ANNUAL ENVIRONMENTAL REPORT

FOR

ARTHURSTOWN LANDFILL
KILL, CO. KILDARE

FOR THE PERIOD

1ST JANUARY 2008 – 31ST DECEMBER 2008

WASTE LICENCE NO. W0004-003

Prepared by:

Facility Management,
Arthurstown Landfill,
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17th February 2009

AER 10

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1. INTRODUCTION

1.1. Site Location

Arthurstown landfill, Kill, Co. Kildare is owned and operated by South Dublin County Council (SDCC). SDCC was granted a waste licence to operate the site by the Environmental Protection Agency. Land-filling commenced in October 1997. The current waste licence register number is W004-003 and was issued on *11th March 2005.* The facility is located approximately 25 km south-west of Dublin City and caters for the Greater Dublin Region.

The national grid coordinates for the facility are E 295691 N 220936. Figure 1.1 is a site location map.

The prevailing land use in the area is the bloodstock industry and agriculture. The site was a disused quarry when purchased by SDCC in 1992. It had been a sand and gravel quarry. Some unauthorised dumping took place in the 1970's. SDCC carried out remediation and restoration works on the unauthorised "dump" known locally as "Gavin's Dump".

Groundwater generally flows in a north-westerly direction. There are two rivers in the area, the Hartwell River and the Kill River. Surface water run-off from the site is first collected and stored in the on-site surface water storage lagoon before being discharged to the Hartwell River along with pumped groundwater. Groundwater levels beneath the landfill were artificially reduced during cell construction using a cut-off pipe system so that the water table is maintained below the landfill lining system base level.

The prevailing winds are south to south westerlies. The annual rainfall for the area is approximately 1,000 mm.

Figure 1.1 Facility Location Map

1.2. Purpose

This Annual Environmental Report (AER) has been prepared in compliance with Condition 11.5 of the waste licence. It is the 10 th AER for the facility.

Condition 11.5 states that:

"Annual Environmental Report"

The licensee shall submit to the Agency for its agreement, within one month at the end of each calendar year, an Annual Environmental Report (AER).

The AER shall include as a minimum the information specified in *Schedule F: Content of Annual Environmental Report*, of this licence and shall be reported in accordance with any relevant written guidance issued by the Agency".

The AER includes all of the items that are required by Schedule F of the current waste licence for the facility.

This AER covers the operational period of the landfill from 1st January 2008 to 31st December 2008.

2. SITE DESCRIPTION AND ACTIVITIES

2.1. Waste Activities

Waste activities carried out at Arthurstown Landfill are in accordance with the licence as follows:

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 deposit of baled municipal waste at the facility.

Class 4 **Surface impoundment, including placement of liquid or sludge discards into pits, ponds or lagoons:**

This activity is limited to the storage of leachate in the storage and treatment tank and lagoons and the storage of surface water and groundwater at the facility.

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 deposit of baled municipal waste into lined cells at the facility.

Class 6 **Biological treatment not referred to elsewhere in this Schedule 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 biological treatment of leachate arising from the waste disposed of on-site.

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 physico-chemical treatment of leachate arising from the waste disposed of on-site.

Municipal waste that has been baled prior to acceptance at Arthurstown Landfill, is land-filled in 15 no. lined discrete cells which are subsequently capped. Leachate is collected from the breakdown of waste and is stored on site and treated in a Sequencing Batch Reactor (SBR) prior to transfer off-site for disposal at a wastewater treatment plant or discharged to the local foul sewer network.

Surface water is collected from rainwater run-off and is stored in a surface water lagoon on site. (The lagoon is maintained for a fire-fighting water source if the need arose. Additional volumes of surface water, not required for this purpose are discharged to the Hartwell river in accordance with the licence.)

2.2. Waste quantities and composition

Table 2.1 is a list of waste material received at the facility for land-filling since operations commenced in 1997 to the end of this reporting period 2008.

Table 2.1 Waste Intake (Tonnes)

Year	Waste Materials (Tonnes)			
	Cumulative Waste Inputs	Annual Waste Inputs	Month 2008	Tonnages 2008
2008	4,372,908	301,828	Jan	31,012.76
2007	4,071,077	480,529	Feb	25,147.02
2006	3,590,548	591,755	Mar	24,408.38
2005	2,998,793	497,400	Apr	25,201.24
2004	2,501,393	423,626	May	28,819.38
2003	2,077,767	483,582	June	24,671.76
2002	1,594,185	463,436	July	26,083.34
2001	1,130,749	334,333	Aug	22,098.26
2000	796,416	274,642	Sept	22,788.12
1999	521,774	271,079	Oct	21,395.10
1998	250,695	216,284	Nov	22,429.86
1997	34,411	34,411	Dec	27,773.70

2.3. Remaining Capacity

2.3.1. Current Filling Rates

Figure 2.1 illustrates the layout of Arthurstown Landfill. The intake of waste into Cell 1 of Stage 1 at the facility began in October 1997. Substantial filling of Stage 1 (Cells 1 to 4) was completed in 2000. Filling of Stage 2 began with Cells 5 - 10 in 2000 and this stage was completed in 2003.

In 2004, SDCC commenced the placement of waste in cell 11 of stage 3 and 4. Since then, SDCC is currently landfilling cells 12 -15. The final cell (Cell 15) accepted waste during November 2007.

To date SDCC has placed a final cap over 65% of this area (150,000 m^2). Waste intake figures show that between October 1997 and December 2008 more than 4.3 million tonnes of waste has been landfilled at the facility.

Table 2.2 details the remaining void space at Arthurstown landfill, which was calculated by Facility Management using a topographical survey taken in January 2009.

Table 2.2 Void Capacity

Air space from January 2009 Site Survey	420,762 m^3		
Plus 20 % Settlement adjustment	420,762 m^3	x 1.20	= 504,914 m^3
Less Final Cap allowance	92,000 m^2	x 1.0 m	= 92,000 m^3
Less Daily Cap allowance (approx 10%)	420,762 m^3	x 10%	= 42,076.2 m^3
Total Void now remaining			= 370,838 m^3
Convert from cubic meters to tonnes	370,838 m^3	/ 0.8 t/m^3	= 463,547 t
Based on 260,000 tonnes per annum Landfilling time left at Arthurtstown	463,547	/ 260,000 t/a	= 1.8 years
Remaining void space based on January 2008 Site Survey	**463,547 tonnes**		

As can be seen from Table 2.2, the estimated remaining capacity at the landfill at the end of 2008 is 463,547 tonnes.
Based on these figures the closure of Arthurstown will due to take place September 2010.

Figure 2.1 Layout of Arthurstown Landfill

2.4. Future Trends in Filling Rates

The Arthurstown landfill has almost reached capacity. As highlighted on the previous pages the approximate time left is 12 months. (depending on rate of fill)
Waste License W0004-003 was granted on 11th March 2005 and increased the allowable annual tonnage input to 600,000 tonnes per annum.

A reduced rate of intake has been introduced at Arthurstown to prolong the life of the landfill until the date outlined in the new planning permission (December 2010).

During 2006 the highest amount of waste was accepted. (591,755 tonnes)
A reduction in waste intake was recorded during 2007. (480,529 tonnes)
A further reduction was implemented at the start of 2008 and waste intake for this period was only 301,828.92 tonnes.

It is envisaged that the tonnage for the coming year 2009 will be further reduced to 260,000 tonnes approximately.

2.5. Waste Deposition

Waste may be accepted at the facility from Monday to Saturday inclusive between the hours of 08.00 to 18.30. Staff may remain on-site until 19.00 each day to carry out general housekeeping duties. Security staff are on-site outside the opening hours of the facility. Facility Management staff are on 24 hour call 7 days a week

The facility is used solely for the land-filling of non-hazardous baled municipal waste. Baled waste is accepted from pre-approved baling centres only, which are also licensed by the EPA. Arthurstown landfill currently receives waste from the facilities outlined in Table 2.3.

Baled waste is transported to the site in fully enclosed containers, via a specified route, which prevents trucks passing through Kill village as well as the preventing a need to cross the traffic flow on the N7 southbound carriageway. The enclosed containers are deposited in a dedicated marshalling yard and onto hydraulic stillages, which is not open to deliveries before 08:00 each morning. The use of a marshalling yard ensures that the road going fleet does not access the actual landfill cell area and minimises to the greatest possible degree the potential for transfer of dirt onto local and site access roads. Site vehicles are regularly cleaned using the vehicle wash facilities installed on site.

Refer to Figure 2.3; Loaded containers are taken to the working landfill face by specially adapted rough terrain vehicles and emptied using a hydraulic ram and an excavator with a grab attachment. The bales are stacked in horizontal rows, like buildings blocks, and covered as the working face travels horizontally along the cell, being sheltered insofar as is possible from the prevailing winds. As the waste generally gives rise to odours, the site management employs techniques to eliminate where possible, or at least minimise, the potential for these odours to be carried off site at all times. Techniques currently employed include use of clay cover material and spraying with odour control mixtures, application of a double layer of Heavy duty Plastic Covering on the vertical face. (See Section 3.9 on Odour Management during 2008).
Currently there are 4 no. Enclosed landfill gas flares at Arthurstown.
The first 2 enclosed landfill gas flares operate in conjunction with the 11 no. landfill gas engines producing 12.5 MW of electricity. The second 2 enclosed flares are at opposite ends of the temporary capped areas. (Cells 11-15)
Waste is not re-excavated once it is land-filled. A schematic of the waste handling operation is shown below. Site activities are carried out under the supervision of the Facility Manager (J. Smith).

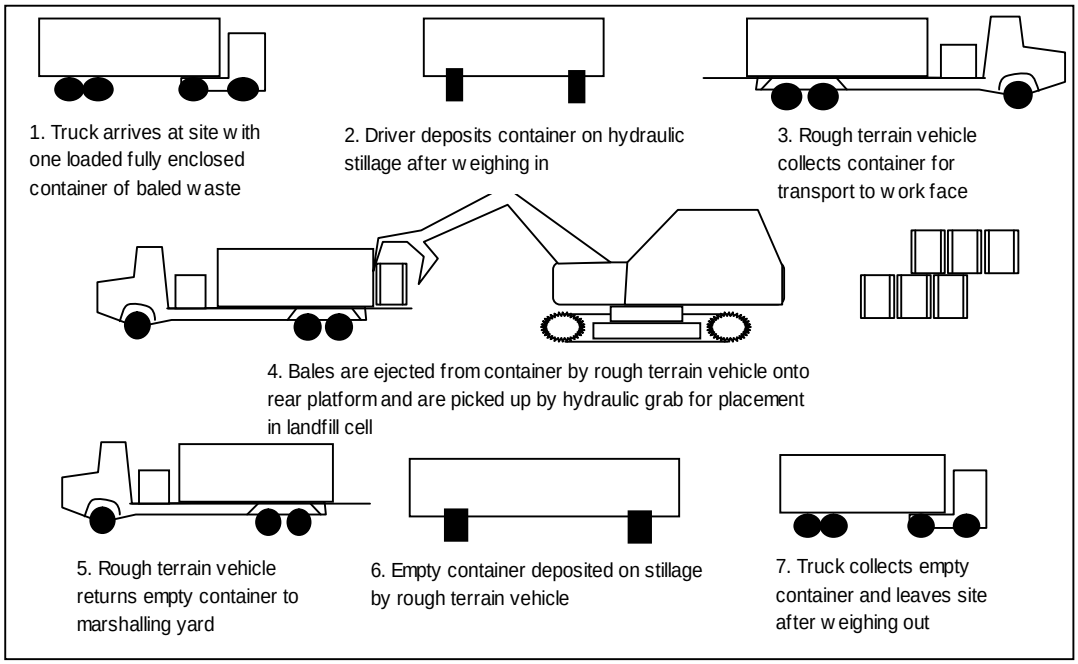
Table 2.3 Baling Stations Supplying Arthurstown Landfill

Facility	Waste Licence No.	Licensee	Operator
Ballymount Baling Station	3-3	SDCC	Veolia (formerly Onyx Ireland)
Thorntons Recycling Centre	44-2	Pardraig Thornton Waste Disposal Limited	Pardraig Thornton Waste Disposal Limited
Ballyogan Recycling Park	15-1	Dun Laoghaire Rathdown County Council	Greenstar
Oxigen Environmental Ltd. Integrated Waste Management Facility	208-1	Oxigen	Oxigen

The principal activity as licensed by the EPA at Arthurstown landfill site is the land-filling of baled municipal waste into pre-constructed fully lined cells.

1. Waste delivered to Arthurstown is handled as follows: Waste is visually inspected at each of the baling stations prior to baling to ensure it is suitable for land-filling at Arthurstown.
1. On arrival at Arthurstown landfill, waste is weighed at the onsite weighbridge. Details of all wastes accepted (type, nature, weight, origin etc) at the site is recorded by the weighbridge operator.
2. Waste containers are set down on hydraulic stillage units in the marshalling yard.
3. The containers are picked up and transported to the active area of the landfill by dedicated on-site vehicles only, known as slave vehicles.
4. At the active waste area, the bales are removed from the site vehicles. An excavator with a grab attachment stacks them in close formation, normally 4 bales high. At the end of each working day, the top horizontal face of the bales is covered with a minimum of 300 mm of clay cover material or greater if deemed necessary by the Facility Manager. The vertical face of the bales is covered with a double layer of plastic sheeting or with clay if the vertical face is to be left unattended for 3 days or more.

Figure 2.3 Illustration of Waste Deposition Method



Continuous intermediate capping is carried out at the landfill. The EPA Landfill Design Manual states that waste material settles by approximately 25% of the depth of waste mass.

Phases 1 and 2 have been fully capped and restored.

Containment Principle

Arthurstown landfill comprises 15 discrete cells occupying at total area of approximately 255,000 m^2. The lining system in these cells comprises of a 2.5 mm thick fully welded high density polyethylene (HDPE) flexible membrane liner underlain by a minimum of 1 m of engineered clay. The clay liner underlying the HDPE flexible membrane liner has a permeability of 1 x 10^{-9} m/sec or lower. This lining system minimises leakage of leachate and migration of landfill gas through the base and side walls of the filling cells and is installed progressively during the development of each phase. All liner placement is carried out under strict quality assurance procedures that are documented and sent to the EPA for their approval. No waste is deposited within a cell without approval from the EPA.

The landfill has been constructed on a phased basis:

- Phase 1 - Cells 1 to 4 are filled and capped
- Phase 2 – Cells 5 to10 are filled and capped
- Phase 3 and 4 - Cells 11 to 15. Cells 12 – 15 are currently being filled.

2.6. Resource and Energy Consumption

The principal resources consumed at the landfill facility are diesel oil and electricity. Site vehicles are fuelled by diesel oil.

Table 2.4 Resource Use and Energy Consumption

Resource/Energy	Units	Quantity Used in 2008.
Diesel Oil	(Litres)	645,300
Electricity (As per SCADA)	(kWh)	797,413

2.7. Leachate Generation

In 2008 leachate was collected from the waste cells and pumped to the leachate treatment plant. It was subsequently removed from site to a wastewater treatment plant by road tanker. Works for a new rising main to eliminate the need to transport treated leachate off site by road tanker are complete. SDCC has received permission from the local authority Kildare County Council to commence discharge via the rising main during 2008. Table 2.5 lists the quantities of leachate tankered off site in 2008 and Table 2.6 shows the quantities of leachate treated in the leachate treatment plant prior to disposal off-site since 2002. During 2008 an additional 3,498 tonnes of treated leachate was discharged to the sewer.

Table 2.5 Leachate Removal Off-Site

Month	Tonnes leachate tankered off site 2008
January	10,017.07
February	9,429.37
March	5,987.60
April	6,578.82
May	7,397.94
June	7,664.16
July	6,551.08
August	6,761.10
September	10,415.96
October	11,593.36
November	10,732.30
December	11,055.96
Total	104,184.72

Table 2.6 Leachate Treatment

	2002	2003	2004	2005	2006	2007	2008
Treated in SBR m^3	12,407	10,922	4,178	10,777	12,210	14,853	5,638
Tankered off-site m^3	39,035	32,599	55,072	63,279	80,270	101,732	104,184

3. ENVIRONMENTAL MONITORING

This is a summary of results and interpretation of environmental monitoring carried out in the period 1st January 2008 to 31st December 2008.

Environmental monitoring of the following is carried out in compliance with Condition 8 and Schedule D of the licence. (W0004-003)

- Landfill Gas
- Landfill Gas Utilisation Plant
- Dust Deposition
- Noise
- Surface Water including Biological Assessment
- Groundwater
- Private Wells (Groundwater)
- Leachate (including discharges to sewer)
- Nuisance
- Meteorological

Schedule D.8 conditions monitoring of emissions to sewer in the event that leachate is discharged directly to sewer. From 1998 to 2007 leachate was not discharged to sewer, but was tankered off-site to an agreed discharge location. From 2008 onwards, treated leachate (once within the parameters set out in Schedule D.8.) will be conveyed via a rising main to the local sewer network in Kill village.

Environmental monitoring is carried out on a weekly, monthly, quarterly, bi-annual and annual basis for various parameters of the various media. The AER presents the results of annual monitoring with interpretation. A review of the other results collected during the year is included.

3.1. Monitoring Locations

The environmental monitoring points are shown on Drawing Number AWL03 – 14. All samples were collected at the sampling points listed in Table D.1.1 of the licence unless specified otherwise in the following sections.

Figure 3.1: Environmental Monitoring Locations Drawing

3.2. Landfill Gas

Perimeter Monitoring Wells

There are 23 no. perimeter gas monitoring wells at the facility. In accordance with Schedule D.2.1 of the licence, monitoring of the wells is carried out on a monthly basis. An investigation was carried out in 2005 into elevated levels of carbon dioxide and methane at a number of perimeter wells. The investigation concluded that the elevated levels of CH_4 and $C0_2$ were due to incidences of rotting vegetation, proximity to old percolation area etc. and was not due to landfill gas migration.

Figures 3.2.1.a, Appendix 3.2 show methane and carbon dioxide levels measured in perimeter wells in 2008. The levels are comparable to those shown in Figures 3.2.1.b , Appendix 3.2 levels recorded in 2004,2005 & 2006.

Gas Extraction Wells

The fully capped areas have a gas extraction system. This system is controlled and monitored by landfill gas field balancing. A gas balancing model is used by the staff at Arthurstown. A recent audit of the system is included in Appendix 3.2.

Experience to date at the facility shows that vents do not produce viable landfill gas until they are approximately 9 - 12 months old. The connection of vents is carried out if waste deposition in the area of the vent has either reached final levels or is to cease for 6 months or more. Temporary connections are also made on the instruction of the Facility Manager. Some of these vents are also located along the temporary landfill access roads.

Site Buildings

There are four permanent gas monitors, one in each building on site:

- Administration building
- Staff services building
- Leachate plant building
- Maintenance building

The following is the report of monitoring for 2008.

- Quarter 1 – no exceedences
- Quarter 2 - no exceedences
- Quarter 3 - no exceedences
- Quarter 4 - no exceedences

3.2.1. Landfill Gas Results

Appendix 3.2 has a series of tables and charts that show landfill gas levels at perimeter monitoring wells. They include:

Table or Figure number	Table or Figure Name
Table A. 3.2.1.a	Landfill Gas Perimeter Monthly

3.2.2. Interpretation of Landfill Gas Results

Landfill gas results are typical for Arthurstown landfill.
Certain wells as indicated in the Table are above the limit for CH4 and CO2. The Facility Management staff already engaged Odour Monitoring Ireland on 17th June 2005 to investigate these levels of methane in some of the perimeter wells.
The report concluded that due to the high sulphuric content of the gas in the perimeter wells that the gas was not migrating from the landfill and that this was occurring naturally due to decaying vegetation in certain areas and as a result of an old percolation area in another location. Before land-filling took place there was also background monitoring carried out. Levels of methane were also detected at that stage also.
Please refer to the consultants report reference 090905A.

Landfill Gas Utilisation Plant Emissions

In accordance with Schedule D.7.1of the licence annual monitoring of the landfill gas utilisation plant was carried out.

The Landfill Gas Utilisation Plant commenced operations April 2004 with three no. Jensbaucher landfill gas engines from Austria extracting gas at a rate of approximately 3,000 m^3/hr. The Council requested that the enclosed flare operate in conjunction with the engines. This was carried out and the extraction rate increased to 4,900 m^3 per hour. During December 2004 a fourth engine was installed and the rate further increased to approximately 5,700 m^3 per hour. In 2005 an additional enclosed flare unit was installed. The extraction rate in the utilisation plant is currently approx. 10,000 m^3/hour, this is generated by 11 no. engines and 2 no. enclosed flares. Currently one 2,500m3 per hour enclosed flare extracts approximately 1,500 m3 per hour of gas from the temporary capped areas. Since the start of 2009 , the second enclosed flare unit is now on standby as some of the gas in this area (Cell 14) is being diverted to the utilisation plant for electricity production. These flare units replace all open flare units on site.

Annual monitoring of the landfill gas utilisation plant emissions is a requirement of the licence. Monitoring was carried out for the period 2008 and the results are contained in Tables 3.1 to 3.11 and also on the following pages.The results show that all engines and flares are in full compliance with Waste License W0004-003.

Table 3.4. Emission value results from landfill gas flare 1.

Flare 1	Conc.	Units[1]	Adjusted units (mg/m^3)	Volumetric flow rate (Nm^3/hr)	Emission conc (mg/Nm^3)	Oxygen corrected emission conc to 3% (mg/Nm^3)[2]	Mass emission rate (kg/hr) at 3% O_2	Emission limit Values
TOC	6.40	mg/Nm^3	6.40	3,995	6.40	9.72	0.039	<10 mg/Nm^3
Hydrogen chloride	4.23	mg/m^3	4.23	3,995	5.78	8.78	0.035	<50 mg/Nm^3
Hydrogen fluoride	0.23	mg/m^3	0.23	3,995	0.31	0.48	0.002	<5 mg/Nm^3
Temperature	1021	degrees	1294.15	3,995	-	-	-	-
CO	4.0	ppm	5.0	3,995	5.00	7.60	0.030	<50 mg/Nm^3
O_2	9.12	%	9.12	3,995	-	-	-	-
Total NOx [as NO_2]	34	ppm	69.82	3,995	69.82	106.10	0.42	<150 mg/Nm^3
SO_2	27	ppm	77.14	3,995	77.14	117.22	0.47	-
CO_2	9.33	%	9.33	3,995	-	-	-	-

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

Table 3.5. Emission value results from landfill gas flare 2.

Flare 2	Conc.	Units[1]	Adjusted units (mg/m^3)	Volumetric flow rate (Nm^3/hr)	Emission conc (mg/Nm^3)	Oxygen corrected emission conc to 3% (mg/Nm^3)[2]	Mass emission rate (kg/hr) at 3% O_2	Emission limit Values
TOC	3.20	mg/Nm^3	3.20	3,850	3.20	4.77	0.018	<10 mg/Nm^3
Hydrogen chloride	4.11	mg/m^3	4.11	3,850	5.61	8.38	0.032	<50 mg/Nm^3
Hydrogen fluoride	0.54	mg/m^3	0.54	3,850	0.74	1.10	0.004	<5 mg/Nm^3
Temperature	1072	degrees	1345.15	3,850	-	-	-	-
CO	3.0	ppm	3.75	3,850	3.75	5.59	0.02	<50 mg/Nm^3
O_2	8.90	%	8.9	3,850	-	-	-	-
Total NOx [as NO_2]	28	ppm	57.5	3,850	57.50	85.77	0.33	<150 mg/Nm^3
SO_2	49	ppm	140	3,850	140.00	208.83	0.80	-
CO_2	10.29	%	10.29	3,850	-	-	-	-

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

Table 3.6. Emission value results from landfill gas flare 3.

Flare 3 (located at front of site)	Conc.	Units[1]	Adjusted units (mg/m^3)	Volumetric flow rate (Nm^3/hr)	Emission conc (mg/Nm^3)	Oxygen corrected emission conc to 3% (mg/Nm^3)[2]	Mass emission rate (kg/hr) at 3% O_2	Emission limit Values
TOC	3.20	mg/Nm^3	3.20	1,935	3.20	4.81	0.010	<10 mg/Nm^3
Hydrogen chloride	4.11	mg/m^3	4.11	1,935	5.61	8.44	0.020	<50 mg/Nm^3
Hydrogen fluoride	0.54	mg/m^3	0.54	1,935	0.74	1.11	0.0020	<5 mg/Nm^3
Temperature	1072	degrees	1345.15	1,935	-	-	-	-
CO	5.0	ppm	6.25	1,935	6.25	9.39	0.010	<50 mg/Nm^3
O_2	8.99	%	8.99	1,935	-	-	-	-
Total NOx [as NO_2]	23	ppm	47.23	1,935	47.23	70.99	0.14	<150 mg/Nm^3
SO_2	25	ppm	71.43	1,935	71.43	107.35	0.21	-
CO_2	9.94	%	9.94	1,935	-	-	-	-

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

Table 3.7. Emission value results from landfill gas flare 4.

Flare 4	Conc.	Units[1]	Adjusted units (mg/m^3)	Volumetric flow rate (Nm^3/hr)	Emission conc (mg/Nm^3)	Oxygen corrected emission conc to 3% (mg/Nm^3)[2]	Mass emission rate (kg/hr) at 3% O_2	Emission limit Values
TOC	4.0	mg/Nm^3	4.0	4,272	4.00	7.96	0.030	<10 mg Nm^{-3}
Hydrogen chloride	3.12	mg/m^3	3.12	4,272	4.26	8.49	0.040	<50 mg Nm^{-3}
Hydrogen fluoride	0.32	mg/m3	0.32	4,272	0.44	0.87	0.0040	<5 mg Nm^{-3}
Temperature	1097	degrees	1370.15	4,272	-	-	-	-
CO	4.0	ppm	5	4,272	5.00	9.96	0.040	<50 mg Nm^{-3}
O_2	11.91	%	11.91	4,272	-	-	-	-
Total NOx [as NO_2]	23	ppm	47.23	4,272	47.23	94.04	0.40	<150 mg Nm^{-3}
SO_2	31	ppm	88.57	4,272	88.57	176.35	0.75	-
CO_2	11.21	%	11.21	4,272	-	-	-	-

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

Table 3.8. Emission value results from gas utilisation engine AR01.

Gas Utilisation engine AR01	Conc.	Units[1]	Adjusted units (mg/m^3)	Volumetric flow rate (Nm^3/hr)	Emission conc (mg/Nm^3)	Oxygen corrected emission conc to 5% (mg/Nm^3)[2]	Mass emission rate (kg/hr) at 5% O_2	Emission limit Values
TNMVOC	4.91	mg/m^3	7.85	3,002	7.85	9.06	0.027	<75 mg/Nm^3
Average THC	222	mg/m^3 [propane]	355.2	3,002	355.20	409.85	1.23	<1000 mg/Nm^3
Hydrogen chloride	3.65	mg/m^3	3.65	3,002	4.99	5.75	0.02	<50 mg/Nm^3 (at mass flows >0.30 kg/h)
Hydrogen fluoride	0.18	mg/m^3	0.18	3,002	0.25	0.28	0.001	<5 mg/Nm^3 (at mass flows >0.05 kg/h)
Temperature	446	degrees	719.15	3,002	-	-	-	-
CO	901	ppm	1126.25	3,002	1126.25	1299.52	3.90	<1400 mg/Nm^3
O_2	7.12	%	7.12	3,002	-	-	-	-
Total NOx [as NO_2]	193	ppm	396.33	3,002	396.34	457.31	1.37	<500 mg/Nm^3
SO_2	2.0	ppm	5.71	3,002	5.71	6.59	0.02	-
CO_2	10.8	%	10.8	3,002	-	-	-	-
Particulates	13.11	mg/m^3	13.11	3,002	34.52	39.83	0.12	<130 mg/Nm^3

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

Table 3.9. Emission value results from gas utilisation engine AR02.

Gas Utilisation engine AR02	Conc.	Units[1]	Adjusted units (mg/m^3)	Volumetric flow rate (Nm^3/hr)	Emission conc (mg/Nm^3)	Oxygen corrected emission conc to 5% (mg/Nm^3)[2]	Mass emission rate (kg/hr) at 5% O_2	Emission limit Values
TNMVOC	3.12	mg/m^3	4.99	2,974	4.99	5.92	0.018	<75 mg/m^3
Average THC	314	mg/m^3 [propane]	502.4	2,974	502.40	596.57	1.77	<1000 mg/m^3
Hydrogen chloride	2.81	mg/m^3	2.81	2,974	3.83	4.55	0.014	<50 mg Nm^{-3} (at mass flows >0.30 kg/h)
Hydrogen fluoride	0.25	mg/m^3	0.25	2,974	0.342	0.406	0.001	<5 mg Nm^{-3} (at mass flows >0.05 kg/h)
Temperature	443	degrees	716.15	2,974	-	-	-	-
CO	902	ppm	1127.5	2,974	1127.50	1338.85	3.98	<1400 mg Nm^{-3}
O_2	7.51	%	7.51	2,974	-	-	-	-
Total NOx [as NO_2]	176	ppm	361.43	2,974	361.42	429.18	1.27	<500 mg Nm^{-3}
SO_2	1.0	ppm	2.86	2,974	2.85	3.39	0.010	-
CO_2	11.12	%	11.12	2,974	-	-	-	-
Particulates	14.33	mg/m^3	14.33	2,974	37.57	44.61	0.13	<130 mg Nm^{-3}

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

Table 3.10. Emission value results from gas utilisation engine AR03.

Gas Utilisation engine AR03	Conc.	Units[1]	Adjusted units (mg/m^3)	Volumetric flow rate (Nm^3/hr)	Emission conc (mg/Nm^3)	Oxygen corrected emission conc to 5% (mg/Nm^3)[2]	Mass emission rate (kg/hr) at 5% O_2	Emission limit Values
TNMVOC	4.21	mg/m^3	6.73	3,437	6.74	7.77	0.027	<75 mg/m^3
Average THC	285	mg/m^3 [propane]	456	3,437	456	526	1.80	<1000 mg/m^3
Hydrogen chloride	1.81	mg/m^3	1.81	3,437	2.47	2.853	0.010	<50 mg Nm^{-3} (at mass flows >0.30 kg/h)
Hydrogen fluoride	0.17	mg/m^3	0.17	3,437	0.23	0.268	0.001	<5 mg Nm^{-3} (at mass flows >0.05 kg/h)
Temperature	467	degrees	740.15	3,437	-	-	-	-
CO	932	ppm	1165	3,437	1,16	1,344.23	4.62	<1400 mg Nm^{-3}
O_2	7.12	%	7.12	3,437	-	-	-	-
Total NOx [as NO_2]	196	ppm	402.5	3,437	402.5	464.42	1.59	<500 mg Nm^{-3}
SO_2	2	ppm	5.71	3,437	5.71	6.59	0.023	-
CO_2	11.97	%	11.97	3,437	-	-	-	-
Particulates	16.11	mg/m^3	16.11	3,437	43.65	50.36	0.17	<130 mg Nm^{-3}

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

Table 3.11. Emission value results from gas utilisation engine AR04.

Gas Utilisation engine AR04	Conc.	Units[1]	Adjusted units (mg/m^3)	Volumetric flow rate (Nm^3/hr)	Emission conc (mg/Nm^3)	Oxygen corrected emission conc to 5% (mg/Nm^3)[2]	Mass emission rate (kg/hr) at 5% O_2	Emission limit Values
TNMVOC	3.41	mg/m^3	5.456	3,233	5.45	6.18	0.020	<75 mg/m^3
Average THC	367	mg/m^3 [propane]	587.2	3,233	587.20	665.94	2.15	<1000 mg/m^3
Hydrogen chloride	1.93	mg/m^3	1.93	3,233	2.63	2.99	0.010	<50 mg Nm^{-3} (at mass flows >0.30 kg/h)
Hydrogen fluoride	0.34	mg/m^3	0.34	3,233	0.46	0.52	0.002	<5 mg Nm^{-3} (at mass flows >0.05 kg/h)
Temperature	465	degrees	738.15	3,233	-	-	-	-
CO	967	ppm	1208.75	3,233	1,208.75	1,370.84	4.43	<1400 mg Nm^{-3}
O_2	6.88	%	6.88	3,233	-	-	-	-
Total NOx [as NO_2]	192	ppm	394.29	3,233	394.28	447.15	1.44	<500 mg Nm^{-3}
SO_2	2	ppm	5.71	3,233	5.71	6.48	0.021	-
CO_2	11.61	%	11.61	3,233	-	-	-	-
Particulates	16.71	mg/m^3	16.71	3,233	45.15	51.21	0.166	<130 mg Nm^{-3}

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

Table 3.12. Emission value results from gas utilisation engine AR05.

Gas Utilisation engine AR05	Conc.	Units[1]	Adjusted units (mg/m^3)	Volumetric flow rate (Nm^3/hr)	Emission conc (mg/Nm^3)	Oxygen corrected emission conc to 5% (mg/Nm^3)[2]	Mass emission rate (kg/hr) at 5% O_2	Emission limit Values
TNMVOC	3.11	mg/m^3	4.98	3,089	4.97	6.15	0.019	<75 mg/m^3
Average THC	481	mg/m^3 [propane]	769.6	3,089	769.60	952.27	2.94	<1000 mg/m^3
Hydrogen chloride	2.11	mg/m^3	2.11	3,089	2.882	3.567	0.011	<50 mg Nm^{-3} (at mass flows >0.30 kg/h)
Hydrogen fluoride	0.23	mg/m^3	0.23	3,089	0.31	0.38	0.0012	<5 mg Nm^{-3} (at mass flows >0.05 kg/h)
Temperature	448	degrees	721.15	3,089	-	-	-	-
CO	902	ppm	1127.50	3,089	1127.50	1395.11	4.31	<1400 mg Nm^{-3}
O_2	8.05	%	8.05	3,089	-	-	-	-
Total NOx [as NO_2]	193	ppm	396.34	3,089	396.33	490.41	1.51	<500 mg Nm^{-3}
SO_2	1.0	ppm	2.86	3,089	2.85	3.53	0.0109	-
CO_2	12.11	%	12.11	3,089	-	-	-	-
Particulates	12.32	mg/m^3	12.32	3,089	32.52	40.24	0.12	<130 mg Nm^{-3}

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

Table 3.13. Emission value results from gas utilisation engine AR06.

Gas Utilisation engine AR06	Conc.	Units[1]	Adjusted units (mg/m^3)	Volumetric flow rate (Nm^3/hr)	Emission conc (mg/Nm^3)	Oxygen corrected emission conc to 5% (mg/Nm^3)[2]	Mass emission rate (kg/hr) at 5% O_2	Emission limit Values
TNMVOC	3.21	mg/m^3	5.13	3,382	5.13	6.74	0.023	<75 mg/m^3
Average THC	421	mg/m^3 [propane]	673.60	3,382	673.60	884.41	2.99	<1000 mg/m^3
Hydrogen chloride	3.44	mg/m^3	3.44	3,382	4.69	6.17	0.021	<50 mg Nm^{-3} (at mass flows >0.30 kg/h)
Hydrogen fluoride	0.31	mg/m^3	0.31	3,382	0.423	0.556	0.002	<5 mg Nm^{-3} (at mass flows >0.05 kg/h)
Temperature	445	degrees	718.15	3,382	-	-	-	-
CO	834	ppm	1042.50	3,382	1,042.50	1,368.76	4.62	<1400 mg Nm^{-3}
O_2	8.79	%	8.79	3,382	-	-	-	-
Total NOx [as NO_2]	161	ppm	330.63	3,382	330.62	434.09	1.46	<500 mg Nm^{-3}
SO_2	2.0	ppm	5.71	3,382	5.71	7.50	0.025	-
CO_2	10.80	%	10.80	3,382	-	-	-	-
Particulates	8.43	mg/m^3	8.43	3,382	22.16	29.10	0.098	<130 mg Nm^{-3}

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

Table 3.14. Emission value results from gas utilisation engine AR07.

Gas Utilisation engine AR07	Conc.	Units[1]	Adjusted units (mg/m^3)	Volumetric flow rate (Nm^3/hr)	Emission conc (mg/Nm^3)	Oxygen corrected emission conc to 5% (mg/Nm^3)[2]	Mass emission rate (kg/hr) at 5% O_2	Emission limit Values
TNMVOC	3.16	mg/m^3	5.05	3,222	5.05	5.83	0.019	<75 mg/m^3
Average THC	492	mg/m^3 [propane]	787.2	3,222	787.20	908.30	2.92	<1000 mg/m^3
Hydrogen chloride	2.65	mg/m^3	2.65	3,222	3.620	4.177	0.013	<50 mg Nm^{-3} (at mass flows >0.30 kg/h)
Hydrogen fluoride	0.36	mg/m^3	0.36	3,222	0.492	0.567	0.002	<5 mg Nm^{-3} (at mass flows >0.05 kg/h)
Temperature	451	degrees	724.15	3,222	-	-	-	-
CO	886	ppm	1107.5	3,222	1,107.50	1,277.88	4.12	<1400 mg Nm^{-3}
O_2	7.12	%	7.12	3,222	-	-	-	-
Total NOx [as NO_2]	199	ppm	408.66	3,222	408.66	471.53	1.519	<500 mg Nm^{-3}
SO_2	1	ppm	2.86	3,222	2.85	3.29	0.011	-
CO_2	11.71	%	11.71	3,222	-	-	-	-
Particulates	9.23	mg/m^3	9.23	3,222	24.36	28.11	0.091	<130 mg Nm^{-3}

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

Table 3.15. Emission value results from gas utilisation engine AR08.

Gas Utilisation engine AR08	Conc.	Units[1]	Adjusted units (mg/m^3)	Volumetric flow rate (Nm^3/hr)	Emission conc (mg/Nm^3)	Oxygen corrected emission conc to 5% (mg/Nm^3)[2]	Mass emission rate (kg/hr) at 5% O_2	Emission limit Values
TNMVOC	3.22	mg/m^3	5.15	3,118	5.15	5.95	0.019	<75 mg/m^3
Average THC	393	mg/m^3 [propane]	628.8	3,118	628.80	727.12	2.267	<1000 mg/m^3
Hydrogen chloride	2.74	mg/m^3	2.74	3,118	3.74	4.32	0.013	<50 mg Nm^{-3} (at mass flows >0.30 kg/h)
Hydrogen fluoride	0.46	mg/m^3	0.46	3,118	0.628	0.727	0.002	<5 mg Nm^{-3} (at mass flows >0.05 kg/h)
Temperature	481	degrees	754.15	3,118	-	-	-	-
CO	893	ppm	1116.25	3,118	1,116.25	1,290.79	4.02	<1400 mg Nm^{-3}
O_2	7.15	%	7.15	3,118	-	-	-	-
Total NOx [as NO_2]	154	ppm	316.25	3,118	316.25	365.70	1.14	<500 mg Nm^{-3}
SO_2	1.0	ppm	2.86	3,118	2.85	3.30	0.010	-
CO_2	10.48	%	10.48	3,118	-	-	-	-
Particulates	12.54	mg/m^3	12.54	3,118	34.62	40.03	0.125	<130 mg Nm^{-3}

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

Table 3.16. Emission value results from gas utilisation engine AR09.

Gas Utilisation engine AR09	Conc.	Units[1]	Adjusted units (mg/m^3)	Volumetric flow rate (Nm^3/hr)	Emission conc (mg/Nm^3)	Oxygen corrected emission conc to 5% (mg/Nm^3)[2]	Mass emission rate (kg/hr) at 5% O_2	Emission limit Values
TNMVOC	2.35	mg/m^3	3.76	3,655	3.76	3.80	0.014	<75 mg/m^3
Average THC	452	mg/m^3 [propane]	723.20	3,655	723.20	732.41	2.67	<1000 mg/m^3
Hydrogen chloride	2.91	mg/m^3	2.91	3,655	3.975	4.026	0.015	<50 mg Nm^{-3} (at mass flows >0.30 kg/h)
Hydrogen fluoride	0.32	mg/m^3	0.32	3,655	0.43	0.44	0.002	<5 mg Nm^{-3} (at mass flows >0.05 kg/h)
Temperature	492	degrees	765.15	3,655	-	-	-	-
CO	309	ppm	386.25	3,655	386.25	391.17	1.43	<1400 mg Nm^{-3}
O_2	5.20	%	5.2	3,655	-	-	-	-
Total NOx [as NO_2]	175	ppm	359.37	3,655	359.37	363.95	1.33	<500 mg Nm^{-3}
SO_2	1.0	ppm	2.86	3,655	2.85	2.89	0.011	-
CO_2	12.12	%	12.12	3,655	-	-	-	-
Particulates	10.24	mg/m^3	10.24	3,655	28.68	29.05	0.106	<130 mg Nm^{-3}

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

Table 3.17. Emission value results from gas utilisation engine AR10.

Gas Utilisation engine AR10	Conc.	Units[1]	Adjusted units (mg/m^3)	Volumetric flow rate (Nm^3/hr)	Emission conc (mg/Nm^3)	Oxygen corrected emission conc to 5% (mg/Nm^3)[2]	Mass emission rate (kg/hr) at 5% O_2	Emission limit Values
TNMVOC	3.76	mg/m^3	6.01	3,706	6.01	5.85	0.022	<75 mg/m^3
Average THC	367	mg/m^3 [propane]	587.2	3,706	587.20	571.38	2.11	<1000 mg/m^3
Hydrogen chloride	4.61	mg/m^3	4.61	3,706	6.298	6.128	0.023	<50 mg Nm^{-3} (at mass flows >0.30 kg/h)
Hydrogen fluoride	0.38	mg/m^3	0.38	3,706	0.519	0.505	0.002	<5 mg Nm^{-3} (at mass flows >0.05 kg/h)
Temperature	452	degrees	725.15	3,706	-	-	-	-
CO	759	ppm	948.75	3,706	948.75	923.20	3.42	<1400 mg Nm^{-3}
O_2	4.56	%	4.56	3,706	-	-	-	-
Total NOx [as NO_2]	227	ppm	466.16	3,706	466.16	453.60	1.68	<500 mg Nm^{-3}
SO_2	1	ppm	2.86	3,706	2.85	2.78	0.010	-
CO_2	13.21	%	13.21	3,706	-	-	-	-
Particulates	9.23	mg/m^3	9.23	3,706	24.50	23.84	0.088	<130 mg Nm^{-3}

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

3.2.3. Interpretation of Utilisation Emissions

The annual report on emissions monitoring of flares and engine stacks shows all readings are in compliance with waste license W0004-003 for 2008.

3.3. Dust Deposition

Dust monitoring was carried out in accordance with the licence at 6 monitoring locations, three times in the year.

Dust monitoring was carried out over a 30 day period +/- 2 days. The periods were as follows:

- ___30th April 2008
- ___30th July 2008
- ___18th September 2008

3.3.1. Dust Deposition

Dust deposition results for 2008 are shown in Figure 3.3.1.a Dust Monitoring.
Figure 3.3.1.b shows a comparison of dust levels at selected monitoring points from 2002 to 2008 in appendix 3.3.

3.3.2. Interpretation of Dust Deposition Results

The license limit for dust at the facility is 350 mg/m2/day. This was not exceeded during 2008. The highest level recorded in Q1 was 310 mg/m2/day at location D3.

3.4. Noise

In compliance with Schedule D (D.4) of the waste licence, noise monitoring was carried out twice during 2008.

The noise monitoring events took place as follows:

Day time monitoring – 18th November 2008
Night time monitoring – 18th November 2008
Day time monitoring – 17th December 2008
Night time monitoring – 17th December 2008

Noise Results

The results of noise monitoring events are shown in the following tables and charts in Appendix 3.4:

Table or Figure number	Table or Figure Name
Table A.3.4.1.a	Noise Day-time Monitoring
Table A.3.4.2.b	Noise Night-time Monitoring
Figure A.3.4.1.a	Noise Day-time Monitoring (5 Years)
Figure A.3.4.2.b	Noise Night-time Monitoring (5 Years)

3.4.1. Interpretation of Noise Results

Event 1
Daytime Event – 18th November 2008
Night-time Event – 18th November 2008

Exceedences = Day 6 Night 5
A total of seven locations were monitored during the day time period. Six out of the seven were slightly over the day time limit for noise. (55 db)
These were mainly due to the close proximity of the monitoring point to moving traffic on site. The highest reading during this daytime round was 73 dB L_{Aeq} at N9.
The same seven locations were monitored at night and five locations were above the licensed limit of 45 dB L_{Aeq}. The highest reading during this night time round was 56 dB L_{Aeq} at N5. This was a direct result of night time operations at the adjacent BALCAS facility.

Event 2
Day time monitoring – 17th December 2008
Night time monitoring – 17th December 2008.

Exceedences = Day 6 Night 7
A total of six locations out of the seven were slightly over the day time limit for noise. (55 db) These were mainly due to the close proximity of the monitoring point to moving traffic on site. A brief mention is made to reversing beacons contributing to some noise levels. Due to current Health & Safety regulations these reversing beacons must remain in place. The highest reading during this daytime round was 65 L_{aeq} dB at N9.
The highest reading during this night time round was 58 dB L_{Aeq} at N5. This was a direct result of night time operations at the adjacent BALCAS facility.

Noise levels are consistent with previous years monitoring.

3.5. Surface Water

The following is a summary of surface water quality findings in 2008. More detailed information has been submitted in each of the quarterly reports from Bord Na Mona.

There are 5 no. surface water monitoring points. Chemical analyses are carried out at all 5 of the monitoring locations and a biological assessment was carried out at SW1, SW3 (Hartwell River) and at SW4 (Kill River). The 5 no. surface water monitoring points are located as follows:

- SW1 upstream of the outfall from the stormwater lagoon in the Hartwell River
- SW2 outlet for the on site stormwater pond
- SW3 downstream of the outfall from the stormwater lagoon in the Hartwell River
- SW4 downstream of Arthurstown Road in the Kill River
- SW5 inlet to the stormwater pond (storm and groundwaters)

3.5.1. Surface Water Results

Chemical Analysis

The results of surface water analysis are shown in the following tables and charts in Appendix 3.5: (The Reporting Application has information on the 4 elements of the licence with regard to surface water monitoring). A visual and odour inspection of all surface water points is carried out on a weekly basis. Chemical analysis of SW2 is carried out weekly. All surface water monitoring points are monitored on a quarterly basis for a list of parameters and on an annual basis for a more comprehensive list.)

The tables and figures relating to annual monitoring (Table/Figure 3.5.4.a) are discussed here in greatest detail as the quarterly reports submitted to the Agency will have included details of the previous events.

Table or Figure number	**Table or Figure Name**
Table A. 3.5.2.a	Surface Water SW2 Weekly
Figure 3.5.3.a	2007 Surface Water Quarterly
Table 3.5.4.a	2007 Surface Water Annually

3.5.2. Interpretation of Surface Water Results

During 2008 the surface water quality has improved compared with previous years as can be seen with the Q rating in table 3.1 below.
Quarterly monitoring is carried out by Bord na Mona at all monitoring points for surface water.
Monitoring points SW2 and SW5 are within the surface water storage pond. During 2008 there were elevated levels of NH_4 Ammonia. This was as a direct result of the highest amounts of rainfall recorded (example: in the 16 weeks of July to October there was 615.40 mm of rainfall (24 inches / 2 feet) (1.25 metres of rainfall for the year 2008.) on the temporary cap area which may lead to small amounts of “breakout leachate”

entering the surface water swale. These areas are remediated as soon as they occur on the instruction of the Facility Manager.
On examining the results of the monitoring points in the Hartwell River (SW1 & SW3) there was no effect as a result of these ammonia levels and therefore no pollution caused. This proves that the surface water retention pond is working effectively.
The Agency was already informed of these incidents during 2008.

Biological Sampling

Biological sampling was carried out in the Hartwell and Kill Rivers. The Hartwell received a Q rating of 4 and the Kill river a Q rating of 4 quality. This is an improvement of the Q rating figures compared to 2007.

Biological sampling is carried out annually in accordance with the licence. It was carried out during the second quarter of 2008. The Q rating system was used. This rating system recognises five macro-invertebrate communities/faunal groups ranging from A to E (i.e. most sensitive to most tolerant of pollution) and relates to their relative abundance, from a standard 2 minute kick sample, to a quality rating –the Q Index. The area surveyed is then assigned a Q rating from 5 to 1, 5 being pristine unpolluted waters to 1 gross polluted. Results of biological sampling are shown in Table 3.12.

Table 3.1 Q Rating of Surface Waters 2008.

Biological Q Rating for Surface Waters (within rivers)			
Location	SW-1	SW-3	SW-4
Q-Rating	4	4	4

Interpretation of Results

Quality at point SW1 has improved on last year. This point is upstream of the Arthurstown surface water discharge point so this improvement in water quality would be as a result of other external factors i.e. better agricultural or industrial practices. (note: discharge from ALCRETE Ltd is within 5m upstream of the discharge from Arthurstown)
Quality at point SW3 is consistent with previous years which indicate that discharges from the landfill are actually improving the surface water quality at point SW3.
Quality at point SW4 has also improved on last year. This point is on the Kill River which is approximately 500m northeast of the site. No discharges are taking place to the Kill River from Arthurstown landfill so this slight improvement in water quality is as a result of other external factors.

Groundwater

There were 22 no. groundwater monitoring wells and 5. no. private wells. Table 3.13 shows the locations of the wells in relation to the facility and in relation to groundwater flow in the area. Table 3.14 shows the depths of groundwater wells. Private Wells are discussed in Section 3.7.

Table 3.2 Location of groundwater monitoring boreholes relevant to the facility and the groundwater flow in the area

Well	**Direction with respect to the facility**	**Location with respect to groundwater flow***
MW3	**260 M NE**	**US**
MW4	400 m E	US
MW5	400 m E	US
MW6	100 m ESE	US
MW7	80 m SE	US
MW8	**240 m ESE**	**US**
MW20	**150 m S**	**US**
MW21	140 m SSE	US
MW22	400 m E	US
MW2	**260 m NE**	**CG**
MW17	100 m WSW	CG
MW19	20 m WSW	CG
MW1	140 m NE	DS
MW9	**50 m W**	**DS**
MW10	50 m W	DS
MW11	50 m W	DS
MW12	50 m NW	DS
MW13	100 m N	DS
MW14	**200 m NNE**	**DS**
MW15	200 m NNE	DS
MW16	**90 m NNW**	**DS**
MW18	170 m N	DS

*Note: US upstream
DS downstream
CS cross gradient
Wells highlighted in bold font are those that are required to be monitored by the waste licence. SDCC samples more wells than is conditioned for their own data.

Of the 22 no. groundwater wells at the site, SDCC samples each one of these wells for their own records. The waste licence (W004-003), Schedule D.1 Table D.1.states that groundwater levels should be recorded for all wells on a monthly basis and that sampling for chemical parameters should be carried out in 7 no. wells. These 7 wells (as selected by the Agency) are highlighted in bold in Table 3.13.

In order to reduce the quantity of data displayed in the Reporting Application, the selected wells have been labelled as active and the others as inactive. Sampling data for all wells is stored in the database, but only active well results are shown in the charts and tables unless the user specifically changes the status of a well to active in Lab Info.

Table 3.3 Depths of Groundwater Monitoring Wells

Wells	Base of wells m O.D (2006)*	Well height at ground level m O.D	Depth of Borehole (m)
MW1	130.04	138.67	8.63
MW2	130.22	137.00	6.78
MW3	131.67	140.20	8.53
MW4	141.72	143.40	1.68
MW5	146.12	148.00	1.88
MW6A	144.7	150.50	5.80
MW7	147	153.60	6.60
MW8	115.19	149.20	34.01
MW9	110.01	139.50	29.49
MW10	132.19	135.10	2.91
MW11	129.28	133.75	4.47
MW12	130.83	134.74	3.91
MW13	127.28	135.60	8.32
MW14	125.13	129.40	4.27
MW15	126.61	129.42	2.81
MW16	112.84	135.54	22.70
MW17	129.05	139.40	10.35
MW18	102.16	136.68	34.52
MW19	118.72	145.30	26.58
MW20	147.51	156.50	8.99
MW21	146.83	155.00	8.17
MW22	140.64	145.00	4.36

*Note: The total depths of wells are as per measurements in 2006. Wells can silt up gradually over time, diminishing their total depth.

3.5.3. Groundwater Results

Tables and charts showing groundwater results and trends are included as follows in Appendix 3.6:

Table or Figure number	Table or Figure Name
Table/Figure 3.6.2.a	Groundwater Wells Quarterly
Table/Figure 3.6.2.b	Groundwater Wells Quarterly
Figure A.3.6.3.a	2007 Groundwater Annually

3.5.4. Interpretation of Groundwater Results

Annual Results

A total of twenty two groundwater monitoring boreholes are located at Arthurstown Landfill. During the annual sampling event a total number of 11 boreholes were sampled.
Chemical analysis, Metals analysis, Organic analysis and Microbial Analysis were carried out as part of the annual analysis of the groundwater.

Table A.3.6.3.c. Groundwater Annual outlines all exceedences for the annual monitoring event.

Ammonia-N was above the MAC at the following points: MW6A, MW7 & MW8.
Chloride levels were above the MAC at MW2, MW14.
MW14 & MW17 had also elevated levels of conductivity.

Calcium levels were only just over the MAC limit at MW6A & MW7.
Manganese levels were above the MAC limit at MW2, MW6A, MW7, MW8, MW16 & MW18.
Potassium levels were only above the MAC at one location MW2.
Sulphate level was just above the MAC at MW7.
Orthophosphate levels were just above the MAC at MW 18.

Locations MW2 and MW3 are not within the boundary of the landfill and are in an agricultural location (i.e. a farm adjacent to slatted sheds)

The locations MW6, MW7 and MW8 are upstream of the landfill. These locations would be adjacent to lands that are spread with slurry on a regular basis.
The elevated readings at these locations cannot be attributed to the landfill due to its location and the directional flow of groundwater on the site.

It can also be said for locations MW2 and MW3 which are adjacent to the landfill and located on a cross-gradient flow in relation to the groundwater contour flow below the landfill. The elevated readings at MW2 and MW3 cannot be attributed to the landfill due to its location.
External agricultural factors are contributing at these locations.

The majority of monitoring at all other locations is consistent with previous years monitoring results.

3.6. Private Wells (Groundwater)

There are 5 no. private groundwater monitoring wells, referred to as Private Wells. Monitoring of the wells is carried out on a quarterly and annual basis.
PW1 is sampled on a quarterly basis and wells PW2 – PW5 are sampled on an annual basis.

The location of the wells is shown on Drawing Number AWL03 – 14 inserted as Figure 3.1.

3.6.1. Private Wells Results

Tables and charts showing groundwater results and trends are included as follows in Appendix 3.7:

Table or Figure number	Table or Figure Name
Table 3.7.2.a	Private Wells Annual
Figure 3.7.1.b	Private Wells Trend –PW1 PW3 PW5

3.6.2. Interpretation of Results

Annual
All private wells (PW1 – PW5) are sampled on an annual basis.
PW1-PW4 showed slightly elevated Iron (mg/l) and Nickel (ug/l) readings.
PW2 was elevated in Manganese (ug/l).
The location of all wells are rural agricultural.

All other results for 2008 were below MAC limits.

Quarterly

PW 1 is the only private well that is sampled every quarter. See Figure 3.7.1 Private Wells Quarterly.

3.7. Leachate

The waste licence (W004-003), Schedule D.1 Table D.1.states that leachate levels should be recorded for all sumps and collection points on a continuous basis.

SDCC carries out quarterly and annual monitoring of all leachate cells and leachate storage points on site. However the waste licence conditions sampling at 5 locations, LC1, LC3, LC11, LL (leachate lagoon) and LB (leachate balance tank).

SDCC stores and reviews the results of all locations sampled, but for brevity, only the 5 locations, as required by the licence are discussed in the graphs and tables of results.

For interpretative purposes it is also useful to examine the results of LT2 (leachate aeration tank). From 2008 onwards, the rising main connecting the treatment plant at Arthurstown to the wastewater treatment plant will have been completed and monitoring of the sewer discharge will have commenced.

3.7.1. Leachate Results

Tables and charts showing leachate results and trends are included as follows in Appendix 3.8:

Table or Figure number	**Table or Figure Name**
Table A. 3.8.1.b	2008 Leachate Annually
Table 3.8.2.c	2008 Leachate Annually

3.7.2. Interpretation of Leachate Results

Leachate results for 2008 are typical for leachate analysis for Arthurstown Landfill depending on age of the waste in the cell being tested.
At the end of 2007 all 15 cells now contain leachate.
Some treated leachate was discharged to the sewer rising main connection to Kill.
Tables A.3.8.1.b and A.3.8.2.c outlines annual leachate results in Appendix 3.8.

3.8. Meteorological Monitoring

Condition 8.10.1 and schedule D.6.1. of the current Waste Licence W0004-003 requires the daily monitoring of rainfall, temperature (min/max), wind speed and direction, evaporation, humidity and atmospheric pressure at the landfill site. The data for 2008 is summarised in Figures 26.1.10(a) to (f). All presented data has been recorded by the on site "VIASALA" Weather Station which was installed during March 2003.
The data indicates prevailing wind directions from a south to south-westerly direction.

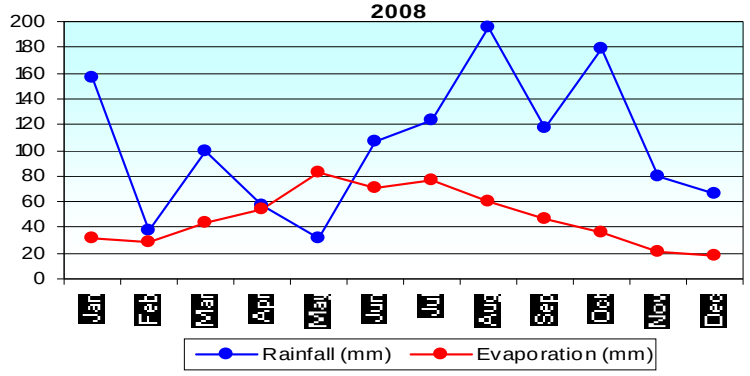
Total annual rainfall during 2008 was approximately 1253 mm, (1.25m) considerably above the annual average of 1000mm and 244mm (9.5 inches) more than the previous years total. This was the highest amount of rainfall recorded at Arthurstown.

Monthly summaries of meteorological conditions are included in Appendix 3.9 for 2008.

Figures 3.8.1 to 3.8.6 outline the annual meteorological results for 2008.

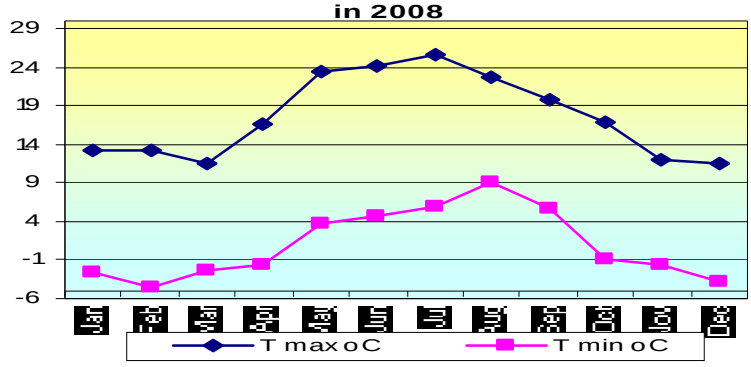
Monthly Rainfall & Evaporation for 2008.

Fig. 3.8.1- Monthly Rainfall & Evaporation (mm) in 2008



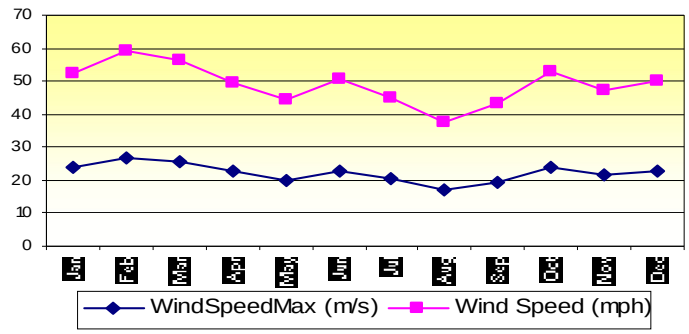
Temperatures (Max and Min) for 2008.

Fig. 3.8.2 - Monthly Temperatures (oC) in 2008



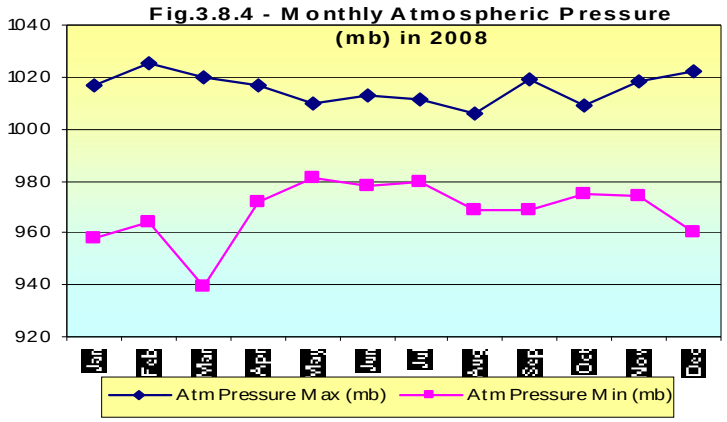
Monthly Max Wind Speeds for 2008.

Fig. 3.8.3 - Monthly Maximum Wind Speed in 2008



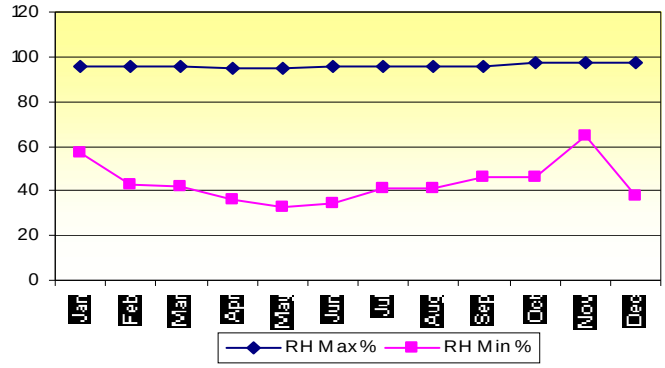
Atmospheric Pressure for 2008 (mb)

Fig.3.8.4 - Monthly Atmospheric Pressure (mb) in 2008

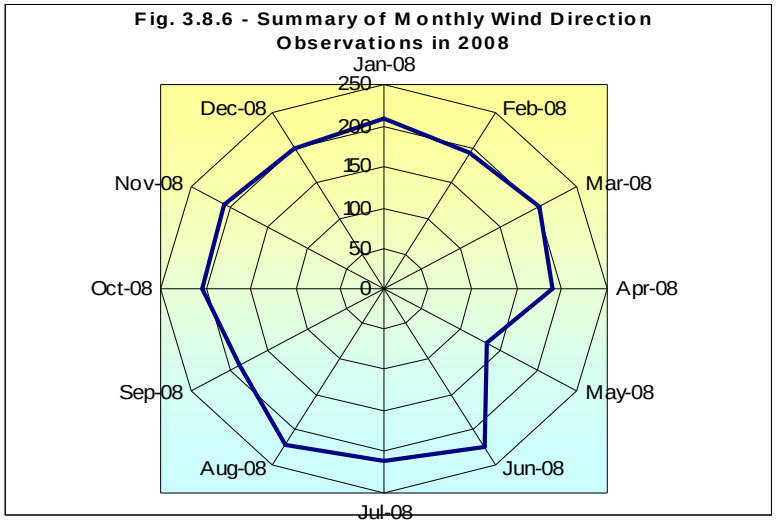


Relative Humidity for 2008. (%)

Fig. 3.8.5- Monthly Relative Humidity (%) in 2008



Wind Direction for 2008.



This radar graph displays changes in values relative to a centre point.
The data indicates prevailing wind directions from a south to south-westerly direction.
(200 degrees approximately for the entire year 2008 – Actual average for 2008 is 198 degrees. See also Wind Direction chart overleaf)

3.9. Odour and Odour Control at Arthurstown

The facility management staff endeavour at all times to reduce odours and complaints at the facility.
The Facility Manager and Deputy Facility Manager are on emergency 24 hour call 7 days a week.
A number of odour control techniques are in operation at Arthurstown, namely:

a) Utilisation plant (11 landfill gas engines and 2 no enclosed flares) which is now operating at 10,000 m3/hour (maximum)
b) 2 no. 2,500 m3 per hour enclosed flares both of which are extracting gas from the temporary capped areas in cells 11-15.
c) Drilling of additional gas extraction wells as directed by the Facility Manager using a purpose built "DIGGA" auger attachment for a Komatsu PC290-$8_{LC.}$ (see plate 3)
d) Sacrificial horizontal gas extraction from the active cells.
e) The landfill is now 65% final capped with a total of 150,000 m2 of final cap laid. Further final capping works are due in Spring/ Summer 2009.
f) Quarterly independent odour assessments carried out by Odour Monitoring Ireland.(See note below)
g) The placing of additional clay cover and the drilling of new gas wells in areas deemed suspect by the Facility Manager. i.e. areas where gas may be leaking through the temporary cap.
h) The placement of Landfill Covertop 32 , an LDPE membrane. (See plates 4 & 5 below) Extraxction is also taking place from under the Covertop 32.
i) Partial Capping of the side slopes as per plates 1 & 2 below.

Other methods used in the past include:

j) The use of the Soil cement. Trialled in an area during the summer 2004. Very weather dependant. Must by dry on application.
k) Large plastic Hessian sheeting. Sheets were too large to manually handle. Health and Safety issues for the operatives at the workplace rendered this unusable.
l) Spraying of essential oils to mask the odour from the landfill. This method is still used at the working face only and at the discretion of the Facility Manager.

Plate 1:

Plate 1: Partial capping material placed on side slopes at rear of Cell 13.

Plate 2:

Plate 2: Partial capping material placed on side slopes at the rear of Cell 15. HDPE Liner welded to anchor trench.

Plate:3 : Auger attached to CAT Excavator. Drilling of new gas wells as deemed necessary by Facility Manager.

Plate 4: CoverTop 32 placed on side slopes of Cell 14.

Plate 5: CoverTop 32 placed on side slopes of Cell 14. (Enclosed Flare in background)

Quarterly Odour Assessments:

Waste license W0004-003 states in condition 8.14.3 that an independent odour assessment be carried out once every quarter. The quarterly odour audits are carried out by Odour Monitoring Ireland.

Landfill gas leakage is the predominant source of odour complaints in Ireland. Although the landfill site is situated in a predominantly rural area, in the past there have been a number of odour complaints from residential properties in the surrounding area. Over the years, staff at Arthurstown are endeavoring to reduce odour complaints from residents through the techniques mentioned earlier.

Quarterly monitoring audits are carried out on site by Odour Monitoring Ireland Ltd.. They took place on:

- Q1 – 27th March 2008
- Q2 – 30th June 2008
- Q3 – 29th September 2008
- Q4 – 17th December 2008

The methodologies employed include:

- Capping source monitoring using a continuous ppb PID and Jerome 631X analyser to detect areas of potential landfill gas release
- Sniff odour assessments at pre-selected resident locations in the vicinity of the landfill
- Geo-referencing of detected leakage locations for remediation.

The new methodology used in the odour audit is very useful in identifying areas of potential leakage. It is concluded that this technique is very successful in the reduction of landfill odours in order to prevent odour impact downwind of the landfill operations.
Once the quarterly odour audit is carried out, the findings are brought to the attention of the Facility Manager who carries out the remediation.

3.9.1. Odour Results

The colour odour charts for the landfill that are produced for each quarter are contained in the following four pages. *(Note massive improvement from Q1 2008 to Q3 and Q4 2008.)*
The colour maps of the site highlight where the most problems arise due to the concentrations measured on the temporary capped areas.
As can be demonstrated from the map from Q1 2008 compared with the map for Q4 2008, there is a significant shift in the source location as landfilling progresses during 2008. Also the introduction of the second 2,500m3 per hour enclosed flare (after Q1) on the temporary capped area is noticeable.
At the end of each odour audit the consultant meets with the Facility Manager to highlight the areas for remediation. These works are carried out as soon as possible.

Note also the massive 80% reduction in complaints in Q4 when compared to same period during 2007.

Q1 – 2007	Total Complaints	117
Q2 – 2007	Total Complaints	89
Q3 – 2007	Total Complaints	83
Q4 – 2007	Total Complaints	114

Total Complaints for 2007 was 382.

Q1 – 2008	Total Complaints	100
Q2 – 2008	Total Complaints	40
Q3 – 2008	Total Complaints	17
Q4 – 2008	Total Complaints	17

Total Complaints for 2008 was 174.

3.10. Landfill Gas Emissions

Table 4.1 is a table of calculated emissions based on the quantity of landfill gas collected by the gas extraction system in 2008.

83,220,000 m^3 of landfill gas was utilised by the gas extraction system in 2008. **(based on average of 9,500 m^3 per hour)* The gas collected from the temporary capped areas by the 2 no enclosed flare units was approximately 30,660,000 m^3.*(based on average of 3,000 m3 per hour)*
Total Landfill gas Collected (Captured) 2008 = 113,880,000 m^3.

Estimates vary as to the efficiency with which gas collection systems in landfills gather the methane formed in waste. Modern gas wells installed throughout a landfill site may collect between 70% – 90%. The efficiency for Arthurstown landfill is estimated here as 90% because the wells are relatively new and in good condition, capping is well progressed *(70% of Landfill Area)* and the daily cover system is good. **Based on this efficiency it is estimated that the total landfill gas generated at Arthurstown Landfill in 2008 was 126,533,333 m^3.**

Gas extracted from the landfill is managed in 3 different ways:

- Landfill gas generation in 11 no. engines at the Bioverda compound
- Flaring in 2 no. enclosed flares at the Bioverda compound
- Flaring in 2 no. 2,500m3 p/hour enclosed flares on the temporary capped areas.

All of the gas collected from the capped areas and a large volume of good quality gas from the uncapped areas is directed to the Bioverda compound for generation and flaring. The generation capacity is currently at maximum at 10,000 m^3 per hour and the capacity to flare poor quality gas from the temporary gas collection system is 5,000m^3.
The maximum available extraction rate is approximately 15,000 m^3/hour.
Note: The current average extraction rate is 13,500 m3 per hour.
Provision has been made for additional capacity during 2009. A further 2,500 m3 per hour will be provided when a new booster station arrives early 2009. (Max capacity will then be 17,500 m3 per hour.)

For the purposes of this exercise it is assumed that landfill gas captured at Arthurstown is 49% methane, 42% carbon dioxide and the remainder is made up of other compounds. These figures are based on average readings at the Bioverda compound.

The combustion equation is CH4 + 2O2 ---> CO2 + 2H2O. 98% of methane is converted to carbon dioxide. Carbon dioxide does not change through the reaction. The calculations of methane and carbon dioxide through the Bioverda plant and flares is shown in Table 4.1. Uncaptured landfill gas has also been taken into account.

Table 4.1 Estimated Landfill Gas Generation

		Captured Gas m^3	Uncaptured Gas m^3
Landfill Gas		113,880,000	12,653,333
Methane		55,801,200	6,200,133
Carbon Dioxide		47,829,600	5,314,399
Other Compounds		10,249,200	1,138,801
Emissions		CH4 + 2O2 ---> CO2 + 2H2O	
CH_4 not combusted (1%)	CH_4	558,012	126,533
$CH_4 \rightarrow CO_2$ by combustion (99%)	CO_2	55,243,188	6,138,131
CO_2 doesn't break down on combustion	CO_2	47,829,600	5,314,399

	m^3	kg	tonnes
Total CH_4 emissions	62,001,333	44,454,955	44,454
Total CO_2 emissions	53,143,999	105,225,118	105,225
Other Compounds		N/A	N/A

In summary, 44,454 t of methane and 105,225 t of carbon dioxide were emitted from Arthurstown landfill in 2008.

Based on the total amount of waste landfilled between 1997 and 2008. It is estimated that approximately 532,906,681 m^3 of landfill gas has been emitted. This calculation is shown in Table 4.2.

A GASSIM model for landfill gas production at Arthurstown was produced during 2008. The findings of the model did not reflect the actual gas production on site. This report on the capacity of the utilisation plant at Arthurstown and possible future capacity issues was submitted to the Agency on 03rd December 2008.

Table 4.2 Cumulative Quantities of Landfill Gas Emissions

Year	Cumulative Waste Inputs	Annual Waste Inputs	Annual Landfill Gas Generation	Rate of generation	Cumulative Landfill Gas Generation	Comparison to Landfill Prediction Model Note 1
	tonnes	tonnes	m^3/annum	m^3/tonne	m^3	m^3
2008	4,372,908	301,828	126,533,333	28.9	532,906,681	Not included
2007	4,071,077	480,529	144,277,200	35.4	406,373,348	Not included
2006	3,590,863	591,755	87,600,000	24.4	262,096,148	86,222,204
2005	2,999,108	497,274	59,982,155	20.0	174,496,148	65,224,225
2004	2,501,834	424,067	40,029,346	16.0	114,513,993	47,434,011
2003	2,077,767	483,582	29,088,737	14.0	74,484,647	32,376,858
2002	1,594,185	463,436	19,130,220	12.0	45,395,910	20,660,181
2001	1,130,749	334,333	11,872,865	10.5	26,265,690	12,255,544
2000	796,416	274,642	7,565,952	9.5	14,392,826	6,242,246
1999	521,774	271,079	4,695,966	9.0	6,826,874	2,229,690
1998	250,695	216,284	2,130,908	8.5	2,130,908	270,387
1997	34,411	34,411	0	0.0	0	0

Note 1: Due to the discrepancies in the landfill gas prediction model results, it is not proposed to include it next year in the AER as a method to quantify landfill gas emissions from the facility.
Note 2: Figures are slightly lower than last year due to the number of open flares on site in previous years. Difficult to estimate flows through open flares. Also less waste was accepted at Facility.

3.11. Indirect Emissions to Groundwater

Estimated Annual and Cumulative Quantity of Indirect Emissions to Groundwater.

Monitoring results to date do not indicate the presence of indirect emissions to groundwaters. Considering that groundwater flow is in a generally north-westerly (NW to NNW) direction, monitoring wells can be deemed to be either upstream, downstream, or cross-gradient of the landfill area. Table 4.3 below presents a summary assessment of monitoring well locations relative to the existing waste body. Parameters selected for this assessment, because they are known to exhibit high concentrations in landfill leachate at Arthurstown, are Ammonia-N, Chloride and Electrical Conductivity.

Condition 6.4.1 states that there shall be no direct emissions to groundwater.

Table 3.4 Calculation of Direct and Indirect Emissions to Groundwater

Location	Direction	Relative Position	Summary of Results since March 1999 - Dec 2008				
			Ammonia (mg/l)		Chloride (mg/l)	Conductivity (uS/cm)	
			Max	Avg	Avg	Max	Avg
MW3	260 M NE	US	2.45 (April'04)	0.13	19.27	913 (May'07)	669
MW4 **	400 m E	US	1.2	<0.31	7.5	952 (Apr '02)	761
MW5 **	400 m E	US	<0.2	<0.2	10.6	686 (Oct '99)	481
MW6A	100 m ESE	US	5.8 (May'08)	0.82	16.4	838 (Nov'08)	755
MW7	80 m SE	US	5.7 (May'08)	1.20	16.4	987 (Nov'08)	881
MW8	240 m ESE	US	1.04 (April '05)	0.14	14.9	692 (Jul '06)	644
MW20	150 m S	US	1.7 (Feb '03)	0.12	15.7	1907 (Apr '05)	1210
MW21	140 m SSE	US	1.5 (May '01)	0.07	15.6	1568 (Apr '05)	1071
MW22	400 m E	US	0.33 (Feb ' 03)	0.07	11.6	805 (Apr '05)	541
MW2	260 m NE	CG	1.5 (May '01)	0.12	33.5	1344 (Jul '06)	815
MW17	100 m WSW	CG	0.6 (May '01)	0.03	29.6	2097 (May'07)	1292
MW19	20 m WSW	CG	3.08 (July '07)	0.20	17.2	1204 (Jul'06)	915
MW1	140 m NE	DS	Dry	Dry	Dry	Dry	Dry
MW9	50 m W	DS	1.2 (July '01)	0.06	13.1	738 (Nov'08)	646
MW10 **	50 m W	DS	Dry	Dry	Dry	Dry	Dry
MW11	50 m W	DS	0.36 (April'04)	0.08	10.4	690 (Apr'04)	617
MW12 **	50 m NW	DS	Dry	Dry	Dry	Dry	Dry
MW13 **	100 m N	DS	0.2 (Nov '02)	<0.2	27.9	944 (Nov'02)	944
MW14	200 m NNE	DS	11.2 (Oct '01)	0.25	23.8	1011 (May'08)	828
MW15 *	200 m NNE	DS	1.0 (May'01	<0.28	33	900 (Feb'03)	802
MW16	90 m NNW	DS	0.7 (July '01	0.04	16.1	992 (Nov'08)	734
MW18	170 m N	DS	1.2 (May'01)	0.07	11.9	703 (May'07)	615

DS – downstream
US – upstream
CG – cross gradient

Locations upstream from the landfill are located in an agricultural area and are therefore sprayed several times a year with “slurry”.
Only locations MW6A and MW7 showed an increase in Ammonia levels during 2008. This can be attributed to agricultural activity on the lands adjacent.

Due to the upstream locations of the majority and cross gradient locations of other boreholes, it can be assumed that emissions to groundwater are satisfactory for the period 2008.

3.12. Water Balance

A number of assumptions were made in the calculation of the water balance.

Evaporation

Due to the nature of baled waste, rainfall tends to flow through the edges of each bale quickly and makes its way deep into the waste body or onto the cell floor quickly. Hence a nominal value of 10% of the recorded evaporation in the calculation.

Active Area

Cells 11-15 were active for all of 2008.
Uncapped Area approx: 92,000 m2
Final Capped Area approx. 150,000 m2

Absorptive Capacity of Waste

Due to the nature of baled waste, cells with new waste will have a lower absorptive capacity. This increases with the age of the waste and as the waste is in contact with moisture for longer periods. An absorptive capacity of 15% of the traditional value of 0.07 m^3/t has been assumed.

The volume of leachate tankered off-site in 2008 was 104,184 m3.Results of the water balance calculation estimate that approximately 70,000 m3 of leachate was produced during 2008.
The difference of 34,000 m^3 can be attributed to the leachate that has been produced in previous years and was not removed from the cells. Due to the volumes of leachate being produced at Arthurstown, this prevented the full volume of leachate being removed from the site each year and this back log of leachate is now being removed.
An unprecedented amount of rainfall also fell during 2008, with 1,253 mm of rainfall.
Facility management staff are endeavouring at all times to maintain the levels to the 1m limit by constant pumping of leachate.

A summary of the calculation is shown as Table 5.1.

Table 5.1 Water Balance Calculation Summary 2008.

Month	Rainfall	Evapo ration	Effective Rainfall	Waste Input	Active Area	Fully Capped Area	Cumulative Predicted Leachate	Actual leachate tankered off site	Actual SW/GW discharged to river
		(mm)	(mm)	(tonnes)	(m^2)	(m^2)	(m^3)	(m^3)	(m3)
Jan-08	157	31.2	125.8	31,012.76	108,000	134,000	13,188.70	10,017.07	2,042.20
Feb-08	38	29.1	8.9	25,147.02	108,000	134,000	13,248.40	9,429.37	320.35
Mar-08	100	43.2	56.8	24,408.38	108,000	134,000	18,787.0	5,987.60	1,075.15
Apr-08	57	53.4	3.6	25,201.24	108,000	134,000	18,811.10	6,578.82	314.47
May-08	32	83.3	-51.3	28,819.38	108,000	134,000	18,811.10	7,397.94	300.74
Jun-08	107.4	70.4	37	24,671.76	108,000	134,000	22,068.20	7,664.16	240.00
Jul-08	122.8	76.4	46.4	26,083.34	108,000	134,000	26,346.90	6,551.08	272.55
Aug-08	195.8	59.6	136.2	22,098.26	108,000	134,000	41,085.10	6,761.10	7,512.93
Sep-08	117.8	46.7	71.1	22,788.12	92,000	150,,000	47,248.00	10,415.96	3,713.89
Oct-08	179	35.7	143.3	21,395.10	92,000	150,,000	60,650.60	11,593.36	6,475.01
Nov-08	79.2	21.3	57.9	22,429.86	92,000	150,000	65,514.40	10,732.30	550.44
Dec-08	66.8	18.7	48.1	27,773.70	92,000	150,000	69,189.40	11,055.96	765.30
Total	**1,252.8**	**569**	**683.8**	**301,828.92**				**104,184.72**	**23,583.03**

Note: Approx 35,000 tonnes more than was calculated from the table was due to Leachate from previous years
And remained within the landfill body. Facility management staff are endeavouring at all times to maintain leachate levels below the 1m limit.

4. FACILITY DEVELOPMENT

4.1. Site Survey

A topographical survey of the landfill facility was carried out by the facility management team during January 2009.
The survey is attached as Appendix 5.1.

4.2. Developments Undertaken in 2008.

4.2.1. Capping Works

During the months July to December 2008, a further 16,000 m^2 of final capping was laid at Arthurstown landfill. This brings the total amount final capped to approximately 150,000 m^2 (65% of the landfill area).
The final capping works were carried out by Roadbridge Ltd at a cost of € 4.50 million Euro. The work was delayed during 2008 with the very bad weather during the summer period but the works were on budget.

A further 20,000 m^2 is planned to commence Spring 2009. *(Weather permitting)*

4.2.2. Bioverda Power Systems Utilisation Plant

Three new engines were installed towards the end of 2008. This brought the total amount of engines on site to 11.
The plant is now extracting 10,000 m3 of gas per hour. (5,000 m3 per booster station)
This plant comprises of 11 no. Jensbaucher landfill gas engines and 2 no. 2,500 m3 per hour enclosed flare units manufactured by HAASE, Germany.
The works necessary for the upgrade and the installation of the 3 additional engines was carried out by the E.S.B. during 2008. This involved an extension to the switchgear room and the upgrade of the 10 kv power line to a 20 kv line.

4.2.3. Purchase of 2,500m3 per hour enclosed flare unit

During 2008 a second 2,500m3 per hour “HAASE” enclosed flare unit was purchased to minimise odour issues from the temporary capped areas at Arthurstown Landfill. It was installed in April 2008 and is now fully operational. There are now two 2,500 m3 per hour enclosed flare units in operation on the temporary capped areas. Power cables to both enclosed flare units also needed to be upgraded and this was also carried out during 2008.

4.2.4. Rising Main from Leachate Treatment Plant to Kill Sewer.

During 2008 the rising main sewer line to Kill was commissioned and permission was granted by both Kildare County Council and the Agency to commence discharge. Discharges to the rising main commenced during 2008.

A total of 3,498 m^3 of treated leachate was discharged to sewer during the latter end of 2008.

4.3. Developments Proposed for 2009.

4.3.1. Capping Works

It is proposed to continue with final capping works in Spring 2009 weather permitting. The specified engineering works for this phase will be submitted in due course.

4.3.2. Leachate Treatment Plant

Facility management staff are looking into the possibility of improving the treatment process i.e. increasing the treatment capacity of the S.B.R. (Sequence Batch Reactor) at Arthurstown.
These upgrades may include the following:

(i) Aeration of leachate in storage tank (using 3 no Aerators)
(ii) Negative air systems on all tanks
(iii) Ammonia stripping (if feasible)

4.4. Restoration Report

4.4.1. Completed Cells

Cells 1-10 are now fully capped and restored.

Landscaping and fencing has been placed and is now established in these areas.

4.4.2. Restoration

Further capping took place during 2008.
Additional capping is due to take place again during 2009. It is hoped that works will commence Spring 2009.

Temporary capping will also be placed in Cells 11-15. This will consist of at least 1 meter of clay cover as deemed necessary by the Facility Manager.

It is envisaged that all the final capping works will be complete by end 2012.

5. ENVIRONMENTAL OBJECTIVES AND TARGETS

5.1. Objectives and Targets

5.2. 2009 Objectives and Targets

The list of objectives and targets for 2009 will be submitted as part of the EMP revision which will be submitted in the coming weeks.

6. FACILITY MANAGEMENT

6.1. Summary of New Written Procedures

The revision of the EMP in the coming weeks will include an updated OMP (Odour Management Plan)

A revised Leachate Management Plan will be submitted during 2009.
The quarterly report for the last quarter 2008 was submitted 03rd February 2009.
This AER (Annual Environmental Report) was submitted w/e 20th February 2009.

6.2. Tank, Pipeline and Bund Testing

Routine inspections of tank, pipeline and bund inspections are carried out once every three years.
Inspections were completed during 2008 and the certificates for the tanks and tankers are available for inspection at the facility as is required by Waste License W0004-003 condition number 3.12.3.

6.3. Reported Incidents and Complaints

6.3.1. Reported Incidents

A summary of reported incidents during 2008 is shown in Table 7.1. Incidents are defined by Condition 1.6 of the current waste licence (W004-003).

There were 19 no. incidences reported to the EPA in 2008. These included:

- 12 no. Gas borehole trigger level incidents
- 1 no. Enclosed Flare failure (Power Loss)
- 1 no. emissions breach from Engine tests (Report for 2007 was submitted 2008)
- 1 no. report of noise trigger level incident
- 4 no. Elevated Levels at SW2

Table 6.1 Summary of Reported Incidences 2008.

	Incident Date	*Cause*	*Mitigation Measure*
Enclosed Flare 2	01/08/2008	Enclosed Flare Failure (Power Failure)	Restarted
Gas borehole trigger levels	290108	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 010208 (submitted to Agency)
	190208	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 190208 (submitted to Agency)
	200308	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 260308 (submitted to Agency)
	240408	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 250408 (submitted to Agency)
	280508	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 300508 (submitted to Agency)
	270608	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 270608 (submitted to Agency)
	240708	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 050808 (submitted to Agency)
	280808	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 290808 (submitted to Agency)
	300908	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 061008 (submitted to Agency)
	291008	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 041108 (submitted to Agency)
	271108	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 031208 (submitted to Agency)
	301208	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 050109 (submitted to Agency)

	Incident Date	**Cause**	**Mitigation Measure**
Sw2	310308	Elevated Ammonia Levels SW2	Remediate Areas on Temporary Cap. (See Report dated 310308 Submitted to Agency)
SW2	080708	Elevated Ammonia Levels SW2	Remediate Areas on Temporary Cap. (See Report dated 080708 Submitted to Agency)
SW2	300908	Elevated Ammonia Levels SW2	Remediate Areas on Temporary Cap. (See Report dated 151008 Submitted to Agency)
SW2	031108	Elevated Ammonia Levels SW2	Remediate Areas on Temporary Cap. (See Report dated 181208 Submitted to Agency)

Table 8.1: Cont'd

	Incident Date	*Cause*	*Mitigation Measure*
Engine Emissions	310108	Elevated Engine Emissions CO & NOx	Bioverda Power Systems notified. (Report to Agency 310108)
Noise	171208	Elevated Noise Readings	None. Causes are proximity to Meter and Adjacent Commercial Activities. (Report to Agency 310108)

6.3.2. Complaints

There were 174 no. complaints to the facility in 2008.
Figure 8.1 is a graphical summary of complaints.

This represents a massive decrease on the number of complaints made in during the previous year 2007. There were 382 complaints in 2007.

Some reasons for the decrease in complaints to the facility are as follows:

(a) Final capping works were ongoing during 2008. As the final cap progresses there is less area prone to fugitive landfill gas emissions.
(b) The installation of the 2 no 2,500 m3 per hour enclosed flare units which extract landfill gas from the temporary capped areas. i.e. Areas which are yet to be final capped.
(c) Facility Manager and Deputy Facility Manager are on 24 hour call 7 days a week. They also receive text messages from both enclosed flare units when there is a shut down.
(d) The placement of Covertop 32 on the side slopes of the landfill also greatly reduced fugitive emissions.
(e) The placing of additional clay material on temporary cap, especially in areas that will not be used for landfilling in the next 3 months.
(f) The use of the drilling Auger rig to place additional gas wells in areas deemed necessary by the Facility Manager.
(g) The use of the long reach excavator to compact side slopes and other areas where standard machines are not able to reach.

A combination of all of the above has dramatically reduced complaints from 382 to 174. (A 55% reduction)
Further reductions have already been observed during the first few weeks of 2009.

Follow up to Complaints

Complaints are followed up by the facility management team where possible i.e. the complainant has left contact details and a time and date of the odour incident.

Figure 8.1 Complaints made to Facility in 2008.

6.4. Review of Nuisance Controls

Litter

Litter is not a nuisance at the Arthurstown landfill. This is mainly due to the baling of the waste. A number of portable litter fences surround the top edge of the landfill in the off chance that litter should escape from the bale face. Litter patrols take place weekly at the facility.

Birds & Vermin

Due to the excellent vector control programme, there are no nuisances caused by Birds and Vermin at this Facility. As a result of the excellent housekeeping in the Marshalling yard and again at the bale face, Vermin do not cause nuisance at this facility. There are also several different types of Birds of Prey on-site throughout the day, seven days a week. A Peregrine falcon, a saker falcon, Harris hawks, American redtailed Eagle and other cross breeds of falcon. All are proving effective means of deterent for birds which otherwise could cause nuisance at the site.

Odour

Odour control mechanisms are constantly being reviewed and discussed at Arthurstown. The facility management team have also noticed a dramatic decrease in complaints during 2008 due to the relocation of the first 2,500 m3 per hour enclosed flare unit and the installation of the second enclosed flare to the rear of cell 14.

See section 3.9 on Odour.

6.5. Report on Staff Training

The following training courses/seminars were attended by the staff at Arthurstown Landfill during 2008.

Table 6.2 Staff Training Log 2008.

Training Course /Seminar	Staff Attendees
FAS Safepass Renewal	J.Smith
FAS Safepass Renewal FAS Safepass Renewal FAS Safepass Renewal Chainsaw	C.Cummins E.Comerford M.Murray M.Murray
Chainsaw	Blessington Plant Hire Staff
Introduction to Computers	S.Finnegan
Agresso Finance Software Agresso Finance Software	E.Comerford C.Cummins

6.6. Non Compliances at Arthurstown Landfill during 2008.

During 2008 Arthurstown landfill received a total of 10 Non-compliances from the Environmental Protection Agency. They were for the following reasons:

Reason for NC	Number	EPA Site Visit
Odour	5	Yes
Leachate Management	1	Yes
Leachate Tank Certification	1	Yes
Continuous Monitoring	1	Yes
Flare Efficiency Report (Open Flare)	1	Yes
Non Notification of Incident	1	Yes

Table 6.3 Non-Compliance Log for 2008.

All non compliances were responded to in writing by the facility management team and returned to the EPA.

Legal action brought by the Agency against South Dublin County Council is currently pending.

6.7. Reports of Financial Provision

Report on Financial Provisions under Waste Licence

South Dublin County Council has taken out a bond in favour of Kildare County Council (the local authority in whose functional area the facility is located) in order to ensure satisfactory completion of Arthurstown Landfill. Significant contributions are made annually towards leachate treatment, environmental monitoring and landfill closure/aftercare. Budgetary estimates for landfilling and ancillary activities at Arthurstown during 2008 were in the region of € 7.80 m. This does not include the costs for capping works which were completed during 2008 at a cost of €4.70 m.

Report on Programme for Public Information

In accordance with Waste Licence W0004-003, information is made available on site and submitted to the EPA on a regular basis. During 2008 there were numerous visits conducted at the facility for interested parties including schools and university groups, local and other international visitors. Information about the facility is available on the website which can be accessed either directly *(www.arthurstown.com)* email address also is *arthurstownlandfill@eircom.net* or through a link on the South Dublin County Council website *(www.sdcc.ie).* Site contact numbers are posted at the facility entrance. The website has been updated to include the final cap and the utilisation of the landfill gas.
A site DVD is now complete since March 2003. This 9 minute short film describes the site from the landfill construction and operational perspectives. It is used during site visits to present visitors with a clear understanding of the nature of the site activities. The site has also featured in televised waste management documentaries as being the most state of the art and well managed landfill to date in Ireland, as well as in landfill operative training courses.

Report on Management and Operation Structure

The site is owned and managed by South Dublin County Council, who also holds the Waste Licence and Planning Permission for the facility. Waste placement at the site is supervised by the Facility Manager (J. Smith) and Deputy Facility Manager (M.Heffernan) under the terms of a Joint Venture with Veolia Ireland Ltd., a waste management company. Veolia Ireland also operates the Council's Municipal Waste Baling and Transfer Station at Ballymount in South Dublin. Waste is also delivered to the facility from a further three baling centres, operated by Padraig Thornton Waste Disposal Ltd., located on the Kileen Road, Ballyfermot,Co.Dublin , Dun Laoghaire Rathdown County Council Baling and Recycling Park in Ballyogan,Co.Dublin operated by Greenstar Ltd and Oxygen Environmental Ltd, Ballymount.

At the end of 2008 South Dublin County Council had 7 direct employees engaged in full time management and administrative functions at the site, namely the Facility Manager (J. Smith), Deputy Facility Manager (M.Heffernan), Site Foreman (S. Finnegan), Assistant Site Foreman (S. Fitzgerald), Weighbridge Attendant (C. Cummins), E. Comerford (GO) and M. Murray (GO).
The Senior Engineer for South Dublin County Council Environmental Services is Mr. Leo Magee and the Director of Services for Environment is Ms. Philomena Poole.

6.8. Local Environmental Project Funding

Contributions to the Locality

South Dublin County Council was conditioned by An Bord Pleanala to contribute the sum of € 100,000 annually to Kildare County Council. SDCC are still awaiting Kildare County Council to respond to requests to form the required committee.

7. ANY OTHER ITEMS

APPENDIX 3.1

Monitoring Locations Drawing

APPENDIX 3.2

Landfill Gas Charts and Tables (perimeter monitoring wells and site buildings)

APPENDIX 3.3

Dust Charts and Tables

APPENDIX 3.4

Noise Charts and Tables

APPENDIX 3.5

Surface Water Charts and Tables

APPENDIX 3.6

Groundwater Charts and Tables

APPENDIX 3.7

Private Wells (Groundwater) Charts and Tables

APPENDIX 3.8

Leachate Charts and Tables

APPENDIX 3.9

Meteorological Monitoring

APPENDIX 4.1

Landfill Gas Emissions (gas extraction system)

APPENDIX 5.1

Topographical Survey