CORK CITY COUNCIL

KINSALE ROAD LANDFILL SITE

Waste Licence Register No: W0012-02

Annual Environmental Report

January 2010 – December 2010

Prepared by:-

Cork City Council,
Kinsale Road Landfill Site,
Cork.

28th January 2011

DOCUMENT CONTROL SHEET

Kinsale Road Landfill Site Annual Report

Reporting Period January 2010 to December 2010

User is Responsible for the Revision Status of this Document

Rev. Nr.	Description of Changes:	Prepared by:	Checked by:	Approved by:	Date:	No. of Copies:
0	First Draft for comment	KR	JT, KR, EB, MOB			1
1	Final Version	KR/JT	JT, KR EB, MOB	MOB	28/01/11	7

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1 INTRODUCTION

1.1 Scope and Purpose of the Report

Cork City Council holds a Waste Licence (Register No. W0012-02) to operate a landfill site at the Kinsale Road, Cork. The aim of this Annual Environmental Report is to provide a review of activities at Kinsale Road landfill site within the past 12 months.

1.2 Background to the Report

The Landfill site at Kinsale Road has been in operation since the 1960's. The site was issued with a waste licence by the Environmental Protection Agency (EPA) on 2nd February 2000 (Register No. 12-1), with a new licence issued on 29th November 2002 (Register No. W0012-02). Cork City Council applied for a review of the licence in 2009. A Proposed Decision (PD W 0012-03) was issued by the Agency in December 2010. Cork City Council has made a submission to the Agency regarding the Proposed Decision.

In accordance with Condition 11.6 of the Waste Licence, Cork City Council is required to submit to the Agency for its agreement, an Annual Environmental Report for its activities during the previous 12 months.

The first Annual Environmental Report covering the period February 2nd 2000 to February 1st 2001 was submitted to the Agency in March 2001 and this report covers the period from January 2010 to December 2010.

1.3 Site Location and Operator details

The landfill is owned and operated by Cork City Council, City Hall, Cork. The address of the facility is as follows.

Kinsale Road Landfill Site,
Ballyphehane,
Curraghconway,
Inchisarsfield,
South City Link Road,
Cork.

The National Grid Reference for the site is 168033E 069658N.

The facility contact details are as below

- Facility Manger: John Twomey
- Contact No: 021 4705913
- Fax No: 021 4319930

- Deputy Facility Manger: Kevin Ryan
- Contact No: 021 4705911
- Fax No: 021 4319930

- Landfill Technician: Patrick Foley
- Contact No: 021 4705914

- Supervisor: Pascal Cooney

- Junior Foreman: Michael Reck

- Weighbridge Operator
- Contact No: 021 4705920

- Environment Department,
  City Hall,
  Cork
- Contact No: 021 4924726
- Fax No: 021 4924054

- City Hall
- Contact No. 021 4924000 / 4966222

2 SITE DESCRIPTION AND ACTIVITIES

2.1 Description of the Site

The facility is a municipal solid waste and non-hazardous industrial waste disposal facility. The site (including former land filling areas) is approximately 72 hectares.
Landfilling at the site ceased on the 15th July 2009.
Up to the 15th July 2009, the facility accepted domestic and commercial MSW and limited quantities of approved non-hazardous industrial sludges. The facility also includes a Civic Amenity Site and a Landfill Gas Combustion plant that operates on site.

The facility is located within 3 km of Cork City at the South City Link Road, in the townlands of Ballyphehane, Curraghconway and Inchisarsfield. The site occupies a large expanse of low-lying peat bog, bounded by the north and east by the Trabeg River, to the west by the South City Link Road and on the south by the Tramore River and South Ring Road.

The site has been operational since the early 1960's. The majority of the developments (commercial and residential) within 500m of the landfill have occurred subsequent to the commencement of waste disposal operations.

Works are ongoing at the site to upgrade the facility in accordance with the conditions of the Waste Licence. These works include leachate collection and treatment system, surface water collection, road infrastructure as well as final capping and restoration of the site.

2.2 Waste Management activities at the Facility

Waste Activities Licensed at the Kinsale Road Landfill Site are restricted to those outlined in Part 1 of the Waste Licence as outlined below: -

Licensed Waste Disposal Activities, in accordance with the Third Schedule of the Waste Management Acts 1996 – 2003.

Class 1	**Deposit on, in or under land (including landfill):**
	This activity is limited to the disposal of the waste types specified in this licence up to a maximum of 100,000 tonnes per annum.
Class 2	**Land treatment, including biodegradation of liquid or sludge discards in soils:**
	This activity is limited to the disposal of non hazardous sludge at the landfill up to a maximum of 7,500 tonnes per annum.
Class 4	**Surface impoundment, including placement of liquid or sludge discards into pits, ponds or lagoons:**
	This activity is limited to the operation of leachate and stormwater retention ponds.
Class 5	**Specially engineered landfill, including placement into lined discrete cells which are capped and isolated from one another and the environment:**
	This activity is limited to the disposal of the certain wastes in exceptional circumstances into lined discrete cells.
Class 7	**Physico-chemical treatment not referred to elsewhere in this Schedule (including evaporation, drying and calcination) which results in final compounds or mixtures which are disposed of by means of any activity referred to in paragraphs 1 to 10 of this Schedule:**
	This activity is limited to the operation of the leachate treatment plant.
Class 11	**Blending or mixture prior to submission to any activity referred to in a preceding paragraph of this Schedule:**
	This activity is limited to the processing and mixing of construction and demolition waste prior to disposal at the facility.
Class 12	**Repackaging prior to submission to any activity referred to in a preceding paragraph of this Schedule:**
	This activity is limited to repackaging waste in an accident/emergency situation.
Class 13	**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:**
	This activity is limited to the storage of waste prior to its disposal.

Licensed Waste Recovery Activities, in accordance with the Fourth Schedule of the Waste Management Acts 1996 – 2003.

Class 2	**Recycling or reclamation of organic substances which are not used as solvents (including composting and other biological transformation processes):**
	This activity is limited to the composting of green waste accepted subject to a limit of 1000m^3 at any one time at the facility and the storage of waste oils at the civic waste facility.
Class 3	**Recycling or reclamation of metals and metal compounds:**
	This activity is limited to the recovery of metal and metal compounds at the construction and demolition facility and at the civic waste facility.
Class 4	**Recycling or reclamation of other inorganic materials:**
	This activity is limited to the recovery of inorganic materials at the construction and demolition facility and the storage of inorganic materials at the civic waste facility.
Class 10	**The treatment of any waste on land with a consequential benefit for an agricultural activity or ecological system:**
	This activity is limited to the use of various suitable wastes as intermediate cover and in the closure/restoration stage of the landfill subject to the agreement of the Agency.
Class 11	**Use of waste obtained from any activity referred to in a preceding paragraph of this Schedule:**
	This activity is limited to the use of processed wastes in roadways, drains etc. at the facility.
Class 12	**Exchange of waste for submission to any activity referred to in a preceding paragraph of this Schedule:**
	This activity is limited to the possible exchange of waste being delivered to the facility in exchange for processed waste subject to the agreement of the Agency.
Class 13	**Storage of waste intended for submission to any activity referred to in a preceding paragraph of this Schedule, other than temporary storage, pending collection, on the premises where such waste is produced:**
	This activity is limited to the temporary storage of waste prior to inspection, recycling, recovery and /or reuse at the facility or elsewhere.

2.3 Quantities and Composition of Waste Received, Disposed of and Recovered.

Kinsale Road landfill site is licensed to deposit up to a maximum of 100,000 tonnes of waste per annum. The waste types and quantities allowed for disposal as per Schedule A of the Waste Licence and are as per Table 2.3 below.

Table 2.3 Waste Types.

Waste Type	Maximum (tonnes per annum)
Household & Commercial waste	98,000
Industrial non-hazardous sludge	1,500
Construction Materials containing asbestos - EWC 17/06/05*	500 Note 1
TOTAL FOR DISPOSAL	100,000
Construction & Demolition Waste	300,000 Note 2
Waste to be imported for restoration purposes	100,000
Green waste for composting	Note 3
Wastes accepted for storage at the civic waste facility prior to recycling, reuse or reclamation	5,000
TOTAL FOR RECOVERY	405,000

Note 1: Subject to restrictions in Condition 5.
Note 2: Construction and demolition waste may be accepted for recovery for use as daily cover, in site construction works and landfill restoration.
Note 3: Limited to 1000m^3 at any one time.

Table 2.3.1 Quantities of Waste received prior to reporting period.

	Non-Hazardous Waste	*Hazardous Waste*
Deposited in landfill prior to report period.	2.737 million tonnes estimated	Not known if any
C&D waste stored at C&D facility prior to report period.	15,000 tonnes	Nil

No waste was landfilled at the site during the reporting period.

Table 2.3.2 Quantities of Waste transferred offsite during the reporting period (monthly).

Month	*Waste transferred off site (tonnes)*
Jan-10	127
Feb-10	171
Mar-10	251
Apr-10	209
May-10	228
Jun-10	219
Jul-10	175
Aug-10	162
Sep-10	154
Oct-10	149
Nov-10	87
Dec-10	122
Total	**2055**

Table 2.3.3 Classes of Waste received for recovery / recycling off site.

Waste Description	*EWC Code*	*Name of Recovery Company*
Paper	20 01 01	Indaver
		Cork Recycling
Metal	20 01 06	Pouladuff Dismantlers
Timber	20 01 07	CTO Environmental
Plastic	20 01 03	Cork Recycling
Glass Bottles	20 01 02	Rehab Recycling Partnership
Aluminium Cans	20 01 05	Rehab Recycling Partnership
Oil	13 00 00	ENVA
Green Waste	20 02 01	CTO Environmental Solutions
Cardboard	20 01 01	Cork Recycling
WEEE	20 01 35	KMK
Aerosols	16 05 04	Eco Safe Systems
Paints	20 01 27	Eco Safe Systems
Car Batteries	16 06 01	KMK
Household Batteries	16 06 01 / 16 06 02 16 06 04 / 20 01 34	KMK

2.3.4 Landfill Inputs and Outputs (Waste and Recycling) {click for hyperlink}

2.4 Landfill Capacity

2.4.1 The landfilling of waste at the facility ceased as of 15th July 2009.

2.5 Economic Contribution

Provision made for Landfilling Operations expenditure in the reporting period was €1,672,500
This can be broken down as:

Landfilling Operations expenditure	2010 Provision (€)
Salaries & Wages	334,800
City Council Plant	81,700
Plant Hired	20,000
Materials - Cover Soil	10,000
- Road Making Materials	15,000
Maintenance of Buildings	40,000
Site Security	50,000
Materials / Chemicals	45,000
E.P.A. Licence and Monitoring	180,000
Maintenance of Mechanical and Electrical Plant	180,000
Vermin Control	12,000
ESB, Telephone, Water charges	50,000
Miscellaneous	65,000
Sampling & External Testing at Lab.	140,000
Landscaping of capped areas	15,000
Sewer Connection - County Council Levy	14,000
Transport of Waste	420,000
Total	1,672,500

A figure of €1,400,000 in respect of Loan Charges for capital works including final restoration was included in the 2010 Adopted Budget.

Provision made for Recycling Facilities expenditure in the reporting period was €346,500. This can be broken down as:

Recycling Facilities expenditure	2010 Provision (€)
Salaries & Wages	261,500
C.A.S. Recycling	60,000
WEEE Management	25,000
Total	346,500

Waste Totals for Kinsale Road Landfill Site - 2010

All weights in tonnes

Commodity	Jan-10	Feb-10	Mar-10	Apr-10	May-10	Jun-10	Jul-10	Aug-10	Sep-10	Oct-10	Nov-10	Dec-10	Total
Municipal	103	116	143	138	115	129	113	117	89	87	80	74	1,304
Rubble	4	10	10	12	12	19	12	13	4	11	4	5	116
Non Levy	20	46	97	58	102	71	50	33	62	51	3	43	635
Total Transferred Off Site	**127**	**171**	**251**	**209**	**228**	**219**	**175**	**162**	**154**	**149**	**87**	**122**	**2,055**

Commodity	Jan-10	Feb-10	Mar-10	Apr-10	May-10	Jun-10	Jul-10	Aug-10	Sep-10	Oct-10	Nov-10	Dec-10	Total
Soil imported for capping	76	1,921	888	235	990	6,218	14,179	17,075	1,300				42,883

Domestic Recycling	Jan-10	Feb-10	Mar-10	Apr-10	May-10	Jun-10	Jul-10	Aug-10	Sep-10	Oct-10	Nov-10	Dec-10	Total
WEEE Out	67.24	77.76	76.34	80.28	66.26	89.34	79.04	82.66	82.54	61.62	58.70	44.10	865.88
Plastic	3.8	2.46	3.46	2.36	3.06	5.9	3.84	2.96	2.70	2.80	2.62	3.08	39.04
Cardboard	5.82	5.7	5.52	5.72	5.5	4.48	6.84	6.34	5.50	4.78	5.72	5.72	67.64
Paper	11.08	9.92	10.14	14.92	10.92	11.56	14.6	13.52	7.70	11.56	10.00	9.88	135.80
Metal	4.92	9.24	7.02	12.66	11.56	7.36	10.02	10.02	10.62	7.38	3.94	2.76	97.50
Green Waste (CA)	5.76	8.12	11.2	25.5	26.1	28.94	29.5	22.98	15.20	16.08	3.40	5.84	198.62
Christmas Trees	57.64	7.14											64.78
Timber (CA)	6.72	13.56	20.56	19.34	17.92	19.56	15.92	18.36	15.28	12.94	9.94	4.18	174.28
Glass	5.44	3.72	4.94	0.08	5.94	5.56	3.46		4.78	3.88	4.06	2.10	43.96
Drink Cans	0.22	0.18	0.1		0.2	0.12	0.06	0.06			0.12		1.06
Oil			1.68		1.58		3.98	0.96					8.20
Paint		2.22	1.02	3.3	2.16	1.26		2.92	1.30				14.18
Clothes	0.84	0.78	0.84	1.02	0.98	0.84	1.08	0.94	0.70	1.20	0.40	0.60	10.22
CA Site Recycling Total inc. WEEE Out	169.48	140.80	142.82	165.18	152.18	174.92	168.34	161.72	146.32	122.24	98.90	78.26	1721.16

Commercial Recycling	Jan-10	Feb-10	Mar-10	Apr-10	May-10	Jun-10	Jul-10	Aug-10	Sep-10	Oct-10	Nov-10	Dec-10	Total
Timber Waste	308.4	455.4	439.96	587.18	414.2	389.3	652.9	542.22	652.74	577.06	550.14	218.36	5787.86
Green Waste	67.58	64.62	97.34	117.38	81.16	112.32	130.52	150.40	95.62	83.04	101.02	33.12	1134.12

Total (inc CA Site)	Jan-10	Feb-10	Mar-10	Apr-10	May-10	Jun-10	Jul-10	Aug-10	Sep-10	Oct-10	Nov-10	Dec-10	Total
Timber	315.12	468.96	460.52	606.52	432.12	408.86	668.82	560.58	668.02	590.00	560.08	222.54	5962.14
Green (inc Xmas Trees)	130.98	79.88	108.54	142.88	107.26	141.26	160.02	173.38	110.82	99.12	104.42	38.96	1397.52

3 SITE DEVELOPMENT WORKS

3.1 Site Development Works during the Reporting Period.

The Waste Licence sets out conditions relating to the completion of certain works within the designated periods following the date of grant of the licence. The works referred to generally formed part of site development works.

Wind measuring mast.

A mast, approximately 70 metres high with attachments at three different height levels to measure and record the strength and direction of the wind was erected in the high central area of the Landfill Site. This study was carried out in conjunction with UCC to determine if it would be feasible to construct a wind turbine on the landfill site.
The mast was taken down in October 2010 after 13 months of data collection.
The data is now being analysed and a report on the feasibility of erecting a wind turbine will follow in due course.

M&E works for landfill gas and leachate management

M & E works are ongoing. These include maintenance of the Leachate Conditioning Plant and the continuing installation of the landfill gas collection network.

MISCELLANEOUS WORKS:

1. Ongoing maintenance of Site Roads.
2. Regular cleaning of Gravel Trap at Leachate Conditioning Plant with replacement of gravel as required.
3. Ongoing sampling & testing with respect to the trial project for the treatment of leachate using natural systems - in association with UCC.
4. CTO Environmental Solutions Ltd. operates a timber reprocessing facility and green waste composting facility on behalf of Cork City Council at the Landfill Site. Shredded timber is sent exclusively to Eirebloc Ltd, Lisarda, Macroom, Co. Cork where it is it is further processed and utilised to manufacture inserts for pallets. 35 staff are employed by Eirebloc Ltd. manufacturing approx. 30 million units per annum.

ONGOING INVESTIGATIVE WORKS:

a) Feasibility Study by Consultants appointed by Cork City Council, for the provision of a South City Maintenance Depot on a 4.5 hectare area of the north-western corner of the Landfill Site, bounded on the northern side by the E.S.B. pitch and putt course and on the western side by the South City Link Road.

b) Site investigation carried out by a third party on a site being transferred from Cork City Council to Blue Demons, on which the Landfill Site Boundary passes through. This site is bounded by Woodies Hardware Store on the northern side, and by the road linking the South City Link Road (Mick Barry road) to the Kinsale Road on the southern side.

Capping Works for 2010 / 2011

Design and execution of further Capping Works (Contract 10)

These works will involve construction of a final engineered cap over an area of approximately 8.65 hectares within the area bounded by the swale, and will be carried out over a period of approximately 18 months. The works will include:

1. Mobilisation to site by the Contractor – (in place July 2010)
2. Regrading including some cut and fill to achieve the required cap profile – (complete)
3. The installation of new gas wells – (complete)
4. The installation of a subliner gas collection system (including pipework and drainage geocomposite) – (ongoing)
5. The installation of an LLDPE liner – (ongoing)
6. The installation of a subsurface water collection layer (i.e. a drainage geocomposite) - (ongoing)
7. The placement of approximately 850 mm of imported subsoil above the liner – (ongoing)
8. The placement of approximately 150 mm of imported topsoil – (June 2011)
9. Grass seeding – (July 2011)
10. The construction of an access road including pedestrian walkway and cycle way – (September 2011)

As of January 2011 approximately 53,000m^2 of the area for capping in Contract 10 has been completed.
Capping works are expected to be completed by October 2011

Waste Licence Review application – W0012-03

A Proposed Decision on the City Councils application for a Waste Licence Review (W0012-03) was issued by the Agency in December 2010. Cork City Council have sought clarification on some items, and lodged an objection to a number of conditions contained in the Proposed Decision.

Other planned works for 2011 are:

- SCADA system upgrades (reporting/management system).
- Installation /renewal of control valves and systems to optimise gas collection.
- Installation /renewal of control valves and systems to optimise storm water treatment.
- Reed beds – further planting and replacement of ineffective plants as required.
- Provision of new gas monitoring wells and gas extraction wells as required.
- Upgrading of site roadways.
- Miscellaneous minor capital works and works arising from Operational Procedures.
- Further experimental works and production of final report into the treatment of leachate using natural systems (trial project) - in association with UCC.
- Investigate the potential of constructing a recharge point for electric vehicles in association with Electricity Suppliers.
- Investigate the potential of constructing a recharge point for Compressed Natural Gas (CNG) powered vehicles in association with Bord Gais.
- Investigate the potential of constructing a Renewable Energy Park, including the installation of a photo voltaic array as well as a wind turbine.

The estimated cost of the Site Development Works Programme to be carried out in 2011 is approximately €5.0 million (subject to the availability of funding).

4 ENVIRONMENTAL INCIDENTS AND COMPLAINTS

4.1.1 Incidents

(An Incident is defined in Condition 1.7 of Waste Licence W0012-02).

Condition 10 and 11 of the Waste Licence requires Cork City Council to make written records of environmental incidents and complaints. Operational Procedure 0P/17 "Recording of Complaints and Suggestions" describes the internal reporting of Non Conformances and incidents relating to the facility. Cork City Council documents all non-conformances and incidents on an internal Non Conformance Report Form SF/05.

The following Registers are attached:

A register of Incidents – 55 in 2010
A register of Non-Conformances – 0 in 2010
A register of Non–Compliances – 2 in 2010

4.2 Complaints

Condition 10.4 of the Waste Licence requires Cork City Council to make written records of all complaints relating to the operation of the facility.

Complaints are dealt with in accordance with the Operational Procedure OP/17 "Recording of Complaints / Suggestions".

4.3 Analysis of Complaints

Total number of complaints was 2 (99 in 2009) in this reporting period. Both were odour incidents were related to composting activities.

4.4 Review of Nuisance Controls

In accordance with Condition 7 of the Waste License Cork City Council are required to ensure that vermin, birds, flies, mud, dust and litter do not give rise to nuisances at the facility or in the immediate area of the facility.

Cork City Council ensures that the activities are carried out in a manner such that odours do not result in significant impairment or interference with amenities or the environment beyond the facility boundary.

The road network in the vicinity of the facility is kept free from any debris caused by vehicles entering or leaving the facility. Any such debris or deposited materials is removed without delay.

Litter Control

Litter fencing is no longer required at the facility as landfilling has ceased (July 2009). Litter picking teams are organised as required to collect any wind blown litter or other waste, placed on or in the vicinity of the facility.

All vehicles removing waste and materials from the facility (Civic Amenity Site and Timber Processing & Green Waste Composting facilities) are appropriately covered.

Dust Control
In dry weather, site roads and any other areas used by vehicles are sprayed with water as and when required to minimise airborne dust nuisance.
Prior to exiting the facility, all waste vehicles use the vehicle wash.

Bird Control
This is no longer an issue as all the waste has been covered and final capping of the site is ongoing.

Odour
Odour from the landfill site is minimised through the extraction of landfill gas and through the application of odour control substances as required.
In 2010, 2 no. odour complaints were received. These complaints were related to composting activities on site.

Flies
Flies are controlled through the use of control substances as deemed necessary by the pest control experts.

Vermin
Vermin are controlled through the use of baiting as deemed necessary by the pest control experts.

Noise
Noise is minimised / controlled by operating the facility between the hours of 8am – 4pm. Contractors may operate between the hours of 8am – 6pm in agreement with the City Council.

Incident Log: 2010

Date	Log No.	Originator	Incident	Status	Suggestion	Completion Target Date	Responsibility	Actions	Resolved Date	Sign.	Supplier / Contractor / Consultancy involved
12/01/2010	652	CH	gas well exceedences 01-12/01/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
14/01/2010	653	CH	TOC out of operation 19/12/09-14/01/10	4	frozen pipes due to extreme cold weather	14/01/2010	CH	thaw in pipes put TOC back in operation	14/01/2010	CH	CCC/CEMS/Kmac
19/01/2010	654	CH	flare & engine shutdown dec 09	4	water problems in pipes	31/12/2009	JT/KR/CH	repaired pipes	31/12/2009	CH	CCC/BPS
19/01/2010	655	CH	carbon monoxide overlimit 15/01/10	4	contact BPS to find out problem	15/01/2010	JT/KR/CH	overspeed fault - fixed	15/01/2010	JT/KR/CH	CCC/BPS
19/01/2010	656	CH	carbon monoxide overlimit 18/01/10	4	contact BPS to find out problem	18/01/2010	JT/KR/CH	start up of engines	18/01/2010	JT/KR/CH	CCC/BPS
19/01/2010	657	CH	flare & engine shutdown 18/01/10	4	contact BPS to find out problem	18/01/2010	JT/KR/CH	maintenance	18/01/2010	JT/KR/CH	CCC/BPS
21/01/2010	658	CH	gas well exceedences 13-21/01/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
26/01/2010	659	CH	PM10 overlimit 8&13/01/10	4	check any unisual activities going on	26/01/2010	CH	extreme cold weather increased fuel burning	26/01/2010	CH	CCC
29/01/2010	660	CH	CO overlimit 21/01/10	4	contact BPS to find out problem	21/01/2010	CH	gas quality, water in system	21/01/2010	CH	CCC/BPS
01/02/2010	661	CH	gas well exceedences 22-31/01/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
02/02/2010	662	CH	PM10 overlimit 26/01/10	4	check any unusual activities going on	02/02/2010	CH	increased fuel burning due to cold weather	02/02/2010	CH	CCC
10/02/2010	663	CH	gas well exceedences 01-09/02/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
18/02/2010	664	CH	gas well exceedences 10-18/02/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
01/03/2010	665	CH	gas well exceedences 19-28/02/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
22/03/2010	666	CH	gas well exceedences 01-21/03/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
29/03/2010	667	CH	PM10 overlimit 05/03/10	4	investigate any unusual activities on site	29/03/2010	CH	nothing unusual possible high level of fuel burning	29/03/2010	CH	CCC
01/04/2010	668	CH	gas well exceedences 22-31/03/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
13/04/2010	669	CH	gas well exceedences 01-13/04/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
21/04/2010	670	CH	gas well exceedences 14-21/04/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
04/05/2010	671	CH	gas well exceedences 22-30/04/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
11/05/2010	672	CH	gas well exceedences 01-11/05/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS

18/05/2010	673	CH	gas well exceedences 12-18/05/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
27/05/2010	674	CH	gas well exceedences 19-27/05/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
03/06/2010	675	CH	gas well exceedences 28/05-03/06/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
14/06/2010	676	CH	gas well exceedences 04-13/06/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
15/06/2010	677	CH	leachate conditioning plant out of op for cleaning 14-15/06/10	4	kmac / munster drain cleaning pipes	15/06/2010	JT/KR/CH	pipes cleaned	15/06/2010	JT/KR/CH	kmac/munster drain
22/06/2010	678	CH	gas well exceedences 14-22/06/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
29/06/2010	679	CH	carbon monoxide over limit 19/06/10	4	contact BPS to find out problem	19/06/2010	CH	battery problem, resolved	19/06/2010	CH	CCC/BPS
30/06/2010	680	CH	Carbon monoxide overlimit 24/06/10	4	contact BPS to find out problem	24/06/2010	CH	start up of engines	24/06/2010	CH	CCC/BPS
01/07/2010	681	CH	gas well exceedences 23-30/06/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
07/07/2010	682	CH	Carbon monoxide monitor out of operation 01-06/07/10	4	CEMs organised to come in and repair	06/07/2010	CH	repaired pump of monitor	06/07/2010	CH	ccc/kmac/cems
13/07/2010	683	CH	gas well exceedences 01-13/07/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
26/07/2010	684	CH	gas well exceedences 14-26/07/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
03/08/2010	685	CH	gas well exceedences 27/07-02/08/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
10/08/2010	686	CH	leachate conditioning plant out of operation 10-11/08/10	4	scheduled cleaning of gravel trap	11/08/2010	JT/KR/CH	cleaning gravel trap	13/08/2010	JT/KR/CH	ccc/kmac
11/08/2010	687	CH	gas well exceedences 03-10/08/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
23/08/2010	688	CH	gas well exceedences 11-23/08/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
01/09/2010	689	CH	gas well exceedences 24-31/08/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
07/09/2010	690	CH	gas well exceedences 01-07/09/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
24/09/2010	691	CH	gas well exceedences 08-23/09/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
01/10/2010	692	CH	gas well exceedences 24-30/09/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
08/10/2010	693	CH	gas well exceedences 01-08/10/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS

15/10/2010	694	CH	gas well exceedences 09-15/10/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
26/10/2010	695	CH	gas well exceedences 16-25/10/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
01/11/2010	696	CH	gas well exceedences 26-31/10/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
08/11/2010	697	CH	gas well exceedences 01-08/11/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
16/11/2010	698	CH	noise overlimit 05/01/10	4	due to circumstances outside landfill control	ongoing	JT/KR/CH	due to traffic on link rd etc	05/10/2010	JT/KR/CH	CCC
17/11/2010	699	CH	gas well exceedences 09-16/11/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
23/11/2010	700	CH	gas well exceedences 17-23/11/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
02/12/2010	701	CH	gas well exceedences 24-30/11/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
07/12/2010	702	CH	gas well exceedences 01-07/12/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
14/12/2010	703	CH	gas well exceedences 08-14/12/10	2	ongoing measures being put in place	ongoing	JT/KR/CH	ongoing gas measures being implemented	ongoing	JT/KR/CH	CCC/FTC/BPS
15/12/2010	704	CH	PM10 overlimit 04&06/12/10 at heatherton	4	investigated	15/12/2010	CH	increased fuel burning due to cold weather	15/12/2010	CH	CCC/FTC/BPS
15/12/2010	705	CH	conductivity at SRP1 overlimit 09/12/10	4	investigated	15/12/2010	JT/KR/CH	reedbed reduced conductivity unsure as to reason for high cond at inlet	15/12/2010	JT/KR/CH	CCC
21/12/2010	706	CH	PM10 overlimit at heatherton 18/12/10	4	investigated	21/12/2010	CH	increased fuel burning due to cold weather	21/12/2010	CH	CCC

Non Compliance Log: 2010

Date	Log No.	Originator	Incident	Status	Suggestion	Completion Target Date	Responsibility	Actions	Resolved Date	Sign.	Supplier / Contractor / Consultancy involved
11-May-10	1	EPA	financial capability for restoration & aftercare, dissolved methane at discharge	4	finance available for restoration and aftercare, dissolved methane now within limits since installation of splash plate	05-Jul-10	JT/KR	finance details given and splash plate installed	05-Jul-10	JT/KR	
27-Sep-10	2	EPA	pdf version of aer 2008	4	report submitted	12-Nov-10	JT/KR	report submitted	12-Nov-10	JT/KR	

5.1 Environmental Objectives

1 **Environmental Objective 1:** Operation of the Facility in accordance with the Conditions of the Waste Licence W0012-02

Objective 1: Operate the facility in accordance with the Waste Licence W0012-02				
Responsibility: **Facility Management**			**Start Date:** 29th Nov 2002 **Revised Date:** January 2011	
Target: To operate the landfill site in accordance with the waste licence and all the associated conditions as laid down by the EPA				
Ranking:			**Score:**	
Task	**Details**	**Due Date**	**By Whom**	**Status**
1	Waste Licence W0012-02 was granted on the 29th November 2002	NA	EPA	Done
2	All deviations from the Licence in the form of Non Compliances, Non Conformances, Incidents and Complaints are reported to the Agency as they arise	As they arise	Facility Management	On going
3	In the event of the City Council not being able to meet the time constraints of a given Licence Condition, the Facility Management will contact the EPA with respect to extending the deadline.	As they arise	Facility Management	On going
4	Landfilling of waste has ceased at the facility as of 15th July 2009. Cork City Council has applied to the Agency for a Licence Review. Proposed Decision (W0012-03) announced in December 2010.	Done Dec 2010	Facility Management Facility Management	Done Done
5	City Council has reviewed the PD and have submitted a number of objections to some of the Licence Conditions and have sought clarity on some issues.	Awaiting response from the Agency	EPA	
Objectives Completed: **Signature:** _____ **Date:** _____				

2 **<u>Environmental Objective 2</u> :** Establish infrastructure at the facility in accordance with the timeframe of the Licence W0012-02

Objective 2: Establish infrastructure at the facility in accordance with the timeframe of the Waste Licence W0012-02				
Responsibility: Facility Management			**Start Date:** 29th Nov 2002 **Revised Date:** January 2011	
Target: Establish infrastructure at the facility in accordance with the timeframe of the Waste Licence – initiate proceedings for the new capping Contract 10 – (Final Phase Capping Works)				
Task	**Details**	**Due Date**	**By Whom**	**Status**
1	Preliminary discussions held with appointed consultants to discuss the size & scope of the project	Sept 09	FTC (Project Manager PM) & Facility Mgt	Done
2	Contract documents for Phase 4 Capping to be prepared end 09	Dec 09	FTC (PM) & Env. Dept.	Done – Feb 2010
3	Following revisions & finalisation of plans Invite submissions of interest for tenders from contractors – area of site ~ 1 hectare		FTC (PM) & Env. Dept.	Done – March 2010
4	Assess tenders and seek clarifications from most economically advantageous contractor		FTC (PM) & RE (Resident Engineer)	Done – May 2010
6	Inform successful contractor		CCC	Done
7	Issue construction drawings Contract 10		Facility Management / FTC	Contractor Mobilised July 2010
8	Mobilise Contractor for Contract 10			
9	Advise EPA of Infrastructure development status.		Facility Management	
	Specified Works Supervision			
	As of January 2011 contract approximately 50% complete 53,000 m2 of Contract 10 area for capping substantially complete	Weather dependent – Contract due for completion in October 2011		
Objectives Completed:				
Signature: _____ **Date:** _____				

3 **Environmental Objective 3:** Control of Litter

Objective 3: Control of litter				
Responsibility**:** **Facility Management**			**Start Date:** January 01 **Revised Date:** January 2011	
Target: To control litter on the landfill site				
Task	**Details**	**Due Date**	**By Whom**	**Status**
1	No Active areas remaining – netting was erected during period of waste excavation for capping works – Sept 2010	As required	Mgt team	Ongoing
2	As of July 15th 2009, waste is no longer accepted at the facility for landfilling. There is no longer any need for litter netting however litter patrols shall continue to assess the need for cleanups. Future litter collection shall be organised on an as required basis.	As required	Mgt team	Ongoing
Objectives Completed: **Signature:** _____ **Date:** _____				

4 **<u>Environmental Objective 4</u> :** Continue composting of biodegradable waste

Objective 4: Composting of biodegradable waste				
Responsibility**:** **Facility Management**			**Start Date:** February 01 **Revised Date:** January 2011	
Target: To set up a sustainable on site composting operation that will allow for the diversion of 100% of segregated green waste from landfill.				
Task	**Details**	**Due Date**	**By Whom**	**Status**
1	Promote segregated waste collection and delivery of green material to Landscaping Contractors	Ongoing	Env. Dept.	Ongoing
2	Compost green waste at the facility	As required	CTO	Ongoing
3	Increase public awareness of the timber and green waste processing facility at the Civic Amenity Site	Ongoing	Env. Dept.	Ongoing
4	Continue to improve quality of compost with the aim of achieving Class I compost	Ongoing	Facility Mgt.	Ongoing
5	Investigate possible use of compost for the top soiling of the capping contract - compost shall be in to soil during final stage of capping	Summer 2011	Contractor	
6	Investigate the possibility of street sweepings with compost – reducing waste sent to landfill	Sept 09	CTO & Facility Mgt.	Done & ongoing
Objectives Completed: **Signature:** _____ **Date:** _____				

5 Environmental Objective 5: Control of odours

Objective 5: Control of odours				
Responsibility: Facility Management			**Start Date:** February 01 **Revised Date:** January 2011	
Target: To ensure that the activities shall be carried out in a manner such that odours do not result in significant impairment or interference with amenity areas or the environment beyond the facility boundary.				
Task	**Details**	**Due Date**	**By Whom**	**Status**
1	Landfilling of waste has ceased at the facility as of 15 July 2009 – 300 mm of soil has been placed over the waste upon achieving final contours	As cells are filled	Contractors	Ongoing
2	Install additional gas extraction wells as cells are closed off	As required	Contractors or as directed by Facility Management	Done
3	Connect new gas extraction wells to combustion plant – 18 new wells connected to collection network in August 09	Done	BPS	Done
4	Additional air sampling at odour sensitive locations if requested	As required	Facility Mgt	Ongoing
5	Review programme & Operational practices versus complaints	As required	BPS & Facility Mgt	Ongoing
6	Complete 'Odour Control Form' when deemed appropriate as requested by the EPA	As issues arise	PF	Ongoing
7	Currently in middle of final capping works – due to continue until October 2011 Contractors have odour suppressing materials on site in the event of an odour issue arising during waste excavations / gas well drilling or other activities associated with capping works	As issues arise	Facility Management & Contractor	
Objectives Completed: **Signature:** _____ **Date:** _____				

6 **<u>Environmental Objective 6</u>:** Continue with the operation of the WEEE collection area

Objective 6: Continue with the operation of the WEEE collection area				
Responsibility: **Senior Engineer Environment & Facility Management**			**Start Date:** January 03 **Revised Date:** January 2011	
Target: To increase the availability and accessibility of the WEEE recycling facilities at the Civic Amenity Site				
Task	**Details**	**Due Date**	**By Whom**	**Status**
1	All waste electrical and electronic items are stored in the WEEE compound - WEEE can be delivered to the CA Site by domestic users and by registered EEE retailers		Facility Management	Done & ongoing
2	Set up register of EEE retailers who may avail of the drop off facility	Dec 05	Env. Dept. & Facility Management	Done
3	Inputs from EEE retailers are recorded on the Weighbridge Computer All WEEE outputs to 'KMK Metals are recorded on the WB computer also	Done	Facility Management	Done
4	Assess storage needs with regard to smaller items of WEEE (computers & TVs)	Done	Facility Management	Done & ongoing
5	Advertise the availability of the WEEE drop off facility to the public with the aim of diverting WEEE from the waste stream and to reduce indiscriminate disposal of such materials		Env. Dept	Done & ongoing
6	Apply new safety procedure with respect to manual handling of WEEE	Jan 08	Facility Mgt.	Ongoing
7	New Battery Collection Scheme introduced in Sept 08 – all batteries now accepted free of charge from members of the public & from retailers	Sept 08	Facility Mgt.	Ongoing
Objectives Completed: **Signature:** _____ **Date:** _____				

7 **Environmental Objective 7:** Commission a feasibility study for the South City Maintenance Depot for Cork City Council on the site of the old C & D area

Objective 7:	**Commission a feasibility study for the South City Maintenance Depot for Cork City Council on the site of the old C & D area**			
Responsibility:	**Facility Manager & appointed consultants**	**Start Date:** March 06 **Revised Date:** January 2011		
Target:	Commission a feasibility study for the building of a South City Maintenance Depot for Cork City Council on the site of the old C & D area			
Task	**Details**	**Due Date**	**By Whom**	**Status**
1	Invite tenders for the study	**March 06**	Env. Dept & Facility Management	Done
2	Appoint successful consortium	May 06	Facility Management	Done
3	Carry out feasibility study – starting with site investigation work etc.	June 06	Consultants & Site Investigation Contractor	Done
4	Report due from Consultants in Feb 07	Feb 07	RPS / MCOS	Report received – June 07
5	Based on report - decide as to feasibility of the construction of the South City Maintenance depot on the site	Spring 08	Inter-departmental group	Still in discussions regarding next course of action
6	Appointed consultants have recommended further site investigations Awaiting decision from City Manager	Spring 09		
Objectives Completed: **Signature:** _____ **Date:** _____.				

8 **<u>Environmental Objective 8</u>:** Assess the potential for the treatment of landfill leachate using natural systems

Objective 8: Assess the potential for the treatment of landfill leachate using natural systems				
Responsibility: **KR**			**Start Date:** Oct 04 **Revised Date:** January 2011	
Target: To develop & construct a means of treating landfill leachate using natural systems incorporating reeds beds and peat /compost cells				
Task	**Details**	**Due Date**	**By Whom**	**Status**
1	Commence desktop survey & background reading on the project	Jan 05	KR	Done
2	Design the infrastructure for the project	Spring 05	KR	Done
3	Seek quotations & build infrastructure Quotations received August 05 – building work delayed	Summer 05	KR	Done
4	Building of project commenced January 06 Pumps & pipework installed	Jan 06 - Feb 07	Appointed contractors	Done
5	Commence sampling & allow project to run its course	April 07	KR	Done & Ongoing
6	Project showing promising results Ongoing quarterly updates & presentations given to Senior Engineer & Facility Manager Presented report at Environ 08 Conference in Dundalk in Feb 08			Ongoing
7	Produce report on finding & assess potential for use on a large scale	Project due to run until Autumn 2010	KR	Lab testing finished – Oct 2010 – write up underway
Objectives Completed: **Signature:** _____ **Date:** _____				

9 **<u>Environmental Objective 9</u>:** Rehabilitation & Restoration of the Site with a view to the development of an Amenity Park

Objective 9: Rehabilitation & Restoration of the Site with a view to the development of an Amenity Park				
Responsibility: **Facility Manager**			**Start Date:** January 2011 **Revised Date:**	
Target:				
Task	**Details**	**Due Date**	**By Whom**	**Status**
1	As of January 2011 the facility has been substantially capped and rehabilitated. To date 15 hectares have been capped and grassed over. Contract 10 (current capping contract) involves the capping of a further 9 ha – of which 5.3ha has been substantially completed.			
2	Further rehabilitation of the facility includes the following: • Development of a playing pitch (completed 2009) • Planned events area • Planned walkway, cycle tracks and jogging routes • Planed orienteering course through the park • Development of walkway through the wetland areas • Proposed sustainable energy demonstration projects			
Objectives Completed: **Signature:** _____ **Date:** _____				

10 **<u>Environmental Objective 10</u>:** Development of North-Central Area of the site

Objective 10: Development of North-Central Area				
Responsibility: **Facility Management & appointed contractor**			**Start Date:** Nov 08 **Revised Date:** January 2011	
Target: To restore & cap the North-Central area of the site with an aim to developing an events area for the provision of amenities				
Task	**Details**	**Due Date**	**By Whom**	**Status**
1	Preliminary discussions held with appointed consultants to discuss the size & scope of the project	Sept 08	MOB / JT / FTC	Done
2	Contract documents to be prepared for Spring 2010 – currently on hold	Currently on hold	FTC	
3	Following revisions & finalisation of plans Invite submissions of interest for tenders from contractors – area of site ~ 1 hectare	Dates to yet to be finalised		
4	Assess tenders and seek clarifications from most economically advantageous contractor			
5	Inform successful contractor			
6	Issue construction drawings Contract 09			
7	Mobilise Contractor for Contract 09			
8	Advise EPA of Infrastructure development status.			
9	Specified Works Supervision			
Objectives Completed: **Signature:** _____ **Date:** _____				

11 **<u>Environmental Objective 11</u>:** Continue with the tree planting regime around site perimeter

Objective 11: Continue with the tree planting regime around site perimeter				
Responsibility: **Facility Management**			**Start Date:** Oct 05 **Revised** Date: January 2011	
Target: To plant additional trees around the site perimeter for aesthetic purposes and to promote natural habitats				
Task	**Details**	**Due Date**	**By Whom**	**Status**
1	Identify suitable areas and species for planting	Oct -05	JG	Done
2	Seek quotations from suitable contractors	Nov 05	JG	Done
3	Plant trees in agreement with contractor, with consideration of trees species (willow, alder, poplar), age and stand height.	Dec – March 05/06	KR	Done
4	Continue with tree planting regime as required – Trees along SW corner of site – along the leachate trench require re-planting due to capping works	January 08	Appointed contractor	Done
5	Investigate areas for replanting with respect to trees / saplings removed for construction purposes during the current capping contract Tree planting on hold for the present time until contract works have been completed	March 08	Facility Mgt	
6	Christmas trees along NE perimeter are inspected & cleared of weeds on an ongoing basis by landscaping contractor	Ongoing		
Objectives Completed: **Signature:** _____ **Date:** _____				

12 **<u>Environmental Objective 12</u>:** Investigate the possibility of holding a rally sprint around the site perimeter road

Objective 12: Investigate the possibility of holding a rally sprint around the site perimeter road				
Responsibility: **Site Management**			**Start Date:** Nov 2010 **Revised Date:** January 2011	
Target: To promote the facility as a future amenity area				
Task	**Details**	**Due Date**	**By Whom**	**Status**
	Following on from the very successful rally sprint in June 2010 – Cork City Council shall investigate the possibility of holding a similar event in 2011			
1	Make initial contacts with Cork Rally Club	December 2010	CCC & Cork Rally Club	Done
2	Produce a plan & set a provisional date for the rally sprint	December 2010	CCC & Cork Rally Club	Done
3	Meet with security and emergency personnel for preliminary discussions (Fire Brigade, Gardai, St. John's Ambulance etc.)	March 2011	Emergency services personnel, CRC & CCC	
4	Set a date & apply for planning permission	March 2011		
5	Depending on the outcome of the planning permission rally sprint will be held in May 2011	May 2011		
6	Advertise event in local media – April 2011			
Objectives Completed: **Signature:** _____ **Date:** _____				

5.2 Site Management Structure

The Staff Management Structure for the facility is detailed in the Organisational Chart.
The responsibilities of the site staff are listed below.

Facility Manager
The Facility Manager has overall responsibility for operation of the facility in accordance with the conditions of the Waste Licence and best operational practices.

The Facility Manager co-ordinates all of the activities and contractors on site and implements procedures and practices in accordance with the Environmental Management Programme.

Deputy Facility Manager
The Deputy Facility Manager assists the Facility Manager in the management in the facility, acts as Facility Manager in his absence and is responsible for the daily operation of the landfill site.

Site Supervisor and Junior Foreman
The Supervisor and Junior Foreman are responsible for ensuring that the site staff carry out their designated duties, and liaises with the Facility Manager in the implementation of procedures and practices at the facility. They have completed the FAS "Waste Management" course.

Relief Site Supervisor
The Relief Site Supervisor performs the functions of the Site Supervisor in the event of his / her absence. The Relief Site Supervisor has also completed the FAS "Waste Management" course.

Weighbridge Operator
The Weighbridge Operator records incoming waste and controls access to the facility.

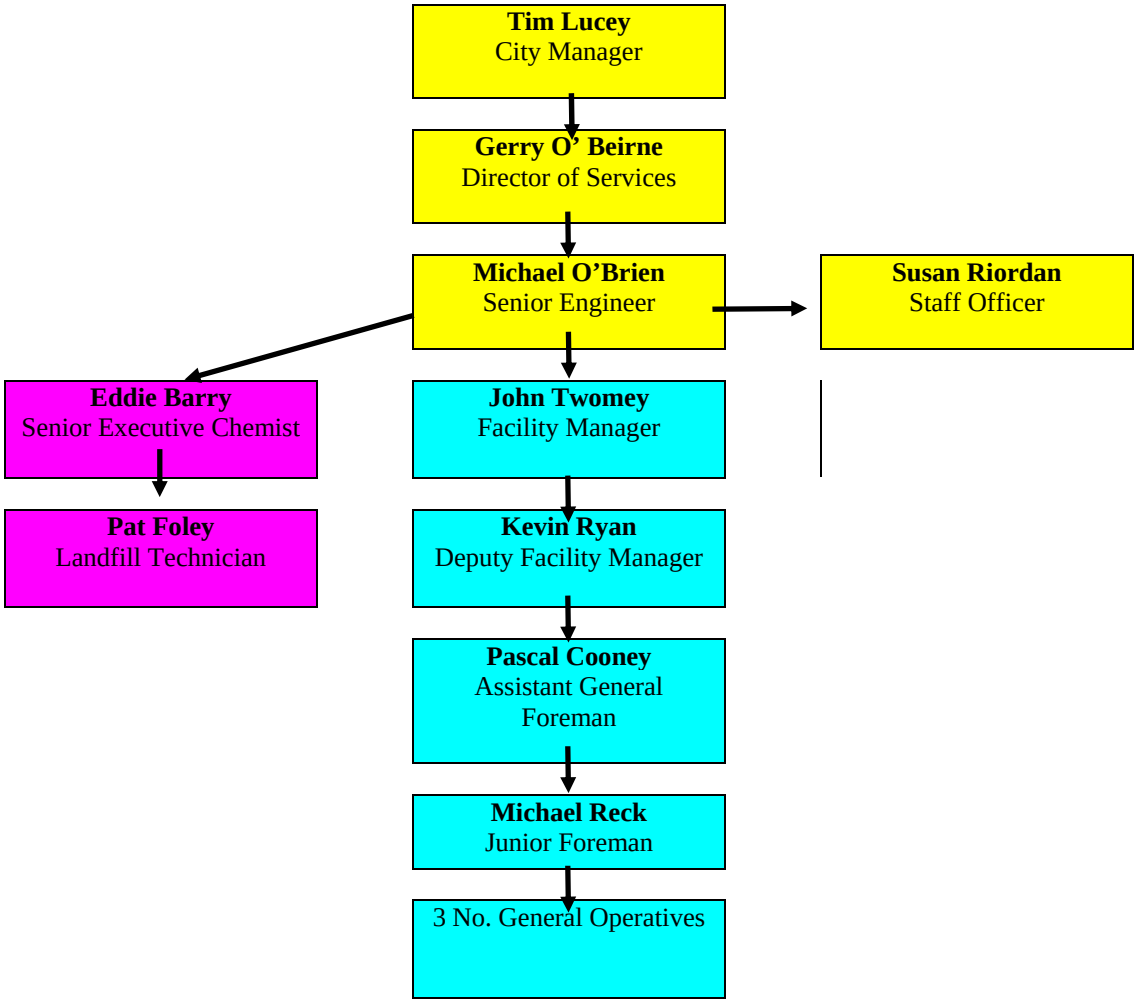
Senior Executive Chemist
The Senior Executive Chemist co ordinates the surface water, ground water and leachate sampling at the facility. Duties include the interpretation of monitoring carried out by Cork City Council and by outside contractors and the preparation of the quarterly reports on environmental monitoring.

Landfill Technicians
The Environmental Technicians carry out monitoring, sampling and analysis at the facility under the supervision of the Senior Executive Chemist and are based at the landfill site.

Staff Officer Environment
The Staff Officer Environment (not based on site) is responsible for the maintenance of the Waste Licence public file including dealing with queries from the public. Duties also include liaising with waste contractors regarding acceptance of waste and accounts etc.

5.2.1 Organisational Chart

The Management Structure of Kinsale Road Landfill Site, including Environmental Monitoring (Laboratory) and Administration (City Hall).



6 (a)

Summary Report on Emissions

Noise Emissions

Monitoring Locations

Within the Landfill B1-B4
B1 is located just north of the reception area or west perimeter.
B2 is located to the north perimeter.
B3 is located to the east perimeter.
B4 is located to the south perimeter.

Outside the Landfill A1-A4

A4 is located north of landfill in Secondary School Grounds (Christ King).
A1 is located at the end of Greenhills.

Monitoring Details

Monitoring was carried out on the 5th January 2011 (OB1, OB2, OB3) by S E Chemist.
The instrument used was the Cell 495, Type 1.

Monitoring Results

The results (day-time) are presented below. The 1/3 octave results are at end of section. Previous years results are in brackets.

	Leq(A)	L10	L90
B1	60 (62) (64)	62	53
B2	54 (55) (53)	54	53
B3	47 (48) (54)	49	46
B4	59 (62) (63)	60	56
A1	57 (46) (56)	60	44
A4	45 (57) (58)	46	44

Interpretation

Limits
The dB(A) Leq 30 minutes should not exceed 55 during the day and 45 at night at the sensitive locations A1 and A4.

Results and Interpretation.

It was cold with a light easterly wind.

There were some Landfill capping operations and timber recycling operations.
The over riding noise source at each location was traffic.
B1 was about same as last year.
B2 was about same as last year. The impacts here are traffic, Garage depot and ESB transformer station outside Landfill. The Landfill is over the brow of the hill and the timber shredder is shielded.
B3, towards Greenhills, was much lower than previously. The major impact at B3 is traffic which was lighter than other years and wind was from a different direction. The works operations around the landfill and construction at the playing fields were not contributing.
B4 was impacted by proximity of South Ring Road approximately 100 metres away.
It would not be possible to separate landfill impact from traffic and other sounds in order to check compliance with the licence. The nearest outside station A4 (Christ King School) was about same as last year. Subjectively, sound levels here are always due to traffic and birds rather than landfill.
A1 (end of Greenhills) was much lower than last year. Traffic was lighter and wind from a different direction.

The landfill does not operate at night.

One third Octave Band Analysis
The charts are in the Appendix.
The one-third-octave band analysis shows that the noise regime in the landfill and surrounding areas is dominated by traffic. The B4 position (South) is clearly dominated by traffic and the profile is similar to A1. B2 (North) had a peak at 100 Hz that may be attributed to the ESB Transformer. B2 and B3 lose some of the higher pitched levels due to distance. The overall pattern at each station is similar indicating the predominant traffic influence from surrounding roads.

Landfill Gas

Buildings

Limits

The limits in the licence are 1% v/v (20% LEL) for methane and 1.5% v/v for carbon dioxide.

Monitoring Details

Six buildings are monitored on a weekly basis.
The instrument used was the Gasdata GFM Series and the monitoring was carried out by the Landfill Technicians.

Summary of the Results

No methane was detected and only minute traces of CO2.
The Park and Ride administration building had no methane shows.

Interpretation

No landfill gases are entering the buildings.

Gas Monitoring Wells

Trigger Levels

These are 1.0 % v/v for methane and 1.5% v/v for carbon dioxide "measured in any service duct or manhole on at or immediately adjacent to the facility and/or at any point located outside the body of the waste."

Monitoring Details

The instrument used was the Gasdata GFM Series and the monitoring was carried out by the Landfill Technicians.
The wells (DP) in the old landfill area across the South Link Road are into the body of the waste and were designed to check for gas generation not migration. They could not be expected to comply with the trigger levels.
DP1 and DP2 are not being monitored any more. There are 15 other wells drilled around the periphery of the old landfill site and along the South Link Road - 137 to 175; these would most likely be drilled into some waste.
Most of the wells to the north, east and south and west of the landfill LG1-LG19 are drilled into soil surrounding the landfill and are designed to check for migration of methane laterally to surrounding areas.
Due to shows of gas, in the eastern and north eastern periphery; approximately fifty new wells have been installed off site in the green area

between Greenhills and the landfill. Many of these new wells were designed to function as venting wells/monitoring wells. From 2005, the wells closest to the landfill periphery (LG) have been used as monitoring wells and the middle wells for venting purposes (two weeks venting and one week capped). Wells are drilled to different depths and have different sensitivities. There are local soil factors that make it difficult to assess trends and comparisons. In addition weather plays a role in gas migration through soil.

Monitoring Results (2009 Results in brackets)

Old Landfill Area

Park and Ride

The 15 periphery wells that are monitored on a daily or weekly basis around the old landfill site and along the South Link Road show the presence of gas on the odd occasion.
In 2010 wells numbered 137, 138, 139 and 140 showed gas on the odd occasion (less than 2% of the time) most likely linked to the flare going down.
141-146 had no gas. The wells 171-175, monitored weekly, showed no gas - same as last year.
Trials have shown that there is insufficient gas in this sector for power generation although gas is pulled for destruction by flaring.
The Park and Ride building showed no evidence of gas in 2010.

Present Landfill Area

There are no shows of gas in the wells monitored in the **southern** and **western** perimeters of the landfill.

Northern Sector LG1-LG4:
LG1 could not be monitored in 2010.
LG2 had one small show at 1.1% methane.
LG3 and LG4 had no exceedances.

Eastern Sector
LG5-LG8
In the **eastern sector** of the landfill, methane levels began exceeding trigger levels in 2002 and this led to increased monitoring on a daily and weekly basis in addition to the monthly monitoring normally undertaken up to then.
The interception trench (constructed in 2004) and venting procedures have stabilised gas levels in the eastern perimeter wells and reduced if not eliminated gas shows in wells further east although the situation in LG9A and LG10A is anomalous.
The situation needs further investigation as these wells (LG9A and 10A) are most likely drilled into waste and therefore are not suitable for monitoring potential gas migration.

Charts showing methane concentrations over the years at the eastern landfill periphery wells LG5A, LG6A and LG8A are in the attached Appendix.
These wells are some of the few monitoring wells on the landfill perimeter still showing some gas and they are steadily decreasing in gas with time (see Chart in Appendix). It is interesting to examine the reasons for the fluctuations with time for gas concentrations.
LG5A is a well on generally dry ground while the other three wells are progressively more on wetter ground. It is the landfill technicians' experience that gas levels are higher in the wells after rain. LG5A has a pattern of increased gas levels in summer time probably due to increased biological activity promoting increased gas production and drier soil facilitating the lateral passage of gas. If there is rain on the surface layers in summer then gas transmission to the air is inhibited and lateral passage increased. The pattern is repeated in LG6A but not to the same extent because it is in more boggy soil where lateral passage of gas is slow. There is also less gas in LG6A. There is less consistency in the pattern for LG8A.
Interpretation of gas presence and passage through soil is inherently difficult; there is a range of confounding factors.
LG5 had no gas in 2010 but LG5A showed gas consistently in the range of 4-48% v/v CH4.
The gas levels in LG5A are decreasing: the average in 2008 was 27%, 2009 was 21% and 2010 was 17% v/v CH4.
LG6 had no gas but LG6A showed gas consistently in the range of 1-17% v/v CH4.
LG6A is decreasing: the average in 2008 was 24%, 12% in 2009 and 9.2% in 2010.
LG7A and LG8 had no gas but LG8A showed a few small exceedances.
These wells are in a line nearest the landfill; wells that are further out towards Greenhills show far lower levels of gas and most show no gas.
TP1 has decreased from 10% (1999) to 1%in v/vCH4 last year.
LG9, LG10 and LG11 have become inoperative and have been replaced by the new wells, LG9A and LG10A. These new wells are much closer to the landfill and are possibly contaminated by leachate. They are showing very high levels of gas and this needs further investigation.
Some of the new wells, with the tag A, drilled in proximity to the older wells generally show a stronger presence of gas than the original wells. This may be due to the greater depth drilled, the variability of the gas in the area, differing gas well construction methods or soil disturbance.

There are very many other wells east of the LG5-11 line but these are being used for venting as well as monitoring so more variations in monitored trends would be expected. Gas readings are taken in the following manner: two weeks venting and one week capped
In the intermediate line, TP3 is in range 0-6% and LG52 is in range of 0-1.6%v/v CH4 - these wells show some exceedances but all the other wells are clear.

In the line farthest from the Landfill, there were no exceedances.
The shallow gas wells in Greenhills Estate that are monitored on a monthly basis gave no show of gas as in other years. Other wells such as at Nemo Rangers Gate also show no gas.

Interpretation

The wells to the south and west show no evidence of methane migration.
Gas concentrations in the eastern periphery wells began to decline in 2005 and decreased further in 2008, 2009 and 2010. The decline could be due to the installation of the interception trench in late 2004 preventing the flow of gas eastward. It could also be due to the venting measures in the green area to the east. The wells east of the landfill periphery have reduced considerably in gas.
The shallow gas wells in Greenhills were free of gas in 2007, 2008, 2009, and 2010.
Interpretation of gas presence and passage through soil is inherently difficult and there are extraneous confounding factors such as atmospheric pressure, temperature, soil water saturation, biological processes and soil disturbance.
The consistent decline in average levels in wells in the eastern sector over the last few years is very encouraging.

Measures to Control Gas

The analysis of trace components in the gas did not conclusively establish the origin of the gas. Consultants who examined the data suggested that the gas could be derived from the landfill, historical private waste deposits in the area east of the landfill or from the peat itself.
A programme of measures to control gas from the possible sources listed above is in place since early 2005. These measures incorporate an intensive monitoring regime at stations inside and outside the Landfill, suction and flaring of gas on 36 wells constructed on the eastern periphery of the landfill, a 700 metre long interception trench along the eastern periphery and vent pits.
The measures being taken are controlling the situation. The advice received was to initiate a slow and steady reduction.
The situation in LG9A and 10A needs further investigation and remedial works will follow.

Carbon Dioxide

The carbon dioxide levels were exceeded in most wells.
Where there is presence of carbon dioxide in preference to methane, it may be due to aerobic landfill conditions. The presence of oxygen will also be more noticeable in these wells (as is the case). Aerobic conditions are more likely to

occur at shallow, uncapped landfill sites or any other condition that allows air into the refuse - such as at perimeter locations. Carbon dioxide has asphyxiate but no explosive properties.
The majority of the wells have increased levels of carbon dioxide in the summer time probably due to warmer conditions promoting microbiological activity.

Gas Combustion Plant Intake

There are no limits in the licence.
The instrument used was the Gasdata GFM Series and the monitoring was carried out by the Landfill Technician on a weekly basis.
Summer concentrations are generally higher than winter.

Emissions from Landfill Gas Combustion Plant

Monitoring Requirements

Inlet

Methane	weekly monitoring	as %v/v
Carbon dioxide	weekly monitoring	as %v/v
Oxygen	weekly monitoring	as %v/v
Total Sulphur	Annually	
Total Chlorine	Annually	
Total Fluorine	Annually	

Outlet

SO2	Annually
NOx	Annually
CO	Continuous
Particulates	Annually
TA Luft Cl I, II, III organics	Annually
HCL	Annually
HF	Annually

Carbon Monoxide Continuous Monitoring of the Burner TV01

Limits for Carbon Monoxide Continuous Monitoring (last year results in brackets)

The limits in the licence are 1300 mg/m3 for 30-minute average and 650 for daily average.
The Agency by letter dated 17/07/03 has asked that concentrations exceeding 2800 mg/m3 for the 30-minute averages and concentrations exceeding 1400mg/m3 for the daily averages be regarded as incidents and reported.

TVO1
The 30-minute average varied from 0-12,620 (7127) mg/m3.
Daily averages varied from 0-1260 (0-1001) mg/m3.
TV01 had numerous exceedances in the first half of the year for different reasons and these have been detailed in correspondence to EPA

Emission Limits on Outlet

The license limits on the emissions are as follows.

NOx as NO2	500 mg/m3
CO	650 mg/m3
Particulates	130 mg/m3
TA Luft CLI	20 mg/m3 (at mass flows>0.1kg/hr)
TA Luft CLII	100 mg/m3 (at mass flows>2 kg/hr)
TA Luft CLIII	150 mg/m3 (at mass flows>3 kg/hr)
HCL	50 mg/m3 (at mass flows>0.3kg/hr)
HF	5 mg/m3 (at mass flows>0.05kg/hr)

Monitoring Results

Report in Appendix.
All results of the exhaust from the engine TVO1 and landfill flare are within the emission limit values for the parameters NOx, CO, particulates, TNMVOC, TOC, HCl/HF. While no limits are given in license for SO2, results were low.
The Report estimates that the methane destruction in the landfill flare is 99%.

Emissions to Sewer

Methane (Results in brackets are for previous year)

Headspace and aqueous probe methane measurements that are automatic and continuous have been discontinued because they are very inaccurate.
Grab samples sent to outside laboratories are also not accurate. A standard that was sent to an outside private laboratory was returned at 10% of the true value. This reflects the loss of the volatile gas in transit and is not a reflection on the accuracy of the outside laboratory.
The replacement monitoring system in operation is based on samples taken from the discharge and subjected to GC analysis in the Cork City Laboratory.
In the second half of 2009, a new splash plate was installed in the conditioning plant and was very effective in reducing methane levels in the leachate to well within the license limit.

Flow

Leachate is collected, conditioned and discharged to the sewer. Stormwater from capped areas is directed to reed beds via the swale and stormwater ponds. The temporary leachate treatment plant was upgraded and made operational at the end of 2008. This plant is designed to treat potential contaminated storm water from the temporary capped areas of the site within the swale.
The flow through the main conditioning plant recorded through the 150 mm (6 inch) discharge line varied from 0-14 (0-25) m3 per hour. There was 0 exceedance (0). The licence limit is 25 m3/hr.
The cumulative flow, recorded by the Scada system, in 2010 was 79,857 (55,000), (68,000), (104,243) (122,627) (121,454) m3. The flow recorded was up this year.

pH
The pH results are in required range 7-9.

24 Hour Composite Concentrations (Results in brackets are for previous year)

Samples are taken every month.
BOD values are always low, 17-64mg/l, probably due to ammonia suppression in the test.
The ammonium results varied from 130-280 (140-320) mg/l. The limit for ammonium is 600mg/l for 95% of the samples. All the samples taken complied with the license.
The other parameters: pH, sulphate and suspended solids are well within the limits.

24 Hour Composite Loads

There are **no limits** in the licence.
All the parameters are low in concentration and load except for ammonium.
The ammonium load varied from 9-76 (11-93) kg/day.

Discharge from the Stormwater Retention Pond / Reed beds

Status

This facility has been constructed and reeds planted in 2004. It was commissioned in 2005

Results

Reedbed Discharge

One sample from 17 (0) exceeded the suspended solids limit of 35 mg/l.

Dust Deposition

Monitoring Locations

Dust
D1 is located towards the western perimeter on the present landfill.
D2 is located towards the northern perimeter.
D3 is located towards the eastern perimeter.
D4 is located towards the southern perimeter.
D5 is located in the old landfill across the South Link Road.

Dust Monitoring Results

The five stations are monitored every quarter (20 samples/year)
The **limit** in the licence is 350mg/m2/day.
There was 1 exceedance from the 5 stations taken every quarter, twenty samples in all, (0) due to capping of the site.

6 (b)

Summary of Results and Interpretation of Environmental Monitoring

Asbestos in Soil

Monitoring Locations

The locations are Heatherton Park, NW of lab, north perimeter, near reed bed and south perimeter.

Monitoring Details

The samples were taken by City Council personnel from the topsoil. The analysis is by an outside agency (ACS) and the Report is attached.

Monitoring Results

No asbestos was found in any of the five samples (same as all previous years).

Groundwater Monitoring

Limits

There are no limits on the licence.

Monitoring Locations

A map of the approximate locations is at the end of this section.
The groundwater flow is from west to east.

BR1 and OB1 are bedrock and overburden wells on the northern perimeter of the landfill.
BR2 and OB2 are located on the north-east perimeter.
BR3 and OB3 are located on the eastern perimeter (down gradient).
BR7 and OB7 are located on the southern perimeter. OB7 is located in an area where refuse was deposited and is contaminated with leachate.

The wells NW1 to NW9 are designed to check the efficiency of the leachate collection system. NW1 is in the south west corner just north of the Tramore stream and just east of the South City Link. The wells move in numbered order, anti clockwise, to the north east corner (NW9). The wells are on the landfill side of the streams. The well NW9 has been re-drilled outside the collection drain in 2001.

Monitoring Details

All samples were taken and analysed by City Council laboratory personnel.
The analysis for pesticides, PAH, organochlorines was undertaken in the U.K.

Monitoring Results and Discussion

Monitoring Results (Results in brackets are for last year)

Ammonium in Wells

Overburden Wells
The overburden wells show no pollution in OB1 and OB2 but very high ammonium levels in OB3, 340 (440) mg/l and less so in OB7, 69 (52) mg/l. These shallow wells are drilled into or very near the body of the waste and at peripheral locations and would be expected to show pollution.
Metals were at or below limits of detection except for manganese 1 (1.6) mg/l. Manganese is generally high in groundwaters in the Cork area.
Cyanide concentrations were below 0.005 (0.005) mg/l.
Mercury was below 0.00002 (<0.00002) mg/l

Bedrock Wells
Groundwater to the southwest, west and north show no pollution but the wells to the north east show trace values and the well to east (BR3) is heavily contaminated with ammonium concentrations up to 520 (550) mg/l.
The results indicate very high concentrations of pollutants in this well, the highest values quoted below are from this well.
Recent investigations have shown that this well is inside the sheet pile wall where leachate is collected for return to conditioning plant and sewer discharge. The well is being impacted directly by leachate and is not a proper representation of the down-gradient impact of the landfill. A more suitable location for this well is being sought (onsite or offsite).
Conductivity varies 390-6900 (367-6990) uS/cm.
Chloride levels are normal except for BR3, 922 (680) mg/l.
The other parameters of Visibility/Odour, oxygen, TOC, TON did not show any remarkable trends or concentrations except for BR3.
TOC varies 2-500 (1-109) mg/l.
TON varies 1-11 (1-18) mg/l.

Cyanide was below detection limit of 0.005mg/l.
Chromium was below detection limit of 0.002 mg/l.
Mercury was below 0.00002 except at BR2, 0.00007 mg/l.
Pesticides and herbicides were below detection - generally 0.03 ug/l.
PAH's were below detection- generally <0.03ug/l.
Chlorinated hydrocarbons were below detection limits (generally 0.5-10 ug/l)
Benzene was below detection limits (0.1 ug/l)

NW Wells

The wells NW1 to NW9 are designed to check the efficiency of the leachate collection system consisting of the collection drain and the sheet pile wall in front of NW 1 and 2.
The average concentrations over time is shown in Table 1.

Table 1

Mean Total Ammonium (mg/l)

	NW1	*NW2*	*NW3*	*NW4*	*NW5*	*NW6*	*NW7*	*NW8*	*NW9*
01-02	*64*	*135*	*25*	*53*		*28*	*119*	*31*	*-*
2003	*35*	*-*	*25*	*35*		*21*	*35*	*27*	*0.5*
2004	*24*	*-*	*18*	*26*		*67*	*85*	*21*	*0.2*
2005	*dry*	*dry*	*16*	*20*		*78*	*167*	*13*	*0.1*
2006	*24*	*dry*	*25*	*37*		*98*	*73*	*43*	*0.3*
2007	*21*	*27*	*21*	*26*	*3.3*	*113*	*47*	*15*	*0.3*
2008	*20*	*24*	*47*	*30*	*0.3*	*129*	*63*	*15*	*0.1*
2009	*7.5*	*27*	*20*	*35*	*0.3*	*166*	*45*	*11*	*0.2*
2010	*18*	*34*	*26*	*39*	*2.1*	*129*	*21*	*16*	*1.9*

The table shows that ammonia concentrations are high particularly around NW6. The levels in this well increased in 2004.
The wells comply with the trigger levels.
The mean water well levels show no major change over the years.

Biological Surveys of Streams

Monitoring Locations

Tramore Stream
Sample sites listed are in downstream order as follows:
Samples were taken at the beginning of the old landfill (E) roughly equivalent to EM1, just below the South City Link roughly EM2 (C), halfway along landfill near OB7 (D) and near EM6 (F) below all landfill and downstream of confluence with Trabeg.

Trabeg
Samples were taken at farthest possible upstream point although still in landfill near EM7 (A) and, before confluence with Tramore, near EM8 (B).

Monitoring Details

These surveys were undertaken by the Aquatic Services Unit at UCC in July.
The Report is attached.
The licence conditions specify an annual kick sampling biological assessment of the Tramore and Trabeg streams. This was not possible for the Trabeg because of its structure.
Landfill leachate is now going to sewer and further on to Carrigrenan treatment plant.

Interpretation

Biological quality is graded from Q1 (bad) to Q5 (good).
The Report states: "All of the sites showed similar results to 2009"

Tramore Stream

The Tramore site upstream of the landfill remained at Q2 level (moderately or seriously polluted). The sites within the landfill were of same quality to last year, Q2. The sites remain moderately or seriously polluted again.
The downstream station on the Tramore shows the impact of the Trabeg in addition. The station had the same rating as last year (Q2).

Trabeg stream

The sites are unsuited to kick sampling and difficult to assign a Q rating. The upstream is probably Q2 and downstream not better than Q2. This rating is due to the influence of overflowing combined storm & sewer chambers further upstream of the Landfill Site.

Surface Water Monitoring

Limits

There are no limits on the licence.

Monitoring Locations

Tramore River:

The Tramore River flows to the south of the landfill.
EM0 is about one km upstream of all landfill.
EM1 is just upstream of the bridge on the Kinsale Road and just above all landfill.
EM9 is upstream of the bridge over the South Link Road - at the end of the old landfill across the South Link Road and just before the present landfilling area.
EM2 is at the beginning of the present landfill and just below the bridge over the South Link Road. It is almost in the same location as EM9.
EM10, as shown in the licence documents, has been moved from the point of confluence of the Tramore and Trabeg to about 20 yards upstream of the Tramore and has been renamed EM11. Sampling at a confluence is not good practice - samples taken could represent either the Tramore or the Trabeg or a varying mixture of the two. This EM11 site is also too near the landfill to ensure adequate mixing of the discharges and receiving waters. Mixing is not complete at this site and the sample may not always fully represent the dilution in the stream.
EM6 is about 300 yards downstream of the confluence of the Tramore and Trabeg. At this point, discharges from the landfill are adequately mixed with the receiving waters. This was the historical sampling point for the downstream sample. Possibly at times it may be affected by the back up of tidal waters but it remains the best option for a downstream sample

Trabeg Stream

EM7 and EM8 are on the Trabeg stream that skirts around the north and east of the landfill and then joins the Tramore. EM7 is upstream and EM8 is downstream.

Monitoring Details

The samples were taken and analysed by Cork City Council laboratory personnel
The stations are listed in downstream order (the first station- EM0 is furthest upstream)

Interpretation

Surface water monitoring is very variable with time and little significance can be placed on comparison between annual quarters.

Ammonium and BOD

There can be some contamination of the upstream waters on occasion and this has been noticed in the ecological report.
Because of the variability to be expected in surface waters there is no clear trend over the quarters.
There are four attached charts portraying the quality results for BOD and NH4 at upstream (EM 1) and downstream (EM6-10) for Tramore river locations and also upstream (EM7) and downstream (EM8) for the Trabeg river. These charts span the period 2000-2010.

Tramore
Generally, upstream Tramore (EM1) has BOD values varying from 0-6 mg/l over the 2000-2006 period but have declined since 2006 to values about 3mg/l and below.
Downstream values (EM6-10) ranged from 1-27mg/l over the 2000-2006 period but have declined since 2006 to values about 5mg/l and below.
Generally, EM1 has ammonium values ranging from 0-2 mg/l over the 2000-2010 period but have declined since 2006 to values below 0.4 mg/l.
Downstream values (EM6-10) ranged from 0-22 mg/l over the 2000-2006 period but have declined since 2006 to values below 0.44mg/l.

Trabeg
Generally, upstream Trabeg (EM7) has BOD values varying from 1-14 mg/l over the 2000-2010 period. The downstream values (EM8) have BOD ranging from 1-14 mg/l.
EM7 has ammonium values varying from 0.01-20mg/l in the period 2000-2010. The higher values were observed prior to 2007 and have declined substantially since then to values below 1mg/l. Since landfill leachate is much higher in ammonium values than sewage, this may indicate that pollution from landfill activities has decreased substantially but sewage pollution upstream has remained.
EM8 is similar. Ammonium values varied from 0.02- 37 mg/l in the period 2000-2006 but have declined substantially since 2006 to values below 1mg/l.
The waters upstream and downstream show severe pollution (as also in ecological studies).

Other Parameters
The more extended annual list of heavy metals, pesticides, PAH, organochlorines etc. does not show any remarkable trend or concentrations. Generally these are at or below limits of detection as in the past.

There is generally little difference between upstream and downstream values for these parameters.

Weekly Visual Inspections
Normally there is nothing unusual reported. The most common observation over the stretch of waters inspected is muddy. EM8 (downstream- Trabeg) is generally described as stagnant and greenish. Algae are occasionally observed at the downstream locations and this is not surprising because they are relatively stagnant, at the top of the tide.
EM7 (upstream in the Trabeg) occasionally displays sewage fungus indicating pollution upstream of landfill.

Particulates and Odour

Particulates (Results for previous year in brackets)

Particulates as measured by the total suspended particulate parameter were below the EU limits and guide values in 2010 as in 2009.
Particulates as measured by the PM10 parameter are measured outside and within the landfill. There is a trigger level of 50 ug/m3 for boundary monitoring. It would not be possible to separate ambient levels and the contribution from the facility.
The station outside the landfill, where samples are being taken daily for PM10, had 6 days (10 days) in the year when concentrations exceeded 50 ug/m3. These were most likely were due to domestic fuel burning in the very cold weather experienced in 2010 and not landfill. The main contributor at this station is domestic fuel burning and not landfill. There needs to be 35 daily samples exceeding the 50ug/m3 figure to breach the EU standard.
Within the landfill PM10 samples are taken quarterly and 1 sample (1) exceeded the 50 ug/m3 level.

Odour

Odour Monitoring Ireland Ltd carried out the odour monitoring.
There are no limits in the licence.
Some small increases in downwind odour threshold concentrations were observed across the data set but these increases are not statistically significant due to the inherent difficulties in interpretation of ambient-based olfactometry results (i.e. impossible to take account for the dilutional aspects of the atmosphere, etc.). The highest odour threshold concentration was detected at monitoring location O9 (alongside former active area). A landfill gas odour was detected in the vicinity of this monitoring location. Landfill gas odour was also detected at monitoring location O8 (compost area). Hydrogen

sulphide concentrations recorded at each monitoring location were less than 3ppb in ambient air. GCMS screens illustrated a large array of volatile organic compounds present in the air stream at all monitoring locations. All ambient air concentrations were low and well within any respective exposure threshold concentrations. Monitoring location O9 recorded the highest TVOC concentration, which was located closest to the former active area. It would appear that traffic based emissions have a significant effect on the profile of compounds detected during TD GCMS based surveys for odours.

Nuisances

Monitoring Locations

Weekly visual inspections describe the appearance of the landfill from Amberly Heights (south of the landfill), Greenhills Estate (north east) and Heatherton Park (north).

Results (last years in brackets)
There were 129 (156) observations.
Rodents were observed on 0 occasions (0).
Flies were observed on 0 occasion (1).
Odour was observed on 1 (6) occasions.
Birds were noticed on 0 (4) occasions.
Noise was observed on 0 (0) occasions.
Loose litter was seen on 0 (2) occasions.

Compost

The compost as analysed satisfies the limits for heavy metals in a Grade 1 compost.

Appendix

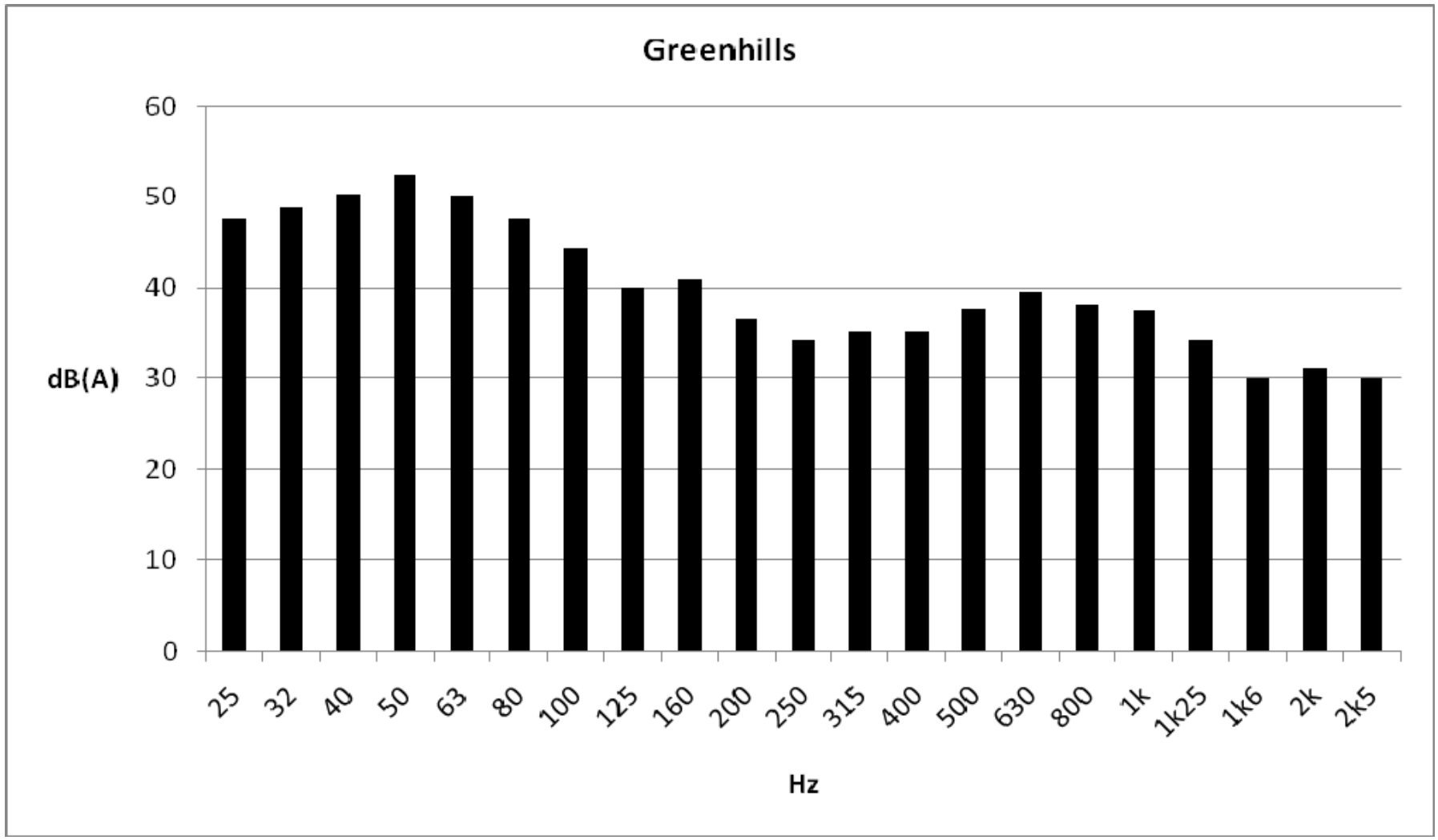
Graphs

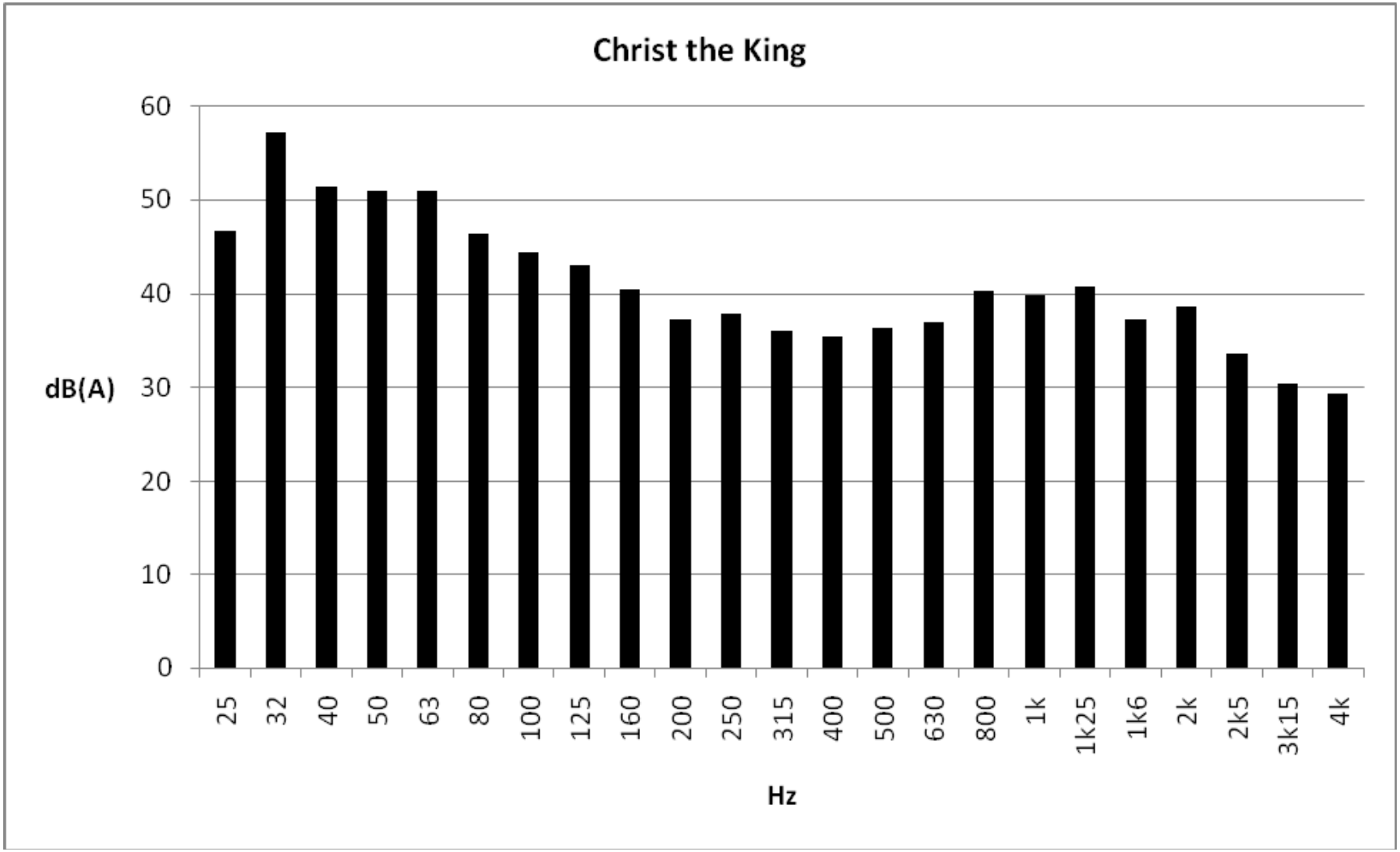
- Noise Monitoring
- Landfill Gas
- Surface Water

Reports

- Biological Survey of Streams Report
- Asbestos Monitoring Report
- Air Emissions testing of the Flare Unit & Gas Utilisation Engine
- PRTR Table for Flare Unit & Gas Utilisation Engine

Noise Monitoring Graphs




Christ the King
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10
0
25
32
40
50
63
80
100
125
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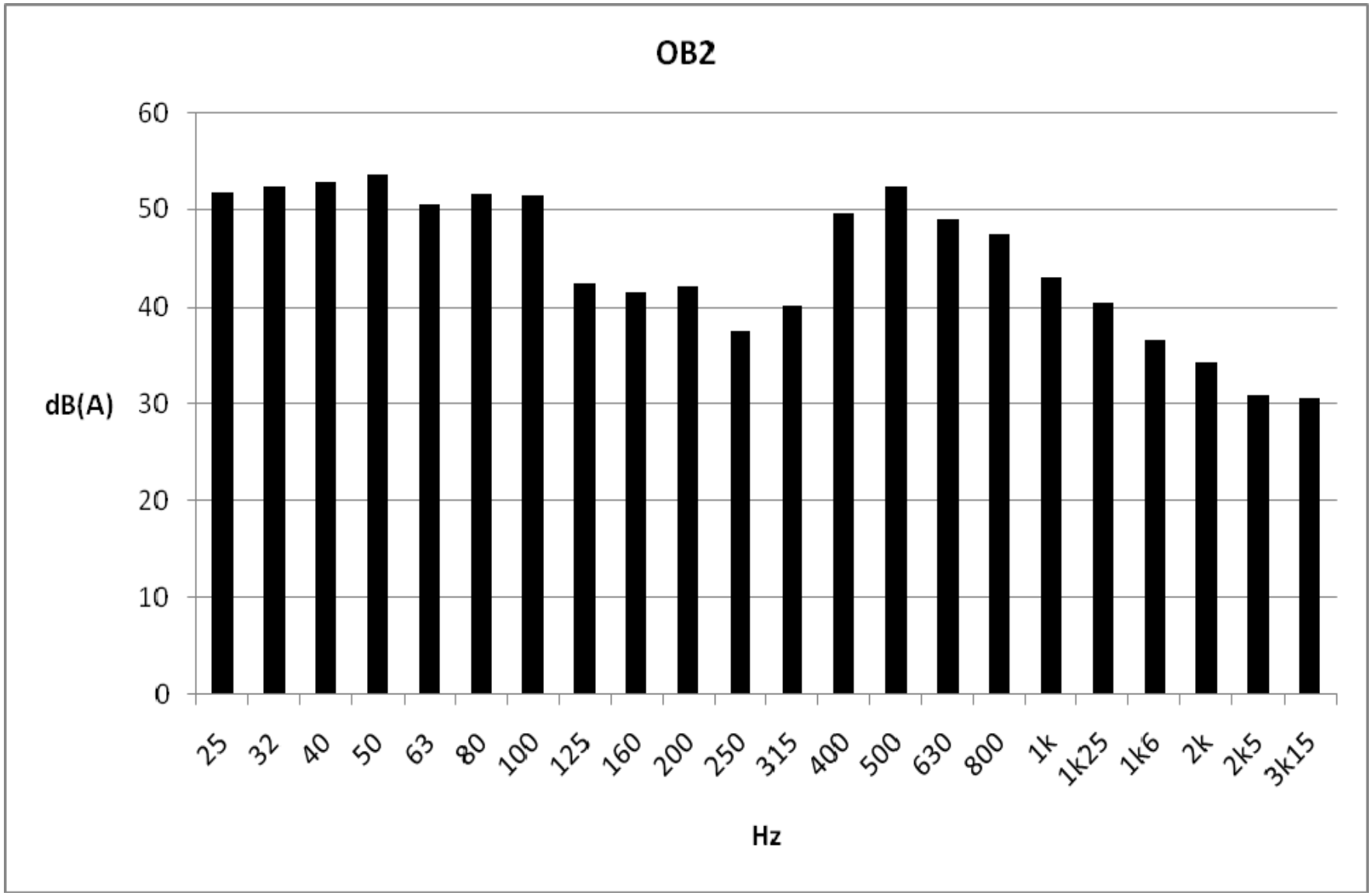
1k6
2k
2k5
3k15
4k
Hz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40
30
20
10
0
dB(A)
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32
40
50
63
80
100
125
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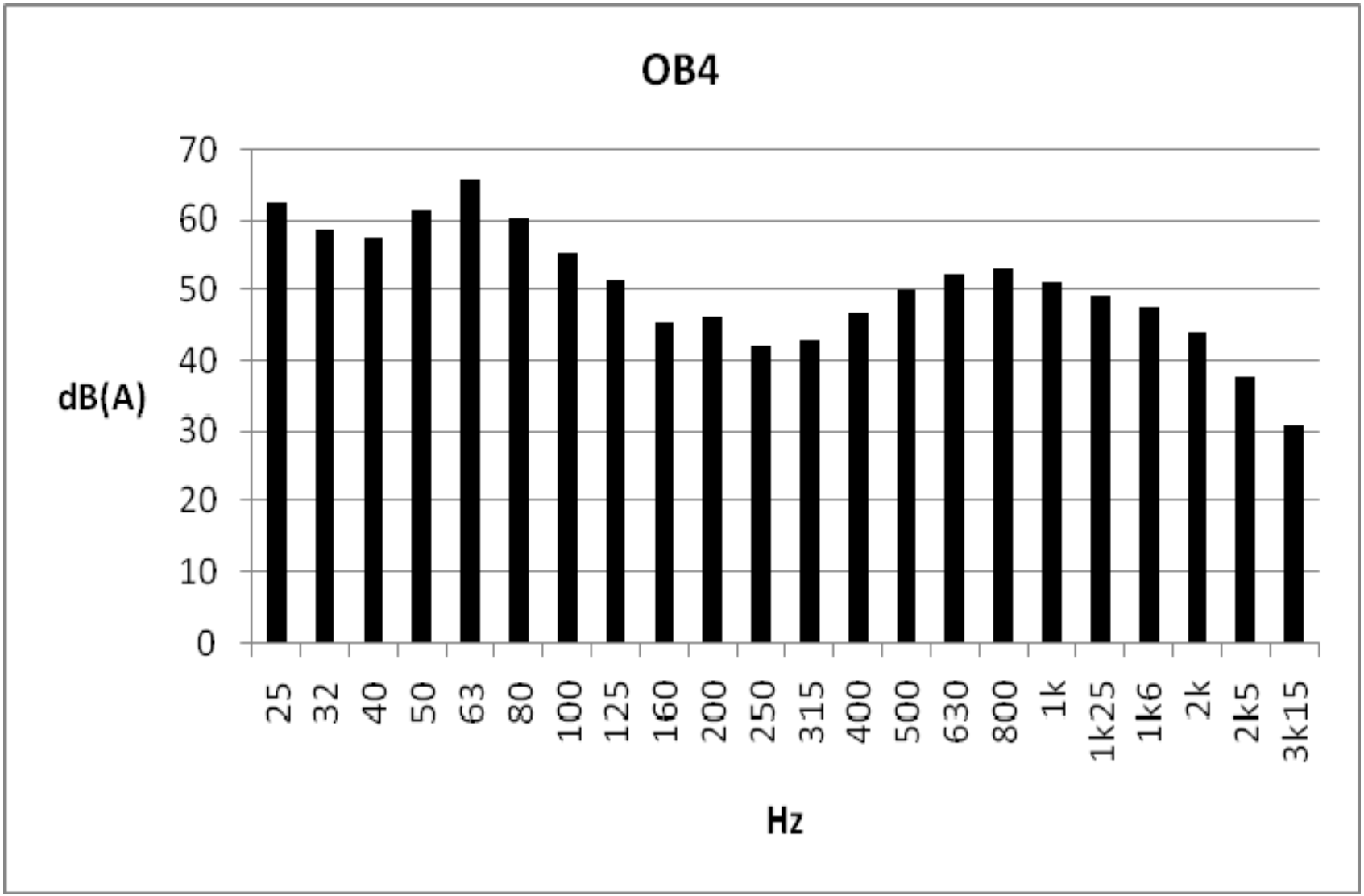
200
250
315
400
500
630
800
1k
1k25
1k6
2k
2k5
3k15
Hz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10
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25
32
40
50
63
80
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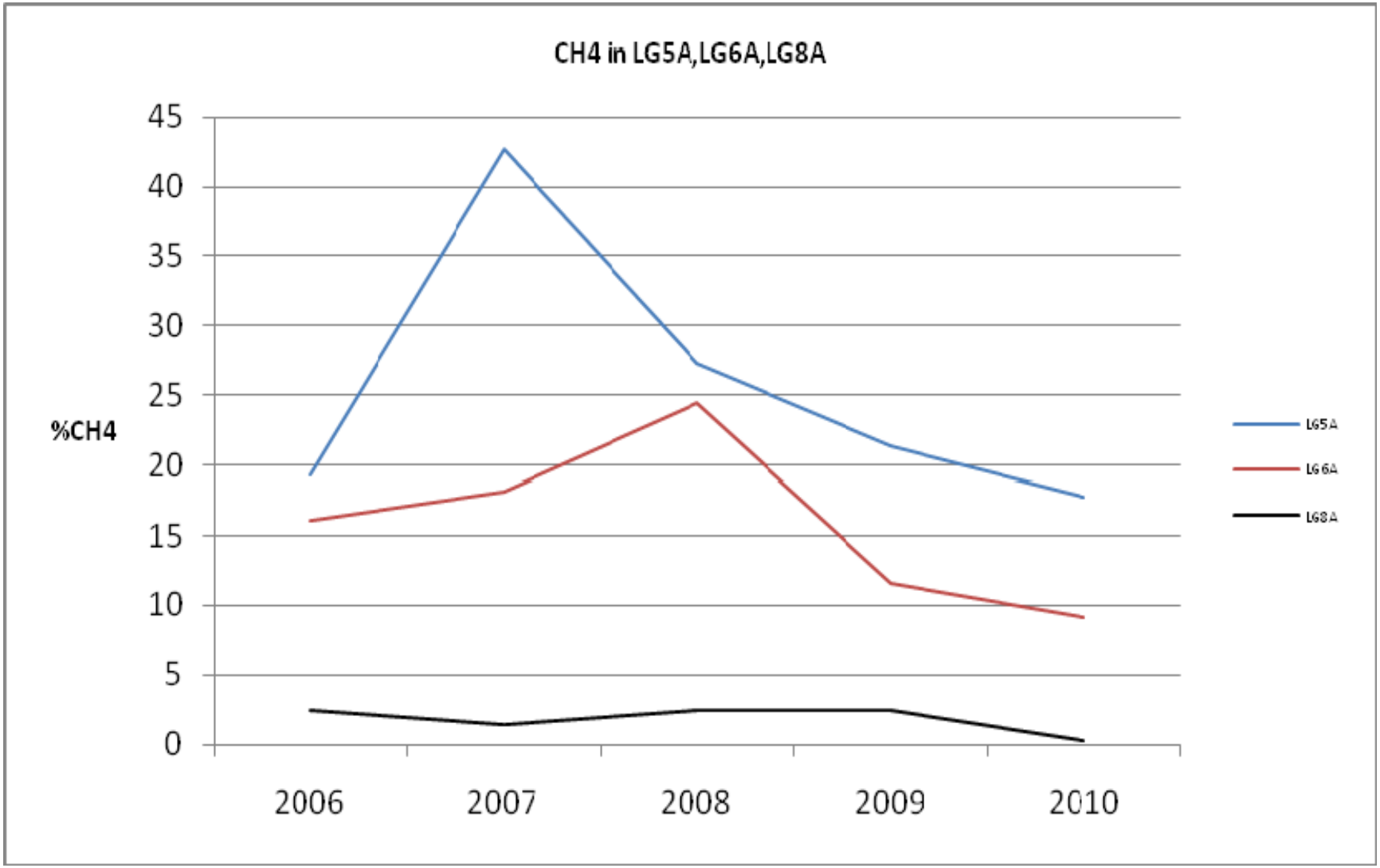
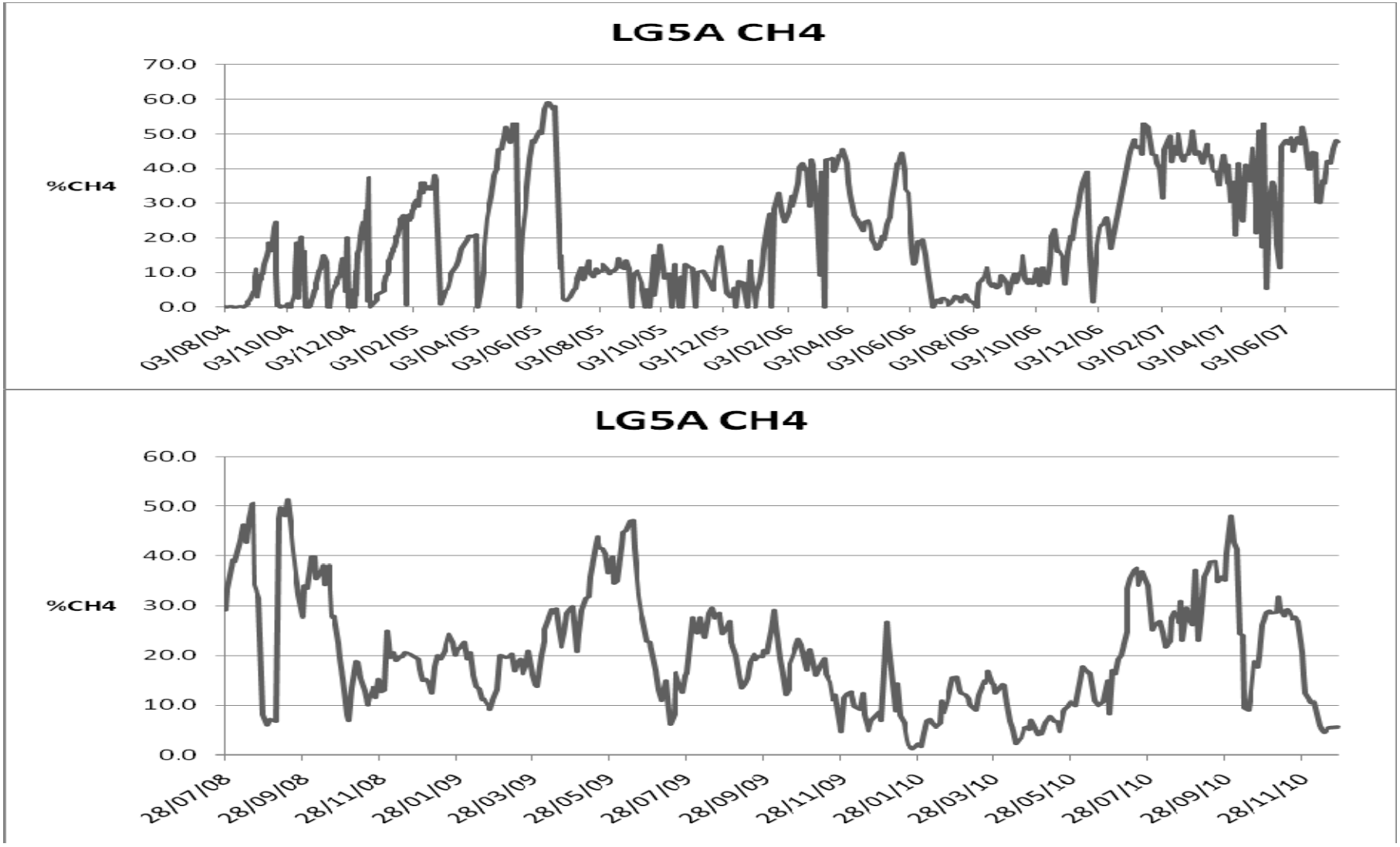
2k5
3k15
Hz

Landfill Gas Graphs

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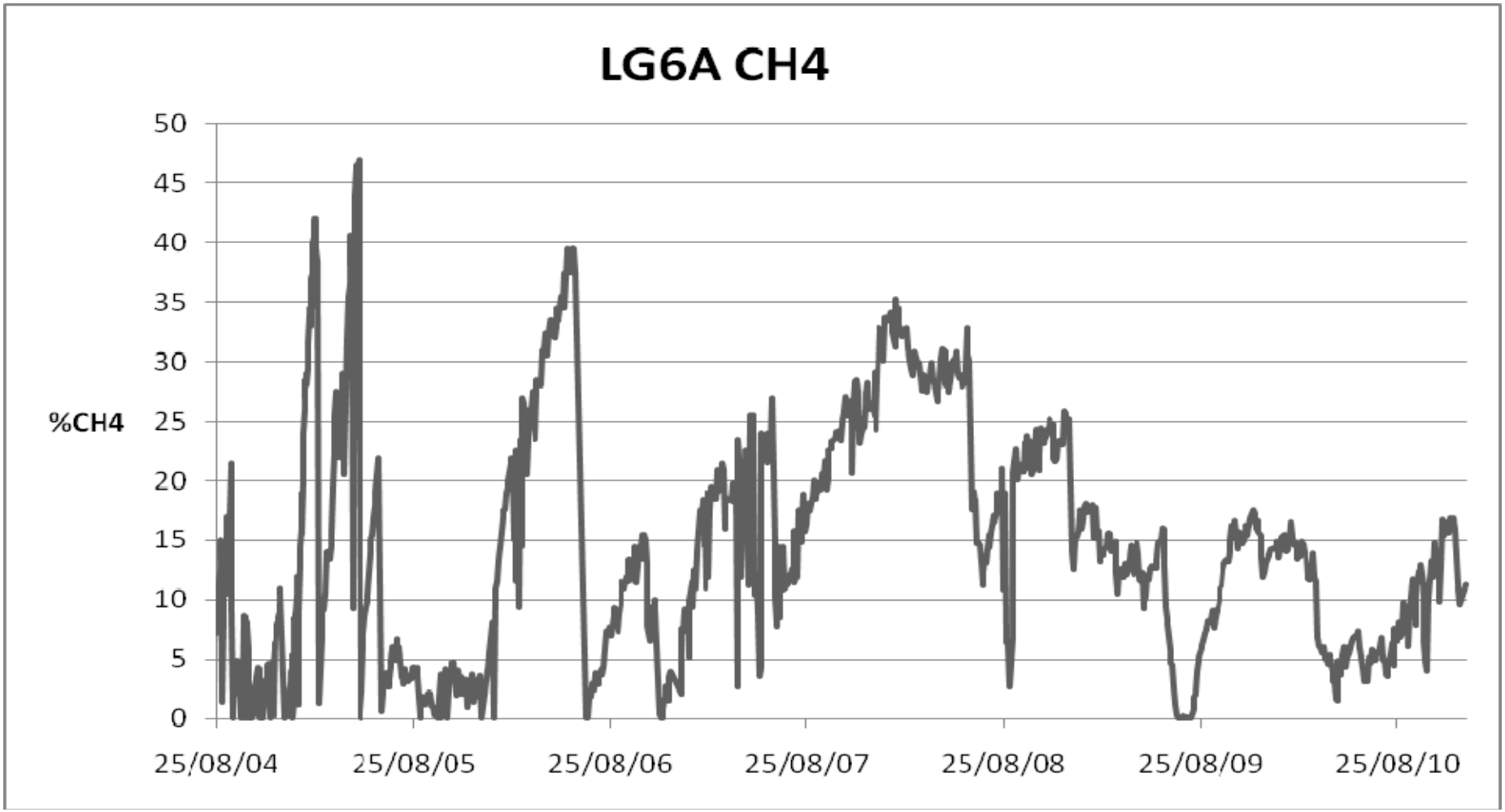
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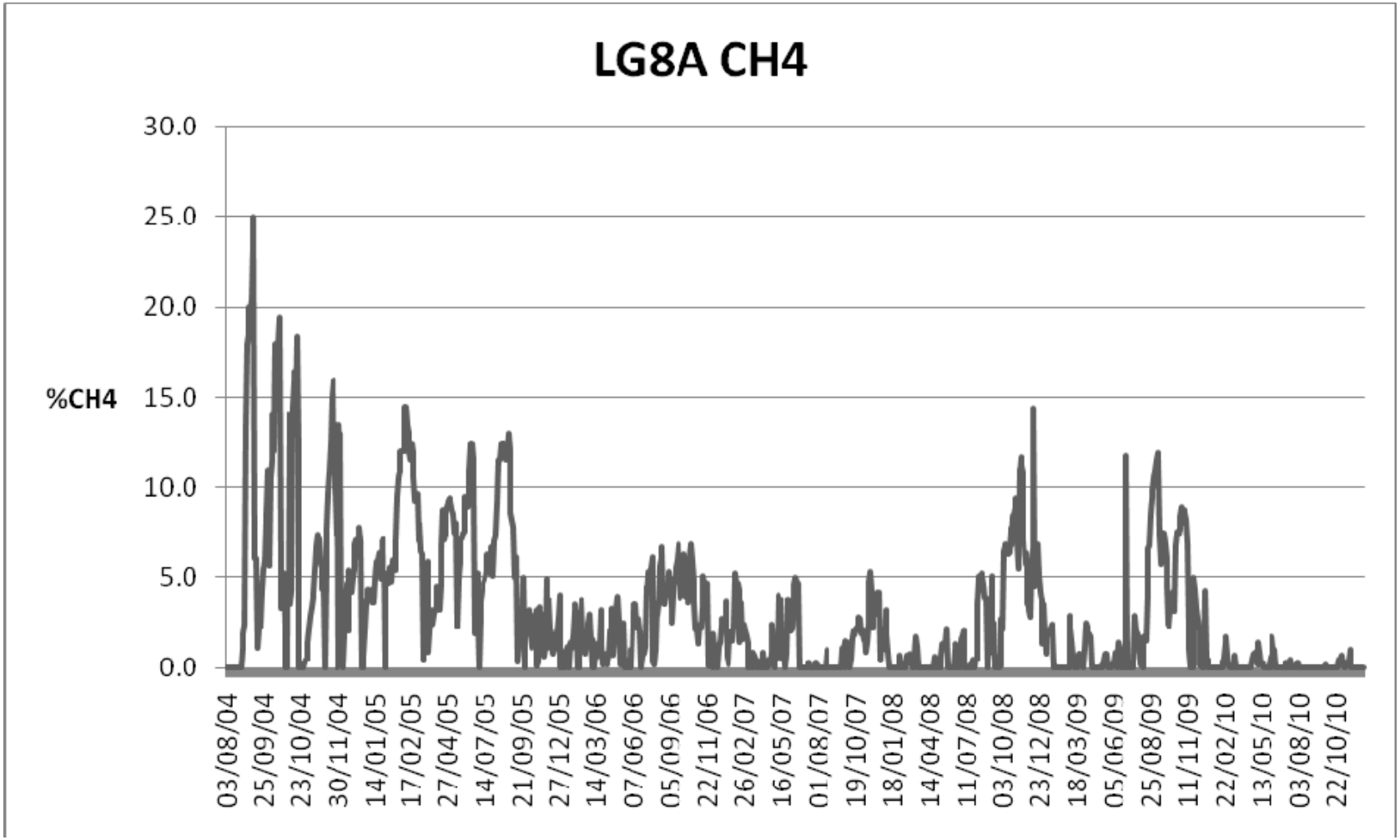
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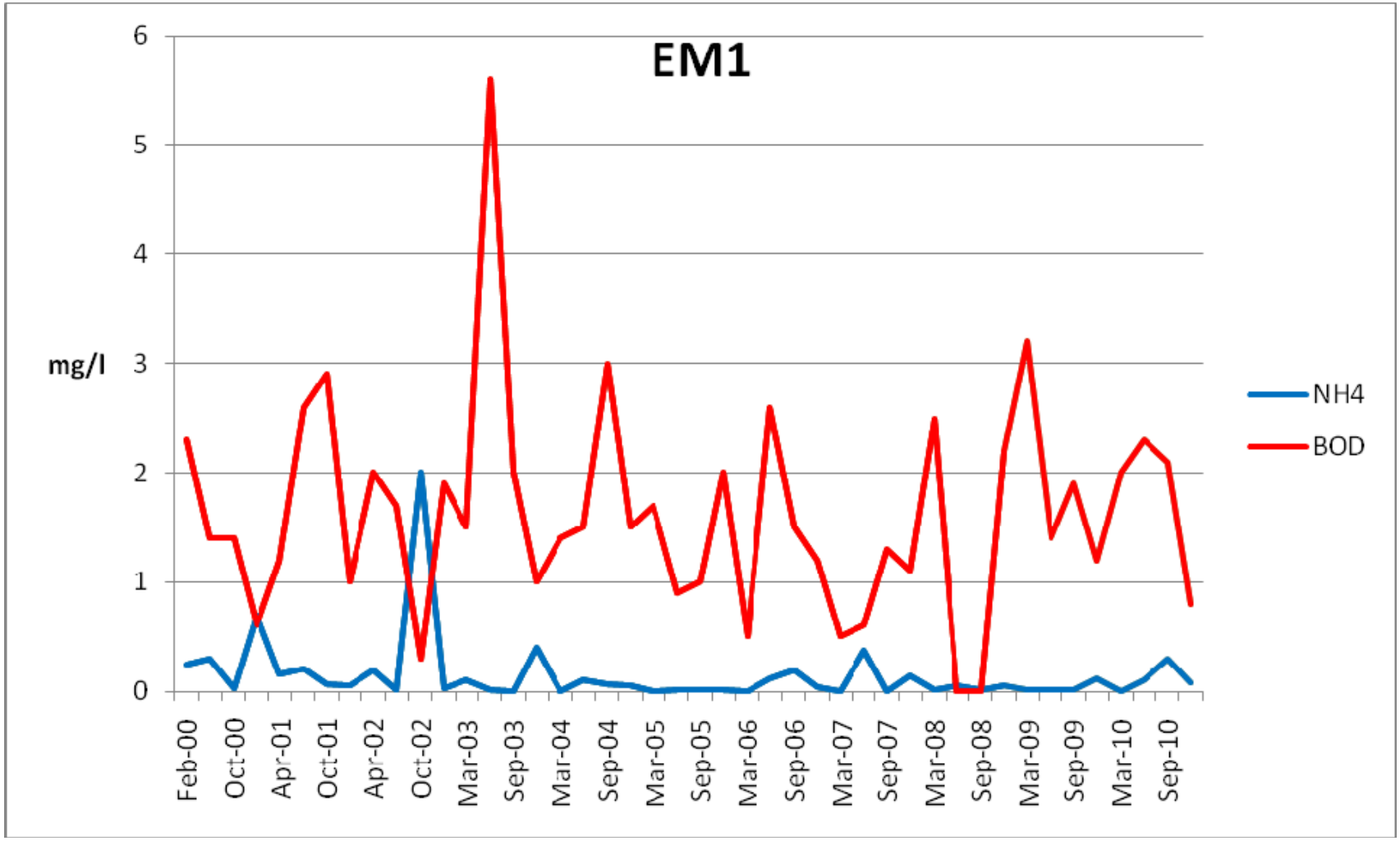
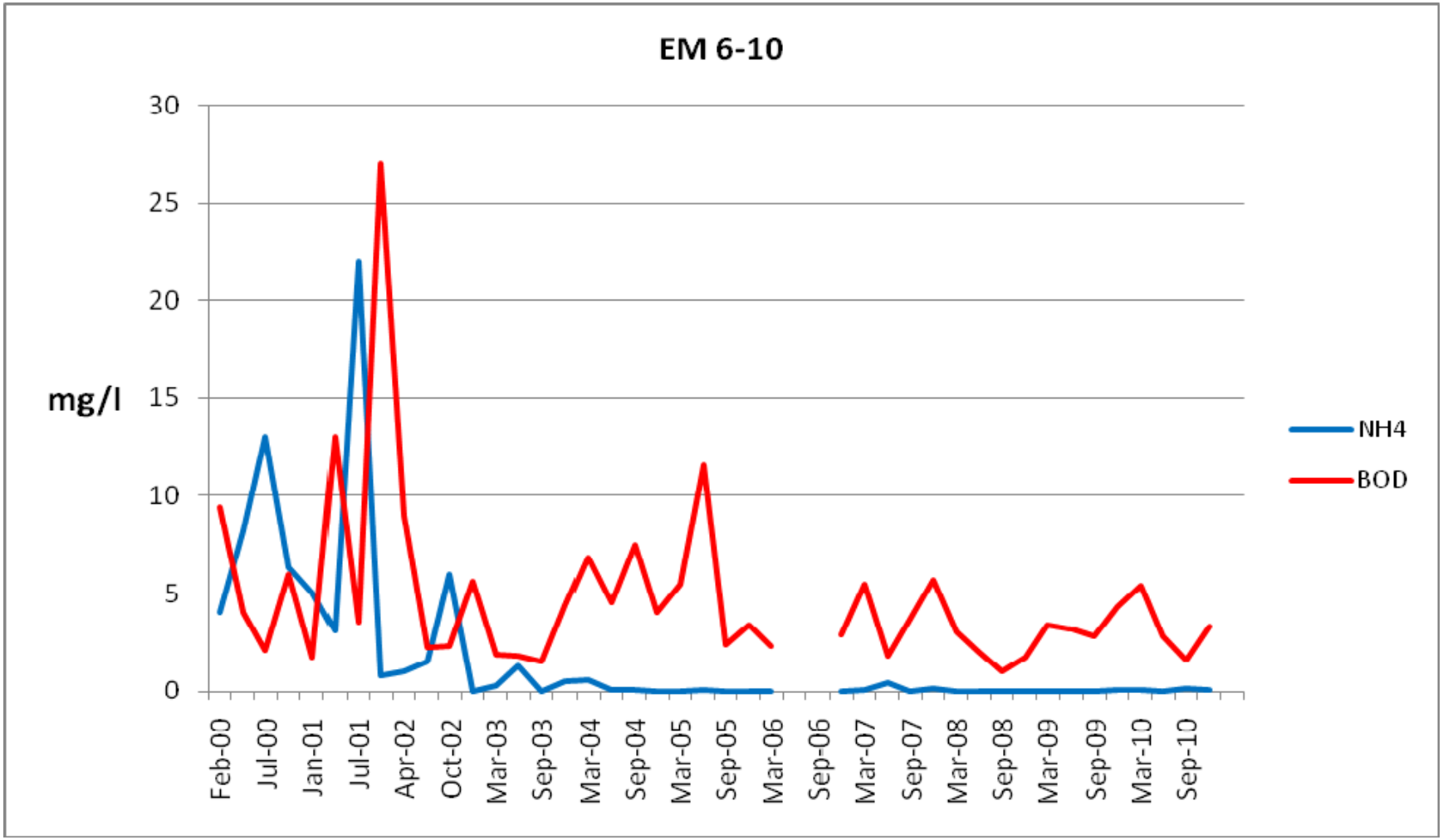
Surface Water Monitoring Graphs

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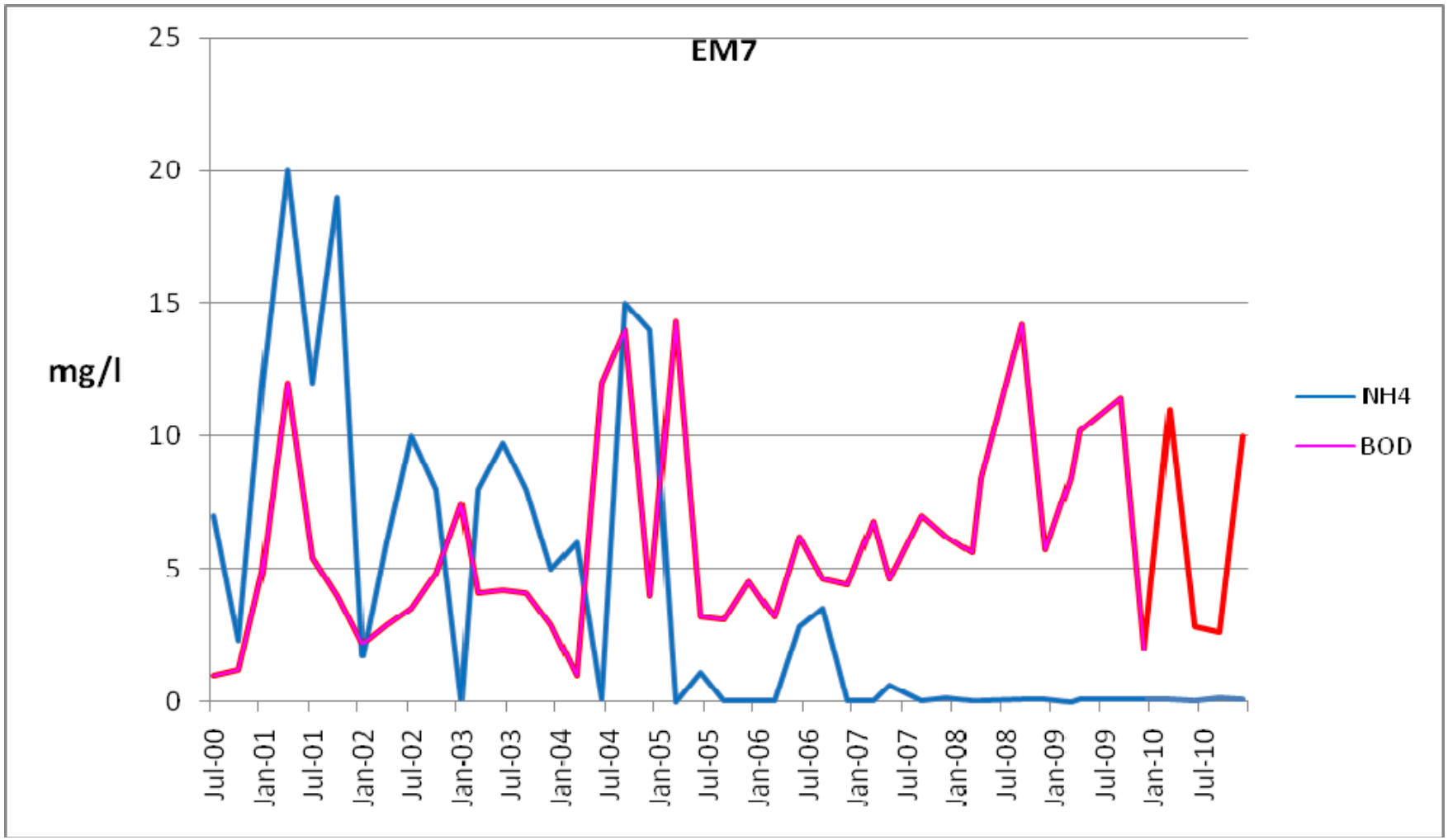
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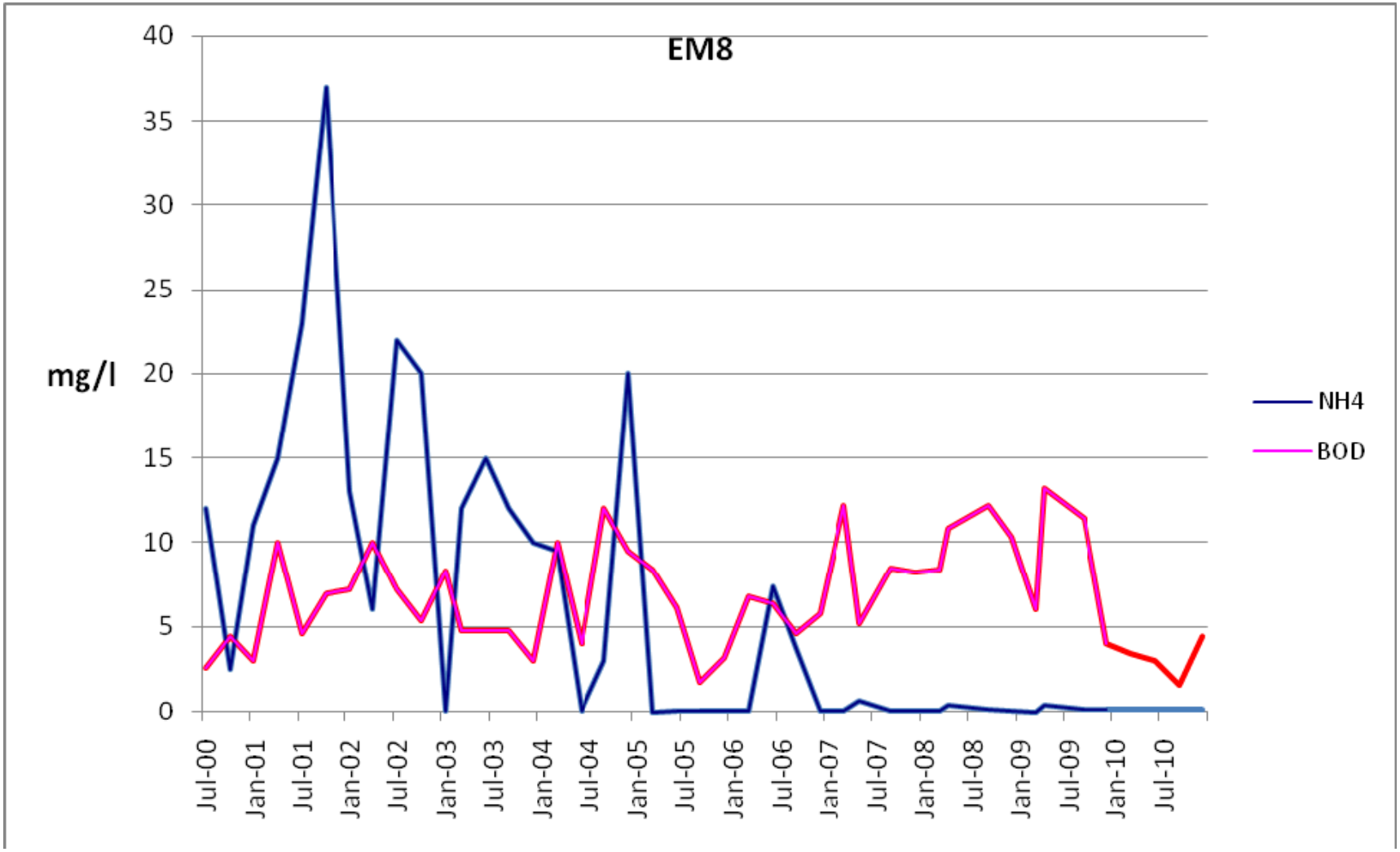
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NH4
BOD

AN ASSESSMENT OF THE WATER QUALITY STATUS OF SELECTED SITES ON THE TRAMORE AND TRABEG RIVERS USING BIOLOGICAL METHODS

(August - 2010)

Commissioned by: Cork City Council
Carried out by: Aquatic Services Unit – UCC.
(December 2010)

Introduction

As part of the their waste licence conditions for the Kinsale Road Landfill, Cork City Council commissioned the Aquatic Services Unit, to undertake a biological assessment of the water quality status of selected sites on the Tramore and Trabeg rivers. Both rivers flow adjacent to or through the site of the landfill and have in the past, at least, been impacted by leachate from the landfill. The fieldwork for the 2010 monitoring was undertaken in late August.

Methods

Two samples (combined as one composite) were taken at each site using a kick-sample technique, where this was possible. Each sample was collected in areas of moderate to shallow swift current in coarse substrate usually comprising small to large stones and cobbles. The samples were then sieved to remove silt and poured into a white sorting tray. There the macroinvertebrates present are identified and their notional abundance estimated. The macroinvertebrate data arising is then assessed using the same biotic index system used by the Environmental Protection Agency (EPA) in their on going monitoring of biological quality in Irish rivers. The index assigns a score to the macroinvertebrate collection at a given site depending on the relative proportion of pollution sensitive and pollution tolerant organisms present. The greater the number and diversity of pollution sensitive types present (particularly, certain mayflies, stoneflies and cased caddis flies) the higher the score or quality class assigned to a given site. The highest score category is Q5 which indicates pristine water quality conditions and is recognised by having a high proportion of pollution sensitive species and very few or any pollution tolerant forms, whereas Q1 at the other end of the scale indicates gross pollution. The table below indicates the Q-value scores, which can be assigned and the corresponding degree of pollution associated with them.

Q-Value	**Degree of Pollution**
Q5, Q4-5, Q4	Unpolluted
Q3-4	Slightly Polluted
Q3, Q2-3	Moderately Polluted
Q2, Q 1-2, Q1	Serious to Gross Pollution

It's important to point out that few sites on the Tramore and Trabeg rivers have sites, which could be said to be ideal for this system of biological monitoring, and some are completely un-suitable (e.g. Sites A and B). In the latter cases the flow is very sluggish and the bottom material consists mainly of mud or peaty mud. In these cases, general observations and experience were used in order to gauge the likely biological water quality status. Furthermore, the second most upstream site on the Tramore River at the 'ford' within the landfill was partially modified since the last survey in 2009 by the installation of a crump weir for discharge gauging. This weir has resulted in the water upstream becoming stiller and more sluggish than usual.

Results

Samples were taken on August 30th 2010 at sites the positions for which were agreed with the EPA and listed in the conditions of the licence.

Site A *(Trabeg River: Upstream Site)*

There was no perceptible flow at the site, which was completely chocked with water Starwort (Callitriche sp.), which covered the entire water surface across the channel. Diatom scum was also in evidence on the plants (Plate 1). These conditions are similar or slightly improved on last year. Conditions at the time were quite dry and run-off probably quite low, which probably helped the water quality. Net-sweeps through the floating vegetation were dominated by *Asellus*, with juvenile gammarid species also common (for the first time). Flatworms (*Dugesia* sp?) were numerous as were tanypod chironomid larvae; one water beetle was collected. Overall, while the flow conditions and substrate were not suitable for assigning a Q-value, the conditions would point to a Q-rating of around Q2 or 2-3, i.e. an improvement on last year.

The left bank margin was dominated by Watercress (*Rorippa nasturtium-aquaticum*) and Fool's Watercress (*Apium nodiflorum*), while the right channel margin was being encroached by Reed canary-grass (*Phalaris arundinacea*). The left bank behind was dominated by Willow with Bramble and Fuschia also common. Nettle and Great Willowherb (*Epilobium hirsutum*) were also present. The Right bank by herbaceous species including Angelica (Angelica sylvestris), nettle, Hedge bindweed, Creeping Thistle and *Phalaris*. (note, a moorhen or coot was heard calling close by)

Site B *(Trabeg River: 2nd Site Downstream)*

This site is like Site 1 in being a very slack flow site dominated by a muddy bottom and also with clear water. There was virtually no out-gassing from the muddy sediment which had a well oxidised brown surface. 60-80% of the open water of the channel was encroached upon by Water starwort, with some Duckweed (*Lemna* sp.) interspersed (Plate 2). Apium occurred occasionally at the margins. The left bank was covered in Bramble, Nettle, occasional Great Willowherb and Bindweed, backed by scattered large Willow. The right bank had scattered small Willow along with Soft Rush, Nettle, Hedge Bindweed, Creeping Thistle and Cleavers (*Galium aparine*).

Nets-weeps were dominated by *Asellus*, occasional to frequent gammarids, 1 juvenile baetid mayfly (first time a mayfly has been recorded here) and water beetles in the overlying water and *Chironomus* and tanypodinae in the mud. Like Site A, the conditions were unsuitable for Q-ratings, because of the muddy substrate and almost standing water conditions. Nevertheless, there were signs of a very slight improvement on last year's conditions and a Q-rating of Q2 to Q2-3 is suggested.

Site C *(Tramore River: most upstream site within the landfill boundary)*

This site is at a fording point in the Tramore River within the precincts of landfill and at the same point is crossed by a kind of bridge for carrying pipes. Since the 2009 sampling, a crump weir has been built at this site for discharge gauging and this has had the effect of creating a stilling basin immediately upstream, where the substrate has become even more silted than usual (Plate 3). The bottom upstream of the weir at the 'ford' comprises heavily silted gravel and small cobble covered in filamentous green algae and diatom scum. Above the crossing point stands of *Typha latifolia* (Greater Reedmace / Bullrush) and branched Burr-reed dominate, with Willow on both banks. Below the weir, Broad-leaved Pondweed (*Potamogeton natans*) dominates in-channel with loose scattered amounts of submerged Water Starwort common. Dense stands of *Sparganium erectum* are also present here with Willow along the banks.

Kick-samples were taken in immediately downstream of the weir in a spot which was a little silted. The results are at presented in the table below. They indicate grossly polluted conditions very similar to 2009.

Macroinvertebrates in Site C kick-samples

Common Name of Group	**Scientific Name**	**Notional Abundance**
Non-biting Midges	Chironomidae	+++
Water Beetles	Haliplid adult	+
Wandering Snail	*Lymnaea peregra*	++
Snail	*Planorbis* sp.	+/+
Snail	*Potamopyrgus jenkinsi*	++++D
Pea Mussels	Sphaeridae	+++
Water Hog Louse	*Asellus*	++
Segmented worms	*Lumbriculus variegatus*	+++
Water mites	Acari	++++
Stickleback		7
EPA Q-value		**Q 2 (Q2-3)**

Site D *(Tramore River: 2nd site downstream of boundary)*

This site is at the 2007 location. The sampling point is at a constriction in the river where the channel flows over a small rock weir immediately downstream of a sluggish stretch, which is dominated by Broad-leaved Pondweed (bank to bank) (Plate 4). Upstream the channel is occluded by dense stands of Typha with P. Natans dominant floating vegetation and Woody nightshade (*Solanum dulcamara*) also common among the *Typha* and bankside vegetation. The right bank was dominated by Great Willowherb, Nettle, Woundwort and grass backed by Alder, while the left bank was dominated Nettle and Bindweed, also backed by Alder and Willow. In-channel *Potamogeton natans* dominates downstream, while *Vaucheria* and *Cladophora* are common on the stones of the semi-submerged 'weir'.

In channel the substrate of the kick-sampling area (just on the weir) comprised angular limestone cobbles and small boulders in a moderate to swift turbulent flow. Results were very similar to 2009 (see Table below).

Kick-sample results Site D:

Common Name of Group	**Scientific Name**	**Notional Abundance**
Mayflies	*Baetis*	+
Non-biting Midges	Chironomidae	++++D
Water beetle larva	Coleoptera	+
Water Hoglouse	*Asellus aquaticus*	+++
Wandering snail	*Lymnaea peregra*	++
Ram's Horn snails	*Planorbis sp.*	+++
Jenkin's Spire shell	*Potamopyrgus jenkinsi*	+++
Pea mussels	Sphaeridae	+++
Leeches	*Glossiphonia complanata*	+
Leeches	*Helobdella stagnalis*	++/+
Leeches	Erpobdellid	+
Segmented worms	Tubificidae	+
Water mites	Acari	+++
Flatworms	Tricladia	+/+
Fish	Eel	1
EPA Q-value		**Q2**

Site E *(Tramore River upstream of the landfill: outside the boundary to the west)*

Access to the site remains very difficult despite some vegetation clearing by City Council staff in 2008. Here the channel, which has been generally over-widened upstream as a result of drainage, narrows through the eye of a small bridge (W6780 6943) – Plate 5. This site was chosen as it is the only one in this section of channel which can be sampled; the listed site (200m u/s) is pure sandy mud and therefore unsuitable. The substrate under the bridge (2-3m wide) is very coarse - angular cobbles and some boulders, and on this occasion was completed silted with virtually no water velocity. It isn't certain, but the new weir at Site C may be contributing to the dead water observed at the site on this occasion.

The site is very shaded and effectively plant free. Immediately upstream of the bridge the channel is much wider (>10m) and comprises deeply silted channel with large stands of *Typha* and *Sparganium erectum,* which are now encroaching on virtually the entire channel. Willow dominates the left bank, while the RHS bank had Willow, Alder, Bramble and a herbaceous understorey. There is also a very large growth of the alien invasive species Japanese Knotweed (*Fallopia japonica*) just upstream of the bridge. The whole system would benefit from some channel dredging and channel reinstatement to improve the geomorphology of the river. The site remains seriously polluted.

Kick-sample results Site E:

Common Name of Group	**Scientific Name**	**Notional Abundance**
Non-biting Midges	Chironomidae	++/+
Non-biting Midges	Tanypodinae	++/+
Water Hoglouse	*Asellus aquaticus*	+++
Pea mussels	Sphaeridae	++++
Leeches	*Glossiphonia complanata*	++/+
Leeches	*Helobdella stagnalis*	++
Fish	Stickleback	1
EPA Q-value		**Q2**

Site F *(150m downstream of the confluence of the Tramore and Trabeg Rivers).*

This site was 150m downstream of the confluence of the Tramore and Trabeg Rivers (Plate 7). Samples were taken in slightly silty fine and coarse gravel and large pebble with sand/clay. There was 50-60% cover of algae including *Cladophora*, *Enteromorpha*. Scattered clumps of the aquatic macrophyte Horned Pondweed (*Zannichellia palustris*), was locally abundant at and downstream of the site. This species is tolerant of eutrophic and brackish conditions. 2 small dead shore crab were noted upstream of the kick-sampling site. The left bank is dominated marginally by Phalaris with Nodding Bur-marigold (*Bidens cernua*), *Apium*, *Callitriche* and *Veronica* backed by Gorse, Bramble and Nettle. The right bank had *Phalaris*, *Apium*, water pepper (*Persicaria hydropiper*), Woundwort and grass, backed by Willow.

Kick-samples were taken toward the centre of the channel in suitable substrate. The water quality was very similar to that recorded in 2009 and remains seriously polluted but there seems to have been a slight improvement in quality since last year.

Kick-sample results Site F:

Common Name of Group	**Scientific Name**	**Notional Abundance**
Non-biting Midges	Chironomidae	++++D
Water beetle adult	Haliplid	+
Water Hoglouse	*Asellus aquaticus*	++/+
Freshwater shrimp	*Gammarus* sp.	++/+
Jenkin's Spire shell	*Potamopyrgus jenkinsi*	++
Pea mussels	Sphaeridae	++++
Leeches	*Glossiphonia complanata*	+
Leeches	*Helobdella stagnalis*	+
Leeches	Erpobdellid	+
Water mites	Acari	+++/+
Fish	Stickleback	1
EPA Q-value		**Q2**

Conclusion

In 2009 all of the sites showed similar results to 2009, however, at Sites A, B and F there were some signs of slight improvements, possibly due to low levels of run-off during the dry summer.

Plate 1 Trabeg River: Site A 30-08-2010

Plate 2 Trabeg River: Site B (view of channel) 30-08-2010

Plate 3 Tramore River: Site C (view upstream) 30-08-2010

Plate 4 Tramore River: Site D (view downstream to kick-sample site) 30-08-2010.

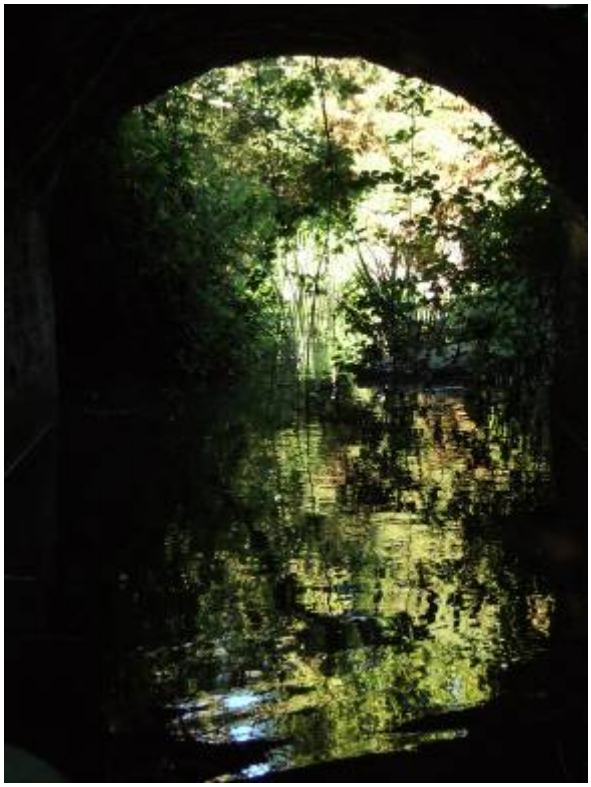

Plate 5 Tramore River: Site E (view d-s to kick-sampling point) 30-08-2010

Plate 6 Tramore River: Site F (view d-s to kick-sampling point) 30-08-2010

Plate 7 Tramore River Site F: showing close-up of substrate with algae and *Zannichellia*. (30-08-2010)

CONFIDENTIAL REPORT

Client:
Cork City Council,
Landfill Office,
Kinsale Road Landfill Site,
South Link Road,
Cork.

Title:
Analysis of Soil Samples

Attention: Ms Cathy Healy

Report ref. ACS 10-247

Order no: TBA

Date recd: 2nd December 2010

Report by: P. G. Byrne

Copies to:

Date: 2nd December 2010

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6. **The laws of Ireland shall apply.**

INTRODUCTION

Five samples of soil taken from the landfill listed below were received for determination of the presence and type of asbestos.

TESTS

The samples were first oven dried for several hours at a temperature in excess of 110 degrees Centigrade. The lumps of clay were broken up using a pestle before the samples were brushed through a 5 mm sieve several times and both fractions weighed (the 1st weight (in grammes) in the table below is the fraction under 5 mms). The fraction larger than 5 mm (whose weight is in brackets was mainly small stones, grass and other vegetation, (sample 4 was completely different in the respect that apart from a small lump of calcite there was little in the way of small stones) was examined for the presence of asbestos containing materials and then discarded. A single layer of the finer fraction was spread on to a large glass tray and examined by stereo microscopy at a magnification of 10x. The sample was then vigorously raked with a dissecting needle (in a magnet like fashion any white asbestos fibres will adhere to the needle). In order to examine the entire fraction this operation was repeated several times for each sample. No inert fibrous material was found in any of the samples examined.

RESULTS

Site :- Kinsale Road Landfill Site, Cork

Sample Identification	Laboratory No.	Result
Site 1 - Heatherton park 411.9, (142.0)	10/373	No asbestos detected – three quarters of the sample was fine clay
Site 2 – OB 2 426.1, (298.3)	10/374	No asbestos detected – as site 1 with slightly more stone content
Site 3 – near EM 8 511.4, (170.5)	10/375	No asbestos detected – similar weight ratios to sample 1
Site 4 – OB7 198.9, (21.3)	10/376	No asbestos detected – calcite like stone noted in this small sample
Site 5 – near laboratory 610. 8, (213.1)	10/377	No asbestos detected – similar weight ratios to sample 1

Note: This report refers exclusively to the samples submitted for analysis.

ODOUR & ENVIRONMENTAL ENGINEERING CONSULTANTS

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

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

AIR EMISSION TESTING OF ONE LANDFILL FLARE AND ONE GAS UTILISATION ENGINE LOCATED IN KINSALE RD LANDFILL, BALLYPHEHANE, CURRAGHCONWAY, INCHISARSFIELD, SOUTH CITY LINK ROAD, CORK.

PREFORMED BY ODOUR MONITORING IRELAND ON BEHALF OR CORK CITY COUNCIL

PREPARED BY:	Dr. Brian Sheridan
ATTENTION:	Ms. Cathy Healy
REFERENCE:	Waste licence W0012-03
DATE:	02nd Dec 2010
REPORT NUMBER:	2010A350(1)
REVIEWERS:	Ms. Cathy Healy

TABLE OF CONTENTS

Document Amendment Record

Client: ***Cork City Council***

Project: Air emission testing of one Landfill flare and one gas utilisation engine located in Kinsale Road Landfill, Ballyphehane, Curraghconway, Inchisarsfield, South City Link Road, Cork.

Project Number: 2010A350(1)			**Document Reference:** Air emission testing of one Landfill flare and one gas utilisation engine located in Kinsale Road Landfill, Ballyphehane, Curraghconway, Inchisarsfield, South City Link Road, Cork.		
2010A350(1)	Document for review	B.A.S.	JMC	B.A.S	02/12/2010
Revision	**Purpose/Description**	**Originated**	**Checked**	**Authorised**	**Date**

1. Introduction

This report has been prepared by Odour Monitoring Ireland and contains the results of emission testing carried out on 1 No. Enclosed ground flare and 1 No. Gas utilisation engines at Kinsale Rd Landfill, Ballyphehane, Curraghconway, Inchisarsfield, South City Link Road, Cork. The emission testing was carried out in compliance with the requirements of Waste licence W012-03.

Odour Monitoring Ireland was commissioned by Ms. Cathy Healy, Environment Section, Cork City Council to perform emission testing of the 1 landfill gas flare and 1 gas utilisation engine stack located within Kinsale Rd Landfill, Ballyphehane, Curraghconway, Inchisarsfield, South City Link Road, Cork. The parameters listed in *Table 1.1* were monitored using the appropriate instrumentation as illustrated in *Table 1.1*.

Table 1.1. Monitored parameters and techniques for Kinsale Rd Landfill 1 No. Enclosed flare and 1 No. Gas utilisation engine located in Kinsale Rd Landfill, Ballyphehane, Curraghconway, Inchisarsfield, South City Link Road, Cork.

Sample location	Parameter	Analytical method
1 Landfill Flare and 1 Gas utilisation engine TV01 outlet	Volumetric airflow rate & Temperature (^{0}C)	Pitot in accordance with EN13284-1 where possible. MGO coated K type thermocouple and PT100 Volumetric airflow rate theoretical calculated for Landfill flare.
1 Landfill Flare and 1 Gas utilisation engine TV01 outlet	Oxides of nitrogen (NO_X as NO_2), Carbon monoxide (CO), Carbon dioxide (CO_2), Sulphur dioxide (SO_2), and Oxygen (O_2)	Flue gas analyser, Testo 350/454 MXL
1 Gas utilisation engine TV01 outlet	Total non methane VOC's	Portable Signal 3030PM FID calibrated with Propane in accordance with EN13526:2002 non- methane hydrocarbon cutter. Charcoal tube/GCMS
1 Landfill Flare and 1 Gas utilisation engine TV01 outlet	Total Volatile Organic Carbon	Portable Signal 3030PM FID calibrated with Propane in accordance with EN13526:2002.
1 Gas utilisation engine TV01 outlet	Total Particulates	TCR Tecora isokinetic Particulate sampler with QMA (Quartz) high temperature filters in accordance with ISO9096:2003.
1 Landfill Flare and 1 Gas utilisation engine TV01 outlet	Total sulphur, Hydrogen chloride and hydrogen fluoride	Impinger train containing 0.10 molar sodium hydroxide and deionised water solution in accordance EN1911, EPA 26A and EN15713:2006

This report presents details of this monitoring programme. This environmental monitoring was carried out Dr. John Casey, Odour Monitoring Ireland on the 18th November 2010. Methodology, Results, Discussion and Conclusions are presented herein.

2. Materials and Methods

This section provides brief details of the methodology employed to perform emission testing of one landfill flare and one gas utilisation engine stacks located in Kinsale Rd Landfill, Ballyphehane, Curraghconway, Inchisarsfield, South City Link Road, Cork.

2.1 Volumetric flow rate and temperature measurement

The volumetric flow rate of the landfill flare was determined from theoretically calculated total volumetric flow rates using the assumptions presented in *Appendix II*. The inlet landfill gas velocity measurements were calculated from the CEMS monitoring system within the landfill flare control building. In addition, airflow measurement was performed on the inlet header gas main using a pitot tube and differential manometer connected to a Testo 454/350 MxL. Outlet airflow rate measurements on the gas utilisation engines stacks were carried out in accordance with EN13284-1:2002, where possible (when sufficient duct diameters upstream and downstream of the sample location). Temperature traverse measurements were performed across the stack in one plane only. Only one plane was possible due to access port issues. A magnesium oxide K type and PT100 thermocouple was used for measuring temperature in one landfill flare and one gas utilisation engine.

2.2 In stack analysis of flue gases

Flue gas analysis was performed using a pre-calibrated Testo 350 MXL/454 flue gas analyser. Concentrations of Oxygen, Sulphur dioxide, Carbon dioxide, Temperature, Carbon monoxide and Oxides of nitrogen were measured using electrochemical cells within the analyser box and all data was logged electronically in 1 minute intervals during the sampling exercise. Data was downloaded from the control handheld using the Com soft software and average concentrations calculated are presented within. All results presented are at 273.15 K, 101.3 kPa on a dry gas basis.

2.3 Total non-methane volatile organic compounds (TNMVOC)

In order to measure total non-methane VOC, a total non-methane hydrocarbon cutter was placed in line with and MCERTS certified FID whereby concentrations of total volatile organic carbon and total non-methane organic were displayed digitally upon the display. This allowed for the calculation of total non-methane VOC's. All results are presented in mg/Nm^3 as propane which is in accordance with the EN13526:2002 and EN12619:1999.

Additionally in order to obtain samples for speciated VOC assessment, a static sampling method was used where air samples were collected in pre-conditioned Tedlar sampling bags using a vacuum sampling device and dynamic dilution device (i.e. Dynasampler). 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 filling the bag inside.

All sample bags were pre-flushed with sample air in order to prevent any reductions in the actual VOC due to sample bag surface binding. A leak check was preformed on the sample setup by placing a Primary flow calibrator inline. Once sample acquisition was completed, the sample bag was transferred to another location and connected to the sample pump, tube and Primary flow calibrator. A two bed sorbent was chosen to efficiently bind and pre-concentrate speciated VOC for analysis by GCMS in accordance with established and accredited methodologies. Sealed sorbent tubes were used throughout the study to maintain repeatability and integrity. All sampling for speciated VOC's was preformed in accordance with methodologies discussed within EN 13649:2002.

In order to pre-concentrate speciated VOC upon each sorbent, a pre-calibrated controlled volume of sample air was drawn through each tube by a SKC pump for a period 40 to 80 minutes. Each SKC pump was pre-calibrated with their specific sorbent using a Bios Primary

flow calibrator (NIST traceable certified). Each pump was calibrated to a flow of between 70 to 120 ml min^{-1} depending on the sample, sample pump and sorbent tube as recommended by the sorbent manufactured, analysing laboratory and sampling/test methodology. When sampling was completed all tube were sealed and stored in flexible airtight containers and transported to the laboratory.

2.4 Heated Flame Ionisation Detector-Total hydrocarbon concentration (THC) determination

A heated portable FID (MCERT certified), heated line, controller and data logger was used to analyse the duct air stream for total hydrocarbon concentration. Once stabilised and calibrated using span gas (Propane-500 ppm), a sintered probe connected to a 181 ^{0}C heated line was place in the air stream. After stabilisation, the data logger was activated and commences reading. The FID remained analysing continuously for approximately 45 minutes in the duct air stream. Results were presented as mg [THC] m^{-3} as propane. All sampling was performed in accordance with methodologies contained within EN 13526:2002 and EN12619:1999.

An FID operates on the principle where influent contaminated gas is mixed with hydrogen and the mixture is burned at the tip of a jet with air or oxygen. Ions and free electrons are formed in the flame and enter a gap between two electrodes, the flame jet and a collector, mounted 0.5-1.0 centimetres above the flame tip. A potential (400 volts) is applied across the two electrodes and with the help of produced ions, a very small current flows between the two electrodes. When an organic substance is introduced this is burned in the flame; a complex process takes place in which positively charged carbon species and electrons are formed. The current is greatly increased and therefore the sample is detected. The FID is a mass flow detector, its response depending directly on the flow rate of the carrier gas. Its response also varies with applied voltage and the temperature of the flame.

The following procedure was used for operating the FID:

1. The FID was switched on and the oven temperature and sample line temperature were allowed to stabilise. The set-point temperatures were 181 ^{0}C sample line temperature and 200^{0}C oven temperature. This took approximately 45 minutes.
2. The Hydrogen / He fuel and Propane calibration gases (500 ppm) were attached to the instrument.
3. Once temperatures had stabilised, the instrument was started and the ignition procedure was commenced.
4. Once ignited, the sample procedure was commenced and any VOC upon the sample line was baked off.
5. The analyser was zero calibrated and span calibrated. Zero air is supplied via the on board thermal oxidiser. There is less than 1% of range or 1.6 mg/m^3 in eight hours whichever is greater (see Section 6.1 of EN12619:1999 and Section 6.2.1 EN13526:2001.
6. The analyser calibration procedure was rechecked and recorded,
7. The sample line was checked by presenting calibration gas in the sample line. The value was confirmed to be the value and recorded. This reading must be less than 5% difference from the span/zero reading.
8. The probe was inserted into the stack.
9. The datalogger was commenced (10 second intervals) and manual readings were taking and recorded (every 1 minutes).
10. The instrument was re-spanned every approximately 45 minutes to confirm calibration reading and to isolate any drift.
11. The recorded concentrations were converted for ppm TOC propane to mg/m^3 TOC using the equation contained in Annex E and F of EN12619:1999 and EN13526:2002, respectively.

The analyser is MCERT and TUV approved. The MCERTS certification covers EN12619:1999 and EN13526:2002.

2.5 Particulate sampling and analysis

Particulate sampling was performed using a TCR Tecora iso-kinetic stack sampler and a range of sampling nozzles in accordance with EN113284-1:2002. Once airflow, oxygen and temperature measurements were made, the specific sampling airflow range was established using the onboard self-adjusting computer. The sample port did not obeyed the 2 & 5 requirements (i.e. that is the sampling location is 2 duct diameters upstream and 5 duct diameters downstream from the nearest disturbance). Following cleaning of the filter holder with a brush and acetone, a pre-weighed 47 mm QMA Quartz filter was placed within the filter holder. A 4-inch male insert was used to keep the sample probe positioned within the stack. The initial dry gas pump reading, temperature, pressure and start time were recorded before sampling commenced. Continuous airflow rate and pressure readings were taken over the sampling period (depending on stack process). Once airflow and temperature standard deviations were known for the area of the stack, the filter nozzle was positioned accordingly within the stack. The filter nozzle was positioned at each location (i.e. the sample points used were located at the centre of equal areas in the sampling plane and not located within 3% of the inner duct wall) for at least 5 minutes. Once sampling was finished, the finish time and dry gas pump volume was recorded. The filter was removed from the filter holder and placed within its laboratory holder and transported to the lab. The filter holder was again washed with acetone and a brush. The particulate filters were pre-weighed in the laboratory before despatch. On return, these used filters were re-weighed and the difference in weight minus blank corrections was calculated as total particulate. This filter weighing method is based on MDHS14/3. The particulate concentration was calculated from the sample volume in mg/Nm^3. Results are presented as at standard conditions of 273 K and 101.3 kPa.

2.5.1 Total Particulate matter sampling methodology

2.5.1.1 Job preparation

A pre-site survey must first be taken to obtain the following information. Client details (name and address), description of stack to include name and location), sample platform/access, Hazards, Power supply and location, additional PPE required.

The Iso stack TCR Tecora automatic isokinetic particulates measurement equipment is fully inspected prior to use and its calibration stats observed. This includes:

Pitot tube-All pitot tubes are checked for damage/burrs, paying particular attention to the inlet holes. All dirt and blockages are removed.

Micro manometer-Digital differential pressure metres that are used are capable of measuring in the range of 0 Pa to 2250 Pa with a sensitivity of $\pm$1 Pa. The instrument is checked for physical damage, battery life test and calibration status observed.

Nozzles-All nozzles used have been constructed in accordance with EN13284-1 and ISO 9096:2003. Each nozzle is physical checked for damage and removed if necessary. The nozzle calibration status is observed.

Flow metre-The flow metre is checked for blockages and obvious physical damage. Its calibration status is also observed.

Rope kit-All lifting tackle is physical checked for cuts and contamination.

Laboratory-The gravimetric testing house selected is UKAS accredited for the particular test method.

2.5.1.2 Filter selection and preparation

Stack conditions can vary for temperature, moisture, acidity, low and heavy particulate loading. Following the pre-site survey, the stack condition should be known and the appropriate filter can be selected and prepared as described below.

Filter mediums-glass wool, quartz wool, Low ash PVC membranes and a range of thimbles can be used depending on stack characteristics. Quartz filters were used in this instance as glass fibre filters can react to SO_3 and lead to overweight measurement.

Filters are prepared by drying in an oven at 180^0C for a period of 1 hour and placed in a dessicator to cool. The filters are weighed accurately on a 4-figure balance and then placed in clean filter holder before transport to site. Spare filters are also prepared.

2.5.2 Sampling location

2.5.2.1 Suitability of sampling location

Before sampling can commence, a preliminary velocity and temperature survey must be undertaken along the two sampling lines at nine equally concentric spaced areas in the stack. This is performed in accordance with ISO10780:1994. The procedures as set out in *Section 2.1* were followed. The stack diameter is measured using a steel rod. The angle of gas flow must be less than 15^0 with regard to duct axis. There should be no local negative flow. The minimum velocity should be larger than 5 Pa for Pitot tube measurement. Sampling is undertaken from either four or eight sampling points on each plane. Sampling points shall be located either more than 3% of the sampling line length or more than 5 cm whichever is the greater value from the inner wall. If the ratio of the highest to the lowest dynamic pressure exceeds 9:1 of the ratio of the highest to lowest gas velocity exceeds 3:1, another sampling plane should be used. Sampling is undertaken from either four sampling points on each plane. Temperature is also measured at nine equally spaced points along the sampling line and average temperature calculated during the initial survey. Should the temperature at any of the sampling points differ by more that ±10% from that of the average, then that point must not be used.

The required number of sampling points can now be calculated using the following:

- 8 point sampling on two planes, circular stacks 0.067 X D, 0.25 X D, 0.75 X D, 0.933 X D.

2.5.2.2 Leak checks

A leak check is undertaken before and after the isokinetic sampling is carried out. This is to make sure that all intake volume is through the sampling nozzle only.

2.5.2.3 Sampling

Once the isokinetic sampling flow rates have been calculated, the probe is inserted into the stack at 90^0 to the stack gas flow, as not to impinge any particulate matter on to the filter media prior to sampling. The filter head is allowed to attain stack temperature. The pump is started and the nozzle is turned into the flow and the timing device is started (automatic on TCR Tecora kit).

2.5.2.4 Duration of sampling

Duration of sampling time depends on:

- Ensuring adequate quantities of particulate matter on the filter for weighing (> 0.3% of the filter weight),

- Whether cumulative or incremental sampling is undertaken,
- The number of sampling points,
- The continuity of the plant operation.

2.5.2.5 Cumulative sampling

After the first sample is taken from the first sampling location, the probe is moved to the next position and the values recorded. This should be performed until all sampling points have been used. Sampling is continued till all locations are sampled.

2.5.2.6 Repeat Velocity and temperature readings.

Since the TCR Tecora is an automatic system, continuous velocity and temperature readings are carried out using the instrument. All data is stored upon the on board computer and recorded following the sampling event. The % DI (deviation) is also computed and recorded continuously.

2.5.2.7 Weighing of the sample

When finished, the sample filter is placed in its container and all particulate from the filter head is added to the particulate matter on the filter (i.e. filter wash).

The used filter is placed in an over at 160^0C for at least 1 hour and dried thoroughly, cooled and equilibrated is a dessicator and weighed as quickly as possible so as to avoid any errors to moisture. The gross weight of the filter should be measured to within $\pm$0.01 to 0.10 mg. The filter weight and any of the residual particulate matter from the filter head can then be used in the final report to calculate the particulate concentration.

2.6 Hydrogen chloride (HCL) and Hydrogen fluoride (HF) analysis

Volatile chloride and fluoride gas concentrations were determined using an impinger train containing 0.10 molar sodium hydroxide and deionised water solution, in which such gases are readily soluble. The sampling methodology was based upon USEPA Method 26 and the European Standard, EN 1911. Small sorption liquid volumes were used to attain lower limits of detection. Impingers were placed in series to ensure effective trapping of chloride and fluoride gas concentrations.

The sampling probe was placed within the stack and sample air was drawn through a heated sample line and two glass midget impingers containing 0.10 molar Sodium hydroxide positioned in series. Sampled solutions were sealed and transported to the UKAS accredited laboratory for analysis via ion chromatography (RPS Analytical laboratory, Manchester, UK). The results of mg/m^3 have been converted to mg Nm^{-3} at 273.15 K, 101.3 kPa.

2.7 Total Sulphur, chlorine and fluorine

Total Sulphur, chlorine and fluorine concentrations were monitored using an impinger train containing 0.10 molar sodium hydroxide and deionised water solution, in which such gases are readily soluble. Analysis of the impingement solution was performed using ion chromatography and ion selective electrode. The results of hydrogen chloride and hydrogen fluoride are presented in *Tables 3.2.* The results of mg/m^3 have been converted to mg/Nm^3 at 273.15 K, 101.3 kPa.

3. Results-Emission testing.

This section will present the results of the monitoring exercise.

3.1 Sampling time

Table 3.1 summarises the sampling times for stack monitoring. *Table 3.2* illustrates the inlet landfill gas parameters as characterised from the CEMS analyser system operating within the landfill flare control building. In addition, manual monitoring was performed using a GA2000 landfill gas analyser. The total volume of landfill gas utilised by the landfill flare during monitoring was 534 m^3/hr.

All outlet gas samples were taken approximately 1.20 metres below the top of the stack for the landfill flare and approximately 0.35 metres for TV01. All sampling was performed through the existing 25mm and 100 mm sampling ports on the landfill flare and gas utilisation engine, respectively. A one-plane oxygen and temperature traverse was performed to assess any difference in oxygen concentrations and temperature across the sampling plane. Temperature and Oxygen differences were less than the 15% deviation level as recommended by the UK Environmental Agency (Guidance for monitoring enclosed Landfill flares, 2002).

3.2 Volumetric flow rate results

Sampling for airflow rate was not performed in accordance with EN13284-1:2002 due to sample port position and access restrictions on the landfill flare. *Table 3.3* summarises the theoretical airflow rate calculations for the Landfill gas flare. The data obtained for the one gas utilisation engines was measured using a pitot manometer. *Tables 3.4 to 3.5* includes the stack velocity, expressed in metres per second (m/s) and exhaust volumetric airflow rate expressed in m^3/hr at both actual and standard reference conditions of 273.15 K, 101.3 kPa (i.e. standard temperature and pressure).

3.3 Flue gas concentration results

Flue gas concentrations were monitored using a pre-calibrated Testo 350/454 MXL flue gas analyser. The results of SO_2, NO_x as NO_2 + NO, CO, and O_2 are presented in *Tables 3.4 to 3.5.* The results of ppm have been converted to mg Nm^{-3} at 273.15 K, 101.3 kPa, on a dry gas basis with correction for oxygen content. In accordance with EPA flare/gas utilisation engine monitoring requirements, Oxygen correction to 3% and 5% should be performed for landfill gas flares and gas utilisation engines, respectively. The average temperature of the gas analyser on the day of sampling was 284.15 K.

3.4 Total hydrocarbon concentration (THC) results

THC concentrations were monitored using a pre-calibrated FID analyser. The results of THC are presented in *Tables 3.4 to 3.5.* The results of ppm have been converted to mgC/Nm^3 at 273.15 K, 101.3 kPa, with correction for oxygen content. Conversion from ppm to mgC/Nm^3 was performed using a 1.60 multiplication factor for propane. In accordance with EPA monitoring requirements, Oxygen correction to 5% should be performed for gas utilisation engines. The average temperature of the FID on the day of sampling was 454 K.

3.5 Total non-methane volatile organic compound (TNMVOC) results

Table 3.5 illustrates the results of the continuous non-methane volatile organic compounds (TNMVOC) the monitoring locations. The monitoring of TNMVOC was performed using a TNMVOC hydrocarbon cutter and a continuous monitoring Flame ionisation detector operated in accordance with EN13526:2002 and using sorbent tube analysis by GCMS. The monitoring

of THC will provide the total hydrocarbon concentration including any propane or methane fraction within the airstream. The use of a hydrocarbon cutter facilitates the removal of the methane and propane fraction from the airstream and the presented results therefore consist of the non-methane fraction only.

3.6 Total particulates

Total Particulates concentrations were monitored using a TCR Tecora Particulate sampling train. The results of Total Particulates are presented in *Tables 3.5 to 3.8.* The results of mg/m^3 have been converted to mg/Nm^3 at 273.15 K, 101.3 kPa, with correction for oxygen content. In accordance with EPA gas utilisation engine monitoring requirements, Oxygen correction to 5% should be performed for gas utilisation engines.

3.7 Hydrogen chloride (HCL) and Hydrogen fluoride (HF)

Hydrogen chloride and hydrogen fluoride concentrations were monitored using an impinger train containing 0.10 molar sodium hydroxide and deionised water solution, in which such gases are readily soluble. The results of hydrogen chloride and hydrogen fluoride are presented in *Tables 3.4 to 3.8.* The results of mg/m^3 have been converted to mg/Nm^3 at 273.15 K, 101.3 kPa, with correction for oxygen content. In accordance with EPA flare/gas utilisation engine monitoring requirements, Oxygen correction to 3% and 5% should be performed for landfill gas flares and gas utilisation engines, respectively.

3.8 Total Sulphur, chlorine and fluorine

Total Sulphur, chlorine and fluorine concentrations were monitored using an impinger train containing 0.10 molar sodium hydroxide and deionised water solution, in which such gases are readily soluble. Analysis of the impingement solution was performed using ion chromatography and ion selective electrode. The results of Total sulphur, hydrogen chloride and hydrogen fluoride are presented in *Tables 3.2.* The results of mg/m^3 have been converted to mg/Nm^3 at 273.15 K, 101.3 kPa.

Table 3.1. Sampling time runs on the 18th November 2010 for monitoring of landfill flare and 1 gas utilisation engine.

Parameter	Approx. Sampling period for 1 landfill flare	Approx. Sampling period for one gas utilisation engine
Inlet CH_4	45 minutes	40 minutes
Inlet O_2	45 minutes	40 minutes
Inlet Total sulphur, chlorine and fluorine	45 minutes	-
Volumetric air flow rate	Theoretically calculated	Manually calculated
SO_2	45 minutes	45 minutes
NO_x	45 minutes	45 minutes
CO	45 minutes	45 minutes
O_2	45 minutes	45 minutes
CO_2	45 minutes	45 minutes
Stack gas temp	45 minutes	45 minutes
THC/TOC	45 minutes	45 minutes
Particulates	-	45 minutes
TNMVOC	-	45 minutes

Table 3.2. Characteristics of raw inlet gas to one enclosed Landfill flare gas burner and 1 No. Gas utilisation engine.

Inlet compound identity	Compound Loading Landfill Gas engine 1 and Landfill flare	Unit values
CH_4	43.1	%
CO_2	28	%
O_2	0.4	%
Total Landfill gas volumetric airflow rate	673	m^3/hr
Total Sulphur	48	mg/Nm^3
Total Chlorine	9	mg/Nm^3
Total Fluorine	0.45	mg/Nm^3

Table 3.3. Theoretically calculated landfill gas exhaust volume and physical characteristics from the Landfill flare.

Parameter	Enclosed flare
Total Volumetric methane loading (m^3/hr)	290
Total Volumetric Oxygen loading (m^3/hr)	2.6
Ratio to complete combustion of methane assuming no excess Oxygen	9.57
Oxygen concentration level in flue gas (%)	5.88
Flue gas temperature (Kelvin)[2]	1318
Theoretical calculated Volumetric exhaust airflow rate (m^3/h)	4,795
Normalised average exhaust airflow rate ($Nm^3\ h^{-1}$)[3]	993

Notes: [1] denotes data from 18th November 2010.
[2] denoted converted from degrees Celsius to Kelvin (^{0}C + 273.15);
[3] denotes normalised to 273.15 Kelvin and 101.3 kPa.

Table 3.4. Emission value results for one landfill gas flare.

Landfill Flare No. 1	Conc.	Units	Adjusted units (mg/m^3)	Emission conc (mgN/m^3)	Oxygen corrected emission conc for flare to 3% (mgN/m^3)[1]	Mass emission rate (kg/hr)	Emission limit Values
TOC	2	mgC/m^3	3.20	3.20	3.81	0.015	<10 mg/Nm^3
HCL	2.45	mg/m^3	2.45	3.35	3.99	0.016	<50 mg/Nm^3 (at mass flow > 0.30 kg/hr)
HF	0.75	mg/m^3	0.75	1.02	1.22	0.004	<5 mg/Nm^3 (at mass flow > 0.050 kg/hr)
Temperature	1045	degrees	1318	-	-	-	>1273 K
CO	0	ppm	0	0	0	0	<50 mg/Nm^3
O_2	5.88	%	5.88	-	-	-	-
Total NO_X as NO_2	49	ppm	100	100	119	0.4	<150 mg/Nm^3
SO_2	0	ppm	0	0	0	0	-
CO_2	7.89	%	7.89	-	-	-	-
Volumetric airflow rate (Nm^3/hr)	993	Nm^3/hr	-	-		833	<3,000
Inlet Methane conc	208	mg/Nm^3	-	-	-	-	-
Methane destruction efficiency	>99	%	-	-	-	-	-

Notes: [1] denotes refer to *Appendix II* for Oxygen correction calculations.

Table 3.5. Emission value results for gas utilisation engine TV01.

TV 01	Conc.	Units	Adjusted units (mg/m^3)	Emission conc (mgN/m^3)	Oxygen corrected emission conc to 5% engine (mgN/m^3)[1]	Mass emission rate (kg/hr)	Emission limit Values
TNMVOC[2]	2.85	mg/m^3	4.56	4.56	5.01	0.015	[2]20 mg/Nm^3 (at mass flow of 0.10 kg/hr)
Average THC	364	mg/m^3 [propane]	582	582	639	1.87	--
HCL	2.65	mg/m^3	2.65	3.62	3.98	0.012	50 mg/Nm^3 (at mass flows >0.3 kg/hr)
HF	0.54	mg/m^3	0.54	0.74	0.81	0.002	5 mg/Nm^3 (at mass flows >0.05 kg/hr)
Temperature	453	degrees	726	-	-	-	--
CO	448	ppm	560	560	615	1.80	<650 mg/Nm^3
O_2	6.43	%	6.43	-	-	-	--
Total NOx [as NO_2]	215	ppm	441	441	485	1.42	<500 mg/Nm^3
SO_2	0	ppm	0	0	0	0	--
CO_2	10.9	%	10.9	-	-	-	--
Particulates	19.21	mg/m^3	19.21	39.38	43.28	0.127	<130 mg/Nm^3
Volumetric airflow rate (Nm^3/hr)	3217	-	-	-	-	2928	<3,000
Inlet Methane conc	124	mg/Nm^3	-	-	-	-	-
Methane destruction eff	98.49	%	-	-	-	-	-

Notes: [1] denotes refer to *Appendix II* for Oxygen correction calculations.
[2] denotes limit values TA Luft Organics Class I 20 mg/m^3 (at mass flows >0.1 kg/hr), Class II 100 mg/m^3 (at mass flows >2 kg/hr), Class 150 mg/m^3 (at mass flows >3 kg/hr)

4. Discussion of results

Tables 3.1 to *3.5* present the results of the emission monitoring carried out on the landfill flare stack burner and one utilisation engines located in Kinsale Rd Landfill, Ballyphehane, Curraghconway, Inchisarsfield, South City Link Road, Cork.

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 600^0C 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% & 5% 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. These calculations were validated through use of the published Environment Agency equation (see *Eqn 8.3.1*) (Environment Agency, 2002).

Landfill methane destruction efficiency was calculated using the inlet methane loading concentration and the exhaust total methane hydrocarbon concentration as presented in *Table 3.4*. As can be observed, the landfill flare is achieving a methane destruction efficiency of greater than 99%. Typical reported concentrations of methane from landfill flare burner systems are in the order of 0.040% to 0.52%. The complete combustion of methane results in the formation of CO_2 and H_2O. The incomplete combustion of methane results in the formation of CO. CO concentration levels was low in the flue gas of the landfill flare.

5. Conclusion

The following conclusions can be drawn from this study:

1. A theoretically exhaust flue gas volume was calculated for the landfill flare. Actual measurements were performed on the one gas utilisation engines TV01.
2. NO_x as NO_2, SO_2, CO, O_2, Particulates, TNMVOC, HCL/HF and THC 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% and 5% (v/v) using the appropriate equations as presented in *Section 8.2*.
5. NO_x as NO_2, CO, Particulates, TOC, TNMVOC and HCL/HF in the exhaust gas of the gas utilisation engines were within the emission limit values contained in Waste licence WO12-03.
6. NO_x as NO_2, Carbon monoxide, TOC and HF/HCL emission concentrations from the landfill flare are in compliance with the emission limit values contained in Waste licence W012-03.

6. References

1. Environment Agency. (2002). Guidance for Monitoring Enclosed Landfill Gas Flares. www.environment-agency.co.uk
2. McVay, M., (2003). Personal communication. Environment Agency, Wales, UK.
3. ISO 10780, (1984). Stationary source emissions-Measurement of velocity and volume flow rate of gas streams in ducts.

- 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.
- 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.
- I.S. EN13649:2002-Stationary source emissions-Determination of the mass concentration of individual gaseous organic compounds-Activated carbon and solvent desorption method.

7. *Appendix I*-Sampling, analysis and calculation details

7.1.1 Location of Sampling

Kinsale Rd Landfill, Kinsale Rd, Ballyphehane, Curraghconway, Inchisarsfield, South City Link Road, Cork

7.1.2 Date & Time of Sampling

18th November 2010

7.1.3 Personnel Present During Sampling

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

7.1.4 Instrumentation

Testo 350 MXL/454 in stack analyser;
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.
TCR Tecora Iso-kinetic Particulate and gas sampling train
Portable Signal 3030PM FID calibrated with Propane with non-methane hydrocarbon cutter.
SKC sample pumps, Bios Primary calibrator and impinger trains.

7 OTHER INFORMATION

Information is attached for the following topics:

7.1 Meteorological Data

7.2 Resource Consumption

7.3 Compost Report

7.4 Landfill Gas Modelling Report – Section A - Report

Section B - Calculations

7.5 Water Balance Report - Section A - Report

Section B - Calculations

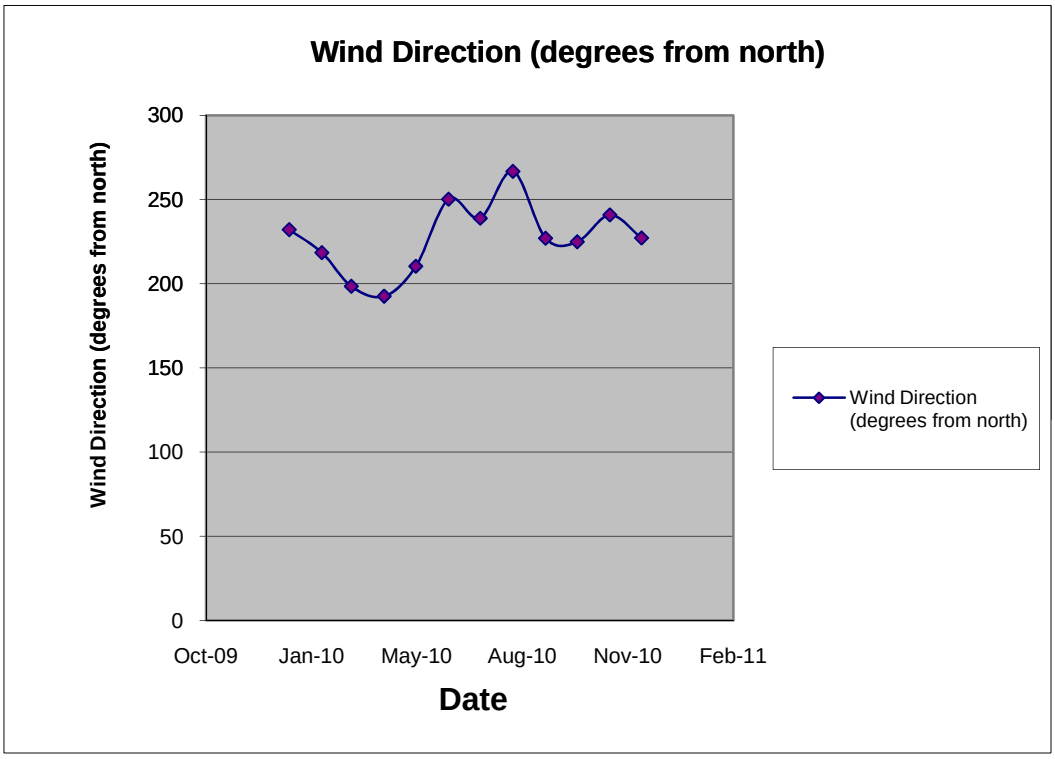
7.6 Groundwater Emissions Report - Section A - Report

Section B - Calculations

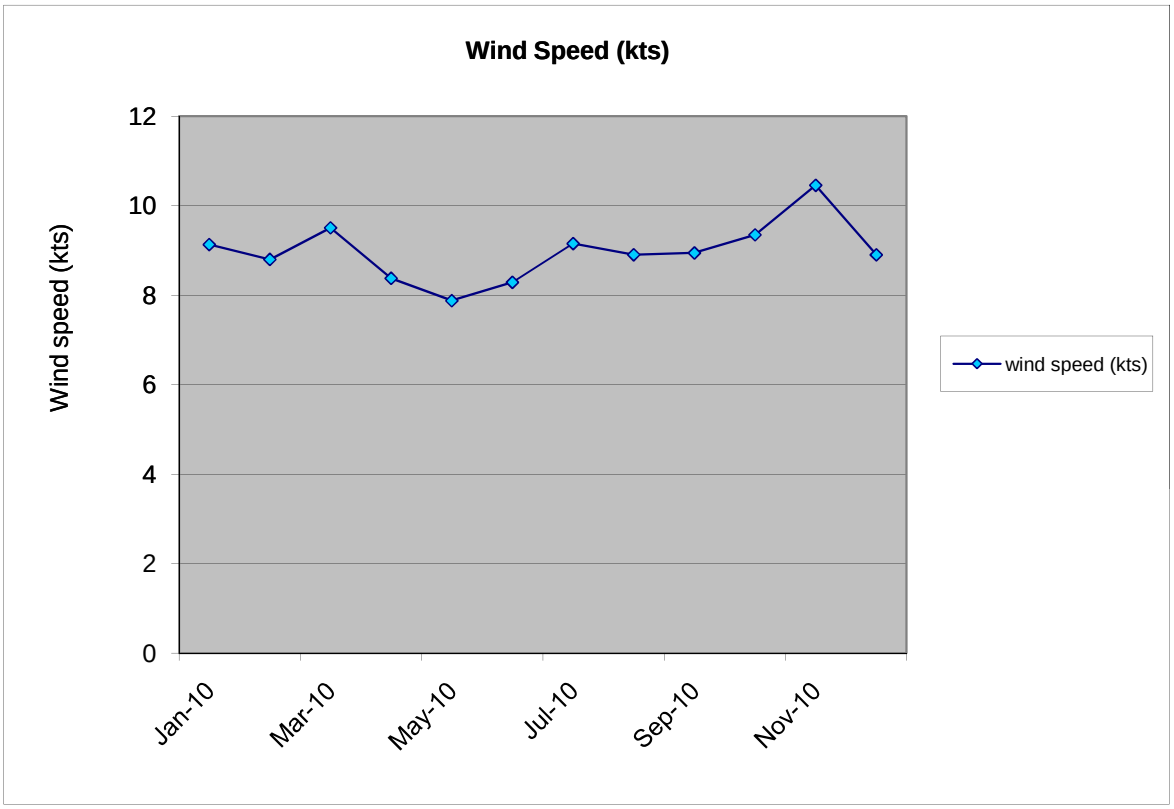
7.7 Location of Sampling Points for Asbestos Testing

7.8 Environmental Monitoring Locations

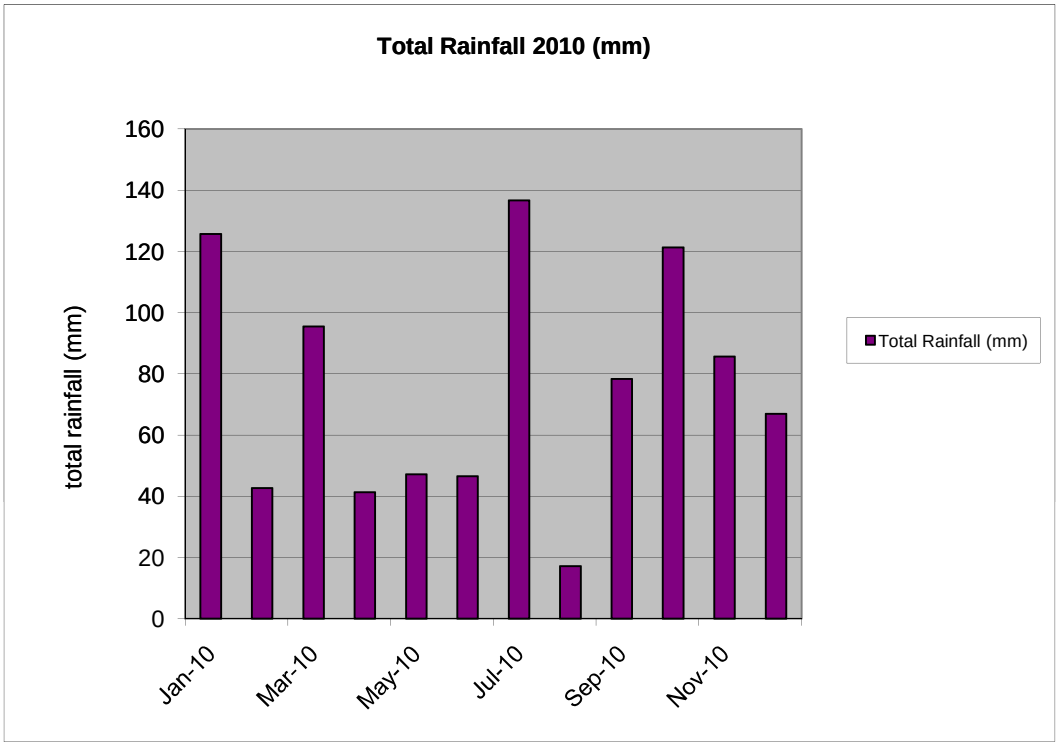
Month	Wind Direction (degrees from north)
Jan-10	232
Feb-10	218
Mar-10	198
Apr-10	193
May-10	210
Jun-10	250
Jul-10	239
Aug-10	267
Sep-10	227
Oct-10	225
Nov-10	241
Dec-10	227



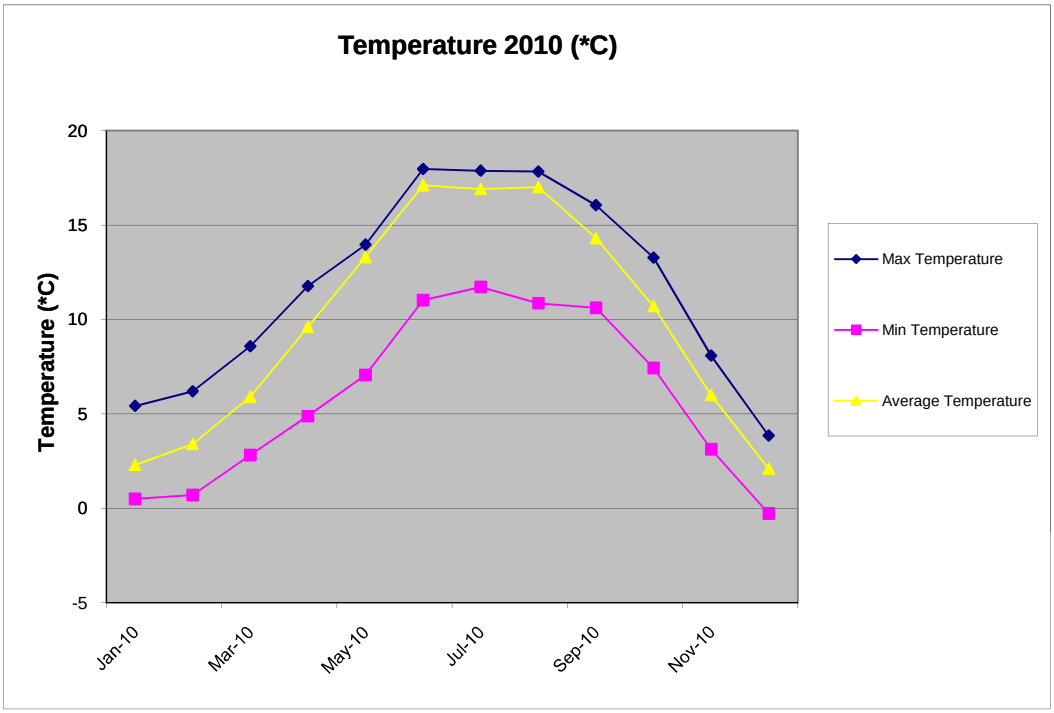
Month	wind speed (kts)
Jan-10	9
Feb-10	9
Mar-10	10
Apr-10	8
May-10	8
Jun-10	8
Jul-10	9
Aug-10	9
Sep-10	9
Oct-10	9
Nov-10	10
Dec-10	9



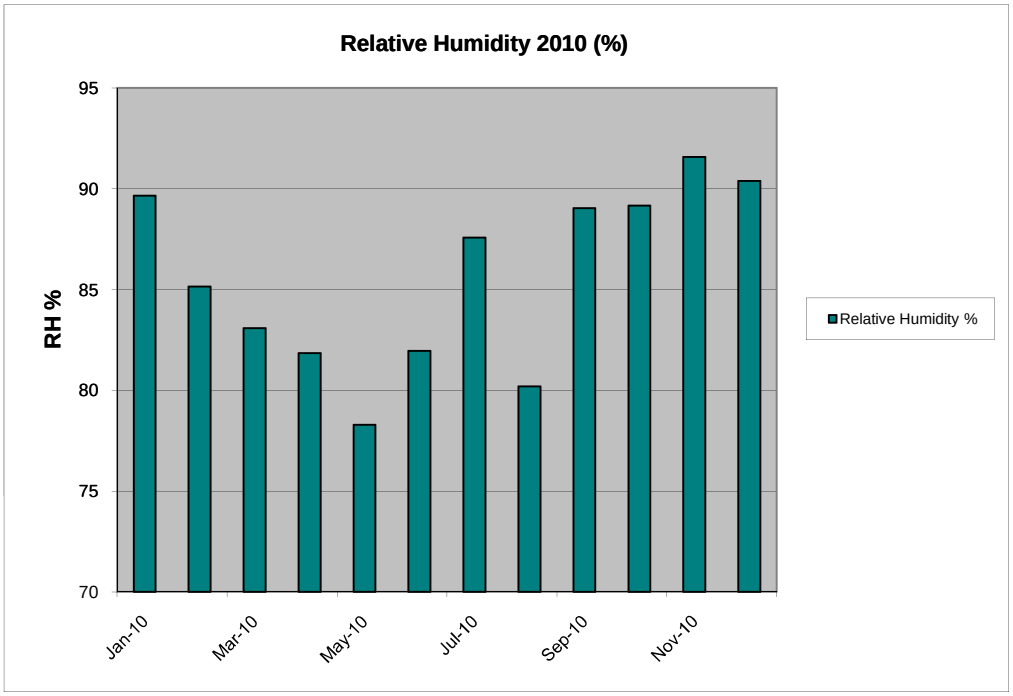
Date	Total Rainfall (mm)
Jan-10	126
Feb-10	43
Mar-10	96
Apr-10	41
May-10	47
Jun-10	47
Jul-10	137
Aug-10	17
Sep-10	78
Oct-10	121
Nov-10	86
Dec-10	67
Total	905



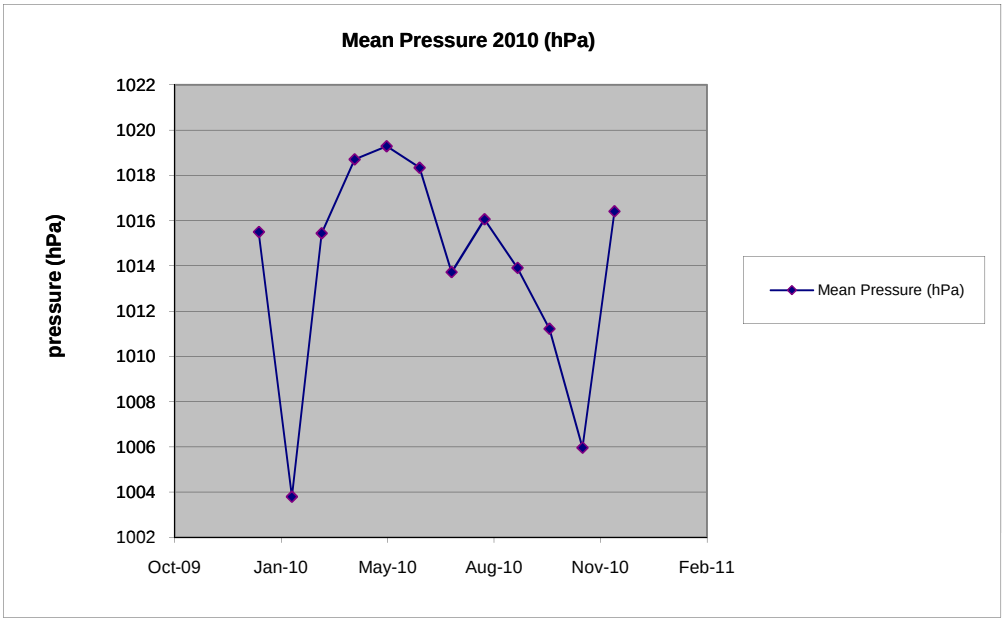
Date	Max Temperature	Min Temperature	Average Temperature
Jan-10	5	1	2.3
Feb-10	6	1	3.4
Mar-10	9	3	5.9
Apr-10	12	5	9.6
May-10	14	7	13.3
Jun-10	18	11	17.1
Jul-10	18	12	16.9
Aug-10	18	11	17
Sep-10	16	11	14.3
Oct-10	13	7	10.7
Nov-10	8	3	6
Dec-10	4	0	2.1



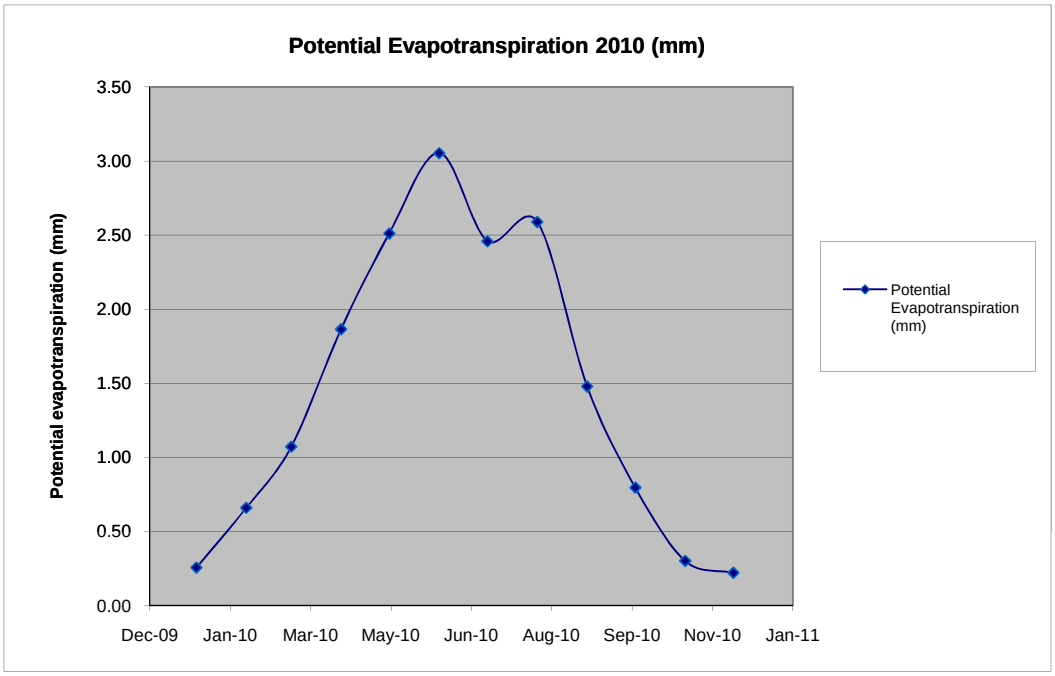
Date	Relative Humidity %
Jan-10	90
Feb-10	85
Mar-10	83
Apr-10	82
May-10	78
Jun-10	82
Jul-10	88
Aug-10	80
Sep-10	89
Oct-10	89
Nov-10	92
Dec-10	90



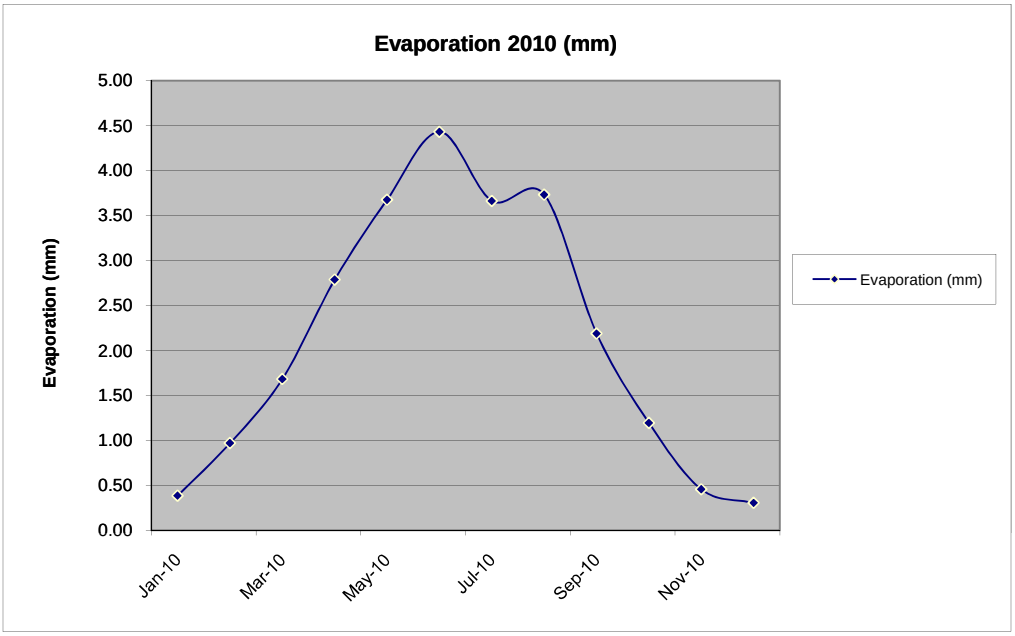
Date	Mean Pressure (hPa)
Jan-10	1015
Feb-10	1004
Mar-10	1015
Apr-10	1019
May-10	1019
Jun-10	1018
Jul-10	1014
Aug-10	1016
Sep-10	1014
Oct-10	1011
Nov-10	1006
Dec-10	1016



Date	Potential Evapotranspiration (mm)
Jan-10	0.26
Feb-10	0.66
Mar-10	1.07
Apr-10	1.86
May-10	2.51
Jun-10	3.05
Jul-10	2.46
Aug-10	2.59
Sep-10	1.48
Oct-10	0.80
Nov-10	0.30
Dec-10	0.22



Date	Evaporation (mm)
Jan-10	0.38
Feb-10	0.97
Mar-10	1.68
Apr-10	2.79
May-10	3.68
Jun-10	4.43
Jul-10	3.66
Aug-10	3.73
Sep-10	2.19
Oct-10	1.19
Nov-10	0.46
Dec-10	0.30



7.2 Resource Consumption

Site machinery involved in operation of the facility during the reporting period involved the following plant: –

1 No. Tractor;
1 no. rigid truck;
1 No. Water Bowser; and
1 No. tractor mounted Road Brush.
2 no. jeeps.
.
1 no. shredder, 1 no. compost turner and 1 no. manitou (with front loader) also operated on site at the Green Waste & Timber shredding facility (operated by CTO Env. Ltd.)

During the period approximately 5,000 litres of fuel was consumed on site by Cork City Council machinery.

The electricity and telephone costs for the reporting period were €37,052 and €6,150 respectively.
The majority of electricity used throughout the period was for office / canteen / weighbridge accommodation, leachate conditioning plant and pumping system, public lighting and vehicle washing operations.

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Environmental Science & Management
Water,Soil & Air Testing

Unit 35,
Boyne Business Park,
Drogheda,
Co. Louth
Ireland
Tel: +353 41 9845440
Fax: +353 41 9846171
Web: www.euroenv.ie
email info@euroenv.ie

Customer	Aidan Stafford CTO Environmental Solutions Rostellan Midleton Co. Cork	*Lab Report Ref. No.*	1336/001/03
		Date of Receipt	01/10/2010
		Date Testing Commenced	01/10/2010
		Received or Collected	Delivered by Customer
		Condition on Receipt	Acceptable
Customer PO		*Date of Report*	14/10/2010
Customer Ref	Kinsale Rd Aug 2010 29/9/10	*Sample Type*	Other

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
% Dry Matter	302	Drying @ 104 C	64.2	%	
% Organic Matter	127	Furnace 500C	55.9	%	
% Volatile Solids	310	Ashing @ 550 C	20.1	%	
Ammonia (Solid)	114	Colorimetry	6.77	mg/Kg as N	
Arsenic Solid (OES)	224	ICP-OES	3630	ug/Kg	
Ash	311	Ashing @ 550 C	44.1	%	
Cadmium Solid (OES)	224	ICP-OES	187.97	ug/Kg	
Carbon Nitrogen Ratio	124	Calculation	11.2	Ratio	
Chloride (Solid)	100	Colorimetry	15087.51	mg/Kg	
Chromium Solid (OES)	224	ICP-OES	7073	ug/Kg	
Conductivity (Solid)	112	Electrometry	1662	scm -1 @25C	
Copper Solid (OES)	224	ICP-OES	41667	ug/Kg	
E Coli (Solid)	157	Filtration/ Incubation 37C/ 24	600	no/100g	
Foreign Matter	126	2mm Dimension Sieve	23.5	%	
Lead Solid (OES)	224	ICP-OES	44747	ug/Kg	
Mercury (Solid)	178	ICPMS	36.9	ug/Kg	
Nickel Solid (OES)	177	ICP-OES	8961	ug/Kg	
Nitrogen (Total Kjeldahl) Solid	104	Digestion/ Distillation/ Titrim	6410.88	mg/Kg as N	
pH (Solid)	110	Electrometry	8.0	pH Units	
Phosphate (Total) Solid	166	Digestion/ Colorimetry	765.207	mg/L as P	
Salmonella (Solid)	0	Filtration/ Incubation 37C/ 24	0	per 25g	
Sulphate (Solid)	119	Colorimetry	330.56	ng/Kg as SO4	
Zinc Solid (OES)	224	ICP-OES	129396	ug/Kg	

Signed : _____ *Date :* 14/10/10

Katherine McQuillan - Technical Manager

Acc. : Accredited Parameters by ISO 17025:2005

All organic results are analysed as received and all results are corrected for dry weight at 104 C
Results shall not be reproduced, except in full, without the approval of EURO environmental services
Results contained in this report relate only to the samples tested

* Subcontracted

7.4 GAS MODEL

7.4.1 Introduction

Landfill Gas Modelling has been carried out using the Land GEM version 3.02. This is the US EPA approved model.

7.4.2 LandGem Input Data

The EPA have previously requested that specific default parameters be used at Kinsale Road Landfill, these are:

- potential methane generation capacity Lo =(inventory conventional) 100 m^3/tonne
- methane generation rate k =0.04 $year^{-1}$ (inventory conventional)
- no known co-disposal (i.e. no hazardous waste)
- assumption that landfill gas generation is 50% methane 50% carbon dioxide by volume

The LandGEM model predictions suggest that 14,263,985 m^3 of landfill gas was generated in 2010 by the landfill (14,218,909 m^3 in 2009).

It should be noted that the model is designed for use as a gas *prediction* model only, and has limited capacity to generate an accurate and reliable estimate of landfill gas *generation* from landfill – particularly one as varied as Kinsale Road.

In order to estimate landfill gas generation and emissions to atmosphere, on-site data has been used. In 2010, the following quantities of landfill gas were utilised at the landfill gas compound operated by Bioverda Power Systems (formerly Irish Power Systems):

Engine Throughput	692,040 m^3
Flare Throughput	5,475,000 m^3
Total Captured Gas	6,167,040 m^3

Note: After calculating the Engine throughput for 2010 it was noted that the figure was the same for 2009. The figures were rechecked to eliminate the possibility of a calculation error – the result was the same and this is merely a coincidence.

For the purpose of this calculation, it is estimated that approximately 70% of landfill gas generated on site is captured, i.e. that 6,167,040 m^3 represents 70% of the total generated volume. Therefore, it is estimated that approximately 8,810,057 m^3 of landfill gas was generated by the landfill in 2010. This figure is less than the estimate given by the LandGEM model. Reasons for this may include:

- The model overestimates gas production.
- The capture rate figure of 70% is too high and that less gas is actually captured by the collection network.
- A greater quantity of gas was captured by the engines and flare than was recorded.
- The methane concentration in the gas being utilised is greater than the 50% assumed by the LandGEM model.

7.4.3 Conclusion & Discussion

It is not realistic to expect a model with so many estimated input values to predict accurately the volumes and tonnages of landfill gas generated and methane emitted to atmosphere.

The following data inputs are estimates for which there is no available factual information:

- waste inputs from 1964 to late 1990's
- location of waste inputs during the period from 1964 to late 1990's
- volumes of waste under cap
- types of waste inputs
- operating efficiency of generators and gas collection system
- clay liner thickness and location across the site

Due to the number of assumptions made to complete the models, it is believed that the calculation carried out based on "on-site" data from the Bioverda Power Systems is more accurate.

Cork City Council

Landfill Gas Model Calculation 2010

Prepared for:
Cork City Council, KRSL,
South Link Road, Cork

Revision: 0 ***Date: 11/01/11***

Prepared by:
Fehily Timoney & Co.
Core House,
Pouladuff Road,
Cork.

CONSULTANTS IN ENGINEERING & ENVIRONMENTAL SCIENCES

Cork : Tel 021-4964133 Fax 021-4964464

DESIGNED: AR **CHECKED:** 0

DATE: 11/1/11 **REVISION:** 0

JOB NUMBER: **LW11-011-01**

CALC NUMBER: **Calc 01**

FILE Q:\2011\LW11\011\01\Calculations\2010 Gas Model\LW1101101_Gas Model Calc Set 2010 Rev A.xls

PROJECT: **Cork City Council**

SHEET Cover

DESCRIPTION: **Landfill Gas Model Calculation 2010**

Rev	Date	Purpose and Description	Prepared	Checked
0	11-Jan-11	The purpose of this calculation set is to prepare a gas model calculation (using the LandGem software package from the US EPA) for Kinsale Road Landfill for inclusion in the 2010 AER.	AR	

Ref.

Output

i references

1 Landgem-v302-guide by US EPA
2 2009 gas model calculations for Kinsale Road Landfill
Q:\2010\LW10\011\01\Calculations\2009 Gas Model\LW1001101_Gas Model Calc Set 2009 Rev 0.pdf
3 Bioverda Power Systems regarding on-site utilisation for 2010
5 2010 LandGem gas model
Q:\2011\LW11\011\01\Calculations\2010 Gas Model\LW1101101__landgem-v302 KRLF 1964-2010.xls

ii List of FTC Drawings

iii List of Appendices
Chart 1 - Predicted LFG production volumes
Appendix A - LandGEM model results

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Core House
Pouladuff Rd.
Cork
Ireland

Ref. | Output

1.0 Introduction & Purpose

The purpose of this Calc Set is to prepare a gas production model for Kinsale Road Landfill using the LandGem software package (produced by the US EPA). The results of this model will be compared with the on-site records of utilisation provided by Bioverda, and provided to Cork City Council for inclusion in the 2010 AER for the site.

2.0 Input Data

Opening Year: 1964
Closure Year: 2009 (July 2009)

2.1 Waste input data

2 The waste input data for the site is as shown below. These figures are based on communications with Cork City Council and from previous calculations carried out by FTC.

Year	Input Units (t/year)
1964	18,500
1965	18,900
1966	19,200
1967	19,600
1968	20,300
1969	20,500
1970	23,000
1971	21,000
1972	25,900
1973	25,100
1974	29,000
1975	32,000
1976	35,000
1977	38,000
1978	41,000
1979	44,000
1980	47,000
1981	50,000

Year	Input Units (t/year)
1982	53,000
1983	54,000
1984	57,000
1985	59,000
1986	61,000
1987	64,000
1988	67,000
1989	67,000
1990	70,000
1991	70,000
1992	80,000
1993	100,000
1994	120,000
1995	130,000
1996	130,000
1997	140,000
1998	159,000
1999	172,000

Year	Input Units t/year
2000	186,000
2001	201,000
2002	125,000
2003	125,000
2004	72,000
2005	61,000
2006	41,480
2007	56,835
2008	65,932
2009	76,690
2010	0

Total waste placed: 3,191,937 tonnes

Waste input for 2009 is up to the month of July only.

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1 ## 2.2 Model Parameters

The Methane Generation Rate, k, determines the rate of methane generation for the mass of waste in the landfill. The higher the value of k, the faster the methane generation rate increases and then decays over time. The value of k is primarily a function of four factors:

- Moisture content of the waste mass,
- Availability of the nutrients for micro organisms that break down the waste to form methane and carbon dioxide
- pH of the waste mass, and
- Temperature of the waste mass.

The k value as it is used in the first-order decomposition rate equation, is in units of 1/year, or year[1.] There are 5 k values given as options in LandGem. The default k value is the CAA k value for conventional landfills.

1 ### *2.2.1 Potential Methane Generation Capacity (Lo)*

The Potential Methane Generation Capacity, Lo, depends only on the type and composition of waste placed in the landfill. The higher the cellulose content of the waste, the higher the value of Lo. The default Lo values used by LandGem are representative of MSW. The Lo value, as it is used in the first-order decomposition rate equation, is measured in metric units of cubic metres per megagram to be consistent with the CAA.
The default Lo value is the CAA Lo value for conventional landfills.

1 ### *2.2.2 Non-methane Organic Compound Concentration*

The NMOC Concentration in landfill gas is a function of the types of waste in the landfill and the extent of the reaction that produce various compounds from the anaerobic decomposition of waste. NMOC concentration is measured in units of parts per million by volume (ppmv) and is used by LandGem only when NMOC emissions are being estimated. The NMOC concentration for the CAA default is 4,000 ppmv as hexane. The NMOC Concentration for the Inventory default is 600 ppmv where co-disposal of hazardous waste has either not occurred or is unknown and 2,400 ppmv where co-disposal of hazardous waste has occurred. The default NMOC concentration is the CAA value. If you use a site-specific value for NMOC concentration, then you must correct for air infiltration.

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1 *2.2.3 Methane Content*

For LandGem, landfill gas is assumed to be 50 percent methane and 50 percent carbon dioxide, with additional, trace constituents of NMOC's and other air pollutants. When using LandGem for complying with the CAA, methane content must remain fixed at 50 percent by volume (the model default value).

You can choose other methane amounts for the methane content using the User-specified selection if data exist to support using another concentration. However, using LandGem at landfills that have methane content outside the range 40 to 60 percent is not recommended. The first-order decomposition rate equation used by LandGem to determine emissions may not be valid outside this range.

The production of methane is determined using the first-order decomposition rate equation and is not affected by the concentration of methane. However, the concentration of methane affects the calculated production of carbon dioxide. The production of carbon dioxide (Q_{CO2}) is calculated from the production of methane (Q_{CH4}) and the methane content percentage (P_{CH4}) using the equation overleaf.

$$Q_{CO2} = Q_{CH4} \times \left\{\left[1/(P_{CH4}/100)\right] - 1\right\}$$

This equation is derived as follows:

$$Q_{total} = Q_{CH4} + Q_{CO2}$$
$$Q_{CH4} = Q_{total} \times (P_{CH4}/100)$$
$$Q_{CO2} = Q_{total} - Q_{CH4} = \left[Q_{CH4}/(P_{CH4}/100)\right] - Q_{CH4}$$
$$Q_{CO2} = Q_{CH4} \times \left\{\left[1/(P_{CH4}/100)\right] - 1\right\}$$

where Q_{total} is the total production of landfill gas.

Where site specific data is available for the actual quantities of gas produced, the model can be calibrated by varying the parameters to match the predicted volumes to the actual volumes as closely as possible.

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3.0 Calculations

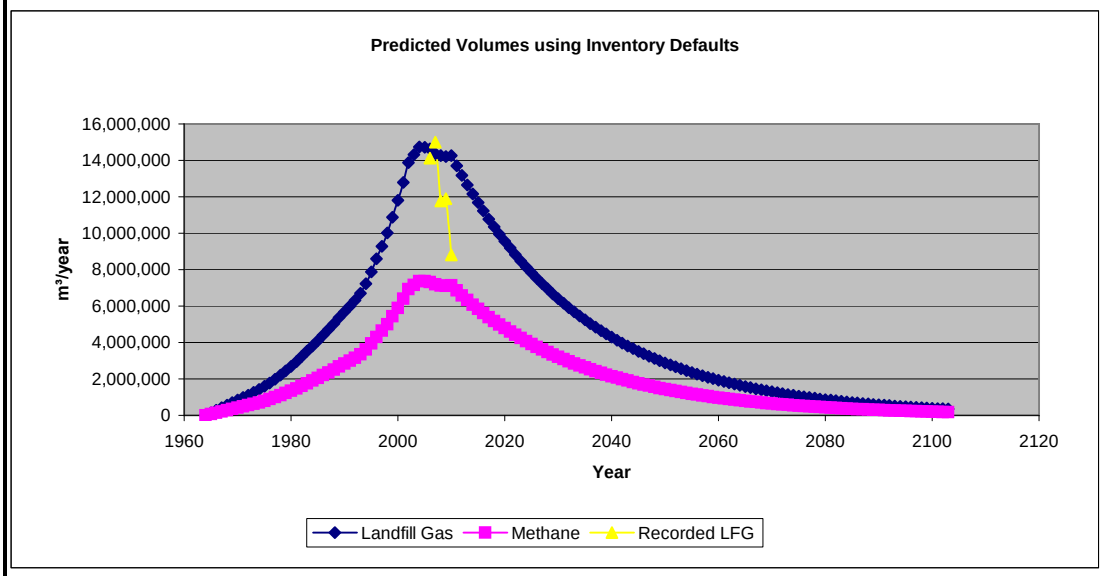
The following calculation was carried out to predict the volumes of gas arising from the landfill. Inventory default parameters were used, as this gives a more realistic prediction for landfill gas production. The EPA has previously expressed a preference for use of the default inventory parameters at Kinsale Road Landfill.

3.1 LandGem Model

MODEL PARAMETERS

Methane Generation Rate, k	0.04 $year^{-1}$
Potential Methane Generation Capacity, Lo	100 m^3/Mg
NMOC Concentration	600 ppmv as hexane
Methane Content	50 % by volume

App A



The results of the calculation are included in Appendix A.

Peak Production Year:	**2004**	
Peak Volumes:	14,734,545 m^3 landfill gas	1,682 m^3/hr
	7,367,273 m^3 methane	841 m^3/hr

These figures give an indication of the volumes of gas likely to be produced based on average recorded production values.

Average production over the next 20 years (2010-2030):	9,844,375 m^3 landfill gas	1,124 m^3/hr
	4,922,187 m^3 methane	562 m^3/hr

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Production Rates for: 2010

14,263,985 m^3 landfill gas = 1,628 m^3/hr

7,131,993 m^3 methane = 814 m^3/hr

3.2 Recorded Volumes

Previous AER's have compared recorded throughput volumes with the predicted volumes from the model.
The recorded volumes have been provided by Bioverda and are as follows:

Year	Flare throughput (m³/annum)	Engine throughput (m³/annum)	Total Captured (m³/annum)	Total Produced* (m³/annum)
2006	7,454,760	2,426,520	9,881,280	14,116,114
2007	8,673,576	1,830,432	10,504,008	15,005,726
2008	6,061,920	2,181,240	8,243,160	11,775,943
2 2009	7,638,750	692,040	8,330,790	11,901,129
3 2010	5,475,000	692,040	6,167,040	8,810,057

*Assuming a capture rate of: 0.7 as per previous calculations.

4.0 Discussion

The volumes of gas recorded on site are generally lower than those predicted by the LandGem model. This could be due to a number of reasons:

- The model may overestimate gas production
- The capture rate of 70% assumed is too high, and the actual capture rate is far lower than this.

- A greater quantity of gas was captured by the engines and flare than was recorded.
- The methane concentration in the gas being utilised is greater than the 50% assumed by the LandGem model.

It is not realistic to expect a model with so many estimated input values to predict accurately the volumes and tonnages of landfill gas generated and methane emitted to the atmosphere.

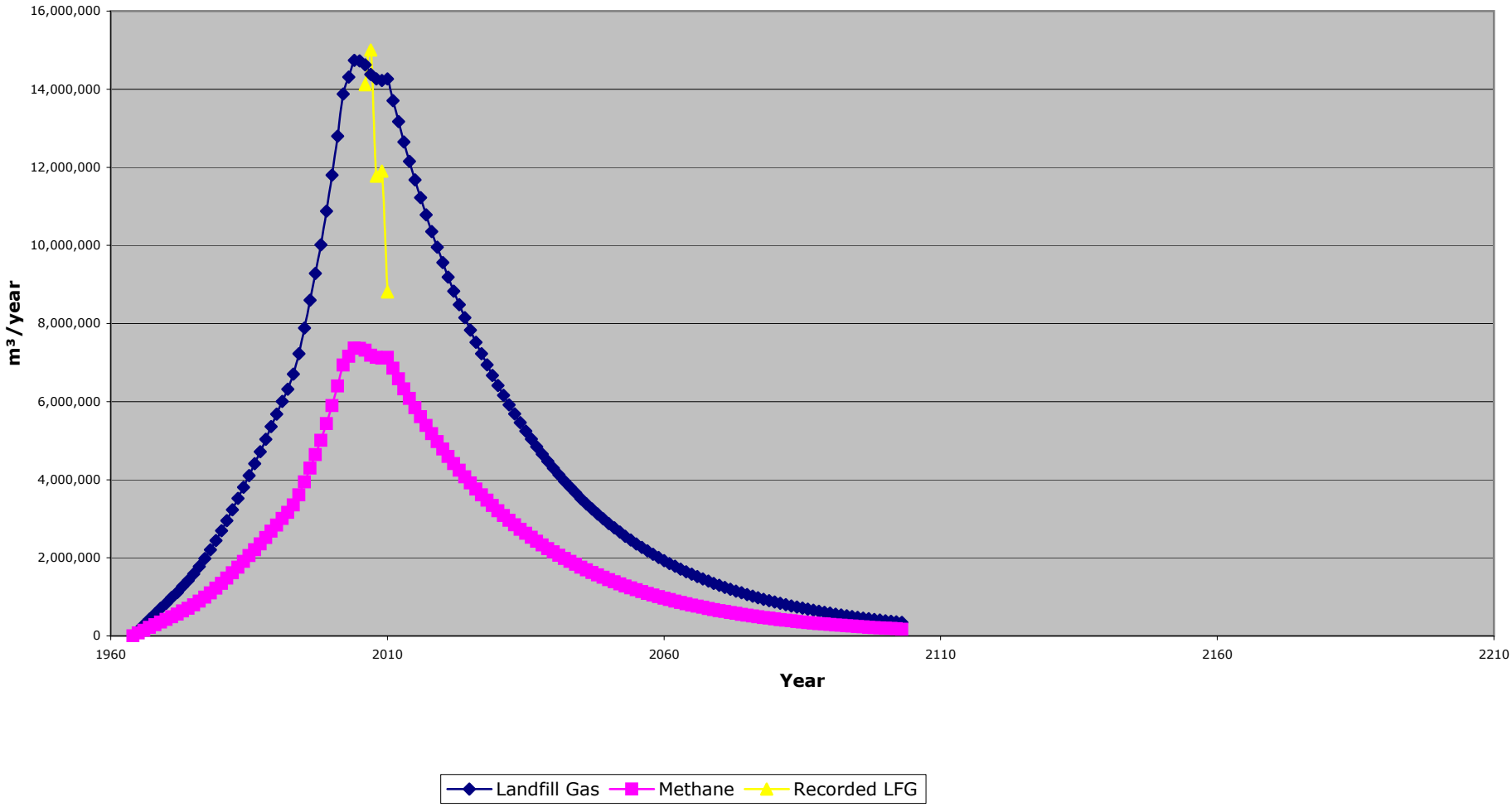
The following data inputs are estimates for which there is no available factual information:

- Waste input records from 1964 to the late 1990s
- Location of waste inputs over the years
- Total volume of waste under capped areas
- Types of waste inputs
- Operating efficiency of generators and gas collection system

Due to the number of assumptions that were necessary to prepare the LandGem model, it is believed that the calculation carried out based on "on-site" data from Bioverda is the more accurate estimate of gas production at the site.

Chart 1 - Predicted LFG production volumes

Predicted Volumes using Inventory Defaults



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Appendix A - LandGEM model results

Appendix A (Gas Model Results)

Year	LandGem				Cumulative	Cumulative	Year
	Landfill Gas m^3/annum	Methane m^3/annum	Landfill Gas m^3/hr	Methane m^3/hr	LFG m^3	Methane m^3	
1964	0	0	0	0	0	0	1964
1965	145,369	72,685	16.59	8.30	145,369	72,685	1965
1966	288,182	144,091	32.90	16.45	433,551	216,776	1966
1967	427,752	213,876	48.83	24.42	861,303	430,652	1967
1968	564,993	282,496	64.50	32.25	1,426,296	713,148	1968
1969	702,352	351,176	80.18	40.09	2,128,649	1,064,324	1969
1970	835,898	417,949	95.42	47.71	2,964,547	1,482,273	1970
1971	983,851	491,926	112.31	56.16	3,948,398	1,974,199	1971
1972	1,110,288	555,144	126.75	63.37	5,058,686	2,529,343	1972
1973	1,270,270	635,135	145.01	72.50	6,328,956	3,164,478	1973
1974	1,417,693	708,847	161.84	80.92	7,746,649	3,873,325	1974
1975	1,589,981	794,990	181.50	90.75	9,336,630	4,668,315	1975
1976	1,779,087	889,543	203.09	101.55	11,115,717	5,557,859	1976
1977	1,984,351	992,176	226.52	113.26	13,100,068	6,550,034	1977
1978	2,205,140	1,102,570	251.73	125.86	15,305,208	7,652,604	1978
1979	2,440,845	1,220,423	278.64	139.32	17,746,054	8,873,027	1979
1980	2,690,882	1,345,441	307.18	153.59	20,436,936	10,218,468	1980
1981	2,954,688	1,477,344	337.29	168.65	23,391,624	11,695,812	1981
1982	3,231,723	1,615,862	368.92	184.46	26,623,347	13,311,673	1982
1983	3,521,469	1,760,735	401.99	201.00	30,144,816	15,072,408	1983
1984	3,807,712	1,903,856	434.67	217.34	33,952,529	16,976,264	1984
1985	4,106,305	2,053,152	468.76	234.38	38,058,833	19,029,417	1985
1986	4,408,905	2,204,452	503.30	251.65	42,467,738	21,233,869	1986
1987	4,715,355	2,357,678	538.28	269.14	47,183,093	23,591,547	1987
1988	5,033,363	2,516,682	574.58	287.29	52,216,457	26,108,228	1988
1989	5,362,475	2,681,238	612.15	306.08	57,578,932	28,789,466	1989
1990	5,678,683	2,839,341	648.25	324.13	63,257,615	31,628,807	1990
1991	6,006,065	3,003,032	685.62	342.81	69,263,679	34,631,840	1991
1992	6,320,610	3,160,305	721.53	360.77	75,584,290	37,792,145	1992
1993	6,701,400	3,350,700	765.00	382.50	82,285,690	41,142,845	1993
1994	7,224,415	3,612,208	824.70	412.35	89,510,105	44,755,052	1994
1995	7,884,079	3,942,039	900.01	450.00	97,394,183	48,697,092	1995
1996	8,596,454	4,298,227	981.33	490.67	105,990,638	52,995,319	1996
1997	9,280,897	4,640,449	1,059.46	529.73	115,271,535	57,635,767	1997
1998	10,017,081	5,008,541	1,143.50	571.75	125,288,616	62,644,308	1998
1999	10,873,697	5,436,849	1,241.29	620.64	136,162,313	68,081,157	1999
2000	11,798,876	5,899,438	1,346.90	673.45	147,961,189	73,980,595	2000
2001	12,797,788	6,398,894	1,460.93	730.47	160,758,977	80,379,488	2001
2002	13,875,398	6,937,699	1,583.95	791.97	174,634,375	87,317,188	2002
2003	14,313,562	7,156,781	1,633.97	816.98	188,947,937	94,473,969	2003
2004	**14,734,545**	**7,367,273**	**1,682.03**	**841.01**	203,682,482	101,841,241	**2004**
2005	14,722,557	7,361,279	1,680.66	840.33	218,405,040	109,202,520	2005
2006	14,624,604	7,312,302	1,669.48	834.74	233,029,644	116,514,822	2006
2007	14,377,105	7,188,553	1,641.22	820.61	247,406,749	123,703,375	2007
2008	14,259,970	7,129,985	1,627.85	813.93	261,666,719	130,833,359	2008
2009	14,218,909	7,109,455	1,623.16	811.58	275,885,628	137,942,814	2009
2010	14,263,985	7,131,993	1,628.31	814.15	290,149,613	145,074,806	2010
2011	13,704,686	6,852,343	1,564.46	782.23	303,854,299	151,927,149	2011
2012	13,167,318	6,583,659	1,503.12	751.56	317,021,617	158,510,808	2012
2013	12,651,020	6,325,510	1,444.18	722.09	329,672,637	164,836,318	2013
2014	12,154,966	6,077,483	1,387.55	693.78	341,827,603	170,913,801	2014
2015	11,678,363	5,839,182	1,333.15	666.57	353,505,966	176,752,983	2015
2016	11,220,448	5,610,224	1,280.87	640.44	364,726,414	182,363,207	2016
2017	10,780,488	5,390,244	1,230.65	615.32	375,506,902	187,753,451	2017
2018	10,357,779	5,178,889	1,182.39	591.20	385,864,681	192,932,341	2018
2019	9,951,645	4,975,822	1,136.03	568.02	395,816,326	197,908,163	2019
2020	9,561,435	4,780,718	1,091.49	545.74	405,377,761	202,688,880	2020
2021	9,186,526	4,593,263	1,048.69	524.35	414,564,287	207,282,143	2021

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Year	LandGem				Cumulative	Cumulative	Year
	Landfill Gas m^3/annum	Methane m^3/annum	Landfill Gas m^3/hr	Methane m^3/hr	LFG m^3	Methane m^3	
2022	8,826,317	4,413,159	1,007.57	503.79	423,390,604	211,695,302	2022
2023	8,480,232	4,240,116	968.06	484.03	431,870,836	215,935,418	2023
2024	8,147,718	4,073,859	930.10	465.05	440,018,553	220,009,277	2024
2025	7,828,241	3,914,120	893.63	446.82	447,846,794	223,923,397	2025
2026	7,521,291	3,760,646	858.59	429.30	455,368,086	227,684,043	2026
2027	7,226,377	3,613,189	824.93	412.46	462,594,463	231,297,231	2027
2028	6,943,027	3,471,513	792.58	396.29	469,537,490	234,768,745	2028
2029	6,670,787	3,335,393	761.51	380.75	476,208,277	238,104,138	2029
2030	6,409,222	3,204,611	731.65	365.82	482,617,498	241,308,749	2030
2031	6,157,912	3,078,956	702.96	351.48	488,775,411	244,387,705	2031
2032	5,916,457	2,958,229	675.39	337.70	494,691,868	247,345,934	2032
2033	5,684,470	2,842,235	648.91	324.46	500,376,338	250,188,169	2033
2034	5,461,578	2,730,789	623.47	311.73	505,837,916	252,918,958	2034
2035	5,247,427	2,623,713	599.02	299.51	511,085,343	255,542,671	2035
2036	5,041,672	2,520,836	575.53	287.77	516,127,015	258,063,508	2036
2037	4,843,985	2,421,993	552.97	276.48	520,971,001	260,485,500	2037
2038	4,654,050	2,327,025	531.28	265.64	525,625,051	262,812,525	2038
2039	4,471,562	2,235,781	510.45	255.23	530,096,613	265,048,306	2039
2040	4,296,230	2,148,115	490.44	245.22	534,392,843	267,196,421	2040
2041	4,127,772	2,063,886	471.21	235.60	538,520,615	269,260,307	2041
2042	3,965,920	1,982,960	452.73	226.37	542,486,535	271,243,267	2042
2043	3,810,414	1,905,207	434.98	217.49	546,296,949	273,148,474	2043
2044	3,661,005	1,830,503	417.92	208.96	549,957,954	274,978,977	2044
2045	3,517,455	1,758,728	401.54	200.77	553,475,410	276,737,705	2045
2046	3,379,534	1,689,767	385.79	192.90	556,854,944	278,427,472	2046
2047	3,247,021	1,623,510	370.66	185.33	560,101,964	280,050,982	2047
2048	3,119,703	1,559,852	356.13	178.07	563,221,667	281,610,834	2048
2049	2,997,378	1,498,689	342.17	171.08	566,219,045	283,109,523	2049
2050	2,879,849	1,439,924	328.75	164.37	569,098,894	284,549,447	2050
2051	2,766,928	1,383,464	315.86	157.93	571,865,822	285,932,911	2051
2052	2,658,436	1,329,218	303.47	151.74	574,524,258	287,262,129	2052
2053	2,554,197	1,277,098	291.57	145.79	577,078,455	288,539,227	2053
2054	2,454,045	1,227,023	280.14	140.07	579,532,500	289,766,250	2054
2055	2,357,821	1,178,910	269.16	134.58	581,890,321	290,945,161	2055
2056	2,265,369	1,132,685	258.60	129.30	584,155,690	292,077,845	2056
2057	2,176,543	1,088,271	248.46	124.23	586,332,233	293,166,117	2057
2058	2,091,200	1,045,600	238.72	119.36	588,423,433	294,211,716	2058
2059	2,009,202	1,004,601	229.36	114.68	590,432,635	295,216,318	2059
2060	1,930,420	965,210	220.37	110.18	592,363,056	296,181,528	2060
2061	1,854,728	927,364	211.73	105.86	594,217,783	297,108,892	2061
2062	1,782,003	891,001	203.42	101.71	595,999,786	297,999,893	2062
2063	1,712,129	856,065	195.45	97.72	597,711,915	298,855,958	2063
2064	1,644,996	822,498	187.78	93.89	599,356,911	299,678,456	2064
2065	1,580,495	790,247	180.42	90.21	600,937,406	300,468,703	2065
2066	1,518,523	759,261	173.35	86.67	602,455,928	301,227,964	2066
2067	1,458,980	729,490	166.55	83.28	603,914,909	301,957,454	2067
2068	1,401,773	700,886	160.02	80.01	605,316,682	302,658,341	2068
2069	1,346,809	673,404	153.75	76.87	606,663,490	303,331,745	2069
2070	1,294,000	647,000	147.72	73.86	607,957,490	303,978,745	2070
2071	1,243,261	621,631	141.92	70.96	609,200,751	304,600,375	2071
2072	1,194,512	597,256	136.36	68.18	610,395,263	305,197,632	2072
2073	1,147,675	573,837	131.01	65.51	611,542,938	305,771,469	2073
2074	1,102,674	551,337	125.88	62.94	612,645,611	306,322,806	2074
2075	1,059,437	529,719	120.94	60.47	613,705,049	306,852,524	2075
2076	1,017,896	508,948	116.20	58.10	614,722,945	307,361,472	2076
2077	977,984	488,992	111.64	55.82	615,700,928	307,850,464	2077
2078	939,637	469,818	107.26	53.63	616,640,565	308,320,282	2078
2079	902,793	451,396	103.06	51.53	617,543,358	308,771,679	2079
2080	867,394	433,697	99.02	49.51	618,410,752	309,205,376	2080
2081	833,383	416,691	95.14	47.57	619,244,134	309,622,067	2081
2082	800,705	400,353	91.40	45.70	620,044,840	310,022,420	2082

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Year	LandGem				Cumulative LFG	Cumulative Methane	Year
	Landfill Gas m^3/annum	Methane m^3/annum	Landfill Gas m^3/hr	Methane m^3/hr	m^3	m^3	
2083	769,309	384,655	87.82	43.91	620,814,149	310,407,075	2083
2084	739,144	369,572	84.38	42.19	621,553,293	310,776,647	2084
2085	710,162	355,081	81.07	40.53	622,263,455	311,131,728	2085
2086	682,316	341,158	77.89	38.94	622,945,772	311,472,886	2086
2087	655,562	327,781	74.84	37.42	623,601,334	311,800,667	2087
2088	629,857	314,929	71.90	35.95	624,231,191	312,115,595	2088
2089	605,160	302,580	69.08	34.54	624,836,351	312,418,176	2089
2090	581,431	290,716	66.37	33.19	625,417,783	312,708,891	2090
2091	558,633	279,317	63.77	31.89	625,976,416	312,988,208	2091
2092	536,729	268,364	61.27	30.64	626,513,145	313,256,572	2092
2093	515,683	257,842	58.87	29.43	627,028,828	313,514,414	2093
2094	495,463	247,732	56.56	28.28	627,524,291	313,762,146	2094
2095	476,036	238,018	54.34	27.17	628,000,327	314,000,164	2095
2096	457,370	228,685	52.21	26.11	628,457,697	314,228,849	2096
2097	439,436	219,718	50.16	25.08	628,897,134	314,448,567	2097
2098	422,206	211,103	48.20	24.10	629,319,340	314,659,670	2098
2099	405,651	202,825	46.31	23.15	629,724,991	314,862,495	2099
2100	389,745	194,873	44.49	22.25	630,114,736	315,057,368	2100
2101	374,463	187,232	42.75	21.37	630,489,199	315,244,599	2101
2102	359,780	179,890	41.07	20.54	630,848,979	315,424,489	2102
2103	345,673	172,836	39.46	19.73	631,194,652	315,597,326	2103
2104	332,119	166,059	37.91	18.96	631,526,771	315,763,385	2104

7.5 WATER BALANCE

7.5.1 Introduction

This section will present the results of the water balance calculation carried out in FTC's Calculation Set LW11-011-01_Water Balance for Kinsale Road Landfill Site; specifically surface water run-off and leachate volumes.

7.5.2 Methodology

To calculate the water balance for Kinsale Road Landfill Site, it is necessary to divide the site into areas according to prevailing hydrological conditions. This calculation is an estimate of the site water balance, based on readily available information. Previous water balance calculations for the site divided the site into fourteen areas, (Water Balance Assessment, December 2003[1]). However, due to the completion of Phase 3 capping, the construction of the access road and playing pitch, and the ongoing capping works at the site, the site is now divided into 17 areas. The format has been retained and updated for this report to reflect the ground conditions (i.e. areas being capped etc) for the reporting period, as summarised in Table 7.5.2 (a). It should be noted that the description of Area 1 as 'semi-active' does not imply that waste activities are taking place in these areas, but rather that these areas have yet to receive any formal capping.

Table 7.5.2 (a): Summary of Subdivisions for Water Balance Calculations

Description	Area (ha)	Infiltration Coefficient	Surface Water Runoff (m^3)	Infiltration as Leachate (m^3)
Area 1 (i)† Semi-Active Area (Jan-Sept 2010)	9.29	0.49	37,564	36,091
Area 1 (ii) † Semi-Active Area (Oct 2010)	6.99	0.49		
Area 1 (iii) † Semi-Active Area (Nov 2010)	5.99	0.49		
Area 1 (iv) † Semi-Active Area (Dec 2010)	4.49	0.49		
Area 2 Phase 1 Capped Area	5.31	0.13	41,002	6,127
Area 3 Soil Storage Area	4.14	0.20	29,392	7,348
Area 4 Pitch & Putt Course	2.20	0.77	4,490	15,033
Area 5 Adjacent to C & D Facility	0.99	0.76	2,104	6,662
Area 6 C & D Facility	4.03	0.13	31,114	4,649
Area 7 Office/CA Area	2.36	0.00	20,971	0
Area 8 Phase 2 Capped Area	5.49	0.005	48,493	244
Area 9 Tramore River Bank	7.20	0.86	8,940	0

[1] Q:\2003\011\14\Reports\CCC-HA_Rpt001-C (Water Balance).doc

Area 10 Lined Lagoon areas	1.43	0.0	12,653	0
Area 11 Eastern Access Road	2.35	0.86	2,918	17,922
Area 12 Marsh/Trabeg River Area	8.36	0.00	74,186	0
Area 13 Blackash Road Area	3.96	0.1	31,636	3,515
Area 14* Phase 3 Capped Area	3.31	0.005	29,227	147
Area 15* Playing Pitch Development	1.26	0.005	11,126	56
Area 16* (i) † Contract 10 Capped Area (Jan-Sept 2010)	0	0.005	8,743	44
Area 16* (ii) † Contract 10 Capped Area (Oct 2010)	2.3	0.005		
Area 16* (iii) † Contract 10 Capped Area (Nov 2010)	3.3	0.005		
Area 16* (iv) † Contract 10 Capped Area (Dec 2010)	4.3	0.005		
Total	**61.67**		**394,560**	**97,837**

†Areas 1 and 16 are subdivided as detailed above based on onsite records of capping progress from October to December 2010.

* Infiltration coefficient for Area 14 (Phase 3 Capping Area), Area 15 (Playing Pitch) and Area 16 (Contract 10 Capped Area) was taken as the same as that for Area 8 (Phase 2 Capping Area).

Infiltration coefficients for each area are the same as those used in water balance calculations from 2004 on. These were originally calculated using the HELP programme[2], and validated against actual site flows in a previous water balance report[1].

Rainfall data and evapotranspiration figures for the reporting period were obtained from Met Éireann for Cork Airport, located approximately 3 km south of the site. The monthly rainfall data is provided in Table 7.5.2 (b). Table 7.5.2 (b) also shows the potential evapotranspiration (PE) for the same period, and the effective rainfall.

[2] Hydrologic Evaluation of Landfill Performance, HELP V3.07, developed by Environmental Laboratory, USAE Waterways Experiment Station for US EPA Risk Reduction Engineering Laboratory.

Table 7.5.2 (b): Rainfall Data (in mm): Cork Airport 2010

Month	Incident Rainfall (mm)	Potential Evapotranspiration (mm)	Effective Rainfall (mm)
January	126	0.26	125.4
February	43	0.66	42.0
March	96	1.07	94.4
April	41	1.86	39.4
May	47	2.51	44.6
June	47	3.05	43.4
July	137	2.46	134.2
August	17	2.59	14.5
September	78	1.48	76.8
October	121	0.80	120.5
November	86	0.30	85.3
December	67	0.22	66.7
Totals	**905**	**17.3**	**887.4**

It should be noted that the effective rainfall for this AER period (887.4 mm) was less than that recorded in the previous AER period (1,075.3 mm), i.e. during the 12 months of 2010, 17.5 % less effective rainfall fell than for the 12 months of 2009.

The fraction of effective rainfall estimated to infiltrate into the ground is represented by the infiltration coefficient. For the purposes of this water balance calculation, several infiltration values were estimated, depending on the cover nature of that area. It is noted that these coefficients are conservative estimates only, and actual values will vary locally.

7.5.3 Annual Water Balance (2010)

Table 7.5.3 represents a summary of the monthly water balance for the site in 2010. The areas and infiltration coefficients used are provided in Table 7.5.2 (a).

Table 7.5.3: Summary of Monthly Water Balance

Month	Leachate (m^3)	Surface Water Runoff (m^3)
January	14,432	55,171
February	4,837	18,490
March	10,864	41,530
April	4,537	17,344
May	5,130	19,610
June	4,999	19,108
July	15,444	59,040
August	1,669	6,382
September	8,838	33,786
October	12,520	54,342
November	8,448	38,880
December	6,119	30,878
Totals	**97,838 m^3**	**394,560 m^3**
Average Flow	**3.1 l/s**	**12.51 l/s**

7.5.4 Leachate Volumes

The volumes of leachate produced, conditioned and discharged to sewer at the Kinsale Road Landfill are provided in Table 7.5.4.

Table 7.5.4: Leachate Conditioning and Production Volumes (2010)

Month	Estimated Leachate Produced (m^3)	Volume of Treated Leachate (m^3)
January	14,432	3,108
February	4,837	5,867
March	10,864	9,243
April	4,537	7,364
May	5,130	6,002
June	4,999	6,265
July	15,444	7,513
August	1,669	7,228
September	8,838	7,133
October	12,520	7,125
November	8,448	6,669
December	6,119	6,340
Annual Total	**97,838**	**79,857**

Note on Table 7.5.4: Leachate is treated on site at the leachate conditioning plant.

The estimated figure of 97,838 m^3 of leachate produced in 2010 is 24.4 % less than the 2009 figure (129,343 m^3). This decrease in leachate production is likely to be due to the decreased effective rainfall. Leachate production volumes at the site should continue to fall significantly over the coming year with the completion of the final capping works.

Cork City Council

Water Balance Calculation 2010

Prepared for:
Cork City Council, KRSL,
South Link Road, Cork

Revision: 0 ***Date: 24/01/11***

Prepared by:
Fehily Timoney & Co.
Core House,
Pouladuff Road,
Cork.

CONSULTANTS IN ENGINEERING & ENVIRONMENTAL SCIENCES

Cork : Tel 021-4964133 Fax 021-4964464

DESIGNED: AR **CHECKED:** ME

DATE: 24/1/11 **REVISION:** 0

JOB NUMBER: **LW11-011-01**

CALC NUMBER: **Calc 01**

FILE Q:\2011\LW11\011\01\Calculations\2010 Water Balance\LW1101101_Water Balance 2010 rev 0.xls

PROJECT: **Cork City Council**

SHEET Cover

DESCRIPTION: **Water Balance Calculation 2010**

Rev	Date	Purpose and Description	Prepared	Checked
0	24-Jan-11	The purpose of this calculation set is to prepare the annual water balance for Kinsale Road Landfill for inclusion in the 2010 AER.	AR	ME

i references

1 2009 water balance calculations for Kinsale Road Landfill
Q:\2010\LW10\011\01\Calculations\2009 Water Balance\LW101101_Water Balance Calc 0.pdf
2 2010 Rainfall Data from Met Eireann via Cork City Council
3 2010 Leachate Treatment Data from Cork City Council
Q:\2011\LW11\011\01\Calculations\2010 Water Balance\LW1101101_leachate volumes 2010.xls

1.0 Introduction & Purpose

Fehily Timoney Company
Core House
Pouladuff Rd.
Cork
Ireland

Ref.

Output

1.0 Introduction & Purpose

The purpose of this calc set is to complete the water balance calculation for the Kinsale Road Landfill Site for inclusion with the site's 2010 Annual Environmental Report. Results are presented in the following pages, and the associated reports will be issued electronically to the site for inclusion with the report.

Fehily Timoney Company
Core House
Pouladuff Rd.
Cork
Ireland

Appendix A - Water Balance 2010

Water Balance Calculation
Kinsale Road AER 2010

#REF!

Date 27 January 2011

2010			SURFACE WATER VOLUMES (m^3)															
Month	Rainfall (mm)	ER (mm)	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7	Area 8	Area 9	Area 10	Area 11	Area 12	Area 13	Area 14	Area 15	Area 16	Totals
January	125.7	125.4	5,943	5,796	4,155	635	297	4,398	2,964	6,855	1,264	1,789	412	10,487	4,472	4,131	1,573	0	55,171
February	42.7	42.0	1,992	1,942	1,392	213	100	1,474	993	2,297	424	599	138	3,514	1,499	1,385	527	0	18,490
March	95.5	94.4	4,474	4,363	3,127	478	224	3,311	2,231	5,160	951	1,346	310	7,894	3,366	3,110	1,184	0	41,530
April	41.3	39.4	1,868	1,822	1,306	200	93	1,383	932	2,155	397	562	130	3,297	1,406	1,299	494	0	17,344
May	47.1	44.6	2,113	2,060	1,477	226	106	1,563	1,054	2,437	449	636	147	3,727	1,590	1,468	559	0	19,610
June	46.5	43.4	2,058	2,007	1,439	220	103	1,523	1,027	2,374	438	619	143	3,632	1,549	1,431	545	0	19,108
July	136.7	134.2	6,360	6,202	4,446	679	318	4,707	3,172	7,336	1,352	1,914	441	11,222	4,786	4,421	1,683	0	59,040
August	17.1	14.5	687	670	481	73	34	509	343	793	146	207	48	1,213	517	478	182	0	6,382
September	78.3	76.8	3,640	3,549	2,544	389	182	2,693	1,815	4,198	774	1,095	253	6,422	2,739	2,530	963	0	33,786
October	121.3	120.5	4,296	5,568	3,991	610	286	4,225	2,848	6,585	1,214	1,718	396	10,074	4,296	3,969	1,511	2,758	54,342
November	85.6	85.3	2,606	3,941	2,825	432	202	2,991	2,016	4,661	859	1,216	280	7,131	3,041	2,809	1,069	2,801	38,880
December	66.9	66.7	1,527	3,081	2,208	337	158	2,338	1,576	3,644	672	951	219	5,574	2,377	2,196	836	3,185	30,878
Totals	**904.7**	**887.4**	**37,564**	**41,002**	**29,392**	**4,490**	**2,104**	**31,114**	**20,971**	**48,493**	**8,940**	**12,653**	**2,918**	**74,186**	**31,636**	**29,227**	**11,126**	**8,743**	**394,560**

Rainfall	ıpotranspirati	Effective Rainfall
126	0.3	125.4
43	0.7	42.0
96	1.1	94.4
41	1.9	39.4
47	2.5	44.6
47	3.1	43.4
137	2.5	134.2
17	2.6	14.5
78	1.5	76.8
121	0.8	120.5
86	0.3	85.3
67	0.2	66.7

2010	GROUNDWATER/LEACHATE VOLUMES (m^3)																		
Month	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7	Area 8	Area 9	Area 10	Area 11	Area 12	Area 13	Area 14	Area 15	Area 16	Totals	Absorption by waste	Total Leachate	Total Groundwater
January	5,710	866	1,039	2,125	942	657	0	34	7,763	0	2,533	0	497	21	8	0	22,195	0	14,432	7,763
February	1,914	290	348	712	316	220	0	12	2,602	0	849	0	167	7	3	0	7,438	0	4,837	2,602
March	4,298	652	782	1,600	709	495	0	26	5,843	0	1,907	0	374	16	6	0	16,707	0	10,864	5,843
April	1,795	272	327	668	296	207	0	11	2,440	0	796	0	156	7	2	0	6,977	0	4,537	2,440
May	2,030	308	369	755	335	234	0	12	2,759	0	900	0	177	7	3	0	7,889	0	5,130	2,759
June	1,978	300	360	736	326	228	0	12	2,689	0	877	0	172	7	3	0	7,687	0	4,999	2,689
July	6,111	927	1,112	2,274	1,008	703	0	37	8,307	0	2,711	0	532	22	8	0	23,751	0	15,444	8,307
August	661	100	120	246	109	76	0	4	898	0	293	0	57	2	1	0	2,567	0	1,669	898
September	3,497	530	636	1,301	577	402	0	21	4,754	0	1,551	0	304	13	5	0	13,592	0	8,838	4,754
October	4,127	832	998	2,041	905	631	0	33	7,457	0	2,434	0	477	20	8	14	19,977	0	12,520	7,457
November	2,504	589	706	1,445	640	447	0	23	5,278	0	1,723	0	338	14	5	14	13,727	0	8,448	5,278
December	1,467	460	552	1,130	501	349	0	18	4,126	0	1,347	0	264	11	4	16	10,245	0	6,119	4,126
Totals	**36,091**	**6,127**	**7,348**	**15,033**	**6,662**	**4,649**	**0**	**244**	**54,916**	**0**	**17,922**	**0**	**3,515**	**147**	**56**	**44**	**152,753**	**0**	**97,838**	**54,916**

Name	Description	Area (ha)	Infiltration coefficient	Runoff coefficient	Waste-bearing?
Area 1 (i)	Semi-Active Area (Jan-Sept 2010)	9.29	0.49	0.51	✓
Area 1 (ii)	Semi-Active Area (Oct 2010)	6.99	0.49	0.51	✓
Area 1 (iii)	Semi-Active Area (Nov 2010)	5.99	0.49	0.51	✓
Area 1 (iv)	Semi-Active Area (Dec 2010)	4.49	0.49	0.51	✓
Area 2	Phase 1 Capped Area	5.31	0.13	0.87	✓
Area 3	Soil Storage Area	4.14	0.2	0.80	✓
Area 4	Pitch & Putt Course	2.20	0.77	0.23	✓
Area 5	Adjacent to C & D Facility	0.99	0.76	0.24	✓
Area 6	C & D Facility	4.03	0.13	0.87	✓
Area 7	Office/CA Area	2.36	0	1.00	✓
Area 8	Phase 2 Capped Area	5.49	0.005	0.995	✓
Area 9	Tramore River Bank	7.20	0.86	0.14	
Area 10	Lined Lagoon areas	1.43	0	1.00	✓
Area 11	Eastern Access Road	2.35	0.86	0.14	✓
Area 12	Marsh/Trabeg River Area	8.36	0	1.00	
Area 13	Blackash Road Area	3.96	0.1	0.90	✓
Area 14	Phase 3 Capped Area	3.31	0.005	0.995	✓
Area 15	Playing Pitch Development	1.26	0.005	0.995	✓
Area 16(i)	Contract 10 Capped Area (Jan -Sept 2010)	0.00	0.005	0.995	✓
Area 16(ii)	Contract 10 Capped Area (Oct 2010)	2.30	0.005	0.995	✓
Area 16(iii)	Contract 10 Capped Area (Nov 2010)	3.30	0.005	0.995	✓
Area 16(iv)	Contract 10 Capped Area (Dec 2010)	4.80	0.005	0.995	✓
Total		61.67	-	-	

Waste Deposition	
Month	Tonnes
Jan-10	0
Feb-10	0
Mar-10	0
Apr-10	0
May-10	0
Jun-10	0
Jul-10	0
Aug-10	0
Sep-10	0
Oct-10	0
Nov-10	0
Dec-10	0

Absorptive Capacity of waste 0.07

Notes to Table

	No Infiltration of Leachate - 100% runoff
	86% of Area 9 water infiltrates to groundwater not to leachate
	Capping/Semi-Active areas changed throughout 2010

Summary of Results (excluding absorption by waste)

Name	Surface Water Runoff (m^3)	Infiltration as Leachate (m^3)	Infiltration as Groundwater (m^3)
Area 1	37,564	36,091	0
Area 2	41,002	6,127	0
Area 3	29,392	7,348	0
Area 4	4,490	15,033	0
Area 5	2,104	6,662	0
Area 6	31,114	4,649	0
Area 7	20,971	0	0
Area 8	48,493	244	0
Area 9	8,940	0	54,916
Area 10	12,653	0	0
Area 11	2,918	17,922	0
Area 12	74,186	0	0
Area 13	31,636	3,515	0
Area 14	29,227	147	0
Area 15	11,126	56	0
Total	**385,817**	**97,794**	**54,916**

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Appendix B - Conditioning Plant Calculations

Leachate Volumes Produced and Treated
Kinsale Road AER 2010

Q:\2011\LW11\011\01\Calculations\2010 Water Balance\LW1101101_Water Balance 2010 rev 0.xls App B Conditioning Plant calcs Date 27 January 2011

2010 Figures

Month	Estimated Leachate produced (m³)	Conditioning Plant Treated (m³)			Difference (m³)
		Main Plant	Temporary Plant	Total	
January	14,432	2,128	980	3,108	11,324
February	4,837	5,607	260	5,867	-1,030
March	10,864	8,826	417	9,243	1,621
April	4,537	7,259	105	7,364	-2,827
May	5,130	5,613	389	6,002	-872
June	4,999	6,215	50	6,265	-1,266
July	15,444	7,402	111	7,513	7,931
August	1,669	7,228	0	7,228	-5,559
September	8,838	7,109	24	7,133	1,705
October	12,520	6,931	194	7,125	5,395
November	8,448	6,282	387	6,669	1,779
December	6,119	6,046	294	6,340	-221
Total	**97,838**	**76,646**	**3,211**	**79,857**	**17,981**

	Predicted Leachate produced	Conditioning Plant Treated
Average flow (l/s)	**3.10**	**2.53**

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7.6 GROUNDWATER

7.6.1 Introduction

This section presents the result of FTC's calculation set LW11-011-01_Groundwater Emissions 2010; specifically annual emissions to groundwater from the landfill site. This calculation is not a detailed study, but rather provides an estimate of the emissions to groundwater from the site, based on readily available information.

7.6.2 Emissions to Groundwater

An estimate of emissions to groundwater can be made by either

- Assuming that the difference in the predicted leachate volume generated and that processed through the leachate conditioning plant is released into the groundwater system, or
- Using the hydrogeological properties of the underlying strata (peat), assuming a leachate head and calculating a vertical throughput flow.

From 2003 to 2008, the head of the leachate body and the associated vertical gradient has been obtained from a series of wells which were installed in 2003 for this purpose. However, due to waste placement these wells are no longer accessible.

Cork City Council have monitored leachate levels at wells SSW4 to SSW10 since 2004. The locations of these wells, relative to the wells historically used are indicated in the FTC calculation. These wells were used in the 2009 AER to provide information on the leachate head within the southern portion of the site, and are used again for this purpose in the 2010 AER.

For the purposes of this calculation, the following will be used for leachate and groundwater level in bedrock figures:

- Leachate levels for the north of the site will be based on an assumed level of 4.5 m OD as in previous years
- Leachate levels for the south of the site will be based on an average value from wells SSW4 to SSW10 for 2010, giving an average of 9.68 m OD;
- Groundwater level in the bedrock will be based on an average value from wells NW1 to NW9 for 2010 (as in previous years), giving an average of 3.32 m OD, for both the north and south of the site.

Using the parameters for the peat and silty clays given in the original waste licence application, the vertical leachate leakage is estimated, using the formula below. Because the peats and clays reduce in depth to the north, and because leachate head increases greatly to the south, calculations have been made for the northern and southern portions of the site separately.

As the hydraulic conductivity of the underlying strata varies across the site, calculations for the maximum and minimum leakage from the north and south of the site are prepared to give the range shown below.

Leakage	Minimum (m^3/yr)	Maximum (m^3/yr)
Leakage in the North Portion (m^3/yr)	1,948	7,811
Leakage in the South Portion (m^3/yr)	3,100	12,432
Total Leakage to the bedrock aquifer (m^3/yr)	**5,048**	**20,243**

This compares to a figure of 5,195 m^3/year calculated for the original Waste Licence Application. The difference in figures is accounted for largely by the increase in the leachate leakage calculated

for the southern area of the site. This is a result of additional data on the leachate head in the area, obtained from a 2003 site investigation.

The maximum figure calculated for the 2009 AER was 19,618 m^3. The increase in the volume predicted for the 2010 AER is likely to be due to a marginal fall in groundwater level from 2009 to 2010 (from 3.5 to 3.32 m OD).

Cork City Council

Groundwater emissions calculation 2010

Prepared for:
Cork City Council, KRSL,
South Link Road, Cork

Revision: 0 ***Date: 24/01/11***

Prepared by:
Fehily Timoney & Co.
Core House,
Pouladuff Road,
Cork.

CONSULTANTS IN ENGINEERING & ENVIRONMENTAL SCIENCES

Cork : Tel 021-4964133 Fax 021-4964464

DESIGNED: AR **CHECKED:** ME

DATE: 24/1/11 **REVISION:** 0

JOB NUMBER: **LW11-011-01**

CALC NUMBER: **Calc 03**

FILE Q:\2011\LW11\011\01\Calculations\2010 GW Calc\LW1101101_Groundwater Emissions 2010 rev 0.xls

PROJECT: **Cork City Council**

SHEET Cover

DESCRIPTION: **Groundwater emissions calculation 2010**

Rev	Date	Purpose and Description	Prepared	Checked
0	24-Jan-11	The purpose of this calculation set is to calculate the annual discharge to groundwater for Kinsale Road Landfill for inclusion in the 2010 AER.	AR	ME

i references

1 2009 Groundwater calculations for AER 2009
Q:\2010\LW10\011\01\Calculations\2009 GW Calc\LW1001101_GW Calc 0.pdf
2 Locations of wells used (and historic wells)
Q:\2010\LW10\011\01\Calculations\2009 GW Calc\LW1001101_GW Calc Well Locations

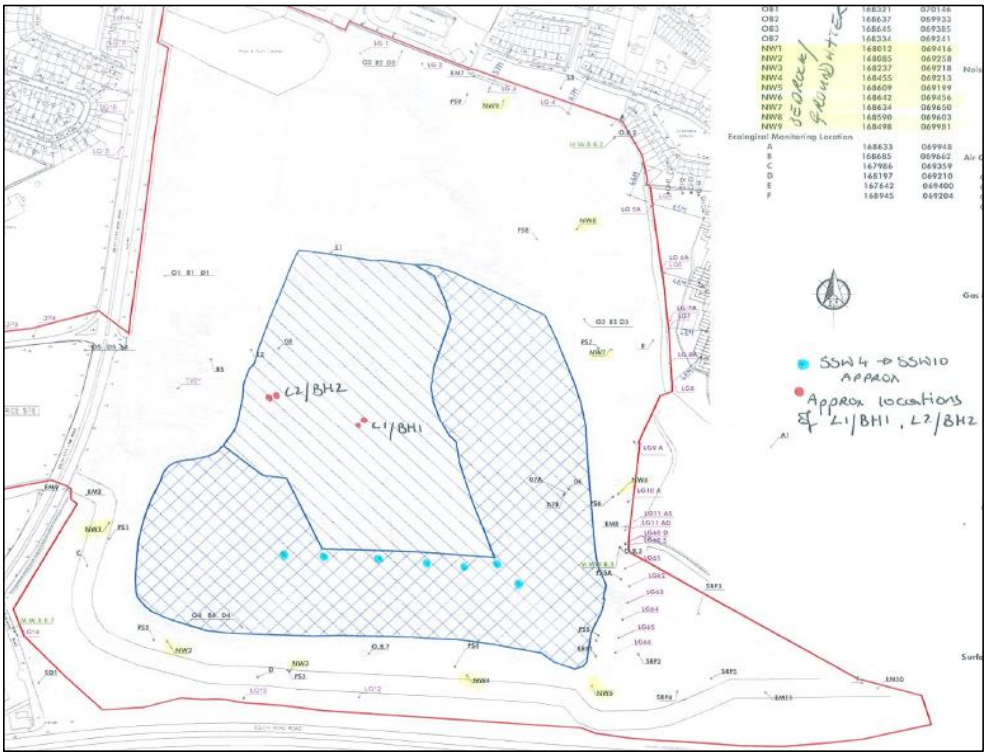
3 Monitoring data from CCC
Groundwater, NW1-NW9: *LW1101101_NW monthly NW 1- 9 levels 2010 & 2011.xls*
Leachate, SSW4-SSW10: *LW1101101_Slope Stability Wells (SSW 4 - 10).xls*

Fehily Timoney Company
Core House
Pouladuff Rd.
Cork
Ireland

1.0 Introduction & Purpose

The purpose of this calc set is to complete the groundwater emissions for the Kinsale Road Landfill Site for inclusion with the site's 2010 Annual Environmental Report. Results are presented in the following pages, and the associated reports will be issued electronically to the site for inclusion with the report.

Historically well pairs, L1/BH1 and L2/BH2 have been used in this calculation. However, these are no longer accessible due to works at the site. CCC have provided monitoring details for wells SSW4-10 to provide leachate data in place of L1 and L2. The sketch below indicates the relative locations of the wells used.



2.0 Calculation

The equation for leakage to groundwater is given as follows:

$$Leakage = \frac{k(h_1 - h_2)}{b}$$

Where:

1 *k = hydraulic conductivity,* this value varies in the site from a maximum of 1.8 x 10^{-9} m/sec (1.56 x 10^{-4} m/day) to a minimum of 4.5 x 10^{-10} m/sec (3.89 x 10^{-5} m/day).

Maximum	1.56E-04	m/day
Minimum	3.89E-05	m/day

1 *b (clay thickness) =* 8 m (south of site)
2 m (north of site)

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Pouladuff Rd.
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Ref. | Output

h_1 *(head of leachate)* =

3a 9.68 m OD (south, average leachate level in wells SSW4 to SSW10)

1 4.5 m OD (north, assumed)

3b h_2 *(groundwater level in bedrock)* =

3.32 m OD (average for site, obtained from CCC 2010 monitoring data)

2.1 Northern Portion of Site

Leakage = 2.30E-05 to 9.20E-05 m³/day for the range of permeability values.

1 The area of waste in the northern portion of the site is 232,500 m²

So the leakage to bedrock ranges from

5.34 to 21.40 m³/day

or, 1,948 to 7,811 m³/year

2.2 Southern Portion of Site

Leakage = 3.09E-05 to 1.24E-04 m³/day for the range of permeability values.

1 The area of waste in the southern portion of the site is 274,630 m²

So the leakage to bedrock ranges from

8.49 to 34.06 m³/day

or, 3,100 to 12,432 m³/year

2.3 Summary

The following table summarises the above calculation:

	Minimum (m³/yr)	Maximum (m³/yr)
Northern Portion	1,948	7,811
Southern Portion	3,100	12,432
Total predicted leakage	**5,048**	**20,243**

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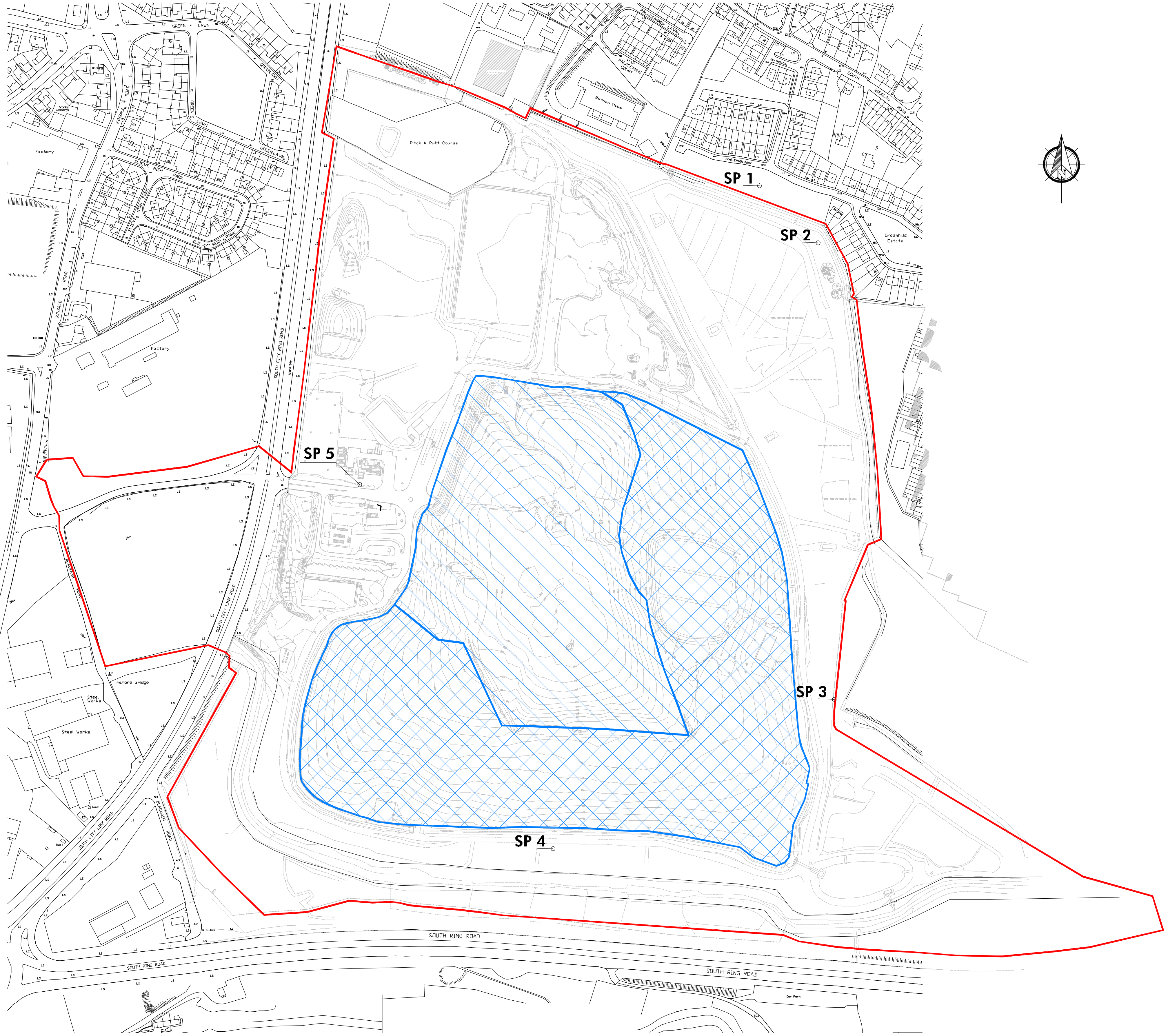
Pouladuff Rd.
Cork
Ireland

Sheet FTC-A1-2006 rev. C (template filed in O:\Acad\Templates\Autocad) (May 2007) = template externally referenced



ASBESTOS SAMPLING POINT LOCATIONS (Source: Cork City Council)		
SAMPLE POINT	EASTING	NORTHING
SP 1	168,570	069,998
SP 2	168,637	069,330
SP 3	168,655	069,412
SP 4	168,334	069,242
SP 5	168,114	069,657

LEGEND

- FACILITY BOUNDARY
- CAPPED AREA
- AREA OF CURRENT CAPPING CONTRACT

SITE PLAN

Scale 1:5000

Scale 1:5000 (0m, 25.00m, 50.00m, 75.00m, 100.00m, 125.00m, 150.00m, 175.00m, 200.00m, 225.00m, 250.00m)

Rev.	Drawn	Chk'd	App'd	Rev Origin / Date	Description
A	AR	AR	AS	Cork / 27.01.11	ISSUE FOR 2010 AER

Revision History: A

Name of Client

CORK CITY COUNCIL

Name of Job

KINSALE ROAD LANDFILL
2010 AER

Title of Drawing

LOCATION OF SAMPLING POINTS
FOR ASBESTOS TESTING

Scales Used: 1:5000

This Drawing was printed to A3

Dwg. No.: LW11-011-01-002

Rev.: A

O:\ACAD\2011\LW11\011\01\LW1101101_002

FEHILY TIMONEY & COMPANY

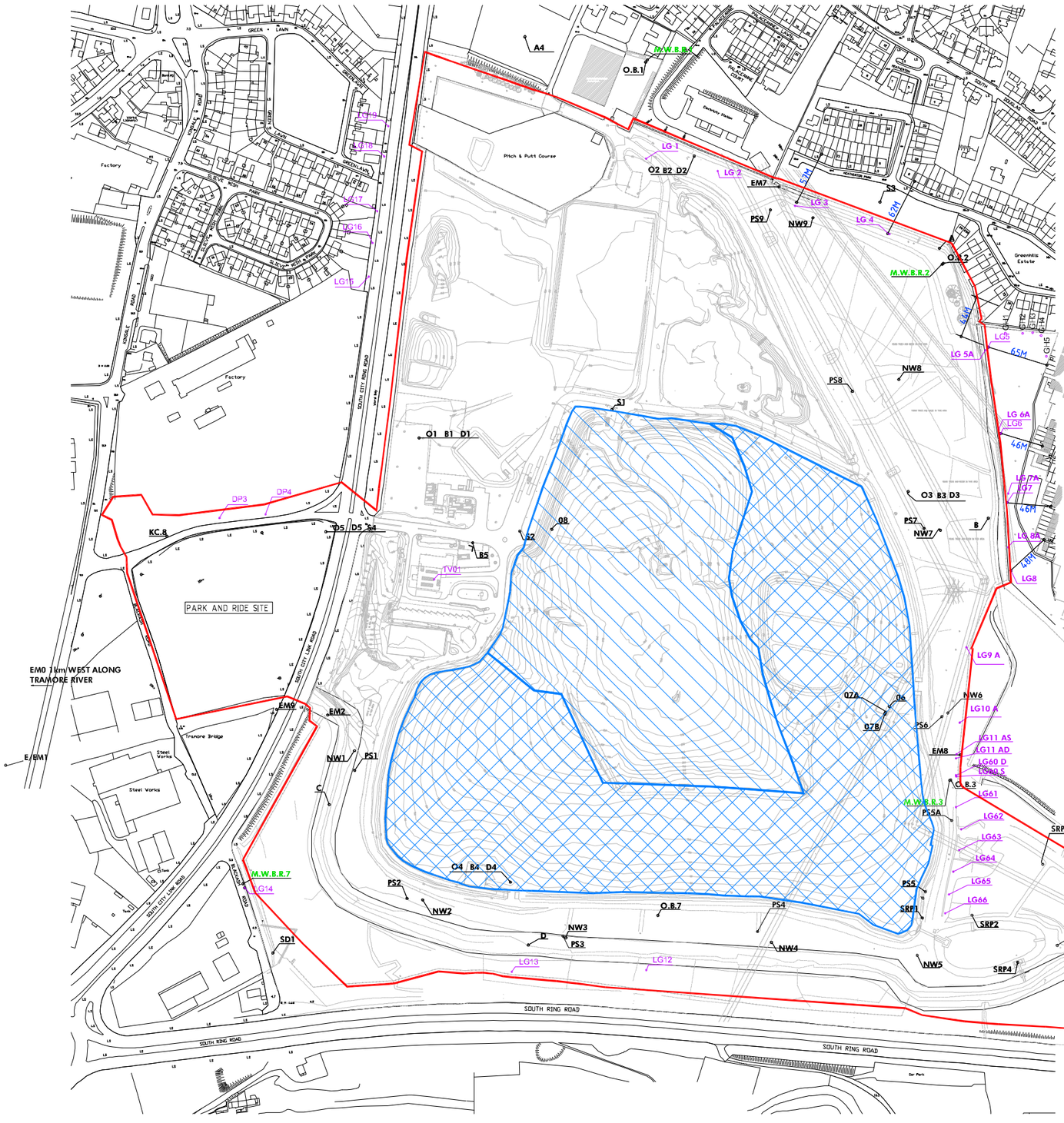
CONSULTANTS IN ENGINEERING & ENVIRONMENTAL SCIENCES

W: www.fehilytimoney.ie, E: info@ftco.ie

Core House, Pouladuff Rd, Cork, Ireland.
T:+353-21-4964133, F:+353-21-4964464

Unit 16, Third Floor, North Park Offices,
North Park, Dublin 11, Ireland.
T:+353-1-6583500, F:+353-1-6583501

ORIGINAL DRAWING SIZE A1 - (841 x 594)



SITE PLAN

Scale 1:5000

STATION	EASTING	NORTHING
Groundwater Monitoring Location		
KC8	167813	069643
MWBR1	168323	070148
MWBR2	168636	069932
MWBR3	168644	069385
MWBR7	167894	069275
OB1	168321	070146
OB2	168637	069933
OB3	168645	069385
OB7	168334	069241
NW1	168012	069416
NW2	168085	069258
NW3	168237	069218
NW4	168455	069213
NW5	168609	069199
NW6	168642	069456
NW7	168634	069650
NW8	168590	069603
NW9	168498	069981
Ecological Monitoring Location		
A	168633	069948
B	168685	069662
C	167986	069359
D	168197	069210
E	167642	069400
F	168945	069204
Surfacewater Monitoring Location		
EM0	166967	069478
EM1	167642	069400
EM2	167984	069454
EM6	169281	069193
EM7	168462	070014
EM8	168655	069412
EM9	167930	069459
EM10	168964	069197
EM11	168825	069191
Stormwater/Reed Beds Monitoring		
SRP1	168654	069305
SRP2	168668	069242
SRP3	168644	069241
SRP4	168739	069227
SRP5	168758	069210
Sewer Monitoring Location		
SD1	167926	069201

STATION	EASTING	NORTHING
Leachate Monitoring Station		
PS1	168013	069395
PS2	168069	069260
PS3	168234	069220
PS4	168440	069225
PS5	168618	069267
PS5A	168646	069342
PS6	168636	069453
PS7	168617	069520
PS8	168541	069797
PS9	168454	069990
Noise Monitoring Location		
B1	168081	069747
B2	168373	070046
B3	168600	069691
B4	168178	069276
A1	168831	069519
A2	169070	069416
A3	168824	068990
A4	168193	070173
Air Quality Monitoring Station		
O1 &D1	168081	069747
O2 & D2	168373	070046
O3 & D3	168600	069691
O4 & D4	168178	069276
O5 & D5	167982	069648
S1	168286	069778
S2	168188	069649
S3	168570	069998
S4	168085	069595
06	168580	069463
08	168222	069651
07A	168576	069457
07B	168575	069455
Gas Monitoring Station		
TV01	168097	069597
DP3	167869	069663
DP4	167918	069666
LG1	168322	070044
LG2	168398	070031
LG3	168480	069994
LG4	168580	069964
LG5	168585	069844
LG5A	168682	069841
LG6	168698	069752
LG6A	168696	069757
LG7	168704	069679
LG7A	168706	069689
LG8	168708	069607
LG8A	168706	069632
LG9A	168718	069525
LG10A	168655	069446
LG11AD	168651	069408
LG11AS	168651	069413
LG12	168322	069183
LG13	168179	069181
LG14	167896	069270
LG15	168027	069918
LG16	168031	069954
LG17	168036	069988
LG18	168044	070046
LG19	168048	070078
LG60D	168651	069390
LG60S	168651	069389
LG61	168651	069356
LG62	168656	069333
LG63	168654	069312
LG64	168648	069288
LG65	168643	069264
LG66	168639	069244

LEACHATE MONITORING STATION-(PS1)
NOISE MONITORING LOCATION-(B1/A1)
AIR QUALITY MONITORING STATION-(D1/S1/O1)
ODOUR MONITORING LOCATION (06/07A/07B)
GAS MONITORING STATION-(LG1/DP1/TV01)
SURFACEWATER MONITORING LOCATION-(EM1)
GROUNDWATER MONITORING LOCATION-(BR1/OB1/KC8/NW1)
STROMWATER/REED BEDS MONITORING-(SRP1)
SEWER MONITORING LOCATION-(SD1)
ECOLOGICAL MONITORING LOCATION-(A)

LEGEND

FACILITY BOUNDARY

CAPPED AREA

AREA OF CURRENT CAPPING CONTRACT

Rev.	Drawn	Chkd	Appd	AS	
A	AR	AR			Cork
					27.01.11
					Rev Origin
					Date
Revision History				A	

ISSUE FOR 2010 AER

Description

Name of Client

CORK CITY COUNCIL

Name of Job

KINSALE ROAD LANDFILL
2010 AER

Title of Drawing

EXISTING ENVIRONMENTAL MONITORING LOCATIONS

Scales Used	This Drawing was printed to
1:5000	A3

Dwg. No.	Rev.
LW11-011-01-001	A

O:\ACAD\2011\LW11\011\01\LW11011001_001

Scale 1:5000

0m 25.00m 50.00m 75.00m 100.00m 125.00m 150.00m 175.00m 200.00m 225.00m 250.00m

FEHILY TIMONEY & COMPANY

CONSULTANTS IN ENGINEERING & ENVIRONMENTAL SCIENCES

W: www.fehilytimoney.ie, E: info@ftco.ie

Core House, Pouladuff Rd, Cork, Ireland.
T:+353-21-4964133, F:+353-21-4964464

Unit 16, Third Floor, North Park Offices,
North Park, Dublin 11, Ireland.
T:+353-1-6583500, F:+353-1-6583501