



Wexford County Council

Killurin Landfill
W0016-02

Annual Environmental Report 2012

Quality Control Sheet

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Address: Wexford County Council
County Hall,
Wexford.

Fintan Ryan, Facility Manager

Tel 053-9120922
Mob 087-1227314
Email fintan.ryan@wexfordcoco.ie

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Contents Page

Annual Environmental Report 2012	1
EXECUTIVE SUMMARY	5
1 INTRODUCTION	6
1.1 General Information	6
1.2 Site information	6
2 MANAGEMENT & STAFFING STRUCTURE	7
2.1 Management and staffing structure for Killurin Landfill 2012	7
2.2 Financial provisions	8
2.3 Environmental Management System	8
3 REPORTED INCIDENTS & COMPLAINTS SUMMARIES	14
3.1 Incidents	14
3.2 Complaints	14
4 DEVELOPMENT WORKS UNDERTAKEN DURING THE REPORTING PERIOD & THOSE PROPOSED FOR THE COMING YEAR	15
4.1 Landfill Engineering Works	15
4.2 Restoration and Aftercare	15
5 WASTE ACCEPTANCE & HANDLING	17
5.1 Waste Activities carried out at the Facility	17
5.2 Total quantity of wastes accepted on site	17
5.3 Total Quantity of Waste Consigned Off Site	17
5.4 Remaining capacity of the site	21
6 ENVIRONMENTAL NUISANCES	22
6.1 Review of environmental nuisance control at the facility for the reporting period	22
7 RESOURCE & ENERGY CONSUMPTION	23
7.1 Electricity and Energy Usage	23
7.2 Water	23
7.3 Diesel	23
8 ENVIRONMENTAL MONITORING & EMISSIONS SUMMARY	24
8.1 Summary report on emissions	24
8.2 Environmental Monitoring	25

APPENDICES

- A1 PRTR 2012
- A2 Topographical and Monitoring location drawings
- A3 Integrity test
- A4 Meteorological Data

EXECUTIVE SUMMARY

This *Annual Environmental Report* has been prepared for Killurin Landfill, Waste Licence 16-2, for the reporting period from **1 January 2012 to 31 December 2012 inclusive**. The report includes the information specified in Schedule G of the Waste Licence, Content of the Annual Environmental Report, in accordance with Waste Licensing - *Draft Guidance on Environmental Management Systems (EMS) and Reporting to the Agency, 1999*. The main topics discussed with this report are as follows:

- ◆ General Site Information
- ◆ Management and Staffing
- ◆ Reported Incidents and Complaints
- ◆ Development Works
- ◆ Waste Acceptance and Handling
- ◆ Emissions Management
- ◆ Environmental Nuisances
- ◆ Resource and Energy Consumption
- ◆ Environmental Monitoring and Emissions

Killurin Landfill was closed to accepting waste on the 07 June 2008. No waste was accepted to landfill in 2012.

Wexford County Council continued to carry out a comprehensive environmental monitoring programme during 2012, in compliance with the waste licence conditions (Schedule D), to assess the significance of emissions. The monitoring programme included Landfill Gas, Leachate Level & Quality, Surface Water Quality, Groundwater Level & Quality, Odour monitoring and Meteorological monitoring as well as Topographical.

1 INTRODUCTION

1.1 General Information

The Annual Environmental Report (AER) for Killurin Landfill includes the information specified in Schedule G of the Waste Licence 16-2, *Content of Annual Environmental Report* and has been prepared in accordance with the Environmental Protection Agency (EPA) publication 'Waste Licensing – Draft Guidance on Environmental Management Systems (EMS) and Reporting to the Agency, 1999'.

The reporting period for this AER is **1 January 2012 to 31 December 2012 inclusive**.

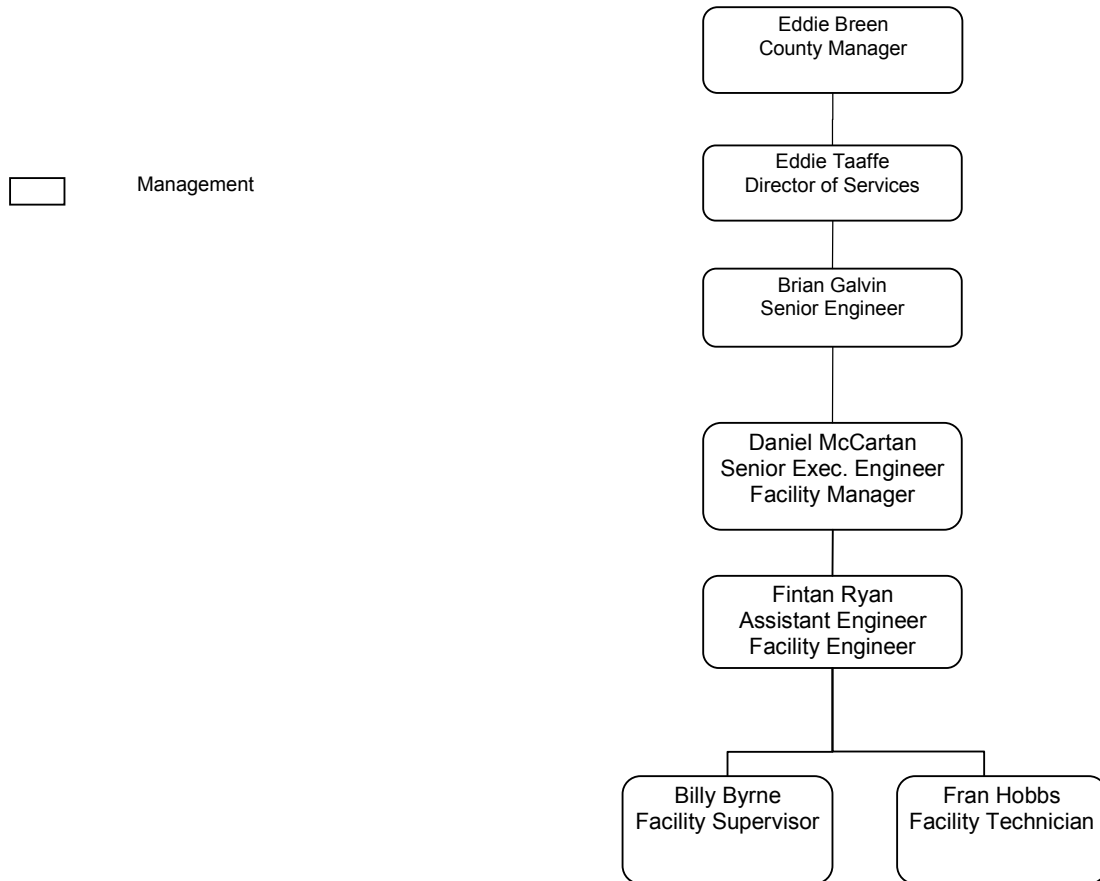
1.2 Site information

Table 1 Site information for Killurin Landfill

KILLURIN LANDFILL	
Waste licence register no:	16-2
Name and address of operator:	Wexford County Council County Hall Spawell Road County Wexford
Name and address of facility:	Killurin Landfill Killurin County Wexford
Site Description:	Killurin Landfill site is located in the town land of Newtown lower, Killurin, close to Deeps Bridge on a meander of the eastern bank of the River Slaney. The site is approximately 11km from Wexford town and covers an area of 10.7 hectares, of which 4.9 hectares are landfill and the remainder is CA site, buildings, car parking and buffer zones/screening. The facility is located in what once was a sand and gravel quarry. The area surrounding the site is rural with a mixed pattern of highly productive pasture and arable land use, with the River Slaney being the prominent landscape feature. Landfilling and CA site operations ceased in June 2008.

2 MANAGEMENT & STAFFING STRUCTURE

2.1 Management and staffing structure for Killurin Landfill 2012



The Killurin Landfill was operated by Wexford County Council during 2012 with consultancy support provided by sub consultants including Fehily Timoney & Company, Irish Biotech Services and ATKINS.

2.2 Financial provisions

In accordance with Condition 12.1 Wexford County Council paid a sum of €16,000 to the Environmental Protection Agency for the management and monitoring of the waste licence.

2.2.1 *Provision for the Closure, Restoration and Aftercare*

Wexford County Council (WCC), as a Local Authority, has made the necessary provisions, for the development, management, restoration and aftercare of Killurin Landfill. WCC has assigned engineering and technical staff to manage the facility. Wexford County Council is committed to the ongoing provision of funding for all site development works, environmental monitoring costs and restoration and aftercare works at Killurin Landfill for the duration of the Waste Licence.

2.3 Environmental Management System

2.3.1 *Environmental Management Programme*

The site has an operational environmental management system (EMS) in accordance with the Waste Licence condition 2.3.2.1. Implementation of the EMS continued during this reporting period (January 2012 - December 2012). The Objectives and Targets of the EMS were reviewed and revised for the reporting period 2012.

2.3.2 *Environmental objectives and targets.*

Table 2 below provides the Objectives and Targets for 2012 and details progress made regarding each objective. Table 3 provides the Objectives and Targets for 2013 and the methods by which they will be achieved.

An environmental management plan (EMP) was prepared as part of the EMS for the facility. The EMP comprises information on the following topics:

- Site description
- Site infrastructure
- Leachate Collection and treatment Leachate Management System
- Landfill Gas Abatement Methods
- Surface water Control Measures
- Environmental Monitoring
- Site Security and Site Offices
- Operational Matters
- Vermin control
- Fires
- Restoration and Aftercare

2.3.3 *Corrective action Procedure*

Procedures are in place in accordance with Condition 2.3.2.3 of the licence to monitor, measure, audit and record the environmental performance of the environmental management system. These procedures establish how non-conformance within the system is dealt with and how any corrective and preventive action is carried out. A corrective action procedure was prepared in October 2008 (reviewed in 2010) and is included in the overall EMS report.

2.3.4 *Awareness and Training Programme*

In accordance with Condition 2.3.2.4 of the licence, an awareness and training programme has been developed to increase environmental awareness among staff and identify training needs of all personnel working at Killurin Landfill. The facility manager has overall responsibility for reviewing training needs on an annual basis to ensure that all staff have the necessary skills and level of awareness to carry out their duties to the highest environmental and safety standards. Training records are kept on file at Holmestown Waste Management Facility.

Table 2 Achievements of Objectives and Targets for 2012

Achievements of Objectives and Targets for 2012			
	Comments	Target	Progress
Objective No 1:			
1.1 Improve current site record keeping and performance of site procedures including documentation of procedure reviews due to the closure of the landfill	Review existing filing system and record storage for the facility, in particular the retention of records for historical review of the facilities environmental performance. This will include for the archiving of files related to the site's operations, communications and compliance of the waste licence at any time.	2012	Ongoing
Objective No 2:			
2.1 Ensure ongoing maintenance of the following site infrastructure: Roads; Surface Water drainage infrastructure; Weighbridge; Site offices and Plant shed; Landfill gas extraction system; Leachate extraction system.	All of the items of existing infrastructure are to be maintained as required and in accordance with suppliers/manufacturers instructions where applicable.	2012	Complete for 2012. Maintenance Ongoing into 2013 Decommissioning ongoing
Objective No 3:			
3.1 Complete the capping of the landfill	There is a gravel access ring road (1km long approx. and 4.5m wide) on the landfill. The landfill cap is to be extended to seal below the access ring road. The surface water drainage and leachate infrastructure where affected to be upgraded as required.	2012	Ongoing- Review of Leachate management plan has resulted in delay of capping to include additional leachate extraction wells, This contract is expected to start Mid 2013
Objective No 4:			
4.1 To improve surface water discharge from the landfill	Complete the Surface Water Management plan and implement the proposal on site. These works are to be carried out as part of the capping works contract.	2012	Ongoing- Additional infrastructure has been identified as part of the capping works which will be progressed in 2013
Objective No 5:			
5.1 Develop a leachate extraction / assessment	Install new and modify existing infrastructure as recommended in	2012	Ongoing- Is being progressed as part of the

Achievements of Objectives and Targets for 2012			
	Comments	Target	Progress
management plan to reduce the potential for pollution of the local environment.	the plan. These works are to be carried out as part of the capping works contract.		above project. Refer to Leachate Management plan.
Objective No 6:			
6.1 Complete the Aftercare plan	A basic restoration and aftercare plan was completed in 2002, this plan is to be further developed and completed.	2012	Ongoing- Is being progressed as part of the above project. Refer to Leachate Management plan.
Objective No 7:			
Monitoring requirement review	As the landfill is now closed and some existing monitoring points have been damaged lost etc. a review is to be undertaken. The objective of this review is to identify and agree the monitoring points required for ongoing monitoring	2012	Ongoing- Is being progressed as part of the above project. Refer to Leachate Management plan.

Table 3 Objectives and Targets for 2013

Objectives and Targets for 2013			
	Comments	Target	Responsibility
Objective No 1:			
1.1 Review and update leachate management plan document	Review existing leachate management plan which was developed and implemented in 2012 and ensure information is revised as required.	2013	Facility Manager / Facility Technician
Objective No 2:			
2.1 Update and review the Restoration and Aftercare plan	Review and update the plan as required.	2013	Facility Manager / Facility Technician
Objective No 3:			
3.1 Complete the capping of the landfill	There is a gravel access ring road (1km long approx. and 4.5m wide) on	Sep/Oct 2013	Facility Manager /

Objectives and Targets for 2013			
	Comments	Target	Responsibility
	the landfill. The landfill cap is to be extended to seal below the access ring road. The surface water drainage and leachate infrastructure where affected to be upgraded as required.		Facility Technician
Objective No 4:			
4.1 Leachate extraction system and landfill gas system	Installation of additional leachate extraction wells have been identified as part of the leachate management plan. These will be installed as part of the landfill capping project in 2013	Sep/Oct 2013	Facility Manager / Facility Technician
4.2 Maintenance of Leachate extraction system	Revise the maintenance schedule and items as per the leachate management plan for servicing of the pumped extraction system	2013	
Objective No 5:			
5.1 Maintain site records and performance of site procedures	Maintain existing filing system and record storage for the facility, in particular the retention of records for historical review of the facilities environmental performance.	2013	Facility Manager / Facility Technician
Objective No 6:			
6.1 Ensure ongoing maintenance of the following site infrastructure: Roads; Surface Water drainage infrastructure; Weighbridge; Site offices and Plant shed; Landfill gas extraction system; Leachate extraction system.	All of the items of existing infrastructure are to be maintained as required and in accordance with suppliers/manufacturers instructions where applicable.	2013	Facility Supervisor

2.3.5 Full title of any procedures developed by the licensee in the year which relates to the facility operation

No additional procedures were developed or submitted during the reporting period.

2.3.6 Report on communication programme

The site's EMS includes a procedure for communication. In addition Wexford County Council provides the following documentation for public viewing at Holmestown Waste Management Facility:

Table 4 List of records available for public viewing in relation to the landfill

List of records available for public viewing
Waste Licence W0016-2
Waste Licence application
Correspondence with the EPA
Incident / complaints records
Audit records
Waste acceptance records
Material acceptance dockets
All monitoring records
Leachate removal records
Vermin control reports

3 REPORTED INCIDENTS & COMPLAINTS SUMMARIES

3.1 Incidents

No incidents were reported during this reporting period. However ongoing elevated levels of ammonia (which are decreasing over time) are still being recorded in downstream groundwater boreholes. Refer to quarterly monitoring reports and the Leachate Management plan for further details.

3.2 Complaints

No complaints were received during this reporting period.

4 DEVELOPMENT WORKS UNDERTAKEN DURING THE REPORTING PERIOD & THOSE PROPOSED FOR THE COMING YEAR

4.1 Landfill Engineering Works

4.1.1 *Completed Engineering Works 2012*

- Demobilising of site accommodation
- Installation of additional Leachate Management infrastructure
- Installation of additional Landfill gas Management infrastructure

4.1.2 *Proposed Engineering Works 2013*

Proposed engineering works for 2013 are detailed in the Leachate Management Plan and are summarized as follows

- Completion of Landfill cap (on existing site access road)
- Install 16 additional dual purpose leachate and landfill gas extraction wells
- Install new leachate collection pipework system
- Surface water Management Works
- Continue the leachate extraction infrastructure maintenance works programme

4.2 Restoration and Aftercare

Several proposals for the end use of the site are currently being reviewed. It is envisaged that the review will be completed in 2013. A report will be submitted to the EPA for approval when the review is complete.

5 WASTE ACCEPTANCE & HANDLING

5.1 Waste Activities carried out at the Facility

No waste disposal operations took place on site at Killurin Landfill during the reporting period 1st January 2012 to 31st December 2012. Total quantity of wastes accepted for transfer on site was 5.4Tonnes

A summary of the total quantity of waste accepted at the facility for the reporting period 1st January to 31st December 2012 is presented below in table 5.

5.2 Total Quantity of Waste Consigned Off Site

A summary of the total quantity of waste consigned off site at Killurin Landfill for the period 1st January 2012 to 31st December 2012 is presented below in table 6.

The total volume of leachate sent off site for treatment at Enniscorthy Wastewater Treatment Works was 4325 Tonnes. The Total weight of dead dogs sent off site for disposal was 5.4 Tonnes . This activity ceased in May 2012.

Table 5 Waste accepted to Killurin Landfill from 1st January 2012 to 31st December 2012 (tonnes)

Waste In	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly totals
DEAD DOGS	1.1	0.66	1.2	1.38	0.900	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.24
Total	1.1	0.6	1.0	1.38	0.900	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.24

Table 6

Waste consigned off-site from Killurin Landfill from 1st January to 31st December 2012 (tonnes)

Waste Out	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly totals
DEAD DOGS	1.1	0.66	1.2	1.38	0.900	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.24
LEACHATE	210	307	242	148	294	181	154	626	343	431	889	500	4325
Total													4330.24

5.3 Remaining capacity of the site

Killurin Landfill closed in the end of June 2008. There is no space remaining in the landfill for deposition of waste.

6 ENVIRONMENTAL NUISANCES

6.1 Review of environmental nuisance control at the facility for the reporting period

Nuisances at Killurin Landfill are logged in a monthly tick-box report and action is taken immediately to address any identified issues. Table 7 below summarises the measures implemented on site to combat environmental nuisances during 2012.

Table 7 **Environmental Nuisance Control during 2012**

Nuisance	Mitigation Measures in Place
Vermin	Permanent bait points set up on site (internal and external). Inspections carried out on a monthly basis. If infection found then weekly inspections until rodent free. Monthly reports produced and kept at Holmestown site office.
Litter	Killurin landfill is litter free.
Flies	No flies present.
Odour	No odour emissions

7 RESOURCE & ENERGY CONSUMPTION

7.1 Electricity and Energy Usage

The cost of electricity on site for 2012 was €32,565.44.

7.2 Water

Domestic water usage data was not recorded.

7.3 Diesel

Total diesel fuel consumption is estimated to be 60 litres from 01 January to 31 December 2012.

8 ENVIRONMENTAL MONITORING & EMISSIONS SUMMARY

8.1 Summary report on emissions

A summary of emissions monitoring at Killurin Landfill carried out during this reporting period (January 2012 – December 2012) is contained in Table 8 below. The E-PRTR Regulation (EC) No. 166/2006 concerning the establishment of a European Pollutant Release and Transfer Register came into force in February 2006 and was brought into Irish law through SI No 123 of 2007. As a result all industries have to annually report environmental emissions and waste transfer data through a web-based form as part of their AER. The PRTR 2012 document is included in Appendix A1.

Table 8 A summary of Emissions monitoring as specified in Waste Licence W0016-2

Emission Monitoring	Frequency
Landfill Gas	Continuously (Dwellings adjacent to Landfill, Flare) Weekly (Site Accommodation) Monthly (Boreholes) Annual (Flare)
Leachate	Monthly (Borehole Level) Quarterly (Analysis) Annually (Analysis)
Surface water	Weekly (Visual) Quarterly (Analysis) Annually (Analysis)
Groundwater Levels	Monthly (Borehole Level)
Groundwater	Quarterly (Analysis) (Note 2) Annually (Analysis)
Noise	As required (Note 1)
Dust	As required (Note 1)
River Water	Quarterly (Analysis)

Note 1: When specific engineering works are being carried out

Note 2: As detailed in the Leachate Management Plan additional monitoring of groundwater and leachate around and within the Landfill footprint took place during 2012

8.2 Environmental Monitoring

Wexford County Council carries out a comprehensive environmental monitoring programme, in compliance with the waste licence conditions, to assess the significance of emissions. The monitoring programme includes Landfill Gas, Leachate Level & Quality, Surface Water Quality, Groundwater Level & Quality, Noise and Dust monitoring (as required), Odour monitoring and Meteorological monitoring, as well as Flare emission and Topographical.

Monitoring during this reporting period was carried out according to Schedule D of Waste Licence W0016-2, Quarters 1, 2, 3 and 4 results for 2012 are summarised in this chapter. Additional monitoring was also carried out as detailed in the Leachate Management Plan. A monitoring point location plan is provided see appendix A2

8.2.1 Landfill gas

In accordance with Schedule D.1 of the Waste Licence W0016-2, the following monitoring has been carried out and reported to the Agency.

- ◆ Monitoring boreholes LB2, LB3, LB4, LB5, LB6, LB7, LB8, LB12, LB13, LB15, LB16 as specified in the licence.
- ◆ Perimeter boreholes T1, T2, T3, T5, T6, T7, T9, T10, T11, T12, T13, T14, T15, T16, T17, T18 and T19 were monitored on a monthly basis by Wexford County Council site staff.

The majority of boreholes have varying levels of gas quality over the reporting period and no particular trend could be identified. Gas monitoring details are provided in Table 9 below.

Table 9 Gas Monitoring Points

Off site and on site gas boreholes		
CO ₂ and CH ₄ levels (monthly)	40 points	In waste gas monitoring wells LB 2 - LB8, LB 12 - LB 16
		Boundary gas monitoring wells T1 –T3, T5- T7, T9-T19 GW1, GW9- GW11, GW17-GW19.
		Resident gas boreholes: GB1 and GB2
Residential Dwelling gas alarms		
CO ₂ and CH ₄ levels (continuously)	2 points	Two closest residences

CO2 and CH4 levels (weekly)	10 points	All site buildings
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Perimeter boreholes

Methane and Carbon Dioxide levels are elevated in gas monitoring wells T14, T15, T16, GW17, GW18 and GW19. The elevated Methane and Carbon Dioxide levels result from the location of these boreholes which are either in or on the periphery of the waste body. WCC propose to discontinue monitoring at these locations as they are no longer deemed as being peripheral wells. T17, T18, T19, GBH1 and GBH2 are in a similar orientation but further removed from the waste body and are considered suitable for ongoing monitoring in this area. No exceedences of licence limits were recorded at T17, T18, T19, GBH1 or GBH2 which would indicate that no landfill gas migration off site has taken place.

Carbon Dioxide levels in T7 and T12 are slightly elevated. The most likely cause of the slightly elevated readings is their location in a mature wooded area. The exceedences are low (max 4% in T12).

No exceedences of licence limits were recorded at any of the remaining peripheral gas monitoring wells. This indicates that landfill gas migration off site has not taken place.

Methane (CH₄)

Resident's boreholes

The following was recorded at resident's boreholes during this reporting period:

- ◆ **GB1 at Carley's:** Methane levels at this monitoring location were seen to be below the 1.0% volume per volume (v/v) trigger-level throughout the reporting period.
- ◆ **GB2 at Foxes:** Methane levels at this monitoring location were seen to be below the 1.0% volume per volume (v/v) trigger-level throughout the reporting period.

The CH₄ trigger level at the gas monitoring wells is 1.0% volume by volume (v/v)

Carbon Dioxide (CO₂)

Resident's boreholes

The following was recorded at resident's boreholes during this reporting period:

- ◆ **GB1 at Carley's:** All results were below the 1.5% volume per volume (v/v) trigger-level.
- ◆ **GB2 at Foxe's:** All results were below the 1.5% volume per volume (v/v) trigger-level.

The CO₂ trigger level at the gas monitoring wells is 1.5% volume by volume (v/v)

Monitoring boreholes GB1 and GB2 are located on the resident's side of the gas migration cut off trench. The cut off trench consists of an excavated trench along the landfill boundary adjacent to Carley's and Fox's residents. Installed in this trench is an impermeable geotextile membrane with a series of gas extraction wells installed on the landfill side. The results indicate that the gas migration cut off trench combined with the gas abstraction system is operating as designed. Continuous monitoring for the detection of landfill gas was carried out at Carley's and Fox's residents. Landfill gas was not detected at either residence in 2012

Methane and Carbon Dioxide levels (as expected) remain elevated in the dual leachate/Gas monitoring wells which are located in the waste body. This gas is being continuously extracted and flared off.

8.2.2 *Flare Emissions*

An air emission test of the landfill flare was carried out by Odour Monitoring Ireland Ltd. on the 26th November 2012. NO_x, SO₂, CO, O₂, HCL, HF and TOC were found to be in compliance with the emission limit values contained in Waste Licence W0016-2 – Schedule C4. The report is included in Appendix 4

8.2.3 *Leachate levels and monitoring*

Leachate monitoring points

Leachate Monitoring			
Level	10 points	LB2-LB8, LB12-LB16	Weekly
Analysis	27 points	Leachate storage tanks, A1 to A12 & W1 to W45	Quarterly & Annually

Leachate levels

Leachate levels were taken at 10 leachate boreholes during 2012 in compliance with Schedule D.5 of the waste licence. Samples for analysis were obtained from leachate extraction wells and the leachate storage tanks in 2012 as required by the

Leachate Management Plan. The levels were recorded using a dip meter on a monthly basis by Wexford County Council staff at the landfill.. The annual analysis results of the leachate removed from the tanks in 2012 is detailed in Table 10. The quantity exported off-site in 2012 was 4325 tonnes compared to 2,627 tonnes in 2011.

Leachate is collected from 30 extraction wells located around the site within the waste boundary. This leachate is directed to the three holding tanks located in the northwest of the landfill. It is then removed by road tanker on a routine basis and transported to Enniscorthy Wastewater Treatment Plant for treatment in accordance with the leachate management plan.

Leachate monitoring

Annual monitoring was undertaken on 26th March 2012. A leachate sample was collected from the leachate storage tanks. The sample was analysed for a range of organic and inorganic parameters as defined in Table D.5.1 of the Waste Licence 16-2.

The typical characteristics of leachate generated on site are presented in Table 10. The results are similar to those obtained for the last reporting period and are in general indicative of a landfill in the methanogenic stage of decomposition of organic compounds i.e. conversion of organic compounds to landfill gas.

Table 10 Leachate analysis results 2012

Sampling Points		Tanks
Parameters	Units	Annual
Depth of Borehole	m	
Leachate level	m	
Temperature	°C	11.2
pH	pH	7.9
Conductivity	µS/cm	5480
Ammonia	mg/l N	330
Chloride	mg/l Cl	513
Ortho-Phosphate	mg/l P	1.4
Total Oxidised Nitrogen	mg/l N	3.24
Chemical Oxygen Demand	mg/l O ₂	484
Biochemical Oxygen Demand	mg/l O ₂	4212.2
Fluoride	mg/l F	2.1
Sulphate	mg/l SO ₄	31
Aluminium	µg/l	88
Antimony	µg/l	4
Arsenic	µg/l	40
Barium	µg/l	560
Beryllium	µg/l	<0.5
Cadmium	µg/l	<0.5
Calcium	mg/l	56

Chromium	µg/l	110
Cobalt	µg/l	8.3
Copper	µg/l	30
Iron	µg/l	5000
Lead	µg/l	3.3
Magnesium	mg/l	42
Manganese	µg/l	390
Mercury	µg/l	<0.5
Molybdenum	µg/l	1.9
Nickel	µg/l	24
Potassium	mg/l	170
Selenium	µg/l	31
Sodium	mg/l	390
Thallium	µg/l	<0.5
Uranium	µg/l	0.6
Vanadium	µg/l	33
Zinc	µg/l	470
Total Cyanide	mg/l	<0.05

Inspection and testing of leachate storage tanks

The tanks were tested in December 2011 and are due to be re- tested in December 2014.

8.2.4 Surface Water

Under Schedule D.5 of the Waste Licence 16-2, surface water monitoring was required in the locations listed below. SW1 is located upstream of the site, SW2 is situated downstream of the site and SW4 is located at the southern tip of the facility. The site streams regularly run dry during the drier months of the year and consequently surface water samples cannot be obtained. These are discussed in subsequent sections.

Table 11 Surface water monitoring locations and frequency

Surface water monitoring locations and frequency			
Parameter	Location	Name	Frequency
Visual Inspection/ Odour	Off site (River Slaney)	S1, S2, S4	Quarterly
Chemical analysis	Off site (River Slaney)	S1, S2, S4	Quarterly and Annual
Visual inspection	On site	SW1, SW2, SW3 and SW4	Weekly

Chemical analysis	On site	SW1, SW2, SW3 and SW4,	Quarterly and Annual
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Visual inspection of surface water

Surface water on site consists of a series of open and piped drains. Weekly visual inspections of surface water were conducted for monitoring points SW1, SW2, SW3 (Is a surface water manhole that collects surface water from the upper cap subsurface drainage layer and is adjacent to the flare compound, monitoring commenced in Q4, 2012) and SW4, and quarterly at off-site locations (River Slaney) S1, S2 and S3. All surface water details are included in previously submitted monitoring reports for the landfill. No visual abnormalities were recorded for any of the surface water inspection points during the reporting period.

Surface water quality analysis

Results for all surface water monitoring carried out in 2012 have been submitted to the Agency in quarterly monitoring reports. Due to dry periods it was not always possible to retrieve samples from all of the monitoring points. No sample was obtainable from SW3 and only 1 sample was collected for SW2 during 2012.

All sampling and analysis was carried out in accordance with recognised quality assurance and control procedures. The detailed monitoring results are presented in the quarterly monitoring reports submitted to the Agency in the reporting period. The range of analysis is as specified in Schedule D.5 of the Waste Licence 16-2 and includes parameters such as ammoniacal nitrogen, BOD, COD, dissolved oxygen, pH, electrical conductivity and organic and inorganic parameters. No exceedences were recorded during the quarterly monitoring in 2012.

8.2.5 Groundwater

Table 12 Groundwater monitoring locations

Groundwater Monitoring Locations		
Downgradient	1 point	GW1
Downgradient (border of reed beds)	1 point	GW9
Downgradient (border of reed beds)	1 point	GW10
Upgradient	1 point	GW11
Upgradient	1 point	GW17
Upgradient	1 point	GW18
Upgradient	1 point	GW19
Upgradient	1 point	GBH1
Upgradient	1 point	GBH2

Groundwater levels

Groundwater levels were measured on a monthly basis using a dip meter. The groundwater dip levels have been submitted to the Agency in the quarterly monitoring reports. Groundwater levels remained relatively constant throughout the monitoring period, with only minor variations in groundwater levels in accordance with prevailing weather conditions. During the drier months the groundwater levels were seen to gradually decrease while during wetter periods where prolonged rain was evident, levels of groundwater were noted to rise slightly over a number of months.

Groundwater quality boreholes

No significant variation from historical result trends were noted in 2012. The highest levels of contaminants have been recorded in the boreholes located along the south east side of the landfill. These BH's are on the maximum hydraulic groundwater gradient that falls from the landfill towards the river. Samples were taken from both soil and underlying rock layers. In both cases the distribution of contamination was not even, with certain boreholes recording higher results than others. This may be due to preferential flow paths caused by gravel/sand lenses in the soils and increased permeability due to higher levels of fracturing or faults in the underlying rock. The result trends show that leachate management on site has had a beneficial effect on these wells and Ammonal, Chloride and Conductivity levels have been decreasing since 2006. Boreholes with low contaminant readings have exhibited little change since 2006. This may be due to the lower permeability and recharge in these zones. Further information on the above can be found in the quarterly monitoring reports and the Leachate Management Plan.

Boreholes GW17-19 are included as groundwater (and peripheral gas) monitoring locations in Table D1.1 of the Licence. They have been reported as dry since 2006. The boreholes are too shallow and too close to the landfill. GBH1 and GBH2 are in a similar orientation and are considered suitable for ongoing monitoring in this area. This revision has be included in the updated Leachate Management Plan

Private Well water analysis

Table 13 Private well monitoring locations

Drinking water		
Private residence	UV treated	Kitchen tap

Quarterly and annually monitoring was carried out on drinking water samples from our neighbours private well.

8.2.6 Noise

As no specific works which could generate noise were carried out on site during 2012 no noise survey was undertaken.

8.2.7 River water

The river water monitoring results for the river Slaney are reported in the Table 14 below. Monitoring location S1 is located upstream of the landfill, monitoring location S2 in the river adjacent to the landfill and monitoring location S3 is located downstream of the landfill and all are located within the tidal zone of the river estuary. Ammonia results were relatively low. There is no evidence from the upstream and downstream river results that the landfill is impacting negatively on the Slaney.

Table 14 River water monitoring results for River Slaney 2012

River water monitoring results for River Slaney 2012													
		Monitoring Locations											
		S1				S2				S3			
Parameter	Limit/ Units												
Date		27-Mar	21-Jun	23-Aug	11-Dec	27-Mar	21-Jun	23-Aug	11-Dec	27-Mar	21-Jun	23-Aug	11-Dec
BOD	5	1	1.1	1.6		1	1	1.3		<1	1	1.9	
COD	40	<10	<10	<10		<10	15	<10		<10	<10	<10	
Chloride as Cl	250	38	26	213	20.9	41	28	16.5	17.2	40	26	16	17.2
Dissolved oxygen		10.1	10.2			10.1	10.1			10.2	10.1		
Conductivity	1500	333	305	213	249	345	310	213	239	330	315	214	239
pH	6<pH>9	7.8	7.7	7.5	7.6	7.8	7.7	7.5	7.6	7.9	7.7	7.5	7.6
Suspended Solids	30	<20	<20	7.6	62.8	<20	<20	10	<20	<25	<20	11.2	<20
Ammonia as NH3-N	0.3	<0.03	<0.03	0.06	0.03	<0.03	<0.03	0.06	0.03	<0.03	0.07	0.07	0.03

8.2.8 *Dust*

As no specific engineering works which could generate dust were carried out on site during 2012 no dust monitoring was undertaken.

8.2.9 *Meteorological monitoring*

All 2012 meteorological monitoring information was obtained from the Met Éireann weather station located at Johnstown Castle, Wexford; this station is within 10km of the Killurin Landfill site. The monitoring data is contained in Appendix A3.

8.2.10 *Topographical Survey*

A topographical survey of the site was carried out by Wexford County Council staff in 2012. The topographical survey drawing is contained in Appendix A2.

APPENDICES

A1 PRTR 2012

A2 Topographical and Monitoring location drawings

A3 Meteorological Data

A4 Air emission report



[Guidance to completing the PRTR workbook.](#)

AER Returns Workbook

Version 1.1.18

REFERENCE YEAR 2012
1. FACILITY IDENTIFICATION
Parent Company Name Wexford County Council
Facility Name Kilmun Landfill Site
PRTR Identification Number W0016
License Number W0016-02

Waste or IPPC Classes of Activity	No.	Class Name
	3.1	Deposit on, in or under land (including landfill).
	3.10	Release of waste into a water body (including a seabed insertion). Repackaging prior to submission to any activity referred to in a preceding paragraph of this Schedule.
	3.12	Storage prior to submission to any activity referred to in a preceding paragraph of this Schedule, other than temporary storage, pending collection, on the premises where the waste concerned is produced.
	3.13	Surface impoundment, including placement of liquid or sludge discharges into pits, ponds or lagoons.
	3.4	The treatment of any waste on land with a consequential benefit for an agricultural activity or ecological system.
	4.10	Recycling or reclamation of organic substances which are not used as feedstock, including composting and other biological transformation processes.
	4.2	Recycling or reclamation of metals and metal compounds.
	4.3	Recycling or reclamation of metals and metal compounds.

Address 1 Newtown Lower
Address 2 Kilurin
Address 3 Co. Wexford
Address 4
Country Ireland
Coordinates of Location 48.56116 52.3816
River Basin District ELSE
NACE Code 382
Main Economic Activity Management and disposal of non-hazardous waste
AER Returns Contact Name Finian Ryan
AER Returns Contact Email Address finian.ryan@wexfordcoco.ie
AER Returns Contact Position Facility Manager
AER Returns Contact Telephone Number 053 9120922
AER Returns Contact Mobile Phone Number 087 1227314
AER Returns Contact Fax Number
Production Volume 0.0
Production Volume Units
Number of Installations 0
Number of Operating Hours in Year 0
Number of Employees 0
User Feedback/Comments
Web Address

2. PRTR CLASS ACTIVITIES	Activity Number	Activity Name
5(c)		Landfills
5(c)		Installations for the disposal of non-hazardous waste
50.1		General
3. SOLVENTS REGULATIONS (S.I. No. 543 of 2002)		
		Is it applicable? No
		Have you been granted an exemption? <input type="checkbox"/>
		If applicable which activity class applies (as per Schedule 2 of the regulations)?
		Is the reduction scheme compliance route being used? <input type="checkbox"/>

4. WASTE IMPORTED/ACCEPTED ONTO SITE
Do you import/accept waste onto your site for on-site treatment (either recovery or disposal activities)?
Guidance on waste imported/accepted onto site.

This question is only applicable if you are an IPPC or Quarry site

4.1 RELEASES TO AIR

SECTION A: SECTOR SPECIFIC PRTR POLLUTANTS

POLLUTANT		METHOD		Please enter all quantities in this section in KGs				
No. Annex II	Name	M/C/E	Method Code	Description or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
03	Carbon dioxide (CO2)	M	ISO 12039:2001		1744894.0	1744894.0	0.0	0.0
08	Methane (CH4)	M	EN 14782:2005		1024.0	1024.0	0.0	0.0
11	Nitrous oxide (N2O/NO2)	M	EN 14781:2005		148.0	148.0	0.0	0.0
02	Sulphur oxides (SOx/SO2)	M	EN 15058:2004		31.0	31.0	0.0	0.0
	Carbon monoxide (CO)	M						

* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button.

SECTION B: REMAINING PRTR POLLUTANTS

POLLUTANT		METHOD		Please enter all quantities in this section in KGs				
No. Annex II	Name	M/C/E	Method Code	Description or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
						0.0	0.0	0.0

* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button.

SECTION C: REMAINING POLLUTANT EMISSIONS (As required in your Licence)

POLLUTANT		METHOD		Please enter all quantities in this section in KGs				
Pollutant No.	Name	M/C/E	Method Code	Description or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
319	Inorganic acids	M	ALT	EN1911:2010 &		25.0	25.0	0.0
301	Total Organic Carbon (as C)	M	ALT	EN15715:2010		7.0	7.0	0.0
				EN12615:1998		0.0	0.0	0.0

* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button.

Additional Data Requested from Landfill operators

For the purposes of the National Inventory on Greenhouse Gases, landfill operators are requested to provide summary data on landfill gas (Methane) flared or utilised on their facilities to accompany the figures for total methane generated. Operators should only report their Net methane (CH4) emission to the environment under T (Total) KG/yr for Section A. Sector specific PRTR pollutants above. Please complete the table below:

Landfill: Kilurui Landfill Site

Please enter summary data on the quantities of methane flared and / or utilised

	Method Used		Facility Total Capacity m3 per hour
	M/C/E	Method Code	
Total estimated methane generation (as per site model)			N/A
Methane flared	744800.0		
Methane utilised in engines	475849.0		1250.0 (Total Flaring Capacity)
Net methane emission (as reported in Section A above)	0.0		0.0 (Total Utilising Capacity)
	2682751.0		N/A

5. ONSITE TREATMENT & OFFSITE TRANSFERS OF WASTE

[PRTR#: W0016] | Facility Name: Killurin Landfill Site | Filename: W0016_2012.xls | Return Year: 2012 |

31/05/2013 15:27

Please enter all quantities on this sheet in Tonnes

Transfer Destination	European Waste Code	Hazardous	Quantity (Tonnes per Year)	Description of Waste	Waste Treatment Operation	Method Used		Location of Treatment	Haz Waste: Name and Licence/Permit No of Next Destination Facility Non-Haz Waste: Name and Licence/Permit No of Recoverer/Disposer	Haz Waste: Address of Next Destination Facility Non-Haz Waste: Address of Recoverer/Disposer	Name and License / Permit No. and Address of Final Recoverer / Disposer (HAZARDOUS WASTE ONLY)	Actual Address of Final Destination i.e. Final Recovery / Disposal Site (HAZARDOUS WASTE ONLY)
						M/C/E	Method Used					
Within the Country	02 02 02	No	5.24	animal-tissue waste	D10	M	Weighed	Offsite in Ireland	Waterford Proteins Ltd., Dept of Agriculture R919	Ferrybank, Waterford, Ireland		
Within the Country	19 07 03	No	4325.0	landfill leachate other than those mentioned in 19 07 02	D9	M	Weighed	Offsite in Ireland	Enniscorthy WWTP Wexford County Council D0029-01	Saint John's, Enniscorthy WWTP Wexford County Council, Wexford, Ireland		
Within the Country	20 01 40	No	0.0	metals	R4	M	Weighed	Offsite in Ireland	Mulligan Dismantling and Salvage Ltd, WP/05/20	Inch, Gorey County Wexford, Ireland		

* Select a row by double-clicking the Description of Waste then click the delete button

[Link to previous years waste data](#)

[Link to previous years waste summary data & percentage change](#)



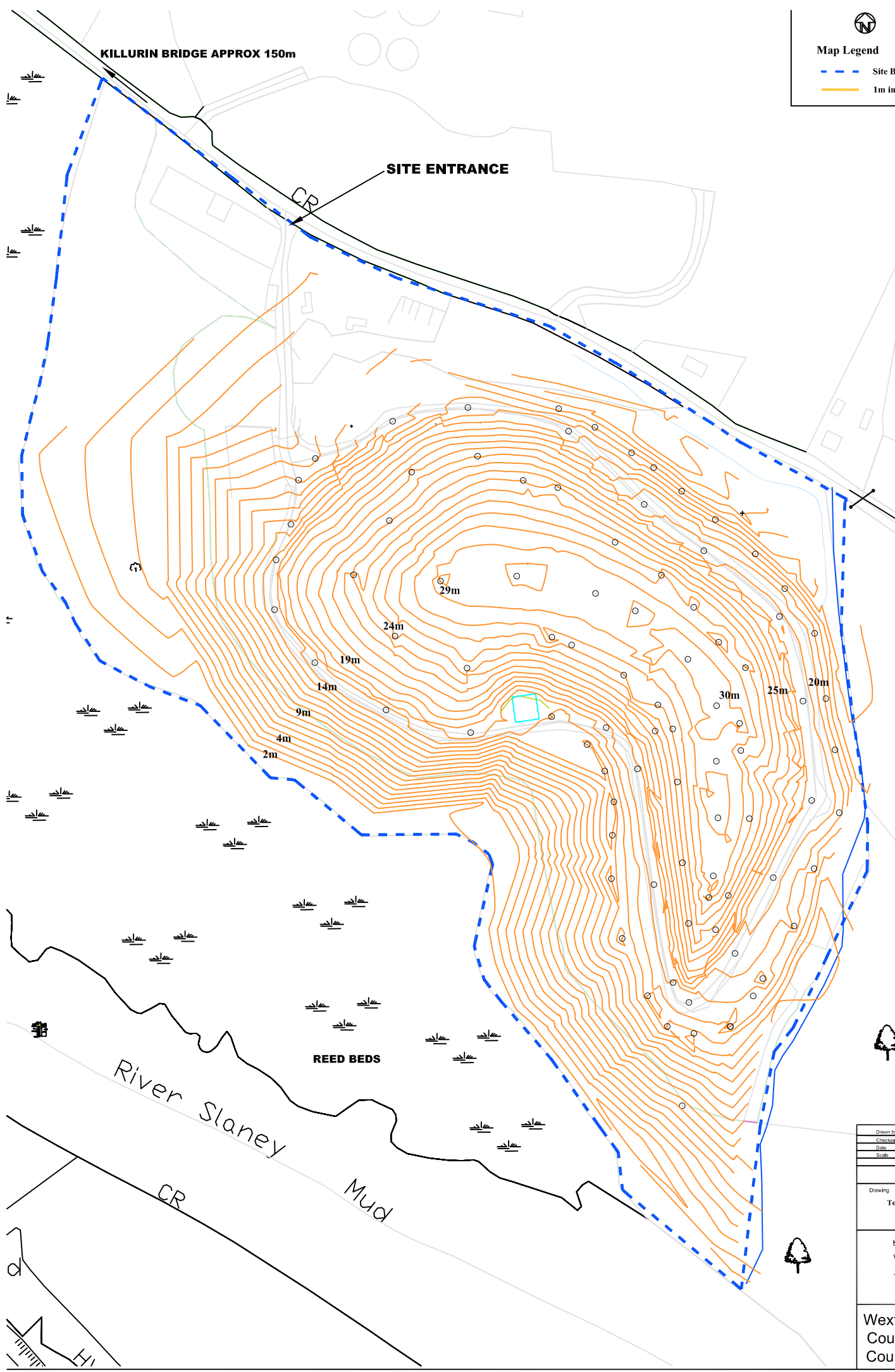
Map Legend

- - - Site Boundary
- 1m interval contours

KILLURIN BRIDGE APPROX 150m

SITE ENTRANCE

CR



Drawn by:	F. Ryan
Checked by:	FR
Date:	17-06-12
Scale:	1:2500
	Drawing No.

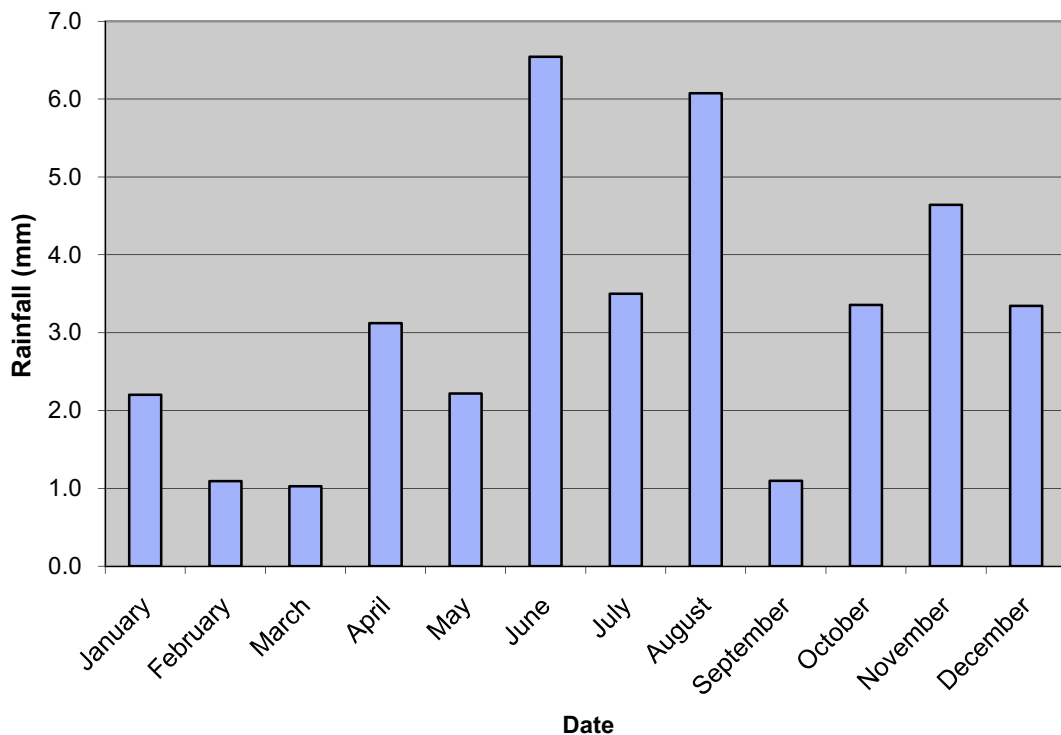
Drawing
Topographical Survey
 2012

Killurin Landfill
 Wexford County
 Council,
 Wexford
 Tel: 053-9120922

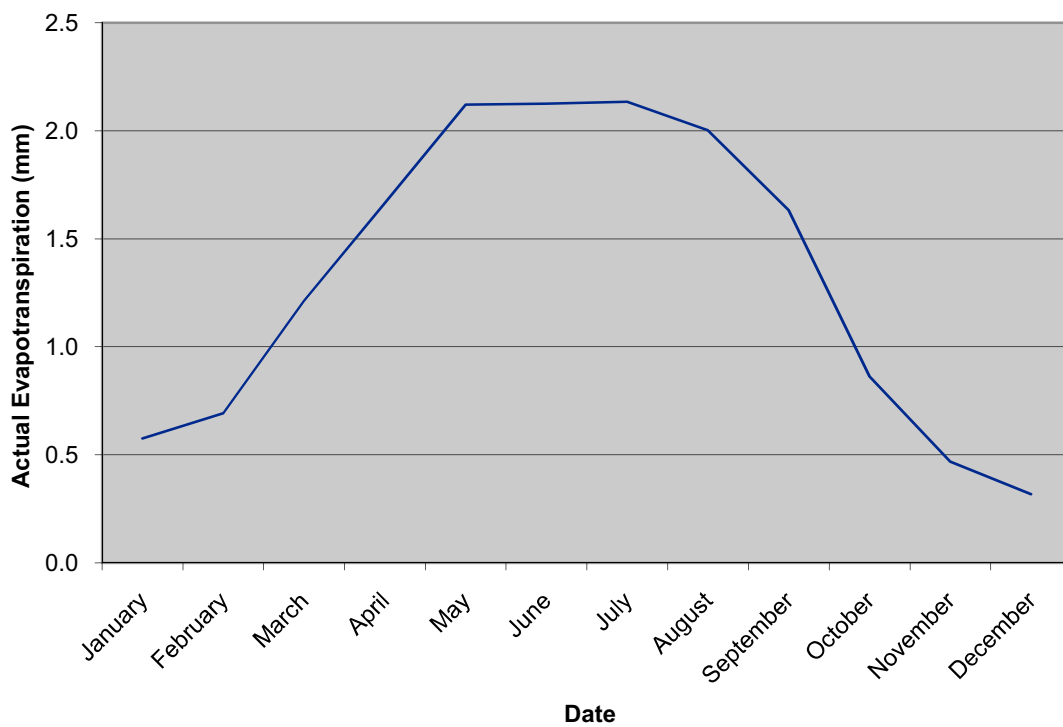
Wexford
 County
 Council 

Meteorological Data Graphs

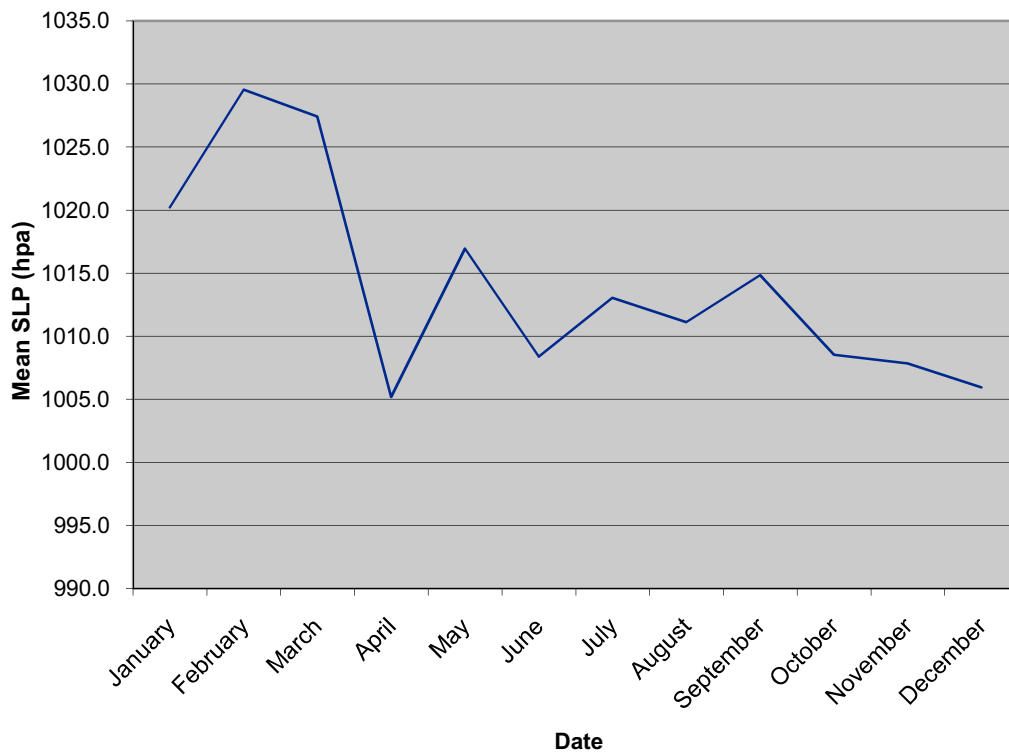
Plot D1: Average Rainfall 2012



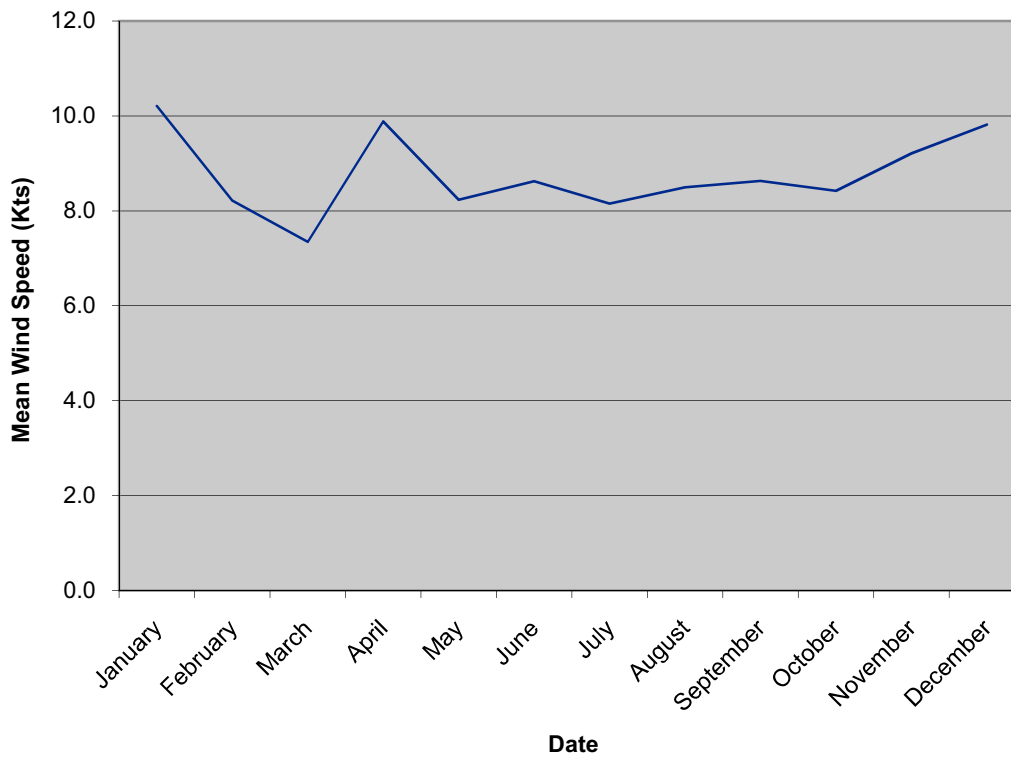
Plot D2: Predicted Evapotranspiration 2012



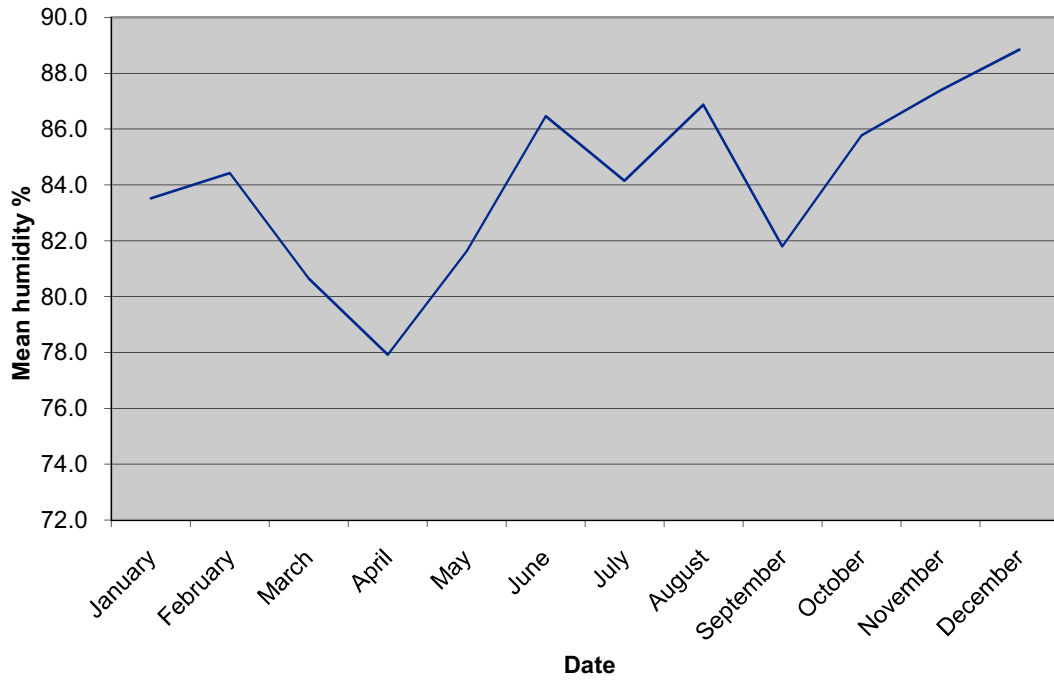
Plot D3: Mean Pressure 2012



Plot D4: Mean Wind Speed 2012



Plot D5: Mean Humidity 2012





ODOUR & ENVIRONMENTAL ENGINEERING CONSULTANTS

Unit 32 De Granville Court, Dublin Rd, Trim, Co. Meath

Tel: +353 46 9437922
 Fax: +353 46 9483696
 Mobile: +353 86 8550401
 E-mail: info@odourireland.com
www.odourireland.com

TITLE: AIR EMISSION TESTING OF ONE LANDFILL FLARE LOCATED IN KILLURIN LANDFILL, NEWTOWN LOWER, KILLURIN, CO. WEXFORD

PREFORMED BY ODOUR MONITORING IRELAND ON BEHALF OF WEXFORD COUNTY COUNCIL.

PREPARED BY:	Dr. John Casey
ATTENTION:	Mr. Fran Hobbs
LICENCE NUMBER:	WL0016-02
LICENCE HOLDER:	Wexford County Council
FACILITY NAME:	Killurin Landfill Facility
DATE OF MONITORING VISIT:	26 th Nov. 2012
NAME AND ADDRESS OF CLIENT ORGANISATION:	Killurin Landfill Facility, Newtown Lower, Killurin, Co. Wexford
NAME AND ADDRESS OF MONITORING ORGANISATION:	Odour Monitoring Ireland, Unit 32 DeGranville Court, Dublin Road, Trim, Co. Meath
DATE OF REPORTING:	11 th Jan 2013
NAME AND THE FUNCTION OF THE PERSON APPROVING THE REPORT:	Dr. Brian Sheridan, Managing Partner, Odour Monitoring Ireland
REPORT NUMBER:	2013537(1)
REVIEWERS:	Dr. Brian Sheridan


TABLE OF CONTENTS

Section	Page number
TABLE OF CONTENTS	i
DOCUMENT AMENDMENT RECORD	ii
1. Executive Summary	1
1.1 Monitoring Objectives	1
1.2 Special Monitoring Requirements	1
1.3 The substances to be monitored at each emission point	2
2. Monitoring Results	3
2.1 Operating Information	3
2.2 Monitoring Result Reference Conditions	3
2.3. Sampling Location Summary	3
2.4. Sampling run times	4
2.5. Characteristics of raw inlet gas to enclosed Landfill flare	5
2.6. Theoretically calculated landfill gas exhaust volume and physical characteristics from the Landfill flare.	6
3. Discussion of results	8
4. Conclusion	9
5. References	9
6. Appendix I-Sampling, analysis	10

Document Amendment Record

Client: Wexford County Council

Project: Air emission testing of one enclosed Landfill flare located in Killurin Landfill, Newtown Lower, Killurin, Co. Wexford.

Project Number: 2013537(1)			Document Reference:		
2013537(1)	Document for review	B.A.S.	JWC	B.A.S	11/01/2013
Revision	Purpose/Description	Originated	Checked	Authorised	Date
					

Signing sheet



Brian Sheridan Ph.D Eng

For and on behalf of Odour Monitoring Ireland

1. Executive Summary

The results of the monitoring exercise are contained in Section 2 of this report.

- NO_x as NO₂, CO, TOC and HCL/HF emissions from Flare 1 were within the emission limit values specified in Waste licence W0016-02;

1.1 Monitoring Objectives

This report has been prepared by Odour Monitoring Ireland and contains the results of emission testing carried out on 1 No. Enclosed ground flare Killurin Landfill, Newtown Lower, Killurin, Co. Wexford. The monitoring was carried out at this facility as part of compliance monitoring with the requirements of Waste licence W0016-02. The emission testing was carried out by Odour Monitoring Ireland on behalf of Wexford County Council.

1.2 Special Monitoring Requirements

There were no special monitoring requirements for this campaign.

1.3 The substances to be monitored at each emission point

The parameters listed in *Table 1.1* were monitored using the appropriate instrumentation as illustrated in *Table 1.1*. All monitoring was carried out in accordance with Environmental Protection Agency Office of Environmental Enforcement (OEE) Air Emission Monitoring Guidance Note 2 (AG2).

Table 1.1. Monitored parameters and techniques

Sample location	Parameter	Analytical method
Landfill Flare	Volumetric airflow rate & Temperature ($^{\circ}\text{C}$)	Pitot in accordance with EN13284-1 where possible. MGO coated K type thermocouple and PT100 Volumetric airflow rate theoretical calculated for Landfill flare.
Landfill Flare	Oxides of nitrogen (NO_x as NO_2), Carbon monoxide (CO), Carbon dioxide (CO_2), Sulphur dioxide (SO_2), and Oxygen (O_2)	Horiba PG250 All analytes, Oxygen EN14789, Oxides of Nitrogen Chemiluminescence, Carbon Monoxide EN15085.
Landfill Flare	Hydrogen chloride (HCL)	Impinger train containing high purity deionised water solution in accordance ISEN 1911:2010
Landfill Flare	Hydrogen fluoride (HF)	Impinger train containing 0.10 molar sodium hydroxide ISEN 15713:2006
Landfill Flare	Total Organic Carbon (TOC)	TOC analyser in accordance with EN12619:2002

This report presents details of this monitoring programme. This environmental monitoring was carried out Dr. John Casey, Managing Partner, Odour Monitoring Ireland on the 26th Nov. 2012. Methodology, Results, Discussion and Conclusions are presented herein.

2. Monitoring Results

This section will present the results of the monitoring exercise.

2.1 Operating Information

Emission Point Reference	Date	Process Type	Process Duration	Fuel	Feedstock	Abatement	Load
Flare 1	26/11/2012	Landfill flare	Continuous	Landfill Gas	N/A	None	Landfill Gas

2.2 Monitoring Result Reference Conditions

Emission Point Reference	Temperature (K)	Pressure	Moisture Correction	Oxygen Correction (%)
Flare 1	K	101.3	Yes	3

2.3. Sampling Location Summary

Comment	Yes/No
Recommended 5 hydraulic diameters straight length before sampling plane	Yes
Recommended 2 hydraulic diameters straight length after sampling plane	Yes
Ports number <1.5m - 2 ports >1.5m - 4 ports	1 port on the flare
Appropriate port size	Yes
Suitable working platform	Yes

Note: Temperature and airflow rate traverse measurements were performed across the stack in one plane only. Only one plane was possible due to access port issues.

2.4. Sampling run times for the monitoring

Parameter	Approx. Sampling period for landfill flare
Inlet CH ₄	30 minutes
Inlet O ₂	30 minutes
Volumetric air flow rate	Theoretically calculated
SO ₂	40 minutes
NO _x	40 minutes
CO	40 minutes
O ₂	40 minutes
CO ₂	40 minutes
Stack gas temp	40 minutes
TOC	40 minutes
HCL	35 minutes
HF	35 minutes

2.5. Characteristics of raw inlet gas to enclosed Landfill flare

Parameter	Compound loading Flare1	Units
CH ₄	16.3	%
CO ₂	14.0	%
O ₂	6.3	%
Volumetric flow rate	388	m ³ /hr
Total chloride	21	mg/Nm ³
Total fluoride	<2.5	mg/Nm ³
Total sulphur	2.8	mg/Nm ³

2.6. Theoretically calculated landfill gas exhaust volume and physical characteristics from the Landfill flare.

Parameter	Flare 1
Total Volumetric methane loading (m ³ /hr)	63
Total Volumetric Oxygen loading (m ³ /hr)	24
Ratio to complete combustion of methane assuming no excess Oxygen	9.57
Oxygen concentration level in flue gas (%)	16.4
Flue gas temperature (Kelvin) ²	860
Theoretical calculated Volumetric exhaust airflow rate (m ³ /h)	4,500
Normalised average exhaust airflow rate (Nm ³ h ⁻¹) ³	1,428

- Notes:**
- ¹ denotes data from 26/11/2012.
 - ² denoted converted from degrees Celsius to Kelvin ($^{\circ}\text{C} + 273.15$);
 - ³ denotes normalised to 273.15 Kelvin and 101.3 kPa.

Table 2.7. Emission value results for landfill gas Flare 1.

Flare 1	Conc.	Normalised (mgN/m ³)	Oxygen corrected emission concentration to flare (mgN/m ³) 3% ref.	Expanded uncertainty as percentage of limit value (%) ¹	Emission limit Values	Operating Status
Total NOx [as NO ₂] (ppm)	10.00	20.54	81.69	13.7	<150 mg/Nm ³	As Normal
CO (ppm)	0.50	0.63	2.49	12.4	<50 mg/Nm ³	As Normal
Total Organic Carbon (mg/m ³)	0.97	1.55	6.18	13.74	<10 mg/Nm ³	As Normal
Average Hydrogen Chloride (mg/m ³)	0.29	0.29	1.17	-	<50 mg/Nm ³ (at mass flow > 0.30 kg/hr)	As Normal
Average Hydrogen Fluoride (mg/m ³)	0.20	0.20	0.81	-	<5 mg/Nm ³ (at mass flow > 0.050 kg/hr)	As Normal
SO ₂ (ppm)	1.00	2.86	11.37	-	-	As Normal
O ₂ (%)	16.4	-	-	-	-	As Normal
Temperature (degrees)	587	-	860K	-	>1273K	As Normal
CO ₂ (%)	7.10	-	-	-	-	As Normal
Volumetric Airflow (m ³ /hr)	-	-	-	-	<3,000	As Normal
Efficiency (%)	>99.99	-	-	-	-	As Normal

Notes: ¹ denotes that expanded uncertainty is elevated as the equation has not been validated for use with high temperature sources.
 Leak check results for Horiba = <2%
 Leak check results for Signal = <2%
 Span (<2% range) and drift values within acceptable tolerance (<1%) for Horiba.
 Span (<2% range) and drift values within acceptable tolerance (<1%) for Signal.
 Leak check results HCL = <2%
 Leak check results HF = <2%

3. Discussion of results

Tables 2.1 to 2.7 present the results of the emission monitoring carried out on the landfill flare located in Killurin Landfill.

There was very little variation at one traverse in oxygen and flue gas temperature profiles across the stack during the monitoring exercise (i.e. less than 15% as recommended by the Environment Agency, UK (Environment Agency, 2002)).

A high temperature Inconel 625 and ceramic probe (Testo, Germany) was used to prevent variations in CO emissions data. Normal stainless steel probes when subjected to temperatures above 600°C can release CO from within the structure of the material and cause the recording of erroneous results (Environment Agency, 2002).

Correction of data to 3% oxygen was performed. Due to possible inaccuracies in airflow rate measurement, it was not possible to determine the oxygen intake of the flare through the louver system using measurement. Since the volume of intake air required for complete combustion was known and the oxygen concentration in the exhaust flue gas was known, the volume of intake excess fuel air could be theoretically calculated through numerous iterations using the Solver program (i.e. Microsoft Excel). This allows for the calculation of the volume of intake excess air through the louver landfill flare intake system (Environment Agency, 2002).

4. Conclusion

The following conclusions can be drawn from this study:

1. A theoretical exhaust flue gas volume was calculated for the landfill flare.
2. NO_x as NO₂, SO₂, CO, O₂, TOC, HCL and HF monitoring and analysis was carried out in accordance with specified requirements;
3. All data was standardised to 273.15 Kelvin, 101.3 kPa;
4. All data is presented as Oxygen corrected to 3% (v/v) using the appropriate equations;
5. NO_x as NO₂, CO, TOC, HCL and HF emissions from Flare 1 were within the emission limit values specified in Waste licence W016-02.

5. References

1. Environment Agency. (2002). Guidance for Monitoring Enclosed Landfill Gas Flares. www.environment-agency.co.uk
2. Environmental Protection Agency. (2009). Air Emissions Monitoring Guidance Note 2 (AG2).
3. I.S. EN 13284-1:2002. Stationary source emissions. Measurement of velocity and volume flow rate of gas streams in ducts.
4. IS EN13526:2002-Stationary source emissions-Determination of the mass concentration of total gaseous organic carbon in flue gases from solvent using processes-Continuous flame ionisation detector method.
5. IS EN12619:1999-Stationary source emissions-Determination of the mass concentration of total gaseous organic carbon at low concentrations in flue gases-Continuous flame ionisation detector method.
6. I.S. EN 13284-1:2002. Stationary source emissions. Determination of low range mass concentration of dust. Manual gravimetric method.

6. *Appendix I-Sampling, analysis*

6.1.1 Location of Sampling

Killurin Landfill, Newtown Lower, Killurin, Co. Wexford

6.1.2 Date & Time of Sampling

26th Nov. 2012

6.1.3 Personnel Present During Sampling

Dr. John Casey, Odour Monitoring Ireland, Trim, Co. Meath.

6.1.4 Instrumentation check list

Federal Method 2 S type pitot and MGO coated thermocouple;

L type pitot tube

Testo 400 handheld and appropriate probes.

Ceramic and Inconel 625 sampling probes.

Portable Signal 3030PM FID calibrated with Propane with non-methane hydrocarbon cutter.

SKC sample pumps and Bios Primary calibrator

Horiba PG250.