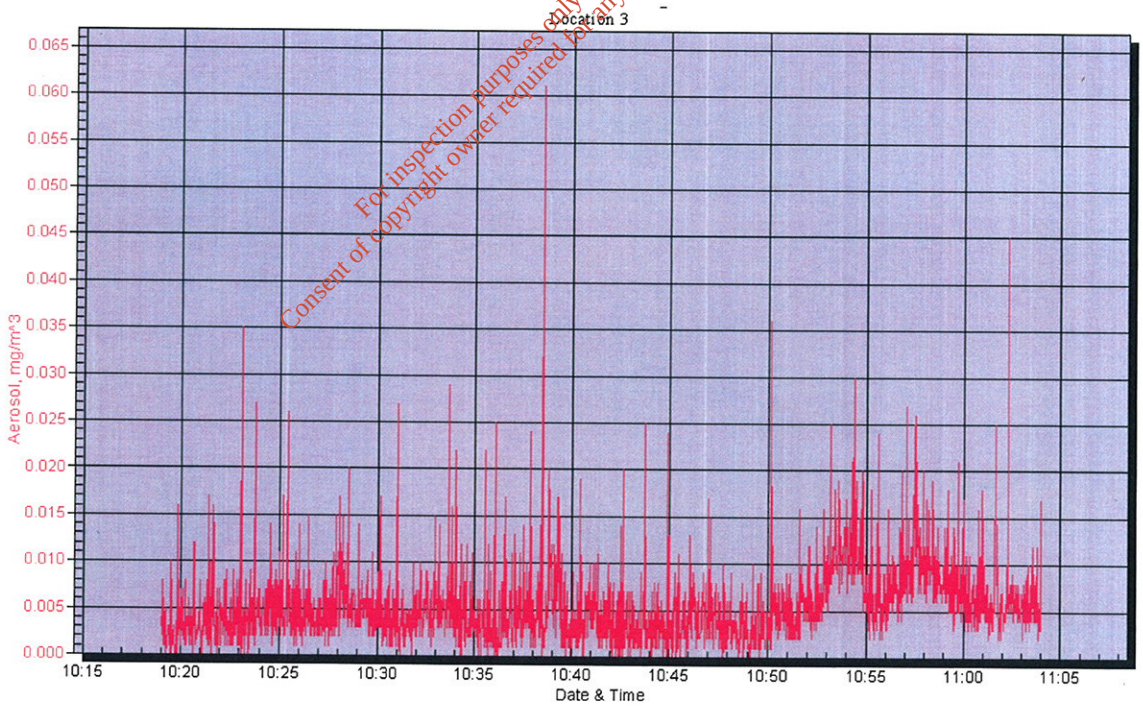
Sample Location	Sampling Times		PM_{10} conc. µg/m^3		
	Start	*Finish*	*Average*	*Minimum**	*Maximum**
1	0843	0928	22	3	177
2	0931	1016	5	1	25
3	1018	1103	5	1	17
4	1242	1337	5	2	20
O'Connells	1120	1205	23	10	101

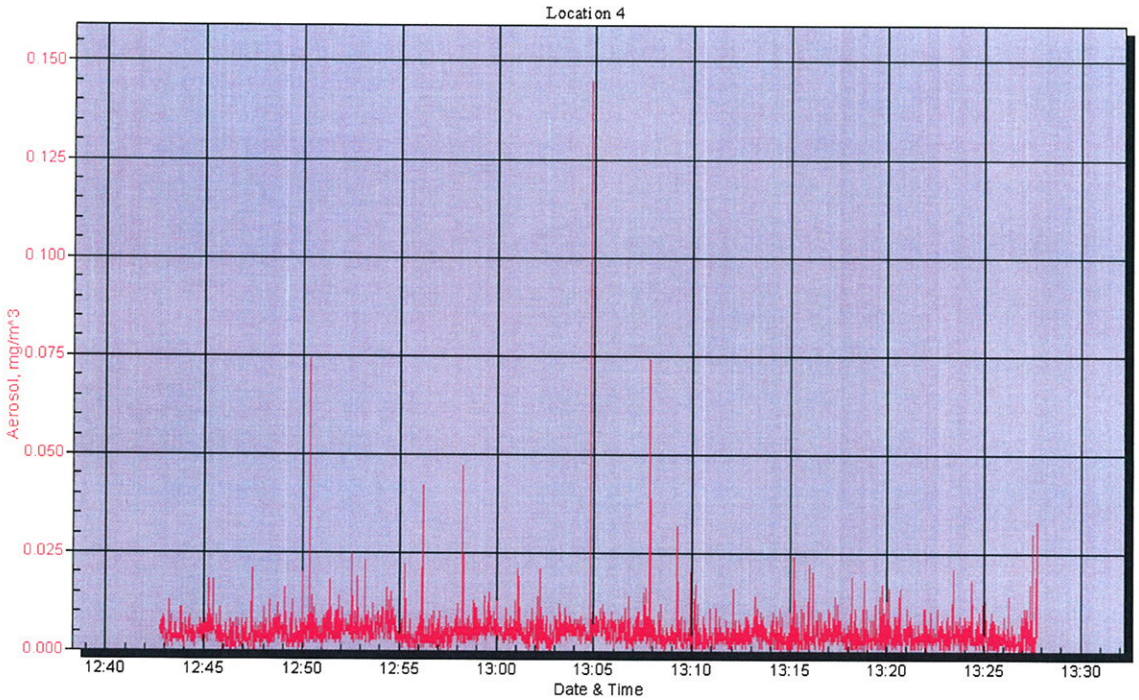
Minima and maxima are averaged over a 10 second time constant.

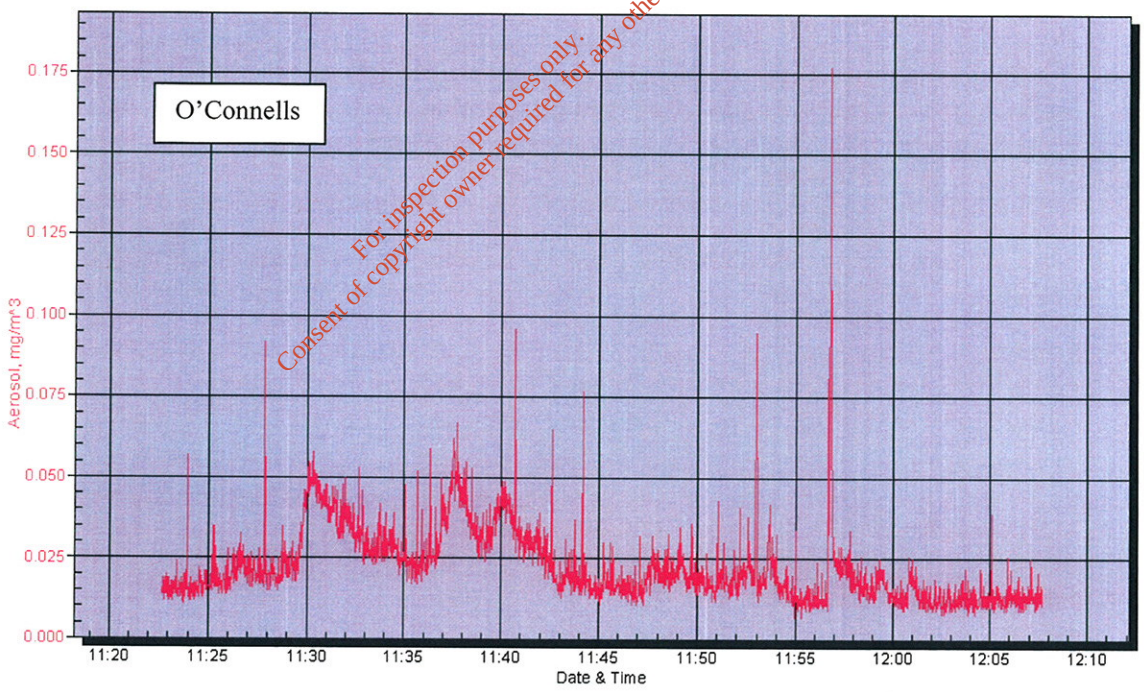
The following graphs show actual PM_{10} concentrations measured throughout the monitoring periods.











5.0 Interpretation of Results

In order to protect our health, vegetation and ecosystems, EU directives set down air quality standards in Ireland and the other member states for a wide variety of pollutants. The European Commission set down the principles to this approach in 1996 with its Air Quality Framework Directive. This became Irish law through the Environmental Protection Agency Act 1992 (Ambient Air Quality Assessment and Management) Regulations 1999 (SI 33 of 1999).

Four "daughter" directives lay down limits for specific pollutants. The first of these directives is

1999/30/EC - first 'daughter' directive - limiting values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air

An extract of the pertinent part of the directive is presented below outlining the limit values that apply in the case of PM_{10} dust.

ANNEX III

LIMIT VALUES FOR PARTICULATE MATTER (PM_{10})

	Averaging period	Limit value	Margin of tolerance	Date by which limit value is to be met
STAGE 1				
1. 24-hour limit value for the protection of human health	24 hours	50 µg/m³ PM_{10} not to be exceeded more than 35 times a calendar year	50 % on the entry into force of this Directive, reducing on 1 January 2001 and every 12 months thereafter by equal annual percentages to reach 0 % by 1 January 2005	1 January 2005
2. Annual limit value for the protection of human health	Calendar year	40 µg/m³ PM_{10}	20 % on the entry into force of this Directive, reducing on 1 January 2001 and every 12 months thereafter by equal annual percentages to reach 0 % by 1 January 2005	1 January 2005
STAGE 2 (1)				
1. 24-hour limit value for the protection of human health	24 hours	50 µg/m³ PM_{10} not to be exceeded more than 7 times a calendar year	To be derived from data and to be equivalent to the Stage 1 limit value	1 January 2010
2. Annual limit value for the protection of human health	Calendar year	20 µg/m³ PM_{10}	50 % on 1 January 2005 reducing every 12 months thereafter by equal annual percentages to reach 0 % by 1 January 2010	1 January 2010

(1) Indicative limit values to be reviewed in the light of further information on health and environmental effects, technical feasibility and experience in the application of Stage 1 limit values in the Member States.

As can be seen from Table 4.1 the average concentrations of Particulate Matter are below stage 1 limit values (50µm/m^3) expressed in this directive at all monitoring locations.

The averaging period for each of these measurements was 8 hours each.

It should be noted that the results can only be compared to the limit values for information purposes as the monitoring period used for this study are different from the averaging periods expressed in the Directive (8 hours compared to 24 hours).

6.0 Conclusions

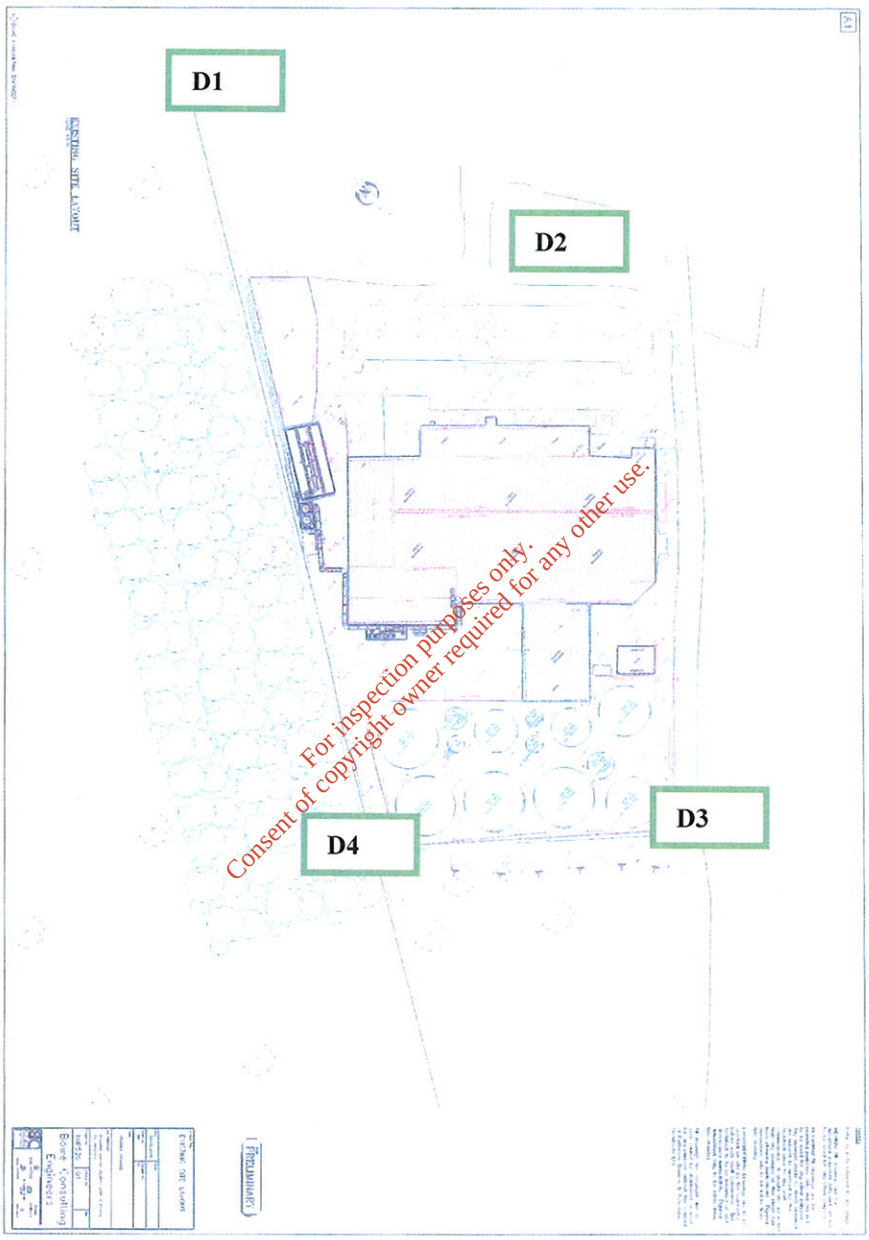
The average concentrations of PM_{10} are below stage 2 limit values ($50\mu g/m^3$) expressed in the first daughter directive at all locations.

7.0 References

1. Council Directive 1999/30/EC, 22nd April 1999. 'relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air.'

Appendix 1

Site Map of Dust Monitoring Locations at the Ormonde Organics Facility



Site Location Map of the nearest dust sensitive location to the Ormonde Organics Facility

Section 2: Baseline Dust Deposition (Bergerhoff)

Glossary

1.0 Introduction

At the request of Ormonde Organics, BHP conducted a dust-monitoring programme at their operation at Killowen, Portlaw, Co.Waterford.

All sampling and analysis was conducted in accordance with Germany Standard VDI 2119 using Bergerhoff dust deposition gauges.

The EPA Publication 'draft guidelines on the information to be contained in environmental impact statements' has been used as a reference for this report.

2.0 Sampling

The sampling was carried out in accordance with VDI 2119 Part 2 using Bergerhoff dust deposition gauges. The pots were in place between the 17th of September and the 18th of October 2010. The gauges were located by Ormonde Organics personnel on this site and the pots were collected and transported to BHP laboratories by BHP personnel.

2.1 Sampling Locations

The gauges were all placed at ground level. The locations of the sampling sites are presented in appendix 1.

2.2 Quality Control

The Chemical and Environmental Monitoring laboratory (CEM) operates a rigorous approach to quality assurance. The central elements of the quality control system are outlined.

a) Chain of Custody and Client Instruction

Every sample received at BHP laboratories is inspected by the laboratory manager Pat O'Sullivan or by site manager Paul O' Sullivan.

A client instruction is required to start analysis.

All samples are then given a unique BHP reference number before storage between 0 and 4°C.

b) Training and Competence

All analysts conducting work at BHP are fully trained. Training involves demonstration of accuracy and precision of analysis. All analysts are subject to periodic reviews in their training. All training is fully documented and retrievable.

c) Validation

BHP procedures are subjected to a rigorous validation which includes the following;

- Evaluation of instrument detection limits and limits of detection.
- Evaluation of operator characteristics including bias, precision and uncertainty of measurement.
- Demonstration of Linearity.
- Evaluation of the standard error on the mean and evaluation of any systematic biases.
- Evaluation of total uncertainty and uncertainty budgets.
- Evaluation of the uncertainty in measurement at a regulatory limit.
- Demonstration of repeatability.
- Evaluation of Matrix effects.

d) Quality Control (Skewhart) Charts

Analysis in the CEM laboratory is monitored using control charts. Each analysis will have at least 3 charts monitoring;

- Certified Reference Material recovery
- Precision of analysis
- Accuracy of analysis

Batches of analyses are rejected if any of the control charts indicate a loss in control.

e) Interlaboratory Testing

The CEM laboratory are members of the W.R.C Aquacheck Scheme. The Laboratory also participates in the Environmental Protection Agency's Intercalibration Programme and is listed on the Agency's Register of Quality Approved Testing Laboratories.

The Laboratory participates on a bi-annual basis in the British Gas Interlaboratory Proficiency Schemes for the analysis of contaminated soils and waters.

3.0 Results

The results for the monitoring period are shown in the table:

Monitoring Station	Deposition (mg/m^2/day)
D1	106.4
D2	152.1
D3	85.4
D4	88.3
Average across site	108.1

4.0 Conclusions

All dust deposition levels are low and inside the usual EPA guideline of 350 mg/m^2/day.

5.0 References

1) Draft Guidelines on the information to be contained in environmental impact statements, 2nd Report 1998, Environmental Protection Agency.
2) Measurement of Particulate Precipitations: Determination of Dust Precipitation with collecting pots made of glass (Bergerhoff Method) or Plastic: VDI 2119: Part 2.
3) Environmental Engineers Handbook, Second Edition, David H.F. Liu and Bela G. Liptak, Lewis, 1996.
4) Standard Methods for the examination of water and wastewater, 20th Edition, published by the American Public Health Association, 1998.

Section 3: Predictive Dust Deposition and PM10 levels

The current band of environmental dust emissions based on the dust monitoring report conducted by BHP laboratories is between 85.4 and 152.1 mg/m^2/day with an average of 108.1 mg/m^2/day dust over the area which equates to 39.5 g/m^2 per annum.

The predicted environmental dust emissions for the proposed development using current practice as outlined in the current environmental management system will see dust levels rise to approximately 135 mg/m^2/day or 49.3 g/m^2 per annum.

This projection is based on the current dust deposition level and allowing for an overall increase in activity of 25%.

The current dustfall limit laid down is 350 mg/m^2/day.

Predictive PM_{10} levels assuming a 25% increase in activity will also be below the stage 2 limit values (50µg/m^3) expressed in the first daughter directive at all locations.

From our experience of monitoring such facilities with well-managed dust control and suppression systems in place, dust levels should be consistently under the regulatory limit.

Section 5: Dust Control Checklist

Ormonde Organics Ltd			
Operational Site Measures	Yes	No	Comments
Areas to be protected are fenced or blocked off			
Physical Barriers are correctly placed and maintained			
Site Traffic is controlled and entry/exit points correct			
Watering sprays are utilised during windy conditions or when needed			
Vegetation retention and revegitation measures are being carried out as required			
Storage Piles/ General Material Storage			
Piles if present are a suitable height, width and slope and placed in areas protected from wind			
Activity is limited to the downward side of piled material and the last in-first out system is used			
Watering sprays are utilised on piles if wind is lifting the material			
Hauled Materials			
Watering sprays are used during material loading and unloading when required			
Loads are kept within designated load limits			
Bed liners and load covers are used to prevent material spillage from trucks			
Paved Road Access/Egress			
Site access/exit is stabilised through a concrete or equivalent surface			
Vehicle wheels are washed or brushed prior to leaving the site			
Material spills on roads and pathways are cleaned up immediately			
Monitoring			
Bergerhoff or equivalent dust monitors in place			
This information is true and correct to the best of my knowledge			
Name of the person inspecting the site			
Signature			
Date of Site Inspection			

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DISPERSION MODELLING ASSESSMENT OF EMISSIONS FROM EXISTING AND PROPOSED BIOLOGICAL TREATMENT FACILITY TO BE LOCATED IN ORMONDE ORGANICS, FIDDOWN, PORTLAW, CO. WATERFORD.

PERFORMED BY ODOUR MONITORING IRELAND ON THE BEHALF OF ORMONDE ORGANICS LTD.

REPORT PREPARED BY:	Dr. Brian Sheridan
REPORT VERSION:	Document Ver.1
ATTENTION:	Mr Martin Morrissey
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EXECUTIVE SUMMARY

Odour Monitoring Ireland was commissioned by Ormonde Organics Ltd to perform a dispersion modelling assessment of exhaust gas emissions from the existing and proposed operation of a biological treatment facility to be located in Ormonde Organics, Fiddown, Portlaw, Co. Waterford. Dispersion modelling was performed for the existing facility operations for odour. Dispersion modelling was performed for the proposed facility operations for Carbon monoxide, Oxides of nitrogen, Sulphur dioxide, Total particulates, Total non methane Volatile organic compounds and odours. Specific mass emission rates of compounds were collected for historical and library based mass emission data for the odour control systems and the gas utilisation engines. These were inputted into the dispersion modelling to allow for the assessment of air quality in the vicinity of the existing and proposed emissions points when in operation.

Dispersion modelling assessment was performed utilising AERMOD Prime (11103) dispersion model. Five years of hourly sequential meteorological data from Rosslare (2002 to 2006 inclusive) was used within the dispersion model. The dispersion modelling assessment was performed in accordance with requirements contained in AG4 – Irish EPA Guidance for dispersion modelling. The total existing and proposed mass limit emission rate of each pollutant was inputted with the source characteristics into the dispersion model in order to assess the maximum predicted ground level concentrations of each pollutant in the vicinity of the facility. This was then compared with statutory and guideline ground level concentration limit values for such pollutants.

The following conclusions are drawn from the study:

1. The assessment was carried out to provide information in line with standard information to be provided regulatory bodies for such projects.

2. Specific dispersion modelling was performed for Odours for the existing facility operations.

3. Specific dispersion modelling was performed for Carbon monoxide, Oxides of nitrogen, Sulphur dioxide, Particulate matter, TNMVOC as Benzene and Odour for proposed operations.

4. With regards to odours for the existing facility operations, it is predicted that odour plume spread is in a south easterly direction of approximately 200 metres from the emission points with no sensitive receptors impacted by the plume. All resident locations in the vicinity of the proposed facility operations will perceive an odour concentration less than 1.50 Ou_E/m^3 at the 98th percentile of hourly averages for worst case meteorological year Rosslare 2005 (*see Table 4.3*). In accordance with odour impact criterion presented in *Table 2.1*, and in keeping with currently recommended odour impact criterion in this country, no long-term odour impacts will be experienced by receptors in the vicinity of the proposed facility operations. In addition, the predicted ground level concentration of Odour at each of the 19 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1.*.

5. With regards to Carbon monoxide for the proposed facility operations, the maximum GLC+Baseline for CO from the operation of the facility is 1,464 $\mu g\ m^{-3}$ for the maximum 8-hour mean concentration at the 100th percentile. When combined predicted and baseline conditions are compared to the Irish guideline/limit values and EU Limit values set out in SI 271 of 2002 and Directive 2008/50/EC, this is 14.64% of the impact criterion. In addition, the predicted ground level concentration of Carbon monoxide at each of the 9 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1*.

6. With regards to Oxides of nitrogen for the proposed facility operations, the maximum GLC+Baseline for NO_2 from the operation of the facility is 129μg m^{-3} for the maximum 1-hour mean concentration at the 99.79th percentile. When combined predicted and baseline conditions are compared to SI 271 of 2002 and Directive 2008/50/EC, this is 64.40% of the impact criterion. An annual average was also generated to allow comparison with values contained in SI 271 of 2002 and Directive 2008/50/EC. The maximum predicted annual average ground level concentration in the vicinity of the facility was 24μg/m^3. When compared the annual average NO_2 air quality impact criterion is 59.75% of the impact criterion. In addition, the predicted ground level concentration of Oxides of nitrogen at each of the 19 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1*.

7. With regards to Sulphur dioxide for the proposed facility operations, the maximum GLC+Baseline for SO_2 from the operation of the facility is 178 and 93 μg m^{-3} for the maximum 1-hour and 24 hr mean concentration at the 99.73th and 99.18th percentile respectively. When combined predicted and baseline conditions are compared to SI 271 of 2002 and Directive 2008/50/EC, this is 50.86and 74.40% of the set target limits established for the 1 hour and 24 hour assessment criteria. An annual average was also generated to allow comparison with SI 271 of 2002 and Directive 2008/50/EC. The maximum predicted annual average ground level concentration in the vicinity of the facility was 11μg/m^3. When compared the annual average SO_2 air quality impact criterion is 56.50% of the impact criterion. In addition, the predicted ground level concentration of Sulphur dioxide at each of the 19 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1*.

8. With regards to Particulate matter for the proposed facility operations, the maximum GLC+Baseline for Particulate matter 10μm from the operation of the facility is 38 and 34 μg m^{-3} for the maximum 24-hour mean concentration at the 98.08th and 90.40th percentile, respectively. When combined predicted and baseline conditions are compared to Directive 2008/50/EC, this is 76 and 68% of the impact criterion. An annual average was also generated to allow comparison with the SI 271 of 2002 and Directive 2008/50/EC. The maximum predicted annual average ground level concentration in the vicinity of the facility was 25μg/m^3. When compared, the annual average Particulate matter air quality impact is 62.28 % of the impact criterion. An annual average was also generated for $PM_{2.5}$ to allow comparison with Directive 2008/50/EC. The maximum predicted annual average ground level concentration in the vicinity of the facility was 12 μg/m^3. When compared, the annual average $PM_{2.5}$ air quality impact is 47.64% of the impact criterion. In addition, the predicted ground level concentration of Particulate matter at each of the 19 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1*.

9. With regards to TNMVOC as Benzene, the results for the potential air quality impact for dispersion modelling of TNMVOC as Benzene based on process guaranteed emission rates in *Tables 3.2 to 3.3* are presented in *Tables 4.1 and 4.2*. TNMVOC as Benzene modelling results indicate that the ambient ground level annual average concentrations could be up to 41.80% of the impact criterion (assuming all TNMVOC is Benzene which will not be the case).

10. With regards to odours for the proposed facility operations, it is predicted that odour plume spread is in a north westerly south easterly direction of approximately 100 to 200 metres from the emission points with no sensitive receptors impacted by the plume. All resident locations in the vicinity of the proposed facility operations will perceive an odour concentration less than 1.50 Ou_E/m^3 at the 98th percentile of hourly averages for worst case meteorological year Rosslare 2005. In accordance with odour impact criterion presented in *Table 2.1*, and in keeping with currently recommended odour impact criterion in this country, no long-term odour impacts will be experienced

by receptors in the vicinity of the proposed facility operations. In addition, the predicted ground level concentration of Odour at each of the 9 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1.* A number of key mitigation measures as outlined in *Section 4.1.6* will need to be implemented into the design of the odour containment, capture and treatment system to ensure compliance.

11. The overall modelling indicates that the facility will not result in any significant impact on air quality in the surrounding area with all ground level concentrations of pollutants well within their respective ground level concentration limit values.

1. Introduction and scope

1.1 Introduction

Odour Monitoring Ireland was commissioned by Ormonde Organics Ltd to perform a dispersion modelling assessment of the existing and proposed facility operations for a range of pollutants which could potentially be emitted from the existing and proposed biological treatment facility located in Ormonde Organics Ltd, Fiddown, Portlaw, Co. Waterford.

The assessment allowed for the examination of both short and long term ground level concentrations (GLC's) of compounds as a result of the operation of the existing and proposed emission points – Gas utilisation engine 1 (AEP1), Gas utilisation engine 2 (AEP2), Odour control unit 1 – Existing woodchip biofilter (AEP3). Odour control unit 2 – Existing LECA biofilter (AEP4) and Proposed LECA biofilter 2 (AEP5). The main compounds assessed included Carbon monoxide, Oxides of nitrogen, Sulphur dioxide, Total particulates, total non methane volatile organic compounds (as Benzene) and Odours. Odour were only assessed for the existing facility operations as there are no gas utilisation engines installed on the existing site.

Predicted dispersion modelling GLC's were compared to proposed regulatory / guideline ground level limit values for each pollutant.

The materials and methods, results, discussion of results and conclusions are presented within this document.

1.2 Scope of the work

The main aims of the study included:

- Air dispersion modelling assessment in accordance with AG4 guidance of the existing and proposed mass emission limits of specified pollutants to atmosphere from the biological treatment facility located in Ormonde Organics Ltd, Fiddown, Portlaw, Co. Waterford.
- Assessment whether the predicted ground level concentrations of pollutants are in compliance with ground level concentration limit values as taken from SI 271 of 2002 – Air Quality Regulations, CAFÉ Directive 2008/50/EC, AG4 guidance document and Environment Agency H4 Guidance documents Parts 1 and 2.

The approach adopted in this assessment is considered a worst-case investigation in respect of emissions to the atmosphere from existing and proposed emission points AEP1 to AEP5. These predictions are therefore most likely to over estimate the GLC's that may actually occur for each modelled scenario. These assumptions are summarised and include:

- Emissions to the atmosphere from the emission points – AEP1 to AEP5 process operation were assumed to occur 24 hours each day / 7 days per week over a standard year at 100% output.
- Five years of hourly sequential meteorological data from Rosslare 2002 to 2006 inclusive was screened to assess worst case dispersion year which will provide statistical significant results in terms of the short and long term assessment. This is in keeping with current national and international recommendations. The worst case year Rosslare 2005 was used for data presentation.
- Maximum GLC's + Background were compared with relevant air quality objects and limits;
- All emissions were assumed to occur at maximum potential emission concentration and mass emission rates for each scenario.
- AERMOD Prime (11103) dispersion modelling was utilised throughout the assessment in order to provide the most conservative dispersion estimates.
- Five years of hourly sequential meteorological data from Rosslare 2002 to 2006 inclusive was used in the modelling screen which will provide statistical significant

results in terms of the short and long term assessment. The worst case year for Rosslare met station was 2005 and was used for contour plot presentation. This is in keeping with current national and international recommendations (EPA Guidance AG4 and EA Guidance H4). In addition, AERMOD incorporates a meteorological pre-processor AERMET PRO. The AERMET PRO meteorological preprocessor requires the input of surface characteristics, including surface roughness (z0), Bowen Ratio and Albedo by sector and season, as well as hourly observations of wind speed, wind direction, cloud cover, and temperature. The values of Albedo, Bowen Ratio and surface roughness depend on land-use type (e.g., urban, cultivated land etc) and vary with seasons and wind direction. The assessment of appropriate land-use type was carried out to a distance of 10km from the meteorological station for Bowen Ratio and Albedo and to a distance of 1km for surface roughness in line with USEPA recommendations.

- All building wake effects on all applicable emission points were assessed within the dispersion model using the building prime algorithm (e.g. all buildings / structures / tanks were included).

2. Materials and methods

This section describes the materials and methods used throughout the dispersion modelling assessment.

2.1 Dispersion modelling assessment

2.1.1 Atmospheric dispersion modelling of air quality: What is dispersion modelling?

Any material discharged into the atmosphere is carried along by the wind and diluted by wind turbulence, which is always present in the atmosphere. This process has the effect of producing a plume of air that is roughly cone shaped with the apex towards the source and can be mathematically described by the Gaussian equation. Atmospheric dispersion modelling has been applied to the assessment and control of emissions for many years, originally using Gaussian form ISCST 3. Once the compound emission rate from the source is known, (g s^{-1}), the impact on the vicinity can be estimated. These models can effectively be used in three different ways:

- Firstly, to assess the dispersion of compounds;
- Secondly, in a "reverse" mode, to estimate the maximum compound emissions which can be permitted from a site in order to prevent air quality impact occurring;
- And thirdly, to determine which process is contributing greatest to the compound impact and estimate the amount of required abatement to reduce this impact within acceptable levels (McIntyre et al. 2000).

In this latter mode, models have been employed for imposing emission limits on industrial processes, control systems and proposed facilities and processes (Sheridan et al., 2002).

Any dispersion modelling approach will exhibit variability between the predicted values and the measured or observed values due to the natural randomness of atmospheric environment. A model prediction can, at best, represent only the most likely outcome given the apparent environmental conditions at the time. Uncertainty depends on the completeness of the information used as input to the model as well as the knowledge of the atmospheric environment and the ability to represent that process mathematically. Good input information (emission rates, source parameters, meteorological data and land use characteristics) entered into a dispersion model that treats the atmospheric environment simplistically will produce equally uncertain results as poor information entered into a dispersion model that seeks to simulate the atmospheric environment in a robust manner. It is assumed in this discussion that pollutant emission rates are representative of maximum emission events, source parameters accurately define the point of release and surrounding structures, meteorological conditions define the local atmospheric environment and land use characteristics describe the surrounding natural environment. These conditions are employed within the dispersion modelling assessment therefore providing good confidence in the generated predicted exposure concentration values.

2.1.2 Atmospheric dispersion modelling of air quality: dispersion model selection

The AERMOD model was developed through a formal collaboration between the American Meteorological Society (AMS) and U.S. Environmental Protection Agency (U.S. EPA). AERMOD is a Gaussian plume model and replaced the ISC3 model in demonstrating compliance with the National Ambient Air Quality Standards (Porter et al., 2003) AERMIC (USEPA and AMS working group) is emphasizing development of a platform that includes air turbulence structure, scaling, and concepts; treatment of both surface and elevated sources; and simple and complex terrain. The modelling platform system has three main components: AERMOD, which is the air dispersion model; AERMET, a meteorological data pre-processor; and AERMAP, a terrain data pre-processor (Cora and Hung, 2003).

AERMOD is a Gaussian steady-state model which was developed with the main intention of superseding ISCST3 (NZME, 2002). The AERMOD modeling system is a significant departure from ISCST3 in that it is based on a theoretical understanding of the atmosphere rather than depend on empirical derived values. The dispersion environment is characterized by turbulence theory that defines convective (daytime) and stable (nocturnal) boundary layers instead of the stability categories in ISCST3. Dispersion coefficients derived from turbulence theories are not based on sampling data or a specific averaging period. AERMOD was especially designed to support the U.S. EPA's regulatory modeling programs (Porter at al., 2003)

Special features of AERMOD include its ability to treat the vertical in-homogeneity of the planetary boundary layer, special treatment of surface releases, irregularly-shaped area sources, a three plume model for the convective boundary layer, limitation of vertical mixing in the stable boundary layer, and fixing the reflecting surface at the stack base (Curran et al., 2006). A treatment of dispersion in the presence of intermediate and complex terrain is used that improves on that currently in use in ISCST3 and other models, yet without the complexity of the Complex Terrain Dispersion Model-Plus (CTDMPLUS) (Diosey et al., 2002).

Input data from stack emissions, and source characteristics will be used to construct the basis of the modelling scenarios.

2.2 Air quality impact assessment criteria

The predicted air quality impact from the operation of proposed emission points AEP1 to AEP5 for each scenario is compared to relevant air quality objectives and limits. Air quality standards and guidelines referenced in this report include:

- SI 271 of 2002 – Air Quality Standards Regulations 2002.
- EU limit values set out in the Directives on Air Quality 2008/50/EC.
- Horizontal guidance Note, IPPC H4, Parts 1 and 2, UK Environment Agency.
- AG4 guidance document on dispersion modelling, Environmental Protection Agency.

Air quality is judged relative to the relevant Air Quality Standards, which are concentrations of pollutants in the atmosphere, which achieve a certain standard of environmental quality. Air quality Standards are formulated on the basis of an assessment of the effects of the pollutant on public health and ecosystems.

In general terms, air quality standards have been framed in two categories, limit values and guideline values. Limit values are concentrations that cannot be exceeded and are based on WHO guidelines for the protection of human health. Guideline values have been established for long-term precautionary measures for the protection of human health and the environment. European legislation has also considered standard for the protection of vegetation and ecosystems.

The relevant air quality standards for proposed emission sources AEP1 to AEP5 are presented in *Table 2.1*.

2.2.1 Air Quality Guidelines value for air pollutants

Table 2.1 illustrates the guideline and limit values for air quality pollutants in Ireland.

Table 2.1. EU and Irish Limit values set out in the SI 271 of 2002, CAFÉ directive 2008/50/EC, H4 Guidance documents Parts 1 and 2 and AG4 guidance document.

POLLUTANT	Objective				TO BE ACHIEVED BY[4]
	Concentration[2]	Maximum No. Of exceedences allowed[3]	Exceedence expressed as percentile[3]	Measured as	
Nitrogen dioxide and oxides of nitrogen	300 μg m^{-3} NO_2 200 μg m^{-3} NO_2 40 μg m^{-3} NO_2	18 times in a year 18 times in a year --	99.79th percentile 99.79th percentile --	1 hour mean 1 hour mean Annual mean	19 Jul 1999[4] 1 Jan 2010 1 Jan 2010
Particulates (PM_{10}) (2008/50/EC)	50 μg m^{-3} 40 μg m^{-3} 20 μg m^{-3}	35 times in a year None None	90.40th percentile -- --	24 hour mean Annual mean Annual mean	1 Jan 2010[6] 1 Jan 2005 1 Jan 2010[6]
Particulates ($PM_{2.5}$) (2008/50/EC)	25 μg m^{-3} – Stage 1 20 μg m^{-3} – Stage 2	None None	-- --	Annual mean Annual mean	1 Jan 2015 1 Jan 2020
Carbon monoxide (CO)	10 mg m^{-3}	None	100th percentile	Running 8 hour mean	31st Dec 2003
Sulphur dioxide (SO_2)	350 μg m^{-3} 125 μg m^{-3} 20 μg m^{-3}	24 times in a year 3 times in a year --	99.73th percentile 99.18th percentile --	1 hour mean 24 hour mean Annual mean and winter mean (1st Oct to 31st March	1st Jan 2005 1st Jan 2005 19th Jul 2001[5]
Total non-methane VOC's as Benzene	5 μg m^{-3}	None	--	Annual mean	---
Odour	<1.50 Ou_E/m^3	175 times in a year	98th percentile	1 hour mean	--

2.3 Existing Baseline Air Quality

The EPA has been monitoring national Air quality from a number of sites around the country. This information is available from the EPA's website. The values presented for PM_{10}, SO_2, NO_2, and CO give an indication of expected rural imissions of the compounds listed in *Table 2.1*. *Table 2.2* illustrates the baseline data expected to be obtained from rural areas for classical air pollutants. Since the proposed facility is located in a rural area, it would be considered located in a Zone D area according to the EPA's classification of zones for air quality. Traffic and industrial related emissions would be medium.

The results of $PM_{2.5}$ monitoring at Station Road in Cork City in 2007 (EPA, 2007) indicated an average $PM_{2.5}/PM_{10}$ ratio of 0.53 while monitoring in Heatherton Park in 2008 (EPA, 2008) indicated an average $PM_{2.5}/PM_{10}$ ratio of 0.60. Based on this information, a conservative ratio of 0.60 was used to generate a background $PM_{2.5}$ concentration in 2008 of 9.0 µg/m^3 with a value of 10 µg/m^3 recorded in 2010 (*see Table 2.2*)

Table 2.2. Baseline air quality data used to assess air quality impact criterion in a number of Zone D region – Navan and Kilkitt.

Reference air quality data – Source identity	Sulphur dioxide-SO_2 ($\mu g\ m^{-3}$)	Nitrogen dioxide-NO_x as NO_2 ($\mu g\ m^{-3}$)	Particulate matter-PM_{10} ($\mu g\ m^{-3}$)	Carbon monoxide – CO ($mg\ m^{-3}$)	Details
Navan – annual mean (Zone D)	4.20	16.90	23	-	Measured 2008
Navan – 98%ile & mean 24 hr value (Zone D)	9.60	-	23	-	Measured 2008
Navan – 8 hr max (Zone D)	-	-	-	1.04	Measured 2008
Zone B - Heatherton Park – Annual mean $PM_{2.5}$	-	-	9.0 ($PM_{2.5}$) (Heatherton Park)	-	Measured 2008
Kilkitt – annual mean (Zone D)	4.0	8.0 (Castlebar)	8.0		Measured 2009
Kilkitt – 8 hr max (Zone D)				0.40 (Newbridge zone C)	Measured 2009
Zone C - Ennis – Annual mean $PM_{2.5}$	-	-	10	-	Measured 2009
Zone C – Newbridge Benzene Annual mean	-	-	1.40 (Benzene)	-	Measured 2009

Notes: [1] denotes taken from Air quality monitoring report 2008 and 2009, www.epa.ie.

2.4 Meteorological data

Five years of hourly sequential meteorological data was chosen for the modelling exercise (i.e. Rosslare 2002 to 2006 inclusive). A schematic wind rose and tabular cumulative wind speed and directions of all five years are presented in *Section 7*. All five years of met data was screened to provide more statistical significant result output from the dispersion model. This is in keeping with national and international recommendations on quality assurance in operating dispersion models and will provide a worst case assessment of predicted ground level concentrations based on the input emission rate data. Surface roughness, Albedo and Bowen ratio were assessed and characterised around each met station for AERMET Pro processing.

2.5 Terrain data

Topography effects were accounted for within the dispersion modelling assessment Individual sensitive receptors were inputted into the model at their specific height in order to take account of any effects of elevation on GLC's at there specific locations. Topographical data was inputted into the model utilising the AERMAP algorithm. Each receptor was established at a normal breathing height of 1.80 m.

2.6 Building wake effects

Building wake effects are accounted for in modelling scenarios through the use of the Prime algorithm (i.e. all building features located within the facility) as this can have a significant effect on the compound plume dispersion at short distances from the source and can significantly increase GLC's in close proximity to the facility.

3. Results

This section describes the results obtained for the dispersion modelling exercise. All input data and source characteristics were developed in conjunction with engineering drawings for the development.

3.1. Dispersion model input data – Source characteristics

Table 3.1 illustrates the source characteristics utilised within the dispersion model. Grid reference location, stack height (A.G.L), maximum volume flow and temperature of the emission point are presented within this table for reference purposes.

Table 3.1. Source characteristics for proposed emission points AEP1 to AEP5**.**

Parameter	Emission point AEP1 – Gas Engine 1[1]	Emission point AEP2–Gas engine 2[1]	Emission point AEP3–Existing woodchip biofilter OCU1[2]	Emission point AEP4–Existing LECA biofilter OCU2[2]	Emission point AEP5 – Proposed LECA biofilter OCU3[2]
X coordinate	247344.1	247345.8	247216 (centre of structure)	247239 (centre of structure)	247259 (centre of structure)
Y coordinate	117945.1	117949.9	117831 (centre of structure)	117860 (centre of structure)	117830 (centre of structure)
Elevation (A.O.D) (m)	10	10	12	11.39	11.39
Stack height (m)	16	16	3.1	4.45	4.45
Orientation	Vertical	Vertical	Vertical-diffuse area source	Vertical-diffuse area source	Vertical-diffuse area source
Temperature (K)	523	523	293	293	293
Efflux velocity (m/s)	16.59	16.59	0.0184	0.05533	0.5533
Max volume flow (Nm^3/hr)	3,000	3,000	50,000 Am^3/hr	50,000 Am^3/hr	50,000 Am^3/hr
Stack tip diameter (m)	0.35	0.35	757 m^2	251 m^2	251 m^2
Max building height (AD tank) (m)	13	13	13	13	13
Max building ground level (m)	10	10	10	10	10

Notes: [1] denotes referencing conditions for emission point AEP1 to AEP2 are 273.15K, 101.3KPa, dry gas, 5% O_2.
[2]denotes referencing conditions for emission point AEP4 to AEP5 are 293K, 101.3KPa, wet gas, 20.9% O_2.

3.2 Process emissions - Volume flow rate and flue gas concentration guarantees

The input mass emission rate data used in the dispersion model for each emission point is presented in *Tables 3.2, 3.3, 3.4, 3.5 and 3.6* for each scenario. All source characteristics and location are reported in *Table 3.1*. These will be utilised as process guarantees for the operating process emission point so as to ensure compliance with the stated guideline limits

Table 3.2. Emission values from exhaust stack of the emission source AEP1 - Proposed.

Parameters – Exhaust stack AEP 1	Conc. Limit Values	Units	Volume flow (Nm^3/hr ref 5% O_2)	Mass emission rate (g/s)
Carbon monoxide (CO)	1,400	mg/Nm^3 5% O_2	3,000	1.17
Oxides of nitrogen (NOx as NO_2)	600	mg/Nm^3 5% O_2	3,000	0.50
Sulphur dioxide (SO_2)	500	mg/Nm^3 5% O_2	3,000	0.42
Total particulates	130	mg/Nm^3 5% O_2	3,000	0.11
Total non methane Volatile organic compounds	50	mg/Nm^3 5% O_2	3,000	0.040

Table 3.3. Emission values from exhaust stack of the emission source AEP2 - Proposed.

Parameters – Exhaust stack AEP 2	Conc. Limit Values	Units	Volume flow (Nm^3/hr ref 5% O_2)	Mass emission rate (g/s)
Carbon monoxide (CO)	1,000	mg/Nm^3 5% O_2	3,000	1.17
Oxides of nitrogen (NOx as NO_2)	500	mg/Nm^3 5% O_2	3,000	0.50
Sulphur dioxide (SO_2)	100	mg/Nm^3 5% O_2	3,000	0.42
Total particulates	130	mg/Nm^3 5% O_2	3,000	0.11
Total non methane Volatile organic compounds	50	mg/Nm^3 5% O_2	3,000	0.040

Table 3.4. Emission values from exhaust stack of the emission source AEP3 – Existing and Proposed.

Parameters – Exhaust stack AEP 3	Conc. Limit Values	Units	Volume flow (Nm^3/hr ref 5% O_2)	Mass emission rate (Ou_E/s)
Odour units	1,000	Ou_E/m^3	50,000	13,889

Table 3.5. Emission values from exhaust stack of the emission source AEP4 – Existing and Proposed.

Parameters – Exhaust stack AEP 4	Conc. Limit Values	Units	Volume flow (Am^3/hr)	Mass emission rate (Ou_E/s)
Odour units	1,000	Ou_E/m^3	50,000	13,889

Table 3.6. Emission values from exhaust stack of the emission source AEP5 - Proposed.

Parameters – Exhaust stack AEP 5	Conc. Limit Values	Units	Volume flow (Am^3/hr)	Mass emission rate (Ou_E/s)
Odour units	1,000	Ou_E/m^3	50,000	13,889

3.3 Dispersion modelling assessment

AERMOD Prime (11103) was used to determine the overall ground level impact of proposed emission points AEP1 to AEP5 located in the biological treatment facility Ormonde Organics site, Fiddown, Portlaw, Co. Waterford. These computations give the relevant GLC's at each 50 and 200-meter X Y Cartesian grid receptor location that is predicted to be exceeded for the specific air quality impact criteria. Individual receptor elevations were established at their specific height above ground and also included a 1.80 m normal breathing zone. A total Cartesian + individual receptors of 1,402 points was established giving a total grid coverage area of 16 square kilometres around the emission points.

Five years of hourly sequential meteorological data from Rosslare (Rosslare 2002 to 2006 inclusive) and source characteristics (*see Table 3.1*), including emission date contained in *Tables 3.2 to 3.6* were inputted into the dispersion model.

In order to obtain the predicted environmental concentration (PEC), background data was added to the process emissions. In relation to the annual averages, the ambient background concentration was added directly to the process concentration. However, in relation to the short-term peak concentrations, concentrations due to emissions from elevated sources cannot be combined in the same way. Guidance from the UK Environment Agency advises that an estimate of the maximum combined pollutant concentration can be obtained by adding the maximum short-term concentration due to emissions from the source to twice the annual mean background concentration.

3.4 Dispersion model Scenarios

AERMOD Prime (USEPA ver. 11103) was used to determine the overall air quality impact of the two existing (AEP3 and AEP4) and five proposed (AEP 1 to AEP5) combined emission points while in operation at 100% capacity for named air pollutants.

Impacts from the emission points were assessed in accordance with the impact criterion contained in Directive 2008/50/EC, SI 271 of 2002, H4 guidance and AG4 guidance documents.

Ten scenarios were assessed within the dispersion model examination for each of the classical air pollutants.

The dispersion modelling is carried out in line with the requirements of guidance document AG4- Dispersion modelling.

The output data was analysed to calculate the following:

Ref Scenario 1: Predicted cumulative ground level concentration of Carbon monoxide emission contribution of cumulative emissions for the 100th percentile of 8 hour averages for Rosslare meteorological station year 2005 for a Carbon monoxide concentration of less than or equal to 100 µg/m^3 assuming 24 hr operation (*see Figure 6.3*).

Ref Scenario 2: Predicted cumulative ground level concentration of Oxides of nitrogen emission contribution of cumulative emissions for the 99.79th percentile of 1 hour averages for Rosslare meteorological station year 2005 for an Oxides of nitrogen concentration of less than or equal to 21 µg/m^3 assuming 24 hr operation (*see Figure 6.4*).

Ref Scenario 3: Predicted cumulative ground level concentration of Oxides of nitrogen emission contribution of cumulative emissions for the Annual average for Rosslare meteorological station year 2005 for an Oxides of

nitrogen concentration of less than or equal to 4 µg/m^3 assuming 24 hr operation (*see Figure 6.5*).

Ref Scenario 4: Predicted cumulative ground level concentration of Sulphur dioxide emission contribution of cumulative emissions for the 99.73th percentile of 1 hour averages for Rosslare meteorological station year 2005 for an Sulphur dioxide concentration of less than or equal to 60 µg/m^3 assuming 24 hr operation (*see Figure 6.6*).

Ref Scenario 5: Predicted cumulative ground level concentration of Sulphur dioxide emission contribution of cumulative emissions for the 99.18th percentile of 24 hour averages for Rosslare meteorological station year 2005 for an Sulphur dioxide concentration of less than or equal to 30 µg/m^3 assuming 24 hr operation (*see Figure 6.7*).

Ref Scenario 6: Predicted cumulative ground level concentration of Sulphur dioxide emission contribution of cumulative emissions for the Annual average for Rosslare meteorological station year 2005 for an Sulphur dioxide concentration of less than or equal to 3 µg/m^3 assuming 24 hr operation (*see Figure 6.8*).

Ref Scenario 7: Predicted cumulative ground level concentration of Total particulates as PM_{10} emission contribution of cumulative emissions for the 98.08th percentile of 24 hour averages for Rosslare meteorological station year 2005 for an Total particulates as PM_{10} concentration of less than or equal to 5 µg/m^3 assuming 24 hr operation (*see Figure 6.9*).

Ref Scenario 8: Predicted cumulative ground level concentration of Total particulates as PM_{10} emission contribution of cumulative emissions for the 90.40th percentile of 24 hour averages for Rosslare meteorological station year 2005 for an Total particulates as PM_{10} concentration of less than or equal to 3 µg/m^3 assuming 24 hr operation (*see Figure 6.10*).

Ref Scenario 9: Predicted cumulative ground level concentration of Total particulates as PM_{10} emission contribution of cumulative emissions for the Annual average for Rosslare meteorological station year 2005 for an Total particulates as PM_{10} concentration of less than or equal to 1.0 µg/m^3 assuming 24 hr operation (*see Figure 6.11*).

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Ref Scenario 10: Predicted cumulative ground level concentration of Total particulates as $PM_{2.5}$ emission contribution of cumulative emissions for the Annual average for Rosslare meteorological station year 2005 for an Total particulates as $PM_{2.5}$ concentration of less than or equal to 1.0 µg/m^3 assuming 24 hr operation (*see Figure 6.12*).

Ref Scenario 11: Predicted cumulative ground level concentration of TNMVOC as Benzene emission contribution of cumulative emissions for the Annual average for Rosslare meteorological station year 2005 for an TNMVOC as Benzene concentration of less than or equal to 0.25 µg/m^3 assuming 24 hr operation (*see Figure 6.13*).

Ref Scenario 12 Existing: Predicted cumulative ground level concentration of existing Odour emission contribution of cumulative emissions for the 98th percentile of hourly averages for Rosslare meteorological station year 2005 for an Odour concentration of less than or equal to 3.0 Ou_E/m^3 assuming 24 hr operation (*see Figure 6.14*).

Ref Scenario 12 Proposed: Predicted cumulative ground level concentration of Odour emission contribution of cumulative emissions for the 98th

percentile of hourly averages for Rosslare meteorological station year 2002 for an Odour concentration of less than or equal to 3.0 Ou_E/m^3 assuming 24 hr operation (*see Figure 6.15*).

4. Discussion of results

This section will present the results of the dispersion modelling.

AERMOD GIS Pro Prime (Ver. 11103) was used to determine the overall named air pollutant air quality impact of the proposed emission points AEP1 to AEP5 during operation.

Various averaging intervals were chosen to allow direct comparison of predicted GLC's with the relevant air quality assessment criteria as outline in *Section 2.2.1*. In particular, 1-hour, 24 hour, percentile and annual average GLC's of the specified pollutants were calculated at 50 metres distances from the site over a fine and coarse grid extent of 9.0 kilometres squared. Relevant percentiles of these GLC's were also computed for comparison with the relevant pollutant Air Quality Standards to include SI 271 of 2002, Directive 2008/50/EC and AG4 guidance document.

In modelling air dispersion of NOx from combustion sources, the source term should be expressed as NO_2, e.g., NOx mass (expressed as NO_2). Some of the exhaust air is made up of NO while some is made up of NO_2. NO will be converted in the atmosphere to NO_2 but this will depend on a number of factors to include Ozone and VOC concentrations. In order to take account of this conversion the following screening can be performed.

Use the following phased approach for assessment:

Worse case scenario treatment

35% for short-term and 70% for long-term average concentration should be considered to assess compliance with the relevant air quality objective.

This is in accordance with recommendations from the Environmental Agency UK for the dispersion modelling of NO_2 emissions from combustion processes, www.environmentagency.gov.uk

Table 4.1 illustrates the tabular results obtained from the assessment for Rosslare meteorological station for:

- Worse case scenario treatment as detailed above (for NO_x only).

Maximum predicted GLC's are presented within this table to allow for comparison with Directive 2008/50/EC and SI 271 of 2002. In addition, the predicted ground level concentrations at the selected residential receptors are presented in the Discussion of Results section of the document for all pollutants. A total of 9 individual sensitive receptors were included within the dispersion model and the location of same is presented in *Figure 6.1*. Illustrative contour plots for information purposes only are presented in *Section 6* of this report for each modelled scenario.

Table 4.1. Predicted ground level concentrations for various averaging periods for proposed emission points AEP1 to AEP5 for each pollutant at or beyond the boundary of the facility.

Averaging period	Maximum ground level conc (GLC)
Carbon monoxide - 8 hr maximum GLC (µg/m^3)	424
Oxides of nitrogen - 1 hr max 99.79th percentile (µg/m^3)	95
Oxides of nitrogen - Max Annual average (µg/m^3)	7.0
Sulphur dioxide - 1 hr Max 99.73th percentile (µg/m^3)	170
Sulphur dioxide - 24 hr Max 99.18th percentile (µg/m^3)	85
Sulphur dioxide – Max annual average (µg/m^3)	7.30
Total particulates - 24 hr Max 98.08th percentile (µg/m^3)	15
Total particulates - 24 hr Max 90.40th percentile (µg/m^3)	11
Total Particulates as PM_{10} - Max annual average (µg/m^3)	1.91
Total Particulates as $PM_{2.5}$ - Max annual average (µg/m^3)	1.91
TNMVOC as benzene – Max Annual average	0.69

Table 4.2 presents the comparison between model predictions for air quality impacts, baseline air quality concentrations for the compounds and the percentage impact of the air quality impact criterion anywhere in the vicinity of the facility.

4.1 Assessment of air quality impacts for pollutants from existing and proposed emission points AEP1 to AEP5

Predictive air dispersion modelling was used to ascertain the maximum ground level concentrations at or beyond the boundary of the facility of selected worst case pollutant concentration to allow for comparison with the ground level limit values contained in *Table 2.1*. *Table 4.2* illustrates the results of the dispersion modelling assessment for each pollutant and comparison with the air quality guideline and limit values contained in *Table 2.1*.

Table 4.2. Comparison between predicted GLC's + baseline national air quality data and limit values contained in *Table 2.1*.

Identity	Predicted %ile GLC - (µg m^{-3})	Baseline concentration value (µg m^{-3})[1]	Baseline + Maximum predicted GLC (µg m^{-3})	Impact criterion (µg m^{-3})[2]	% of Criterion
Carbon monoxide - 8 hr maximum GLC (µg/m^3)	424	1,040	1,337.00	10,000	14.64
Oxides of nitrogen - 1 hr max 99.79th percentile (µg/m^3)	95	33.80 (Twice annual mean as per EA)	99.80	200	64.40
Oxides of nitrogen - Max Annual average (µg/m^3)	7.0	16.90	38.06	40	59.75
Sulphur dioxide - 1 hr Max 99.73th percentile (µg/m^3)	170	8.0 (Twice annual mean as per EA)	45.00	350	50.86
Sulphur dioxide - 24 hr Max 99.18th percentile (µg/m^3)	85	8.0	31.00	125	74.40
Sulphur dioxide – Max annual average (µg/m^3)	7.30	4.0	10.09	20	56.50
Total particulates - 24 hr Max 98.08th percentile (µg/m^3)	15	23	49.00	50	76.00
Total particulates - 24 hr Max 90.40th percentile (µg/m^3)	11	23	44.00	50	68.00
Total Particulates as PM_{10} - Max annual average (µg/m^3)	1.91	23	30.83	40	62.28
Total Particulates as $PM_{2.5}$ - Max annual average (µg/m^3)	1.91	10.0	17.83	25	47.64
TNMVOC as benzene	0.69	1.40	4.41	5.0	41.80

Notes: [1] denotes based on data presented in *Tables 3.1, 3.2, 3.3, 3.4, 3.5, 3.6 and 4.1,*
[2] denotes for impact criterion *see Table 2.1.*

As can be observed in *Table 4.2*, the predicted maximum averaging ground level concentration and baseline concentration are presented as a % of the impact criterion contained in *Tables 2.1*.

4.1.1 Carbon monoxide – Ref Scenario 1

The results for the potential air quality impact for dispersion modelling of CO based on process guaranteed emission rates in *Tables 3.2 to 3.3* are presented in *Tables 4.1 and 4.2.* Results are presented for the maximum predicted percentile emission regime. As can be observed in *Tables 4.1 and 4.2,* the maximum GLC+Baseline for CO from the operation of the facility is 1,464 μg m^{-3} for the maximum 8-hour mean concentration at the 100th percentile. When combined predicted and baseline conditions are compared to the Irish guideline/limit values and EU Limit values set out in SI 271 of 2002 and Directive 2008/50/EC, this is 14.64% of the impact criterion.

In addition, the predicted ground level concentration of Carbon monoxide at each of the 19 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1*.

4.1.2 Oxides of nitrogen – Ref Scenario 2 and 3

The results for the potential air quality impact for dispersion modelling of NO_X as NO_2 based on process guaranteed emission rates in *Tables 3.2 to 3.3* are presented in *Tables 4.1 and 4.2.* Results are presented for the maximum predicted percentile emission regime. As can be observed in *Tables 4.1 and 4.2,* the maximum GLC+Baseline for NO_2 from the operation of the facility is 129 μg m^{-3} for the maximum 1-hour mean concentration at the 99.79th percentile. When combined predicted and baseline conditions are compared to SI 271 of 2002 and Directive 2008/50/EC, this is 64.40% of the impact criterion.

An annual average was also generated to allow comparison with values contained in SI 271 of 2002 and Directive 2008/50/EC. The maximum predicted annual average ground level concentration in the vicinity of the facility was 24 μg/m^3. When compared the annual average NO_2 air quality impact criterion is 59.75% of the impact criterion.

In addition, the predicted ground level concentration of Oxides of nitrogen at each of the 19 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1*.

4.1.3 Sulphur dioxide – Ref Scenario 4, 5 and 6

The results for the potential air quality impact for dispersion modelling of SO_2 based on process guaranteed emission rates in *Tables 3.2 to 3.3* are presented in *Tables 4.1 and 4.2.* Results are presented for the maximum predicted percentile emission regime. As can be observed in *Tables 4.1 and 4.2,* the maximum GLC+Baseline for SO_2 from the operation of the facility is 178 and 93 μg m^{-3} for the maximum 1-hour and 24 hr mean concentration at the 99.73th and 99.18th percentile respectively. When combined predicted and baseline conditions are compared to SI 271 of 2002 and Directive 2008/50/EC, this is 50.86 and 74.40% of the set target limits established for the 1 hour and 24 hour assessment criteria.

An annual average was also generated to allow comparison with SI 271 of 2002 and Directive 2008/50/EC. The maximum predicted annual average ground level concentration in the vicinity of the facility was 11 μg/m^3. When compared the annual average SO_2 air quality impact criterion is 56.50% of the impact criterion.

In addition, the predicted ground level concentration of Sulphur dioxide at each of the 19 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1*.

4.1.4 Particulate matter – Ref Scenario 7, 8, 9 and 10

The results for the potential air quality impact for dispersion modelling of Particulate matter based on process guaranteed emission rates in *Tables 3.2 to 3.3* are presented in *Tables 4.1 and 4.2.* Results are presented for the maximum predicted percentile emission regime. As can be observed in *Tables 4.1 and 4.2,* the maximum GLC+Baseline for Particulate matter 10μm from the operation of the facility is 38 and 34 μg m^{-3} for the maximum 24-hour mean concentration at the 98.08th and 90.40th percentile, respectively. When combined predicted and baseline conditions are compared to Directive 2008/50/EC, this is 76 and 68% of the impact criterion.

An annual average was also generated to allow comparison with the SI 271 of 2002 and Directive 2008/50/EC. The maximum predicted annual average ground level concentration in the vicinity of the facility was 25μg/m^3. When compared, the annual average Particulate matter air quality impact is 62.28 % of the impact criterion.

An annual average was also generated for $PM_{2.5}$ to allow comparison with Directive 2008/50/EC. The maximum predicted annual average ground level concentration in the vicinity of the facility was 12 μg/m^3. When compared, the annual average $PM_{2.5}$ air quality impact is 47.64% of the impact criterion.

In addition, the predicted ground level concentration of Particulate matter at each of the 19 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1*.

4.1.5 TNMVOC as Benzene – Ref Scenario 11

The results for the potential air quality impact for dispersion modelling of TNMVOC as Benzene based on process guaranteed emission rates in *Tables 3.2 to 3.3* are presented in *Tables 4.1 and 4.2*. TNMVOC as Benzene modelling results indicate that the ambient ground level annual average concentrations could be up to 41.80% of the impact criterion (assuming all TNMVOC is Benzene which will not be the case).

4.1.6 Odour – Ref Scenario 12 and 13

The results for the potential air quality impact for dispersion modelling of Odour based on the process guaranteed emission rates in *Tables 3.4, 3.5 and 3.6* are presented in *Table 4.3 and Figures 6.13 and 6.14*. Odour modelling results indicate that the ambient ground level concentrations are below the relevant guideline odour air quality guideline value for both the existing and proposed facility operation.

As can be observed in *Figure 6.13* for the existing facility operation, it is predicted that odour plume spread is in a south easterly direction of approximately 200 metres from the emission points with no sensitive receptors impacted by the plume. All resident locations in the vicinity of the proposed facility operations will perceive an odour concentration less than 1.50 Ou_E/m^3 at the 98th percentile of hourly averages for worst case meteorological year Rosslare 2005. In accordance with odour impact criterion presented in *Table 2.1*, and in keeping with currently recommended odour impact criterion in this country, no long-term odour impacts will be experienced by receptors in the vicinity of the existing facility operations.

With regards to the proposed facility operations, as can be observed in *Figure 6.14*, it is predicted that odour plume spread is in a south easterly to easterly direction of approximately 200 metres from the emission points with no sensitive receptors impacted by the plume. All resident locations in the vicinity of the proposed facility operations will perceive an odour concentration less than 1.50 Ou_E/m^3 at the 98th percentile of hourly averages for worst case meteorological year Rosslare 2005. In accordance with odour impact criterion presented in *Table 2.1*, and in keeping with currently recommended odour impact criterion in this country, no long-term odour impacts will be experienced by receptors in the vicinity of the proposed facility operations.

A number of key mitigation measures will need to be implemented into the design of the odour containment, capture and treatment system to include:

1. All new buildings should be fitted with a high integrity building fabric with a leakage rate of no greater than 3 $m^3/m^2/hr$.
2. The facility buildings should be capable of attaining a negative pressure value of at least 10 Pa when ventilation is applied and the facility is in operation.
3. All sumps, tanks etc. should be sealed with tight fitting high containment efficiency covers so as to prevent the release of odours from such processes.
4. All mechanical processes within the pre-treatment building should be placed under appropriate negative pressure so as to ensure no significant odour release to the headspace of the building.
5. All building should be fitted with appropriate roller doors / access points of sealed nature (max leakage rate of 10 $m^3/m^2/hr$).
6. All buildings / processes holding or processing material with the potential to generate odours shall be placed under negative ventilation with all odourous air ducted to an appropriate odour control system for treatment. The odour control system shall be capable of providing treatment of odourous air to a level of less than or equal to 1,000 Ou_E/m^3 in the treated exhaust air stream.
7. All process specifications shall be independently processed proved including odour control system performance, building integrity testing (leakage rate, smoke integrity testing and applied absolute pressure testing) so as to ensure the containment, capture and treatment systems installed at the facility are functioning adequately. This shall be only carried out by personnel experienced in this method of testing.
8. An odour management plan shall be developed for the operating facility so as to ensure adequate operation of all odour management systems on a day to day basis.

Table 4.3. Predicted ground level concentration (excluding baseline) of each pollutant at each identified sensitive receptor locations Rec 1 to Rec 19 for Scenarios 1 to 8 (*see Section 4 and Figure 6.1 / 6.2*).

Receptor identity	X coord (m)	Y coord (m)	Scen 1 - (µg/m^3)	Scen 2 - (µg/m^3)	Scen 3 - (µg/m^3)	Scen 4 - (µg/m^3)	Scen 5 - (µg/m^3)	Scen 6 - (µg/m^3)	Scen 7 - (µg/m^3)	Scen 8 -(µg/m^3)
R1	246668.4	117437.1	52.037	13.111	0.327	10.561	2.318	0.275	0.500	0.276
R2	246270.5	118243.7	9.552	7.140	0.091	5.471	1.410	0.076	0.204	0.040
R3	246526.7	118601.3	16.706	7.957	0.118	6.126	1.998	0.099	0.323	0.076
R4	246737.8	118150.8	23.006	16.278	0.249	12.912	3.431	0.209	0.644	0.137
R5	246877	118324	41.589	23.221	0.401	16.707	5.433	0.337	1.077	0.195
R6	246965	118227.7	55.028	31.028	0.586	24.878	6.672	0.493	1.562	0.309
R7	246994.1	118138.7	65.903	35.989	0.620	28.589	8.681	0.521	1.593	0.405
R8	247268	117397.4	27.377	16.730	0.484	12.242	3.754	0.407	0.851	0.361
R9	247298.3	117239.8	22.159	11.763	0.370	9.076	2.789	0.311	0.640	0.258
R10	247179	117077.4	12.762	8.456	0.197	5.930	1.559	0.165	0.335	0.154
R11	247223.9	117318.2	19.301	13.681	0.346	9.571	2.684	0.291	0.567	0.258
R12	247861	118575.7	24.085	16.205	0.803	13.329	4.163	0.675	0.851	0.492
R13	246465.8	118581.4	12.759	7.678	0.107	6.212	1.837	0.089	0.282	0.060
R14	246498.4	117830.3	31.702	18.548	0.293	13.760	3.388	0.246	0.613	0.230
R15	246797.3	118074	35.120	22.858	0.350	17.294	4.232	0.294	0.893	0.194
R16	247318.4	117284.8	24.838	13.212	0.437	10.349	3.346	0.367	0.755	0.304
R17	247261.3	117194	18.140	10.334	0.306	7.851	2.277	0.257	0.514	0.213
R18	247276.9	117346.4	25.342	15.224	0.438	11.700	3.357	0.368	0.762	0.313
R19	247300.8	117201.5	20.136	10.662	0.346	8.322	2.620	0.291	0.601	0.252

Table 4.3 continued. Predicted ground level concentration (excluding baseline) of each pollutant at each identified sensitive receptor locations Rec 1 to Rec 19 for Scenarios 9 to 13 (*see Section 4 and Figure 6.1 / 6.2*).

Receptor identity	X coord (m)	Y coord (m)	Scen 9 - ($\mu g/m^3$)	Scen 10 - ($\mu g/m^3$)	Scen 11 - ($\mu g/m^3$)	Scen 12 (Ou_E/m^3)	Scen 13 (Ou_E/m^3)
R1	246668.4	117437.1	0.072	0.072	0.026	0.20	0.29
R2	246270.5	118243.7	0.020	0.020	0.007	0.02	0.04
R3	246526.7	118601.3	0.026	0.026	0.009	0.05	0.07
R4	246737.8	118150.8	0.055	0.055	0.020	0.23	0.34
R5	246877	118324	0.088	0.088	0.032	0.30	0.44
R6	246965	118227.7	0.129	0.129	0.047	0.47	0.68
R7	246994.1	118138.7	0.136	0.136	0.050	0.68	1.00
R8	247268	117397.4	0.107	0.107	0.039	0.70	1.02
R9	247298.3	117239.8	0.081	0.081	0.030	0.39	0.56
R10	247179	117077.4	0.043	0.043	0.016	0.16	0.23
R11	247223.9	117318.2	0.076	0.076	0.028	0.41	0.59
R12	247861	118575.7	0.177	0.177	0.064	0.38	0.55
R13	246465.8	118581.4	0.023	0.023	0.009	0.05	0.08
R14	246498.4	117830.3	0.065	0.065	0.023	0.09	0.14
R15	246797.3	118074	0.077	0.077	0.028	0.34	0.48
R16	247318.4	117284.8	0.096	0.096	0.035	0.52	0.74
R17	247261.3	117194	0.067	0.067	0.024	0.29	0.42
R18	247276.9	117346.4	0.096	0.096	0.035	0.57	0.82
R19	247300.8	117201.5	0.076	0.076	0.028	0.34	0.48

5. Conclusions

Odour Monitoring Ireland was commissioned by Ormonde Organics Ltd to perform a dispersion modelling study of the existing and proposed biological treatment facility located in Fiddown, Portlaw, Co. Waterford. Following a detailed impact and dispersion modelling assessment, it was demonstrated that no significant environmental impact will exist if the source characteristics and emission limit value in the waste gases are achieved.

The following conclusions are drawn from the study:

1. The assessment was carried out to provide information in line with standard information to be provided regulatory bodies for such projects.

2. Specific dispersion modelling was performed for Odours for the existing facility operations.

3. Specific dispersion modelling was performed for Carbon monoxide, Oxides of nitrogen, Sulphur dioxide, Particulate matter, TNMVOC as Benzene and Odour for proposed operations.

4. With regards to odours for the existing facility operations, it is predicted that odour plume spread is in a south easterly direction of approximately 200 metres from the emission points with no sensitive receptors impacted by the plume. All resident locations in the vicinity of the proposed facility operations will perceive an odour concentration less than 1.50 Ou_E/m^3 at the 98th percentile of hourly averages for worst case meteorological year Rosslare 2005 (*see Table 4.3*). In accordance with odour impact criterion presented in *Table 2.1*, and in keeping with currently recommended odour impact criterion in this country, no long-term odour impacts will be experienced by receptors in the vicinity of the proposed facility operations. In addition, the predicted ground level concentration of Odour at each of the 19 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1.*

5. With regards to Carbon monoxide for the proposed facility operations, the maximum GLC+Baseline for CO from the operation of the facility is 1,464 $\mu g\ m^{-3}$ for the maximum 8-hour mean concentration at the 100th percentile. When combined predicted and baseline conditions are compared to the Irish guideline/limit values and EU Limit values set out in SI 271 of 2002 and Directive 2008/50/EC, this is 14.64% of the impact criterion. In addition, the predicted ground level concentration of Carbon monoxide at each of the 9 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1*.

6. With regards to Oxides of nitrogen for the proposed facility operations, the maximum GLC+Baseline for NO_2 from the operation of the facility is 129$\mu g\ m^{-3}$ for the maximum 1-hour mean concentration at the 99.79th percentile. When combined predicted and baseline conditions are compared to SI 271 of 2002 and Directive 2008/50/EC, this is 64.40% of the impact criterion. An annual average was also generated to allow comparison with values contained in SI 271 of 2002 and Directive 2008/50/EC. The maximum predicted annual average ground level concentration in the vicinity of the facility was 24$\mu g/m^3$. When compared the annual average NO_2 air quality impact criterion is 59.75% of the impact criterion. In addition, the predicted ground level concentration of Oxides of nitrogen at each of the 19 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1*.

7. With regards to Sulphur dioxide for the proposed facility operations, the maximum GLC+Baseline for SO_2 from the operation of the facility is 178 and 93 $\mu g\ m^{-3}$ for the maximum 1-hour and 24 hr mean concentration at the 99.73th and 99.18th percentile respectively. When combined predicted and baseline conditions are compared to SI 271 of 2002 and Directive 2008/50/EC, this is 50.86and 74.40% of the set target limits

established for the 1 hour and 24 hour assessment criteria. An annual average was also generated to allow comparison with SI 271 of 2002 and Directive 2008/50/EC. The maximum predicted annual average ground level concentration in the vicinity of the facility was 11μg/m^3. When compared the annual average SO_2 air quality impact criterion is 56.50% of the impact criterion. In addition, the predicted ground level concentration of Sulphur dioxide at each of the 19 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1*.

8. With regards to Particulate matter for the proposed facility operations, the maximum GLC+Baseline for Particulate matter 10μm from the operation of the facility is 38 and 34 μg m^{-3} for the maximum 24-hour mean concentration at the 98.08th and 90.40th percentile, respectively. When combined predicted and baseline conditions are compared to Directive 2008/50/EC, this is 76 and 68% of the impact criterion. An annual average was also generated to allow comparison with the SI 271 of 2002 and Directive 2008/50/EC. The maximum predicted annual average ground level concentration in the vicinity of the facility was 25μg/m^3. When compared, the annual average Particulate matter air quality impact is 62.28 % of the impact criterion. An annual average was also generated for $PM_{2.5}$ to allow comparison with Directive 2008/50/EC. The maximum predicted annual average ground level concentration in the vicinity of the facility was 12 μg/m^3. When compared, the annual average $PM_{2.5}$ air quality impact is 47.64% of the impact criterion. In addition, the predicted ground level concentration of Particulate matter at each of the 19 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1*.

9. With regards to TNMVOC as Benzene, the results for the potential air quality impact for dispersion modelling of TNMVOC as Benzene based on process guaranteed emission rates in *Tables 3.2 to 3.3* are presented in *Tables 4.1 and 4.2*. TNMVOC as Benzene modelling results indicate that the ambient ground level annual average concentrations could be up to 41.80% of the impact criterion (assuming all TNMVOC is Benzene which will not be the case).

10. With regards to odours for the proposed facility operations, it is predicted that odour plume spread is in a north westerly south easterly direction of approximately 100 to 200 metres from the emission points with no sensitive receptors impacted by the plume. All resident locations in the vicinity of the proposed facility operations will perceive an odour concentration less than 1.50 Ou_E/m^3 at the 98th percentile of hourly averages for worst case meteorological year Rosslare 2005. In accordance with odour impact criterion presented in *Table 2.1*, and in keeping with currently recommended odour impact criterion in this country, no long-term odour impacts will be experienced by receptors in the vicinity of the proposed facility operations. In addition, the predicted ground level concentration of Odour at each of the 9 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1.* A number of key mitigation measures as outlined in *Section 4.1.6* will need to be implemented into the design of the odour containment, capture and treatment system to ensure compliance.

11. The overall modelling indicates that the facility will not result in any significant impact on air quality in the surrounding area with all ground level concentrations of pollutants well within their respective ground level concentration limit values.

6. *Appendix I* - Air dispersion modelling contour plots (Process contributions and illustrative purposes only).

6.1 Site layout drawing and location of existing and proposed emission points – AEP1 to AEP5

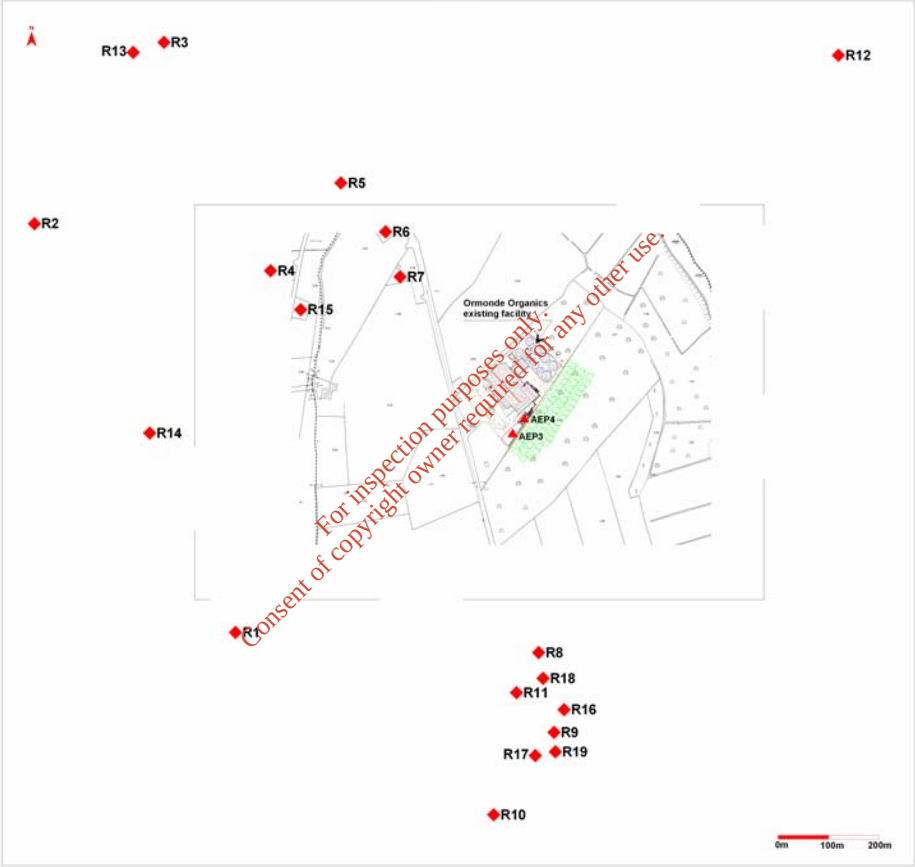

Figure 6.1. Plan view facility layout drawings for existing Ormonde Organics biological treatment facility including specific location of existing emission points AEP3 to AEP4 and nearest sensitive receptors Rec 1 to Rec 19.

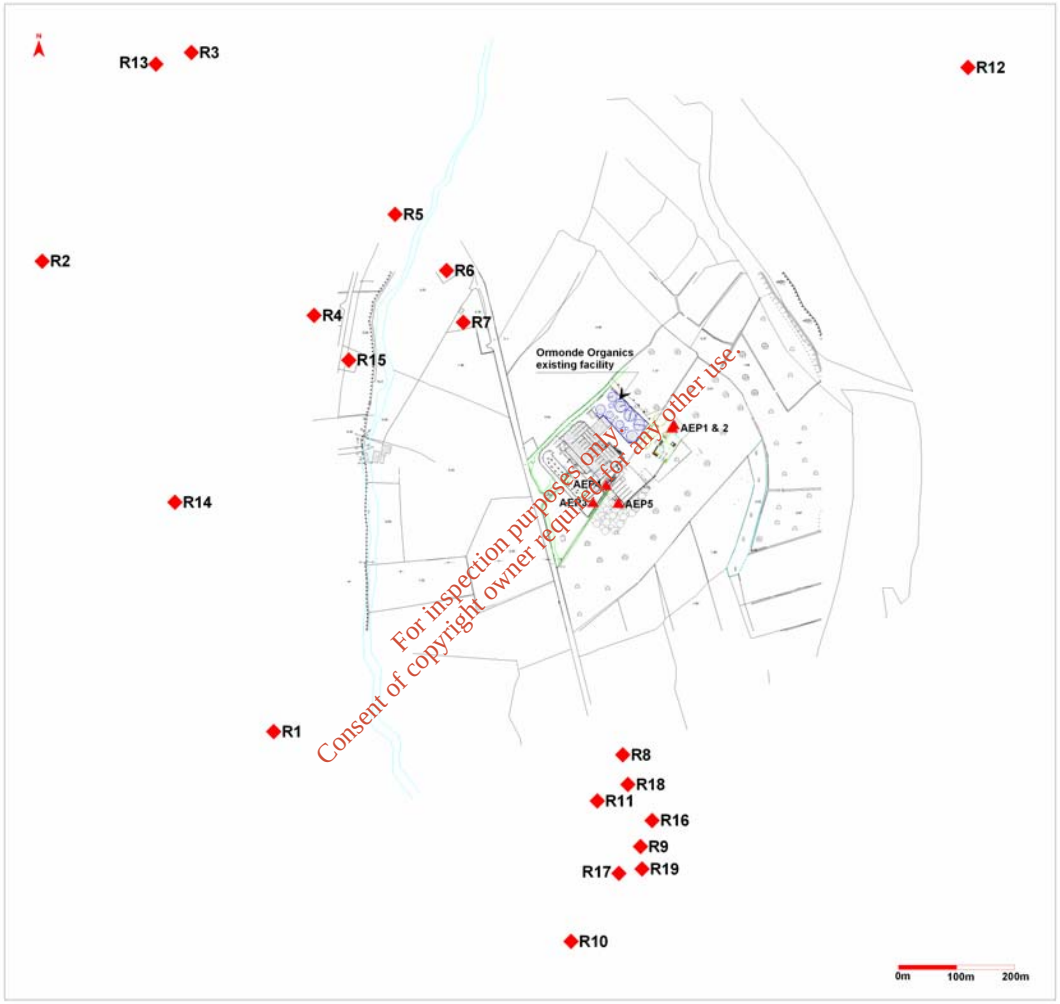

Figure 6.2. Plan view facility layout drawings for proposed Ormonde Organics biological treatment facility including specific location of existing and proposed emission points AEP1 to AEP5 and nearest sensitive receptors Rec 1 to Rec 19.

6.2. Dispersion modelling contour plots for Scenarios 1 to 13 – Worst case meteorological year Rosslare 2005

6.2.1 Scenario 1 - Carbon monoxide

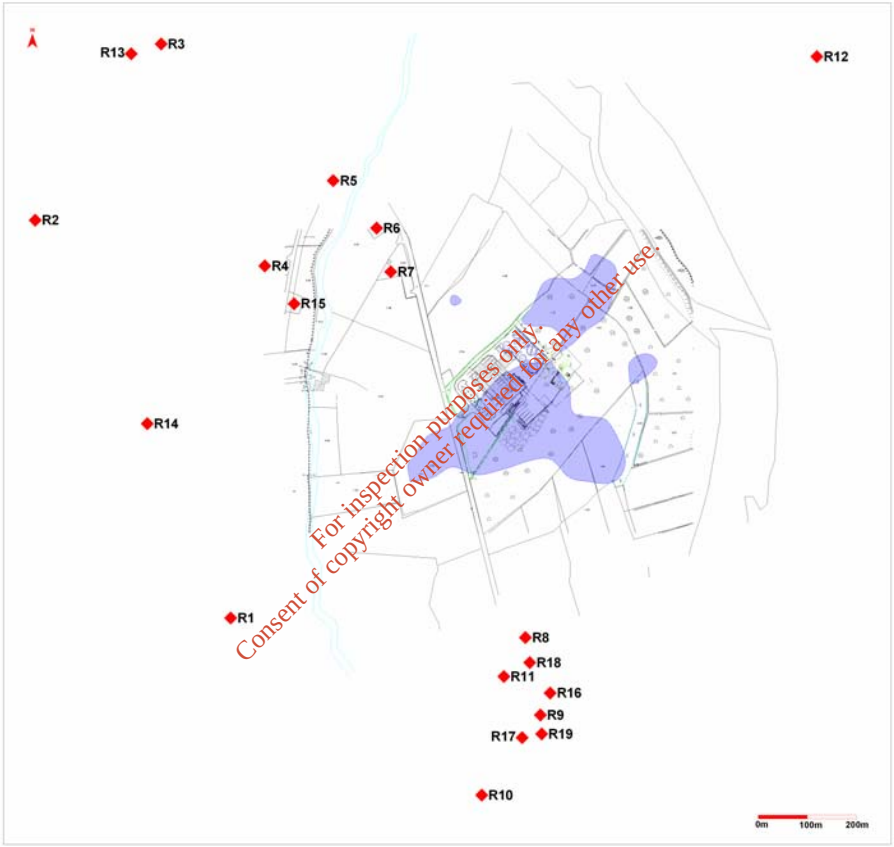

Figure 6.3. Predicted 8 hr average CO ground level concentration of 100 μg/m^3 (▬) for cumulative emissions from emission points AEP1 to AEP2 for Scenario 1 for Rosslare meteorological station (worst case year 2005) - 24 hr plant operation.

6.2.2 Scenario 2 and 3 - Oxides of nitrogen

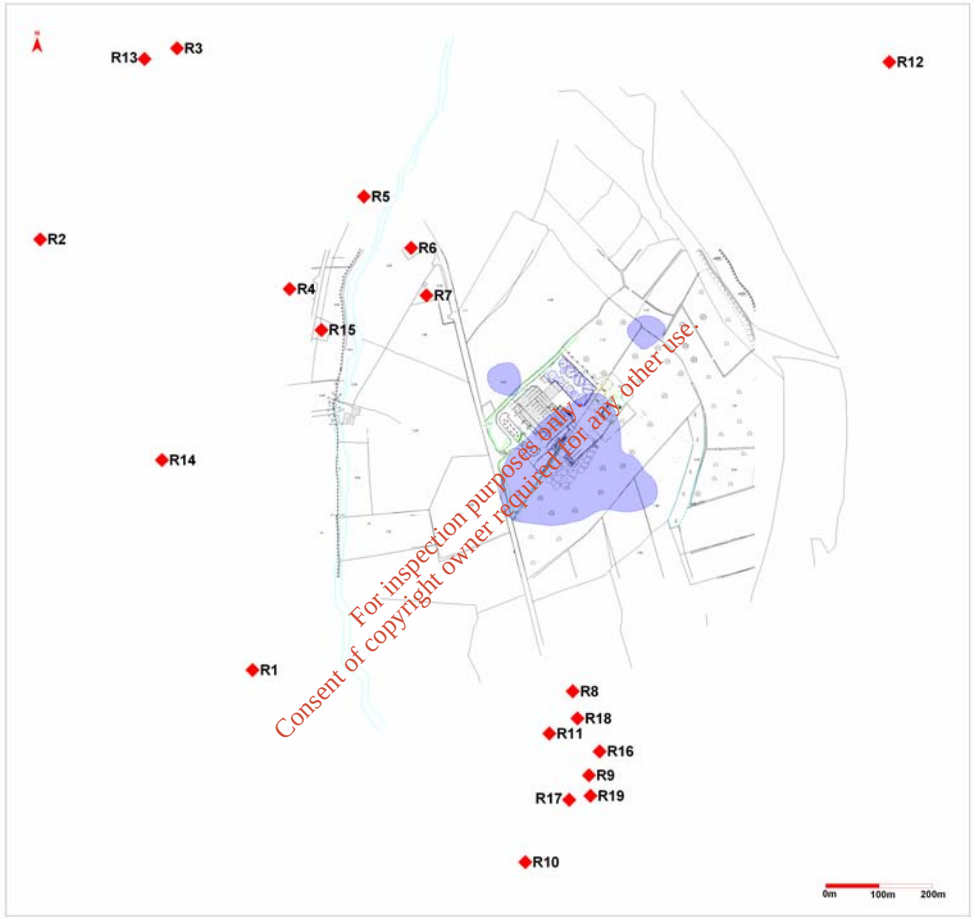

Figure 6.4. Predicted 99.79th percentile of 1 hr averages for NO_2 ground level concentration of 21 μg/m^3 ( ) for cumulative emission for Scenario 2 for Rosslare meteorological station (worst case year 2005) - 24 hr plant operation.

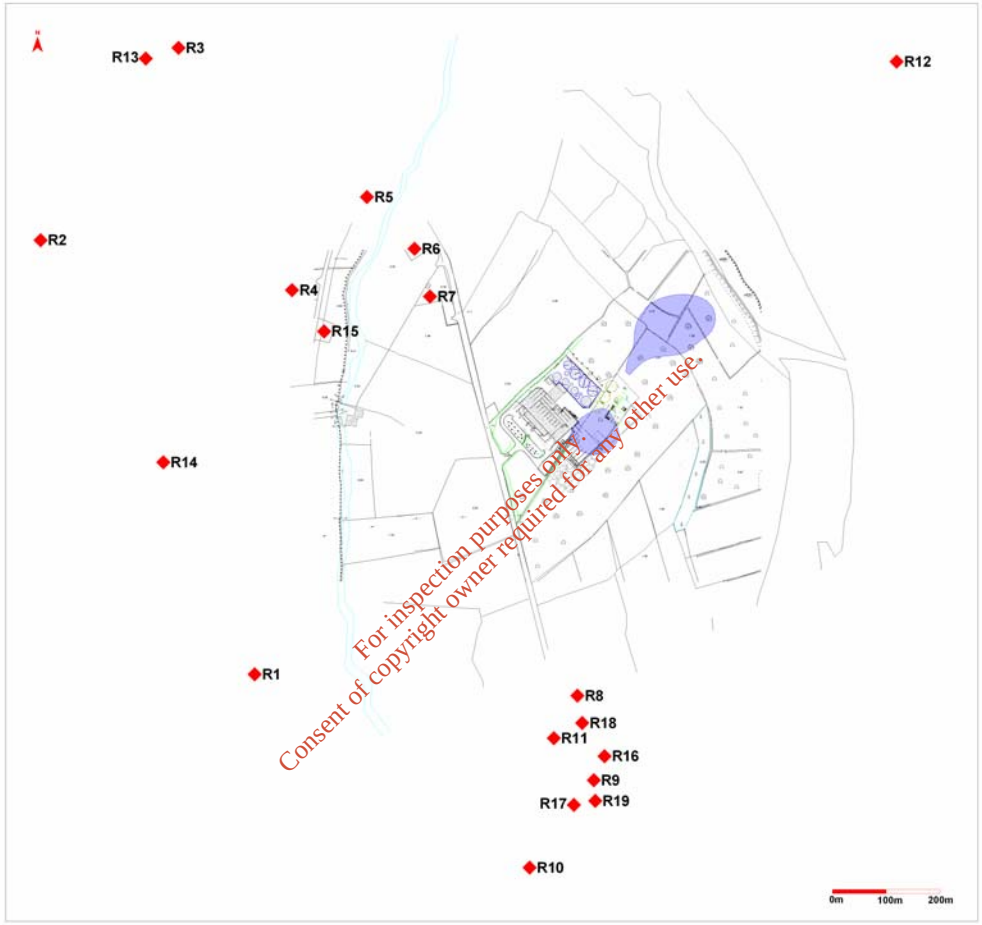

Figure 6.5. Predicted annual average NO_2 ground level concentration of 4 μg/m^3 (▬) for cumulative emissions for Scenario 3 for Rosslare meteorological station (worst case year 2005) - 24 hr plant operation.

6.2.3 Scenario 4, 5 and 6 - Sulphur dioxide

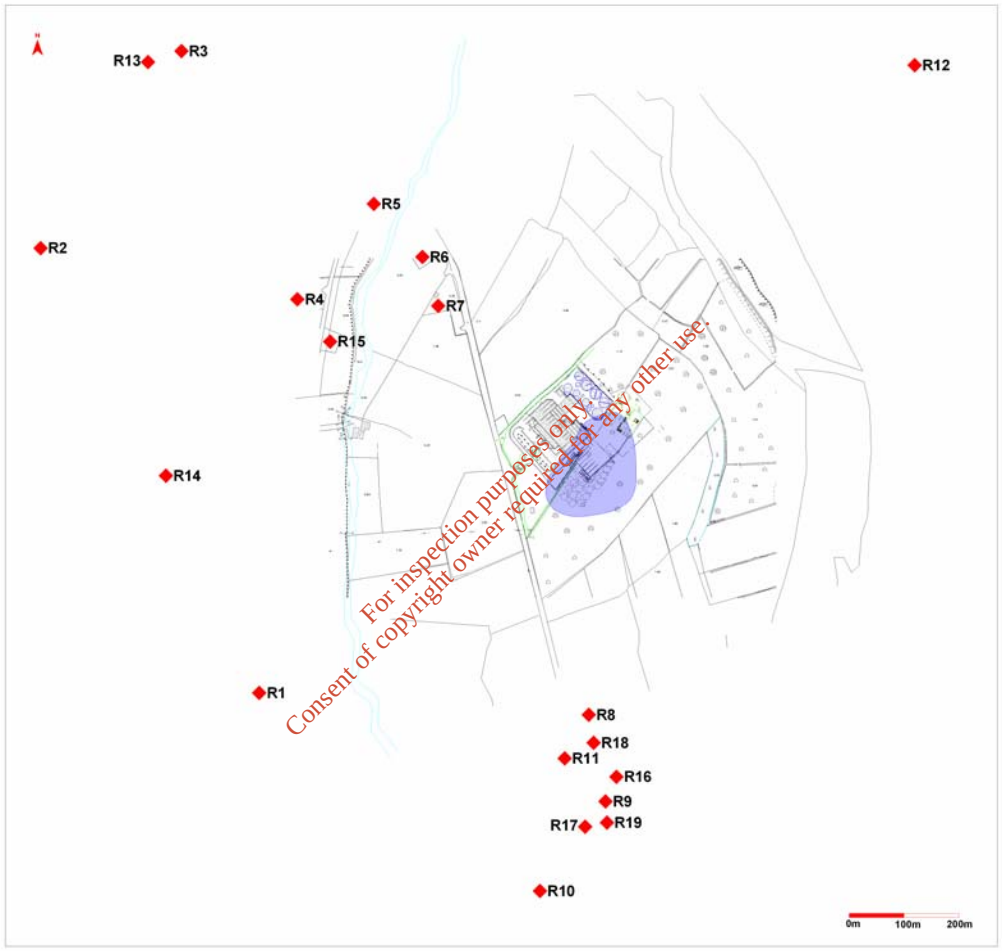

Figure 6.6. Predicted 99.73th percentile of 1 hr averages for SO_2 ground level concentration of 60 μg/m^3 ( ) for cumulative emission for Scenario 4 for Rosslare meteorological station (worst case year 2005) - 24 hr plant operation.

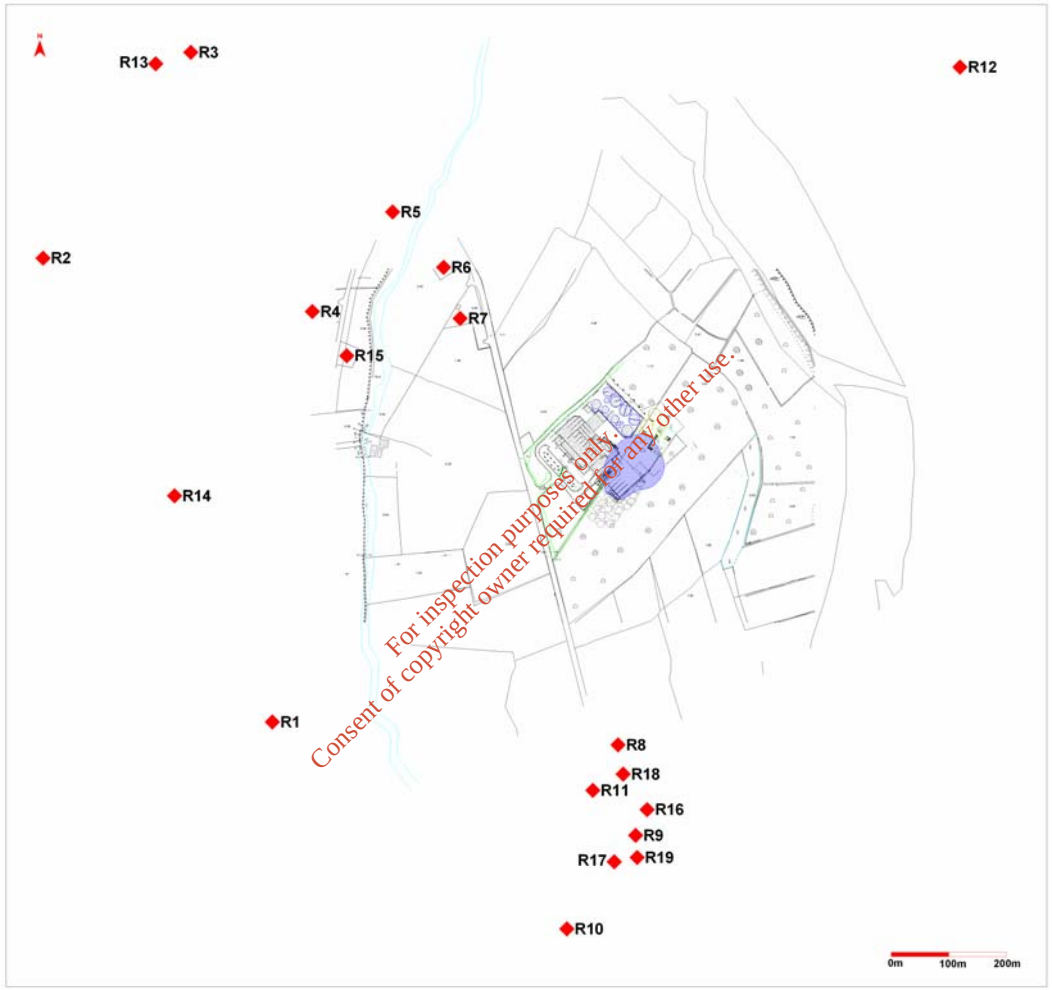

Figure 6.7. Predicted 99.18th percentile of 24 hr averages for SO_2 ground level concentration of 30 μg/m^3 (▬) for cumulative emission for Scenario 5 for Rosslare meteorological station (worst case year 2005) - 24 hr plant operation.

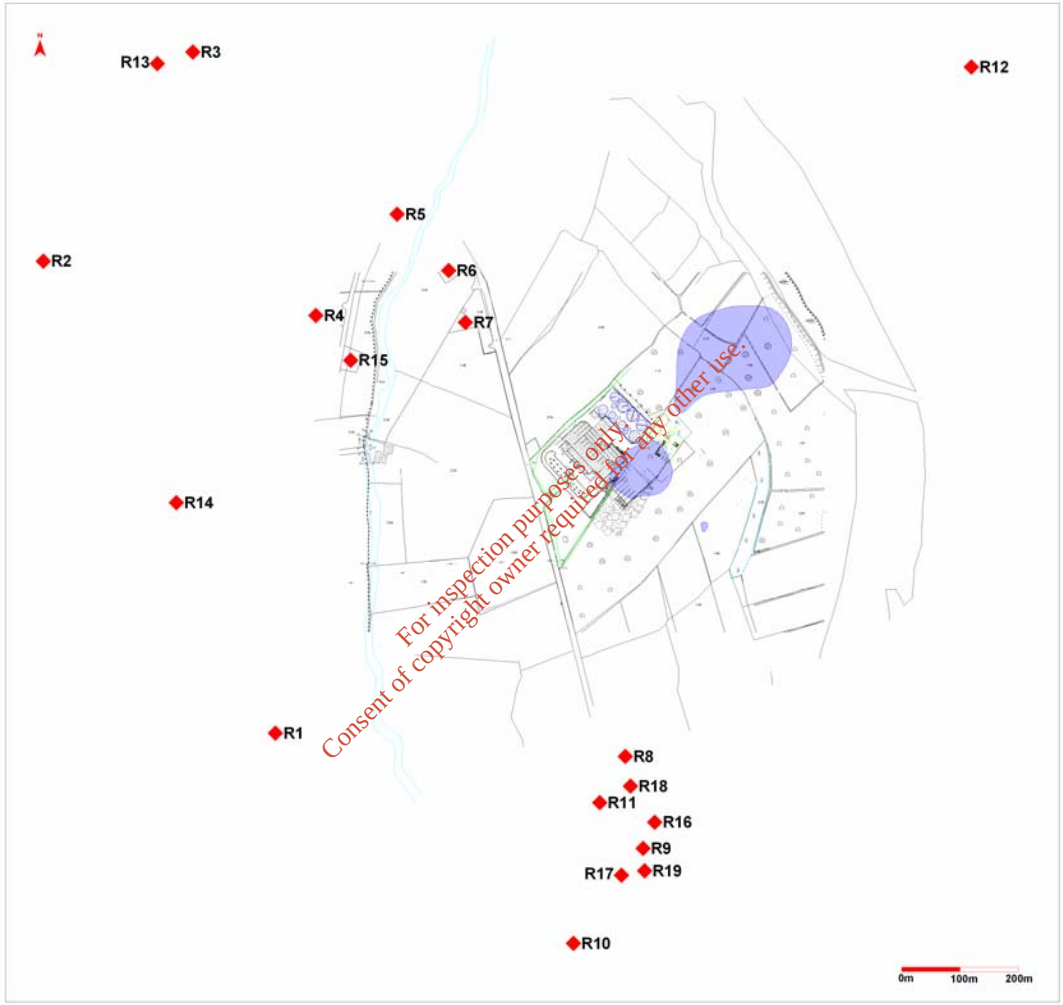

Figure 6.8. Predicted annual average SO_2 ground level concentration of 3 μg/m^3 (____) for cumulative emissions for Scenario 6 for Rosslare meteorological station (worst case year 2005) - 24 hr plant operation.

6.2.4 Scenario 7, 8, 9 and 10 - Total particulates

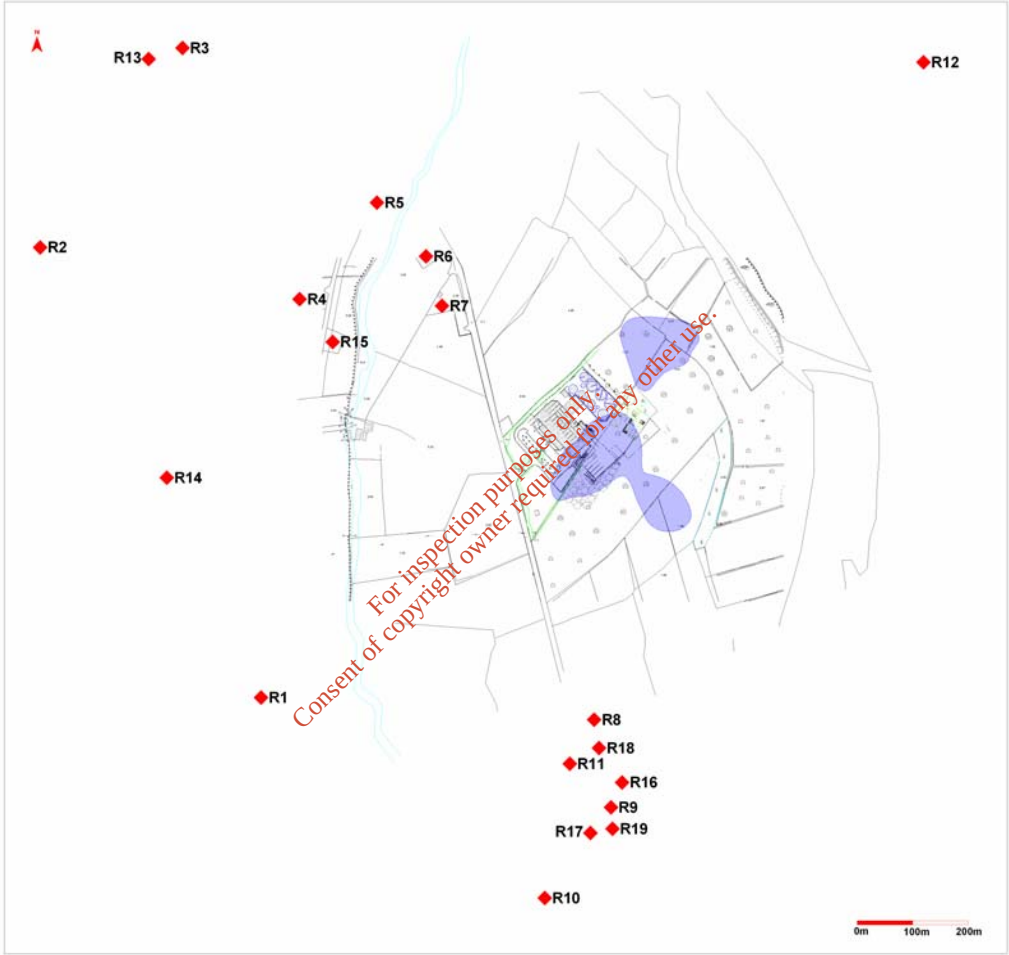

Figure 6.9. Predicted 98.08th percentile of 24 hr averages for Total particulates ground level concentration of 5 µg/m^3 (▬) for cumulative emission for Scenario 7 for Rosslare meteorological station (worst case year 2005) - 24 hr plant operation.

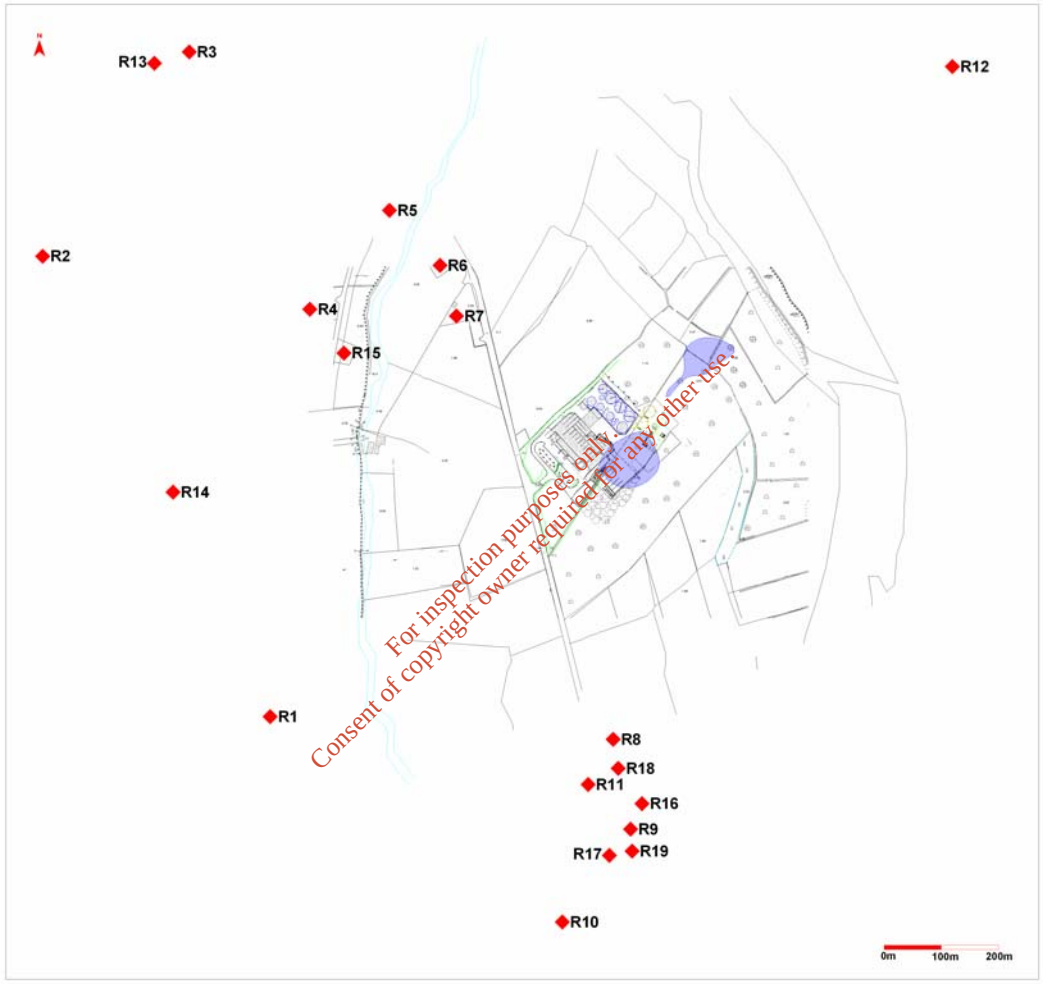

Figure 6.10. Predicted 90.40th percentile of 24 hr averages for Total particulates ground level concentration of 3 μg/m^3 (▬) for cumulative emission for Scenario 8 for Rosslare meteorological station (worst case year 2005) - 24 hr plant operation.

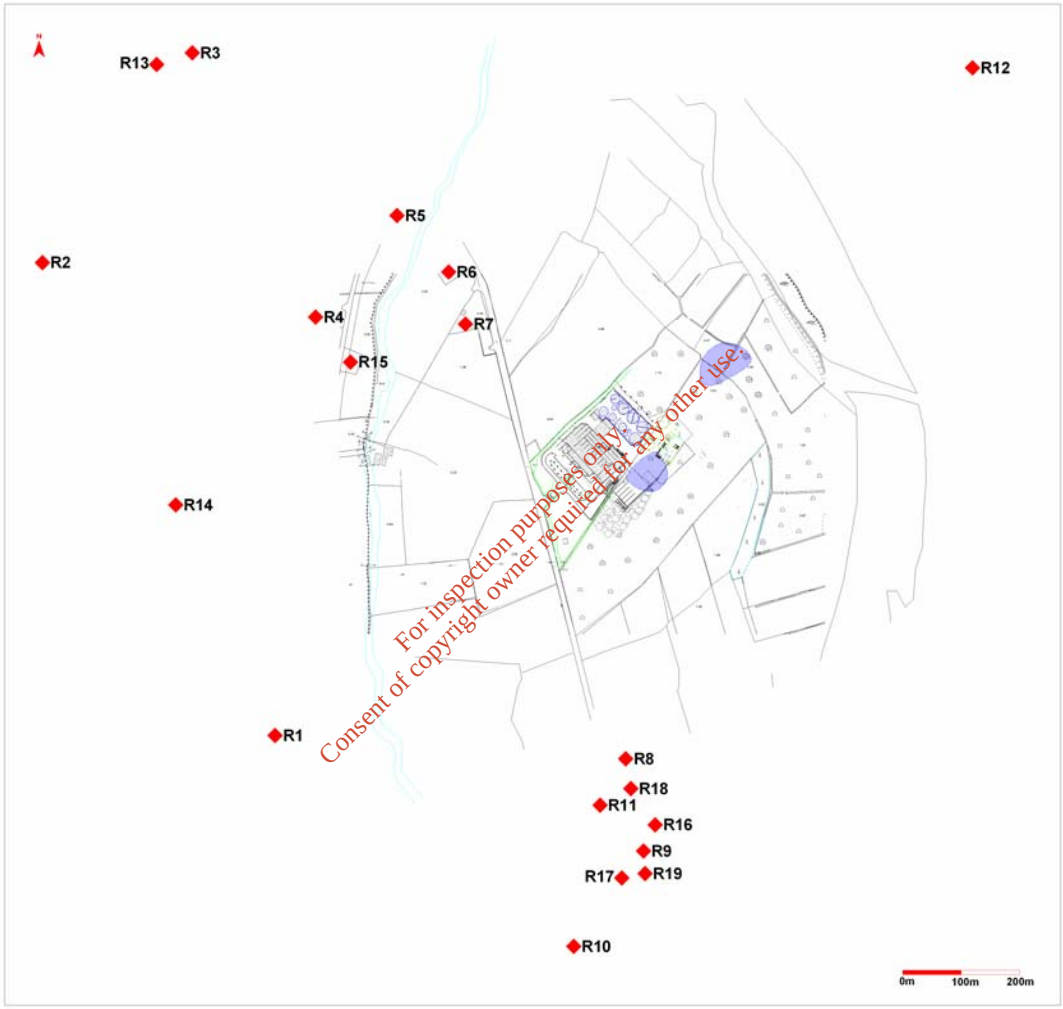

Figure 6.11. Predicted annual average Total particulates ground level concentration of 1.0 μg/m^3 (▬) for cumulative emissions for Scenario 9 for Rosslare meteorological station (worst case year 2005) - 24 hr plant operation.

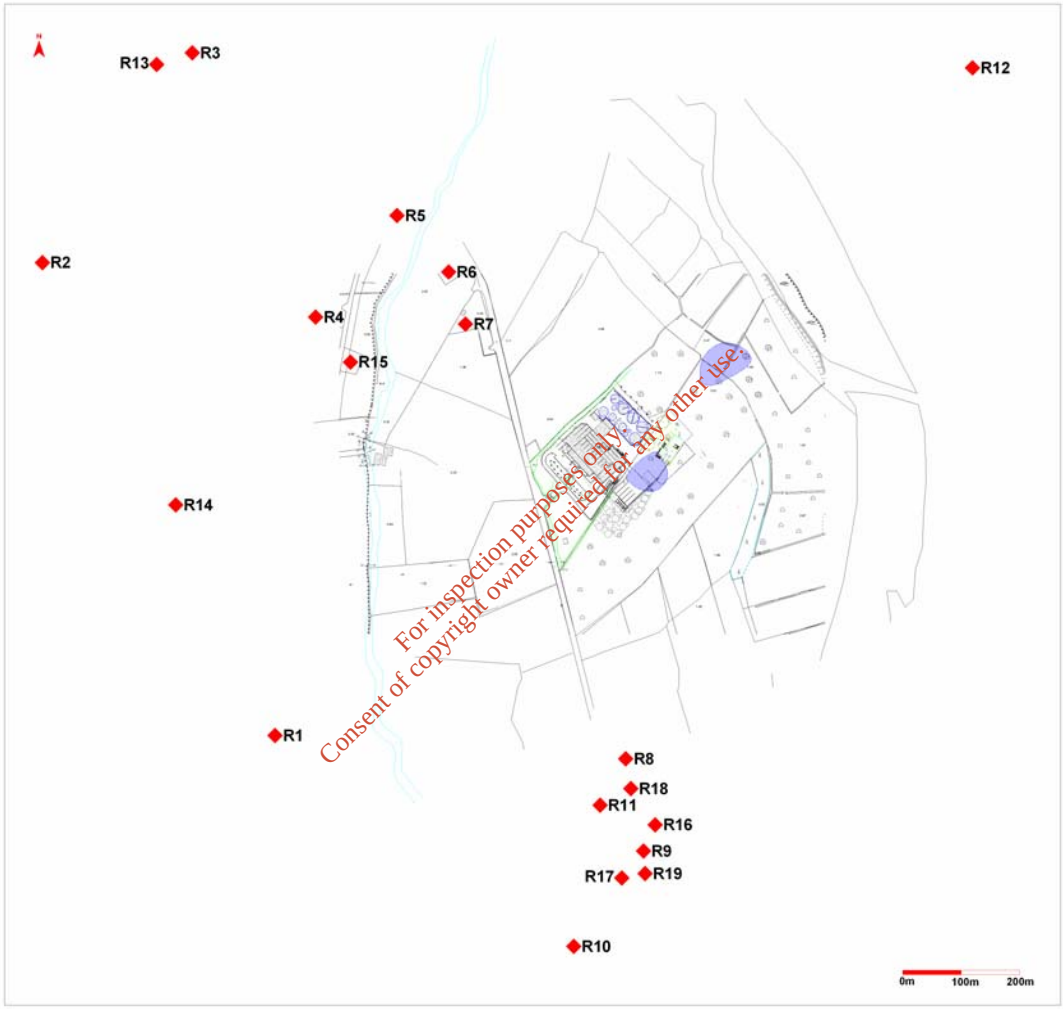

Figure 6.12. Predicted annual average Total particulates as $PM_{2.5}$ ground level concentration of 1.0 μg/m^3 (⟶) for cumulative emissions for Scenario 10 for Rosslare meteorological station (worst case year 2005) - 24 hr plant operation.

6.2.5 Scenario 11 – TNMVOC as Benzene

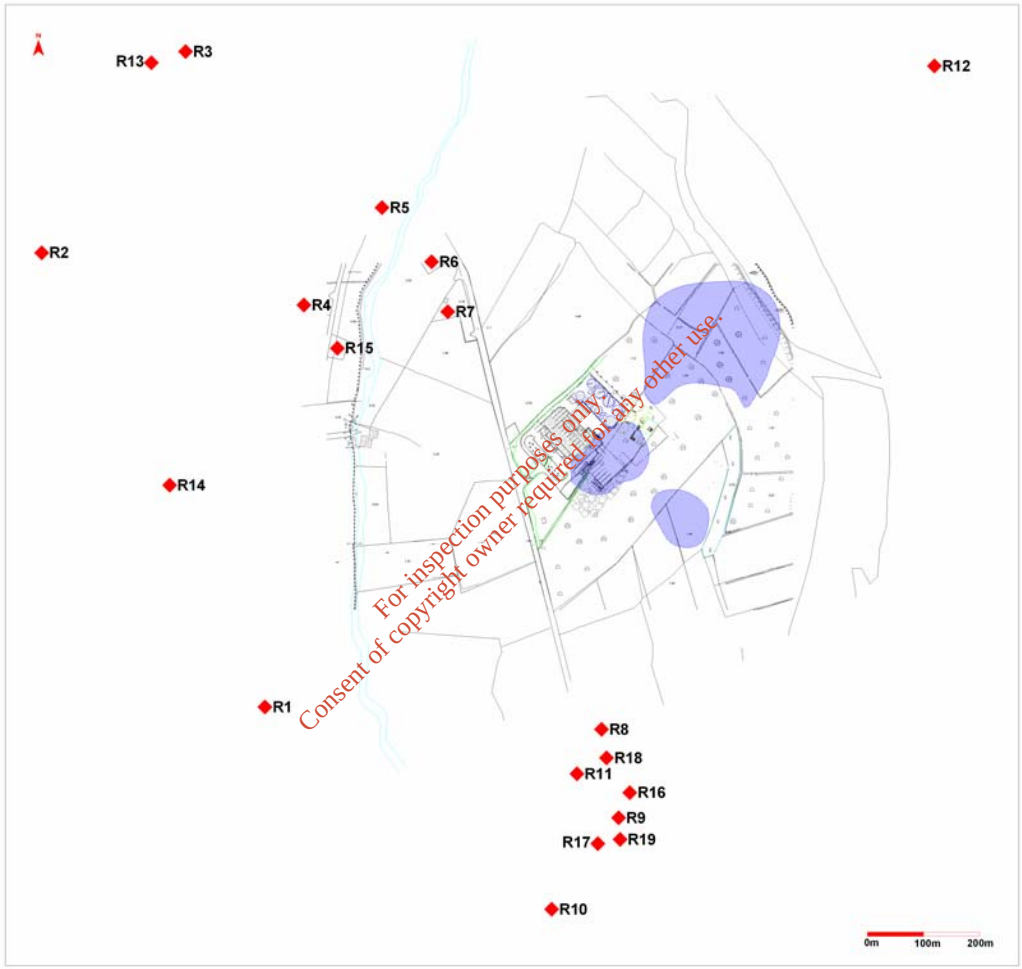

Figure 6.13. Predicted annual averages for TNMVOC as Benzene ground level concentration of 0.25 μg/m^3 ( ) for cumulative emission for Scenario 11 for Rosslare meteorological station (worst case year 2005) - 24 hr plant operation.

6.2.6 Scenario 12 and 13 – Odour

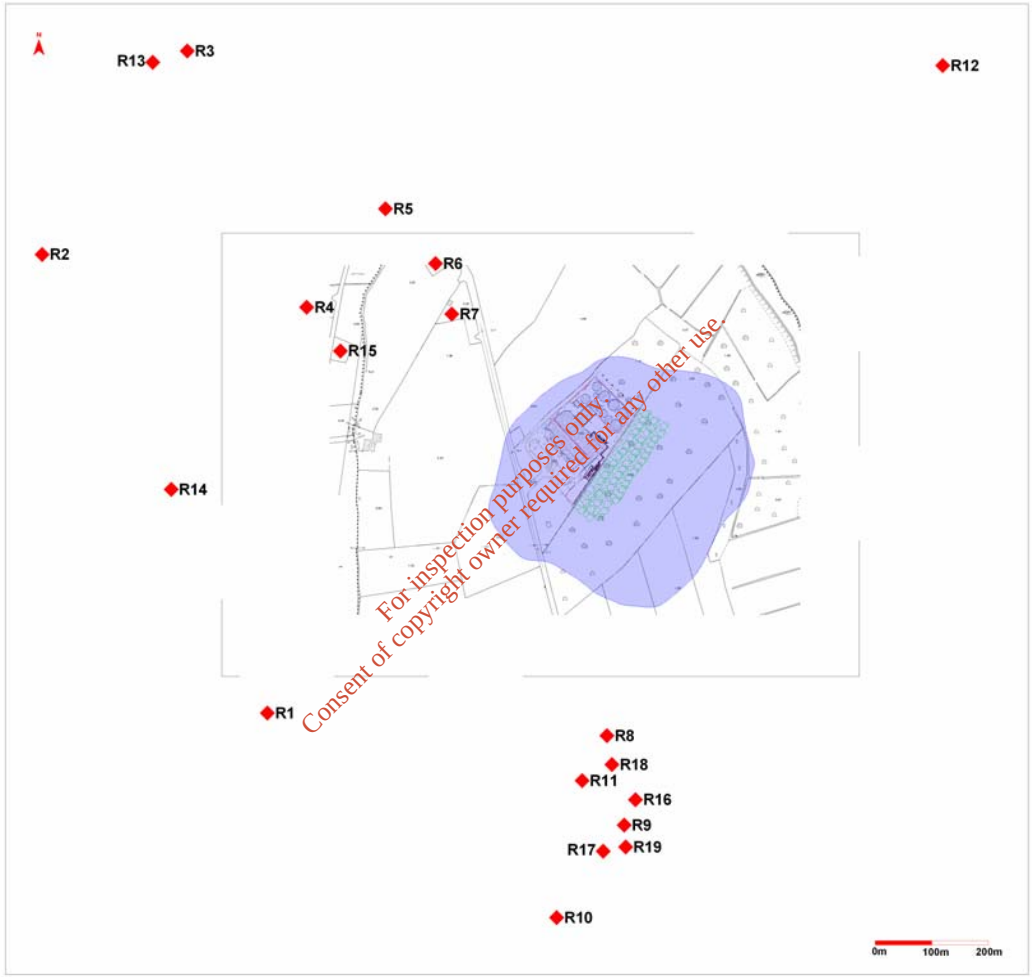

Figure 6.14. Predicted 98th percentile of 1 hr averages for Odour ground level concentration of less than or equal to 3.0 Ou_E/m^3 (——) for cumulative emission for Scenario 12 for Rosslare meteorological station (worst case year 2005) - 24 hr plant operation – Existing site operations.

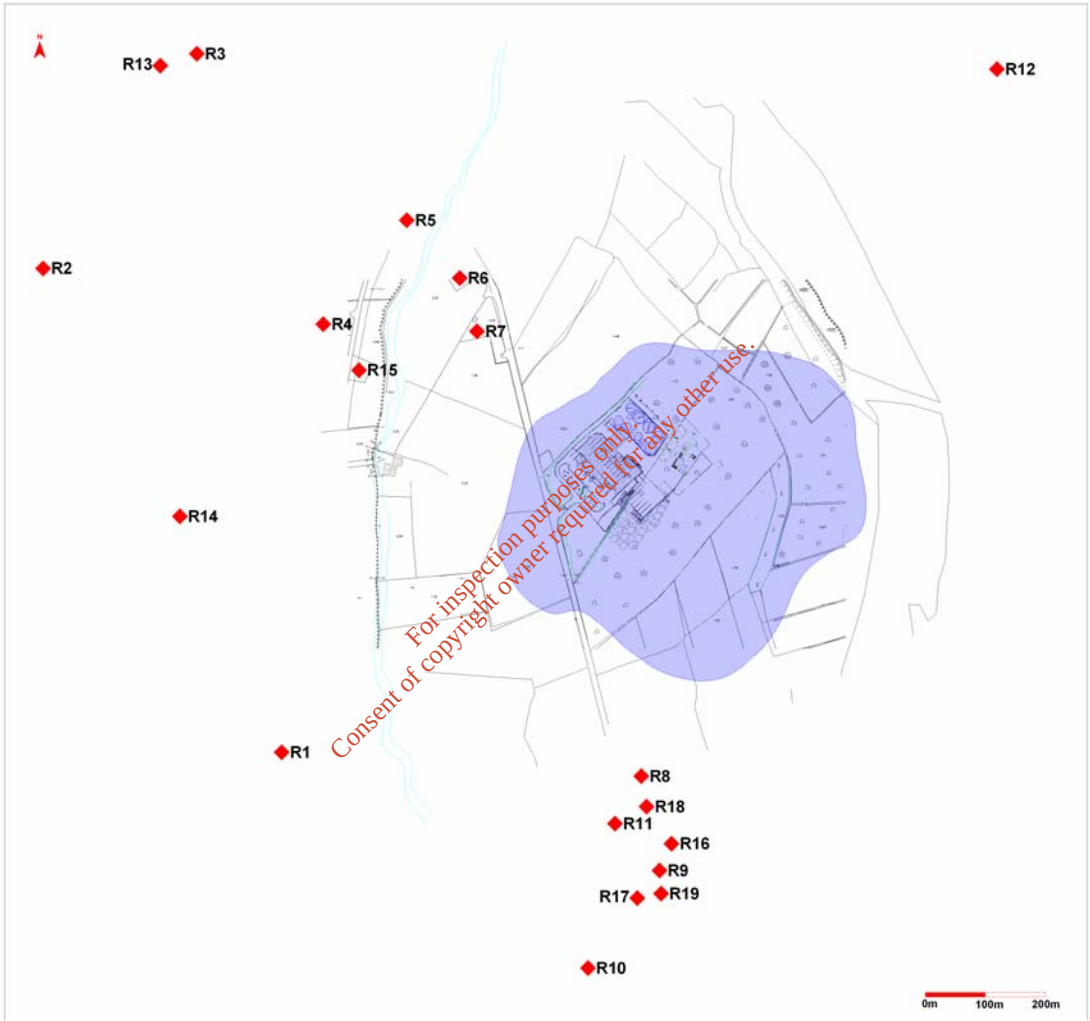

Figure 6.15. Predicted 98th percentile of 1 hr averages for an Odour ground level concentration of less than or equal to 3.0 Ou_E/m^3 (▬) for cumulative emission for Scenario 13 for Rosslare meteorological station (worst case year 2005) - 24 hr plant operation – Proposed site operations.

7. *Appendix II* - Meteorological data used within the Dispersion modelling study.

Meteorological file Rosslare 2002 to 2006 inclusive

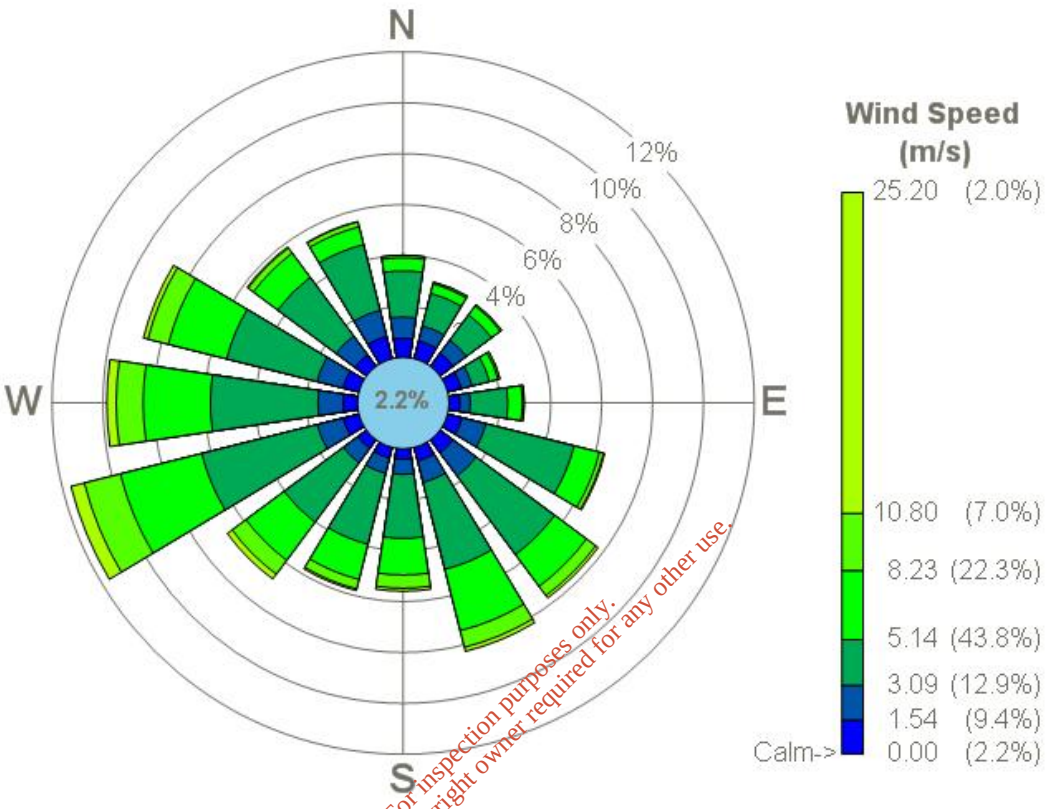

Figure 7.1. Schematic illustrating windrose for meteorological data used for atmospheric dispersion modelling, Rosslare 2002 to 2006 inclusive.

Table 7.1. Cumulative wind speed and direction for meteorological data used for atmospheric dispersion modelling Rosslare 2002 to 2006 inclusive.

Cumulative Wind Speed Categories							
Relative Direction	**> 1.54**	**>3.09**	**>5.14**	**>8.23**	**> 10.80**	**< 10.80**	**Total**
0	0.75	0.83	1.81	0.52	0.09	0.01	4.02
22.5	0.72	0.61	1.32	0.38	0.07	0.01	3.11
45	0.64	0.64	1.23	0.43	0.06	0.01	3.02
67.5	0.56	0.44	0.70	0.35	0.08	0.01	2.12
90	0.43	0.40	1.48	0.57	0.07	0.00	2.96
112.5	0.59	0.96	3.57	1.03	0.17	0.05	6.36
135	0.64	1.13	3.85	1.55	0.45	0.12	7.74
157.5	0.55	0.87	3.52	2.49	0.67	0.17	8.26
180	0.42	0.59	2.51	1.44	0.52	0.12	5.59
202.5	0.43	0.62	2.87	1.43	0.38	0.07	5.80
225	0.42	0.71	2.90	1.86	0.68	0.24	6.81
247.5	0.64	1.05	4.68	3.30	1.46	0.55	11.67
270	0.56	0.99	4.23	2.64	1.07	0.37	9.85
292.5	0.64	1.06	3.66	2.36	0.83	0.18	8.73
315	0.56	0.92	2.86	1.18	0.25	0.05	5.84
337.5	0.90	1.06	2.66	0.72	0.19	0.02	5.56
Total	9.44	12.85	43.85	22.26	7.04	1.99	97.42
Calms	--	-	-	-	-	-	2.24
Missing	-	-	-	-	-	-	0.34
Total	**-**	**-**	**-**	**-**	**-**	**-**	100.00

8. *Appendix III* - Checklist for EPA requirements for air dispersion modelling reporting

Table 8.1. EPA checklist as taken from their air dispersion modelling requirements report.

Item	Yes/No	Reason for omission/Notes
Location map	Section 6	-
Site plan	Section 6	-
List of pollutants modelled and relevant air quality guidelines	Yes	-
Details of modelled scenarios	Yes	-
Model description and justification	Yes	-
Special model treatments used	Yes	-
Table of emission parameters used	Yes	-
Details of modelled domain and receptors	Yes	-
Details of meteorological data used (including origin) and justification	Yes	-
Details of terrain treatment	Yes	-
Details of building treatment	Yes	-
Details of modelled wet/dry deposition	N/A	-
Sensitivity analysis	Yes	Five years of hourly sequential data screened from nearest valid met station- Rosslare 2002 to 2006.
Assessment of impacts	Yes	Pollutant emissions assessment from process identified.
Model input files	No	DVD will be sent upon request. Files are a total of 3.1 GB in size.