ANNUAL ENVIRONMENTAL REPORT

FOR

ARTHURSTOWN LANDFILL
KILL, CO. KILDARE

FOR THE PERIOD

1ST JANUARY 2010 – 31ST DECEMBER 2010

WASTE LICENSE NO: W0004-004

Prepared by:

Facility Management,
Arthurstown Landfill,
Kill,
Co. Kildare.

31st March 2011

AER 12

21 April 2011

Ms.Breege Rooney,
Inspector,
Environmental Protection Agency,
EPA Headquarters,
PO Box 3000,
Johnstown Castle Estate,
Co.Wexford.

RE:- **Arthurstown Landfill Waste license W0004-004**
Submission of Annual Environmental Report for 2010.

Dear Ms. Rooney,

Please find enclosed original plus two copies of the Annual Environmental report.
The reporting period is the calendar year 2010.
The report has been prepared with consideration for the requirements of Schedule F of the Waste License.

Yours sincerely,

J. Smith,
Facility Manager.

M. Hefferman,
Deputy Facility Manager.

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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.

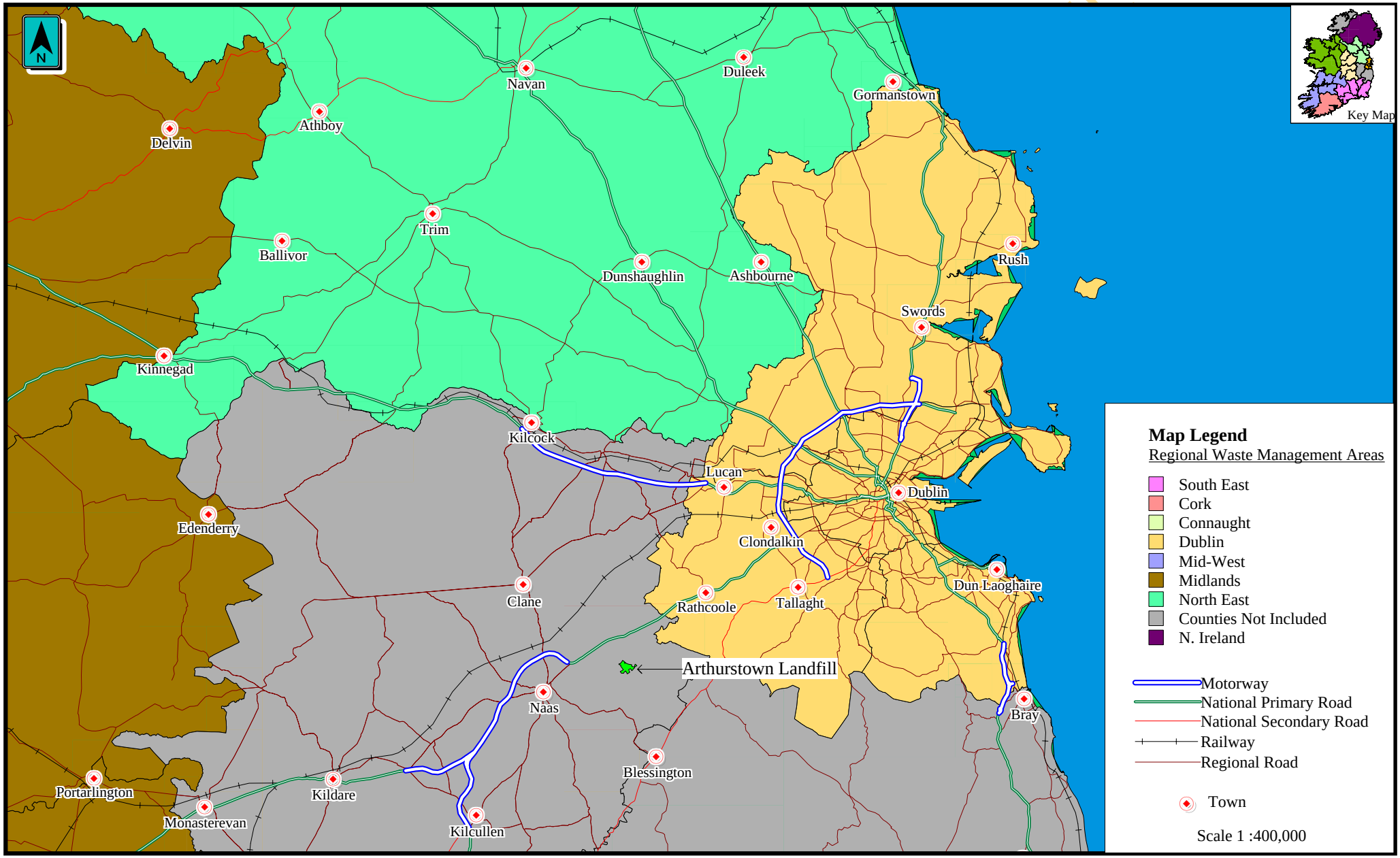
The prevailing land use in the area is the bloodstock industry and agriculture. The site was a disused quarry when purchased by SDCC in 1992. It had been a sand and gravel quarry. Some unauthorised dumping took place in the 1970's. SDCC carried out remediation and restoration works on the unauthorised "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 westerly. The annual rainfall for the area is approximately 1,000 mm.

Figure 1.1 Facility Location Map

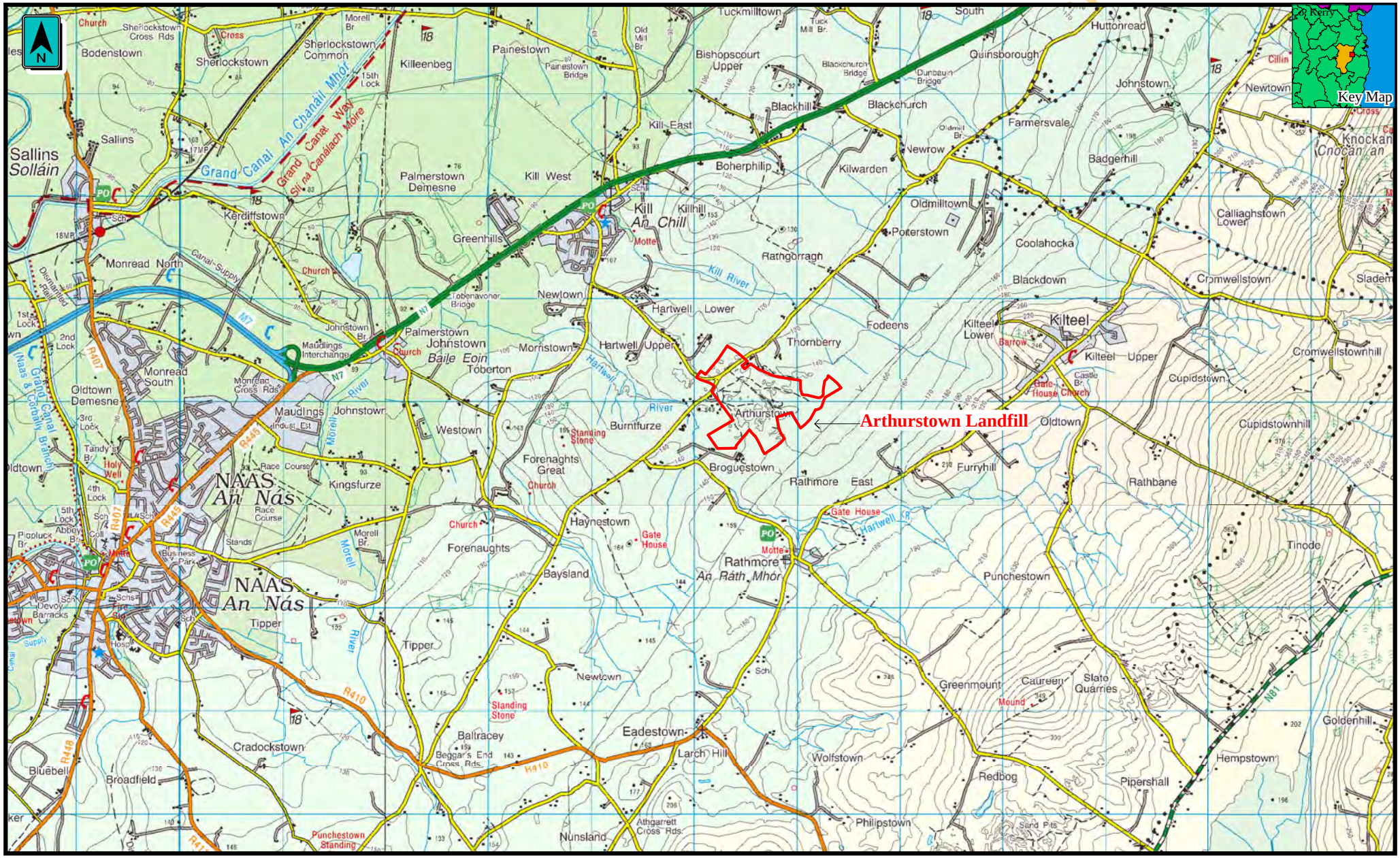
Date 04/09/06 GF/ME R:\Map Production\2006\054\03\Workspace\
SDC-AP_Figure 2.1_ Site Location-Regional _Rev A



Site Location - Regional

Figure 2.1

Date 04/09/06 GF/ME R:\Map Production\2006\054\03\Workspace\
SDC-AP_Figure 2.2_ 1 to 50000 Site Location Map_Rev A



1: 50,000 Site 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 12th AER for the facility.

Condition 11.5.1 states that:

"Annual Environmental Report"

The licensee shall submit to the Agency for its agreement, by 31st March each 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 2010 to 31st December 2010.

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

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 2010.

Table 2.1 Waste Intake (Tonnes)

Year	Waste Materials (Tonnes)			
	Cumulative Waste Inputs	Annual Waste Inputs	Month 2010	Tonnages 2010
2010	4,779,021.09	191,553		
2009	4,587,468	214,560		
2008	4,372,908	301,828	Jan	16,358.64
2007	4,071,077	480,529	Feb	14,093.44
2006	3,590,548	591,755	Mar	17,120.94
2005	2,998,793	497,400	Apr	16,092.40
2004	2,501,393	423,626	May	14,919.36
2003	2,077,767	483,582	June	15,360.72
2002	1,594,185	463,436	July	15,880.14
2001	1,130,749	334,333	Aug	19,212.84
2000	796,416	274,642	Sept	18,432.94
1999	521,774	271,079	Oct	16,842.36
1998	250,695	216,284	Nov	17,712.48
1997	34,411	34,411	Dec	9,526.66

2.3. Remaining Capacity

2.3.1. Current Filling Rates

None.

Table 2.2 details the remaining void space at Arthurstown landfill, which was calculated by Facility Management using a topographical survey taken in January 2010.

As the Facility is now closed since December 21st 2010, and the tonnage figures fell short of the expected target for 2010, the void calculation table from last year is sufficient.

Table 2.2 Void Capacity table from previous years AER.

Air space from January 2010 Site Survey	357,208 m^3		
Using 0.8 t/m3 =	357,208	X 0.8	285,766 tonnes
Plus 20 % Settlement	285,766	Plus 20%	342,919 tonnes
Less Daily Cover, Temp Cap &1 Final Cap	342,919	Less 20%	274,335 tonnes
Remaining Tonnage			**274,335 tonnes**
Predicted Tonnage for 2010			200,000 tonnes
Spare Capacity	274,335	- 200,000	74,335 tonnes
Plus shortfall in tonnage for 2010 of only 191,553 tonnes	74,335 +	(200,000 – 191,533)	
Total Remaining Capacity at Arthurstown at Closure on December 21st 2010	82,802 tonnes		

As can be seen from Table 2.2, the estimated remaining capacity at the landfill at the end of 2009 is 274, 335 tonnes.
Tonnages during 2010 did not reach expected target figures.
As a result the remaining void space was left unfilled at closure on December 21st 2010.

Figure 2.1 Layout of Arthurstown Landfill

N

LEGEND

- LAND OWNERSHIP BOUNDARY
- SITE BOUNDARY
- LG_5 LANDFILL GAS MONITORING POINT
- MW_3 GROUNDWATER MONITORING WELL
- N1 NOISE MONITORING LOCATION
- D4 DUST MONITORING LOCATION
- SW_2 SURFACE WATER MONITORING LOCATION
- PW1 PRIVATE WELL LOCATIONS

STAGE 1

STAGE 2

STAGE 3 & 4

REMEDIATED SITE

Gravel Pit

Pond

Rev.	Drawn	Chkd	Apprvd	Date	Description
C	D.M.	AG	BR	ET	19-05-03	ISSUED FOR PLANNING PERMISSION
B	D.M.		BR	ET	19.02.2003	ISSUED FOR INFORMATION
A	D.M.				29.01.2003	ISSUED FOR APPROVAL

Name of Client
SOUTH DUBLIN COUNTY COUNCIL

Name of Job
ARTHURSTOWN LANDFILL
PLANNING AND EIS

Title of Drawing
ENVIRONMENTAL MONITORING LOCATIONS

Scales Used
1:2500

Dwg. No. 2002-054-01-019 (N:\ACAD\2002\054-01\dwg\-01.dwg)

Rev. C

FEHILY TIMONEY & COMPANY
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WEB SITE: www.fehilytimoney.com

ORIGINAL DRAWING SIZE 841 x 594

NATURAL SCALE 10 0 10 20 50 100mm

2.4. Future Trends in Filling Rates

None.
Arthurstown Landfill is now closed and has now entered the aftercare and monitoring stages.
Final capping will proceed over the coming years as planned.

2.5. Waste Deposition

Waste was accepted at the facility from Monday to Saturday inclusive between the hours of 08.00 to 18.30. 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 was used solely for the land-filling of non-hazardous baled municipal waste. Baled waste was accepted from pre-approved baling centres only, which are also licensed by the EPA. Arthurstown landfill received waste from the facilities outlined in Table 2.3.

Baled waste was transported to the site in fully enclosed containers, via a specified route, which prevented 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 were deposited in a dedicated marshalling yard onto hydraulic stillages. The use of the marshalling yard ensured that the road going fleet did not access the actual landfill cell area and minimised to the greatest possible degree the potential for transfer of dirt onto local and site access roads. Site vehicles were regularly cleaned using the vehicle wash facilities installed on site.

Refer to Figure 2.3; Loaded containers were 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 were stacked in horizontal rows, like buildings blocks, and covered as the working face travelled horizontally along the cell, being sheltered insofar as is possible from the prevailing winds. As the waste generally gave rise to odours, the site management employed several techniques to eliminate where possible, or at least minimise, the potential for these odours to be carried off site at all times. Techniques employed included 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 2010).
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 13 MW of electricity. The second 2 enclosed flares are at opposite ends of the temporary capped areas. (Cells 11-15)
Waste was not re-excavated once it was 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) and deputised by the Deputy Facility Manager (M.Heffernan)

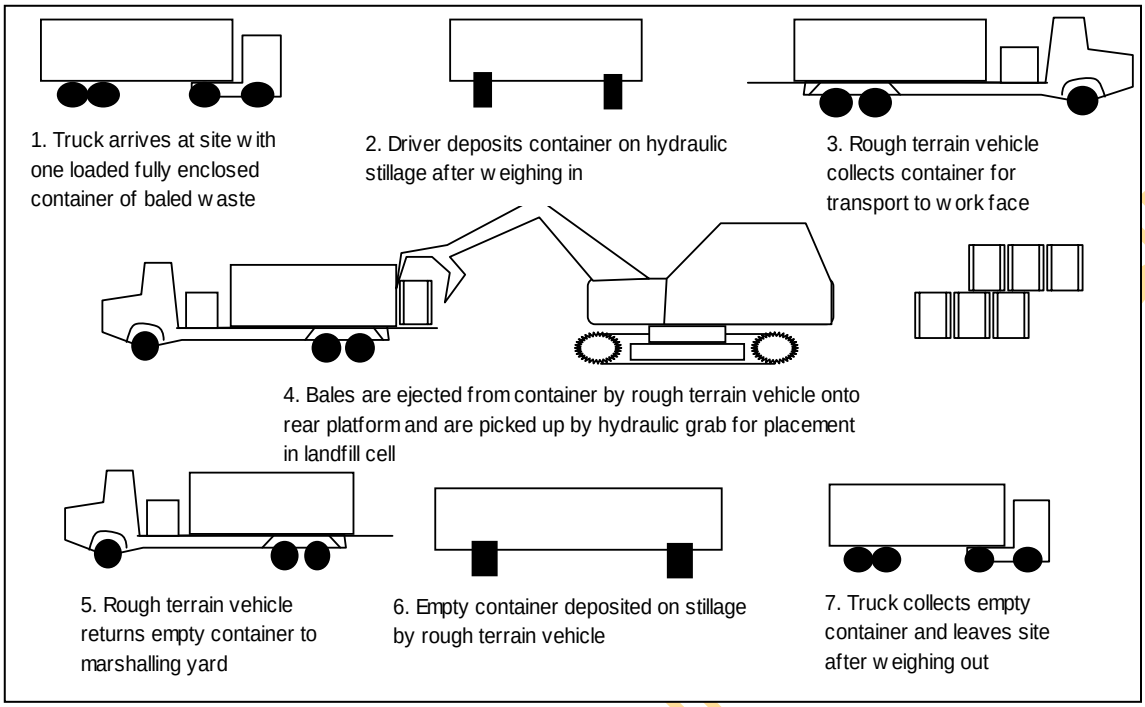
Table 2.3 Baling Stations Supplied Arthurstown Landfill

Facility	Waste License No.	Licensee	Operator
Ballymount Baling Station	3-3	SDCC	Veolia (formerly Onyx Ireland)
Thornton's 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
Oxygen Environmental Ltd. Integrated Waste Management Facility	208-1	Oxygen	Oxygen

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

1. Waste delivered to Arthurstown was handled as follows: Waste was visually inspected at each of the baling stations prior to baling to ensure it was suitable for land-filling at Arthurstown.
1. On arrival at Arthurstown landfill, waste was weighed at the onsite weighbridge. Details of all wastes accepted (type, nature, weight, origin etc) at the site were recorded by the weighbridge operator.
2. Waste containers were set down on hydraulic stillage units in the marshalling yard.
3. The containers were 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 were removed from the site vehicles. An excavator with a grab attachment stacked them in close formation, normally 4 bales high. At the end of each working day, the top horizontal face of the bales were 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 were covered with a double layer of plastic sheeting or with clay if the vertical face was 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 230,000 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 2010
Diesel Oil	(Litres)	210,000 (Approx)
Electricity (As per SCADA)	(kWh)	551,471

2.7. Leachate Generation

In 2010 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. 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 and discharged to sewer in 2010.

The total quantity of leachate tankered off-site and discharged to sewer for 2010 is 105,300.91 tonnes or m^3.

Table 2.5 Leachate Removal Off-Site for 2010.

Month	Tonnes leachate tankered off site 2010	Tonnes Leachate Discharged to Sewer 2010
January	7652.22	1840.57
February	10762.78	1666.89
March	10172.42	1518.09
April	7356.38	1996.89
May	5980.06	1419.30
June	3814.66	1485.65
July	5530.10	1199.04
August	7076.16	1218.44
September	6241.84	1783.21
October	6961.46	796.00
November	10539.94	1207.22
December	5702.88	1378.69
Total	**87,790.90**	**17,510.01**

ENVIRONMENTAL MONITORING

This is a summary of results and interpretation of environmental monitoring carried out in the period 1st January 2010 to 31st December 2010.

Environmental monitoring of the following is carried out in compliance with Condition 8 and Schedule D of the licence. (W0004-004)

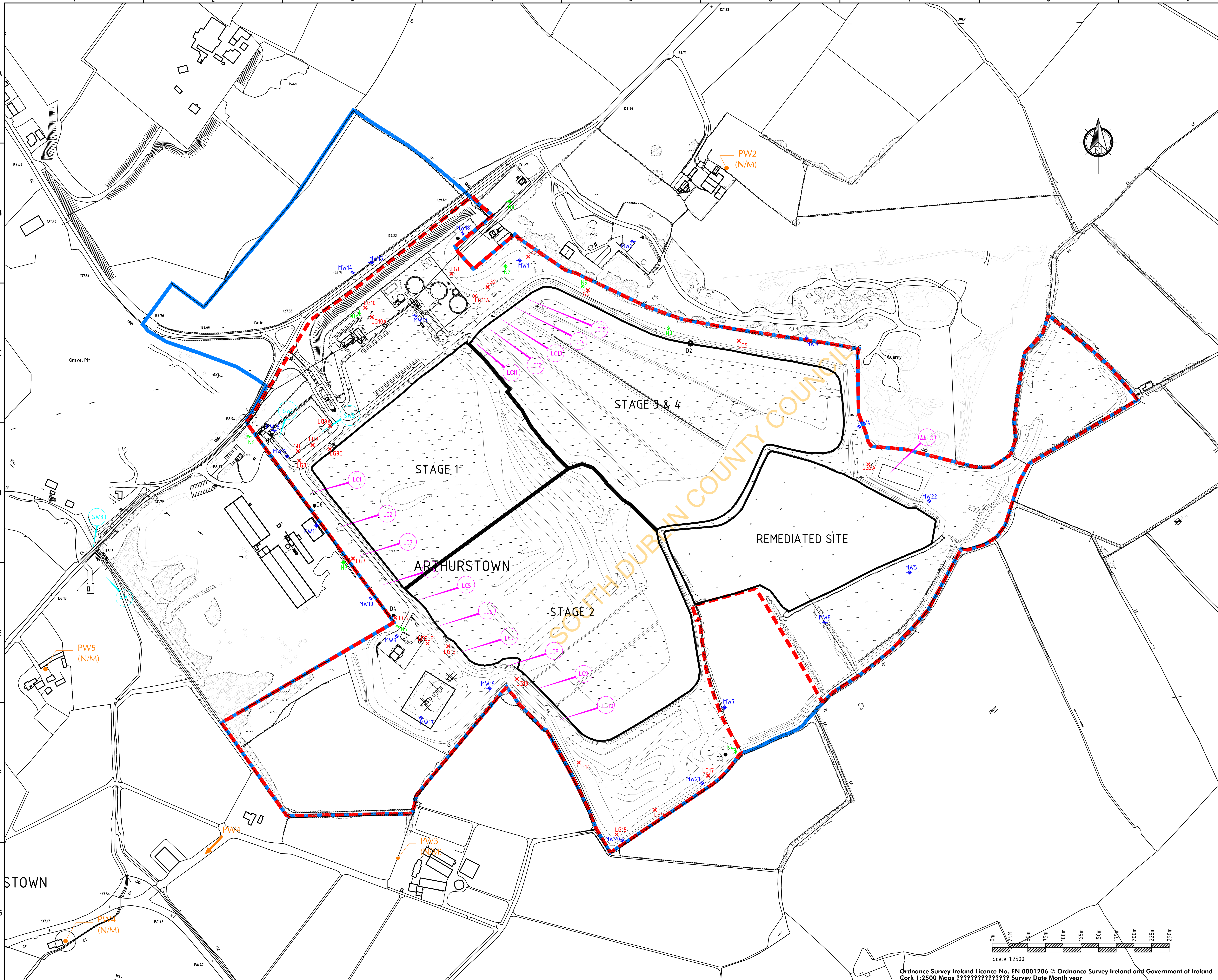
- Landfill Gas
- Landfill Gas Utilisation Plant
- Dust Deposition
- Noise
- Surface Water including Biological Assessment
- Groundwater
- Private Wells (Groundwater)
- Leachate (including discharges to sewer)
- Nuisance
- Meteorological

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.

2.8. 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



LANDFILL GAS	LEACHATE
LG 1	LC 1
LG 2	LC 2
LG 3	LC 3
L.G 4	LC 4
L.G 5	LL 2
LG 6	LT 1
LG 7	LT 2
LG.8	L B
LG.9	L R
LG 10	LGW
LG 2A	LC11
LG 12	LC12
LG 13	LC13
LG 14	LC14
LG 15	LC15
LG 16	LC 5
LG 17	LC 6
LFGF1	LC 7
LG 9A	LC 8
LG 9B	LC 9
LG 9C	LC 10
LG10A	DUST
LG 11A	D 1
GROUNDWATER	D 2
MW 1	D 3
MW 2	D 4
MW 3	D 5
MW 4	D 6
MW 5	NOISE
MW 6	N1A
MW 6A	N2
MW 7	N3
MW 8	N4
MW 9	N5
MW 10	N6
MW 11	N7
MW 12	N8
MW 13	N9
MW 14	SURFACE WATER
MW 15	SW 1
MW16	SW 2
MW 17	SW 3
MW 18	SW 4
MW 19	SW 5
MW 20	PRIVATE WELLS
MW 21	PW 1
	PW 2
	PW 3
	PW 4
	PW 5

Rev.	Drawn	Chk'd	App'd	Rev Origin / Date	Description
A	KL	ME	CC	Cork 14.12.06	ISSUE FOR PLANNING

Revision History A

Name of Client

SOUTH DUBLIN COUNTY COUNCIL

Name of Job

ARTHURSTOWN LANDFILL
PLANNING AND EIS

Title of Drawing

ENVIRONMENTAL MONITORING LOCATIONS

Scales Used
1:2500

Dwg. No. 2006-054-03-FIG2.4 Rev. A

O:\ACAD\2006\054\03\sdc-pa_Fig24

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2.9. 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 areas etc. and was not due to landfill gas migration.

Appendix 3.2 shows methane and carbon dioxide levels measured in perimeter wells in 2010. The levels are comparable to levels recorded in 2008 & 2009.

Gas Extraction Wells

The final capped areas are connected to the 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 (23rd Feb 2011) 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.
All vents on site are now connected to the gas extraction system as the facility is closed.

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 2010.

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

South Dublin County Council
Arthurstown Landfill

2.9.1. 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.	Landfill Gas Perimeter Monthly 2010

2.9.2. 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. This report was again submitted to the Agency during 2009.

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. A further 2 no 2,500m3 per hour enclosed flares operated by SDCC to extract gas from the temporary capped areas are on stand-by as all landfill gas is now being diverted to the utilisation plant for electricity production. These last 2 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 2010 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 W0004-004.

Table 2.4. Emission value results for landfill gas flare 1.

Flare 1	Conc.	Normalised (mgN/m^3)	Oxygen corrected emission concentration to flare (mgN/m^3) 3% ref.	Mass Kg/hr	Expanded uncertainty as percentage of limit value (%)[1]	Emission limit Values	Operating Status
Total NOx [as NO_2] (ppm)	30	61.5	99.35	0.18	18.93	<150 mg/Nm^3	As Normal
CO (ppm)	1	1.25	2.02	0.004	9.05	<50 mg/Nm^3	As Normal
Total Organic Carbon (mg/m^3)	2.12	3.39	5.48	0.01	23.66	<10 mg/Nm^3	As Normal
Average Hydrogen Chloride (mg/m^3)	0.1	0.14	0.22	0.0004	-	<50 mg/Nm^3 (at mass flow > 0.30 kg/hr)	As Normal
Average Hydrogen Fluoride (mg/m^3)	0.06	0.08	0.13	0.0002	-	<5 mg/Nm^3 (at mass flow > 0.050 kg/hr)	As Normal
SO_2 (ppm)	32	91.2	147.34	0.27	-	-	As Normal
O_2 (%)	9.82	-	-	-	-	-	As Normal
Temperature (degrees)	1,054	1,327.15K	-	-	-	>1,273K	As Normal
CO_2 (%)	9.19	-	-	-	-	-	As Normal
Volumetric Airflow (m^3/hr)	-	-	1,853[2]	-	-	<3,000[2]	As Normal
Efficiency (%)	>99	-	-	-	-	-	As Normal

Notes: [1] denotes that expanded uncertainty is elevated as the equation has not been validated for use with high temperature sources.
[2] denotes units m^3N/hr

Table 2.5. Emission value results for landfill gas flare 2.

Flare 2	Conc.	Normalised (mgN/m^3)	Oxygen corrected emission concentration to flare (mgN/m^3) 3% ref.	Mass Kg/hr	Expanded uncertainty as percentage of limit value (%)[1]	Emission limit Values	Operating Status
Total NOx [as NO_2] (ppm)	36	73.8	116.80	0.18	21.37	<150 mg/Nm^3	As Normal
CO (ppm)	14	17.5	27.70	0.04	14.95	<50 mg/Nm^3	As Normal
Total Organic Carbon (mg/m^3)	2.45	3.92	6.20	0.0095	23.91	<10 mg/Nm^3	As Normal
Average Hydrogen Chloride (mg/m^3)	0.06	0.079	0.13	0.0002	-	<50 mg/Nm^3 (at mass flow > 0.30 kg/hr)	As Normal
Average Hydrogen Fluoride (mg/m^3)	0.06	0.079	0.13	0.0002	-	<5 mg/Nm^3 (at mass flow > 0.050 kg/hr)	As Normal
SO_2 (ppm)	11	31.35	49.62	0.08	-	-	As Normal
O_2 (%)	9.59	-	-	-	-	-	As Normal
Temperature (degrees)	1,065	1,338.15K	-	-	-	>1,273K	As Normal
CO_2 (%)	8.55	-	-	-	-	-	As Normal
Volumetric Airflow (m^3/hr)	-	-	1,536[2]	-	-	<3,000[2]	As Normal
Efficiency (%)	>99	-	-	-		-	As Normal

Notes:[1] denotes that expanded uncertainty is elevated as the equation has not been validated for use with high temperature sources.
[2] denotes units m^3N/hr

Table 2.6. Emission value results for landfill gas flare 3.

Flare 3	Conc.	Normalised (mgN/m^3)	Oxygen corrected emission concentration to flare (mgN/m^3) 3% ref.	Mass Kg/hr	Expanded uncertainty as percentage of limit value (%)[1]	Emission limit Values	Operating Status
Total NOx [as NO_2] (ppm)	29	59.45	96.57	0.11	19.45	<150 mg/Nm^3	As Normal
CO (ppm)	8	10	16.24	0.02	12.36	<50 mg/Nm^3	As Normal
Total Organic Carbon (mg/m^3)	1.84	2.94	4.78	0.01	24.12	<10 mg/Nm^3	As Normal
Average Hydrogen Chloride (mg/m^3)	0.29	0.398	0.65	0.0007	-	<50 mg/Nm^3 (at mass flow > 0.30 kg/hr)	As Normal
Average Hydrogen Fluoride (mg/m^3)	0.07	0.099	0.16	0.0002	-	<5 mg/Nm^3 (at mass flow > 0.050 kg/hr)	As Normal
SO_2 (ppm)	126	359	583.29	0.65	-	-	As Normal
O_2 (%)	9.88	-	-	-	-	-	As Normal
Temperature (degrees)	1,097	1,370.15K	-	-	-	>1,273K	As Normal
CO_2 (%)	9.12		-	-	-	-	As Normal
Volumetric Airflow (m^3/hr)	-	-	1,118[2]			<3,000[2]	As Normal
Efficiency (%)	>99	-	-	-	-	-	As Normal

Notes:[1] denotes that expanded uncertainty is elevated as the equation has not been validated for use with high temperature sources.
[2] denotes units m^3N/hr

Table 2.7. Emission value results for landfill gas flare 4.

Flare 3	Conc.	Normalised (mgN/m^3)	Oxygen corrected emission concentration to flare (mgN/m^3) 3% ref.	Mass Kg/hr	Expanded uncertainty as percentage of limit value (%)[1]	Emission limit Values	Operating Status
Total NOx [as NO_2] (ppm)	31	63	101	0.09	20.59	<150 mg/Nm^3	As Normal
CO (ppm)	12	15	24.04	0.02	14.72	<50 mg/Nm^3	As Normal
Total Organic Carbon (mg/m^3)	2.87	4.59	7.36	0.0066	26.05	<10 mg/Nm^3	As Normal
Average Hydrogen Chloride (mg/m^3)	0.10	0.139	0.22	0.0002	-	<50 mg/Nm^3 (at mass flow > 0.30 kg/hr)	As Normal
Average Hydrogen Fluoride (mg/m^3)	0.04	0.05	0.09	0.0001	-	<5 mg/Nm^3 (at mass flow > 0.050 kg/hr)	As Normal
SO_2 (ppm)	141	401	643	0.58	-	-	As Normal
O_2 (%)	9.73	-	-	-	-	-	As Normal
Temperature (degrees)	1,123	1,396.15K	-	-	-	>1,273K	As Normal
CO_2 (%)	8.87	-	-	-	-	-	As Normal
Volumetric Airflow (m^3/hr)	-	-	899[2]	-		<3,000[2]	As Normal
Efficiency (%)	>99	-	-	-	-	-	As Normal

Notes:[1] denotes that expanded uncertainty is elevated as the equation has not been validated for use with high temperature sources.
[2] denotes units m^3N/hr

Table 2.8. Emission value results for landfill gas utilisation AR01.

AR01	Conc.	Normalised (mgN/m^3)	Oxygen corrected emission concentration to flare (mgN/m^3) 3% ref.	Mass Kg/hr	Expanded uncertainty as percentage of limit value (%)[1]	Emission limit Values	Operating Status
Total NOx [as NO_2] (ppm)	93	190	236	0.51	4.81	<500 mg/Nm^3	As Normal
CO (ppm)	696	870	1,080	2.35	7.29	<1,400 mg/Nm^3	As Normal
Average Hydrogen Chloride (mg/m^3)	0.94	1.29	1.60	0.0035	-	50 mg/Nm^3 (at mass flows >0.3 kg/hr)	As Normal
Average Hydrogen Fluoride (mg/m^3)	0.22	0.30	0.37	0.0008	-	5 mg/Nm^3 (at mass flows >0.05 kg/hr)	As Normal
SO_2 (ppm)	0	0	0	0	-	-	As Normal
Particulates (mg/m^3)	41	56	69.58	0.15	1.62	<130 mg/Nm^3	As Normal
Average TVOC (ppm)	468	748	930	2.02	9.03	<1,000 mg/Nm^3	As Normal
TNMVOC (ppm)	5.95	9.52	11.83	0.03	2.58	<75 mg/Nm^3	As Normal
O_2 (%)	8.1	-	-	-	-	-	As Normal
Temperature (degrees)	428.1	701.25K	-	-	-	-	As Normal
CO_2 (%)	9.53	-	-	-	-	-	As Normal
Volumetric Airflow (m^3/hr)	6,922	2,696	2,171	-	-	<3,000	As Normal

Notes:[1] denotes that expanded uncertainty is elevated as the equation has not been validated for use with high temperature sources

Table 2.9. Emission value results for landfill gas utilisation AR02.

AR02	Conc.	Normalised (mgN/m^3)	Oxygen corrected emission concentration to flare (mgN/m^3) 3% ref.	Mass Kg/hr	Expanded uncertainty as percentage of limit value (%)[1]	Emission limit Values	Operating Status
Total NOx [as NO_2] (ppm)	142	291	346	0.67	6.76	<500 mg/Nm^3	As Normal
CO (ppm)	583	728	867	1.68	5.81	<1,400 mg/Nm^3	As Normal
Average Hydrogen Chloride (mg/m^3)	0.77	1.06	1.26	0.0024	-	50 mg/Nm^3 (at mass flows >0.3 kg/hr)	As Normal
Average Hydrogen Fluoride (mg/m^3)	0.24	0.33	0.40	0.0008	-	5 mg/Nm^3 (at mass flows >0.05 kg/hr)	As Normal
SO_2 (ppm)	7	19.95	23.76	0.0459	-	-	As Normal
Particulates (mg/m^3)	46	62.84	74.84	0.14	1.8	<130 mg/Nm^3	As Normal
Average TVOC (ppm)	432	691	823	1.59	7.93	<1,000 mg/Nm^3	As Normal
TNMVOC (ppm)	4.17	6.67	7.95	0.02	2.24	<75 mg/Nm^3	As Normal
O_2 (%)	7.55	7.55	-	-	-	-	As Normal
Temperature (degrees)	430.1	703.25K	-	-	-	-	As Normal
CO_2 (%)	9.92	-	-	-	-	-	As Normal
Volumetric Airflow (m^3/hr)	5,927	2,302	1,933	-	-	<3,000	As Normal

Notes:[1] denotes that expanded uncertainty is elevated as the equation has not been validated for use with high temperature sources

Table 2.10. Emission value results for landfill gas utilisation AR03.

AR03	Conc.	Normalised (mgN/m^3)	Oxygen corrected emission concentration to flare (mgN/m^3) 3% ref.	Mass Kg/hr	Expanded uncertainty as percentage of limit value (%)[1]	Emission limit Values	Operating Status
Total NOx [as NO_2] (ppm)	203	416	473	0.91	9.26	<500 mg/Nm^3	As Normal
CO (ppm)	1,703	2,128	2,421	4.64	16.31	<1,400 mg/Nm^3	As Normal
Average Hydrogen Chloride (mg/m^3)	1.12	1.53	1.74	0.003	-	50 mg/Nm^3 (at mass flows >0.3 kg/hr)	As Normal
Average Hydrogen Fluoride (mg/m^3)	0.33	0.46	0.52	0.001	-	5 mg/Nm^3 (at mass flows >0.05 kg/hr)	As Normal
SO_2 (ppm)	3	8.55	9.72	0.019	-	-	As Normal
Particulates (mg/m^3)	32.54	44.45	50.56	0.10	1.27	<130 mg/Nm^3	As Normal
Average TVOC (ppm)	589	942	1,071	2.05	10.42	<1,000 mg/Nm^3	As Normal
TNMVOC (ppm)	5.87	9.39	10.68	0.02	2.42	<75 mg/Nm^3	As Normal
O_2 (%)	6.92	6.92	-	-	-	-	As Normal
Temperature (degrees)	458.4	731.55K	-	-	-	-	As Normal
CO_2 (%)	10.39	-	-	-	-	-	As Normal
Volumetric Airflow (m^3/hr)	5,837	2,179	1,916	-	-	<3,000	As Normal

Notes:[1] denotes that expanded uncertainty is elevated as the equation has not been validated for use with high temperature sources

Table 2.11. Emission value results for landfill gas utilisation AR04.

AR04	Conc.	Normalised (mgN/m^3)	Oxygen corrected emission concentration to flare (mgN/m^3) 3% ref.	Mass Kg/hr	Expanded uncertainty as percentage of limit value (%)[1]	Emission limit Values	Operating Status
Total NOx [as NO_2] (ppm)	122	250	257	0.45	4.93	<500 mg/Nm^3	As Normal
CO (ppm)	661	826	851	1.48	5.54	<1,400 mg/Nm^3	As Normal
Average Hydrogen Chloride (mg/m^3)	0.61	0.83	0.85	0.001	-	50 mg/Nm^3 (at mass flows >0.3 kg/hr)	As Normal
Average Hydrogen Fluoride (mg/m^3)	0.16	0.22	0.23	0.0004	-	5 mg/Nm^3 (at mass flows >0.05 kg/hr)	As Normal
SO_2 (ppm)	5	14.25	14.68	0.025	-	-	As Normal
Particulates (mg/m^3)	43.12	58.91	60.70	0.11	1.67	<130 mg/Nm^3	As Normal
Average TVOC (ppm)	604	966	995	1.73	9.31	<1,000 mg/Nm^3	As Normal
TNMVOC (ppm)	3.64	5.82	6.00	0.01	1.92	<75 mg/Nm^3	As Normal
O_2 (%)	5.47	5.47	-	-	-	-	As Normal
Temperature (degrees)	442.6	715.75K	-	-	-	-	As Normal
CO_2 (%)	11.46		-	-	-	-	As Normal
Volumetric Airflow (m^3/hr)	4,691	1,790	1,737	-	-	<3,000	As Normal

Notes:[1] denotes that expanded uncertainty is elevated as the equation has not been validated for use with high temperature sources

Table 2.12. Emission value results for landfill gas utilisation AR05.

AR05	Conc.	Normalised (mgN/m^3)	Oxygen corrected emission concentration to flare (mgN/m^3) 3% ref.	Mass Kg/hr	Expanded uncertainty as percentage of limit value (%)[1]	Emission limit Values	Operating Status
Total NOx [as NO_2] (ppm)	85	174	215	0.46	4.58	<500 mg/Nm^3	As Normal
CO (ppm)	835	1,043	1,292	2.77	10.52	<1,400 mg/Nm^3	As Normal
Average Hydrogen Chloride (mg/m^3)	0.77	1.05	1.30	0.002	-	50 mg/Nm^3 (at mass flows >0.3 kg/hr)	As Normal
Average Hydrogen Fluoride (mg/m^3)	0.24	0.33	0.41	0.0009	-	5 mg/Nm^3 (at mass flows >0.05 kg/hr)	As Normal
SO_2 (ppm)	3	8.55	10.59	0.022	-	-	As Normal
Particulates (mg/m^3)	42.36	57.87	71.66	0.15	1.66	<130 mg/Nm^3	As Normal
Average TVOC (ppm)	497	795	984	2.11	16.83	<1,000 mg/Nm^3	As Normal
TNMVOC (ppm)	7.56	12.09	14.98	0.03	2.94	<75 mg/Nm^3	As Normal
O_2 (%)	8.06	8.06	-	-	-	-	As Normal
Temperature (degrees)	461	735	-	-	-	-	As Normal
CO_2 (%)	9.54	-	-	-	-	-	As Normal
Volumetric Airflow (m^3/hr)	7,149	2,657	2,145	-	-	<3,000	As Normal

Notes:[1] denotes that expanded uncertainty is elevated as the equation has not been validated for use with high temperature sources

Table 2.13. Emission value results for landfill gas utilisation AR06.

AR06	Conc.	Normalised (mgN/m^3)	Oxygen corrected emission concentration to flare (mgN/m^3) 3% ref.	Mass Kg/hr	Expanded uncertainty as percentage of limit value (%)[1]	Emission limit Values	Operating Status
Total NOx [as NO_2] (ppm)	81	166.05	196.15	0.44	4.15	<500 mg/Nm^3	As Normal
CO (ppm)	656	820	968.65	2.15	6.69	<1,400 mg/Nm^3	As Normal
Average Hydrogen Chloride (mg/m^3)	0.69	0.94	1.11	0.0025	-	50 mg/Nm^3 (at mass flows >0.3 kg/hr)	As Normal
Average Hydrogen Fluoride (mg/m^3)	0.23	0.32	0.38	0.0008	-	5 mg/Nm^3 (at mass flows >0.05 kg/hr)	As Normal
SO_2 (ppm)	10	28.5	33.67	0.0747	-	-	As Normal
Particulates (mg/m^3)	30.28	41.37	48.86	0.11	1.18	<130 mg/Nm^3	As Normal
Average TVOC (ppm)	520	832	982	2.18	9.76	<1,000 mg/Nm^3	As Normal
TNMVOC (ppm)	7.12	11.39	13.46	0.03	2.74	<75 mg/Nm^3	As Normal
O_2 (%)	7.44	7.44	-	-	-	-	As Normal
Temperature (degrees)	467.3	740.45K	-	-	-	-	As Normal
CO_2 (%)	10.04	-	-	-	-	-	As Normal
Volumetric Airflow (m^3/hr)	7,103	2,620	2,218	-	-	<3,000	As Normal

Notes:[1] denotes that expanded uncertainty is elevated as the equation has not been validated for use with high temperature sources

Table 2.14. Emission value results for landfill gas utilisation AR07.

AR07	Conc.	Normalised (mgN/m^3)	Oxygen corrected emission concentration to flare (mgN/m^3) 3% ref.	Mass Kg/hr	Expanded uncertainty as percentage of limit value (%)[1]	Emission limit Values	Operating Status
Total NOx [as NO_2] (ppm)	63	129	160	0.35	3.53	<500 mg/Nm^3	As Normal
CO (ppm)	1,208	1,501	1,881	4.14	10.1	<1,400 mg/Nm^3	As Normal
Average Hydrogen Chloride (mg/m^3)	0.58	0.80	1.00	0.002	-	50 mg/Nm^3 (at mass flows >0.3 kg/hr)	As Normal
Average Hydrogen Fluoride (mg/m^3)	0.52	0.72	0.89	0.002	-	5 mg/Nm^3 (at mass flows >0.05 kg/hr)	As Normal
SO_2 (ppm)	16	45.6	56.82	0.125	-	-	As Normal
Particulates (mg/m^3)	38.56	52.68	65.64	0.14	1.51	<130 mg/Nm^3	As Normal
Average TVOC (ppm)	658	1,052	1,311	2.89	12.98	<1,000 mg/Nm^3	As Normal
TNMVOC (ppm)	10.28	16.44	20.50	0.05	3.45	<75 mg/Nm^3	As Normal
O_2 (%)	8.14	-	-	-	-	-	As Normal
Temperature (degrees)	452.6	725.75K	-	-	-	-	As Normal
CO_2 (%)	9.52	-	-	-	-	-	As Normal
Volumetric Airflow (m^3/hr)	7,284	2,742	2,200	-	-	<3,000	As Normal

Notes:[1] denotes that expanded uncertainty is elevated as the equation has not been validated for use with high temperature sources

Table 2.15. Emission value results for landfill gas utilisation AR08.

AR08	Conc.	Normalised (mgN/m^3)	Oxygen corrected emission concentration to flare (mgN/m^3) 3% ref.	Mass Kg/hr	Expanded uncertainty as percentage of limit value (%)[1]	Emission limit Values	Operating Status
Total NOx [as NO_2] (ppm)	83	170	203	0.44	4.25	<500 mg/Nm^3	As Normal
CO (ppm)	847	1,058	1,267	2.74	8.65	<1,400 mg/Nm^3	As Normal
Average Hydrogen Chloride (mg/m^3)	4.67	6.37	7.63	0.01	-	50 mg/Nm^3 (at mass flows >0.3 kg/hr)	As Normal
Average Hydrogen Fluoride (mg/m^3)	0.41	0.57	0.68	0.001	-	5 mg/Nm^3 (at mass flows >0.05 kg/hr)	As Normal
SO_2 (ppm)	15	42.75	51.18	0.11	-	-	As Normal
Particulates (mg/m^3)	43.57	59.52	71.26	0.15	1.71	<130 mg/Nm^3	As Normal
Average TVOC (ppm)	512	819	980	2.12	9.64	<1000 mg/Nm^3	As Normal
TNMVOC (ppm)	5.68	9.08	10.88	0.02	2.52	<75 mg/Nm^3	As Normal
O_2 (%)	7.62	7.62	-	-	-	-	As Normal
Temperature (degrees)	453.1	726.25	-	-	-	-	As Normal
CO_2 (%)	9.89	-	-	-	-	-	As Normal
Volumetric Airflow (m^3/hr)	6,877	2,587	2,160	-	-	<3,000	As Normal

Notes:[1] denotes that expanded uncertainty is elevated as the equation has not been validated for use with high temperature sources

Table 2.16. Emission value results for landfill gas utilisation AR09.

AR09	Conc.	Normalised (mgN/m^3)	Oxygen corrected emission concentration to flare (mgN/m^3) 3% ref.	Mass Kg/hr	Expanded uncertainty as percentage of limit value (%)[1]	Emission limit Values	Operating Status
Total NOx [as NO_2] (ppm)	139	284.95	300	0.49	5.87	<500 mg/Nm^3	As Normal
CO (ppm)	676	845	889	1.45	5.95	<1,400 mg/Nm^3	As Normal
Average Hydrogen Chloride (mg/m^3)	4.34	5.93	6.24	0.010	-	50 mg/Nm^3 (at mass flows >0.3 kg/hr)	As Normal
Average Hydrogen Fluoride (mg/m^3)	2.35	3.21	3.38	0.006	-	5 mg/Nm^3 (at mass flows >0.05 kg/hr)	As Normal
SO_2 (ppm)	24	68.4	71.93	0.12	-	-	As Normal
Particulates (mg/m^3)	50.87	69.49	73.08	0.12	1.97	<130 mg/Nm^3	As Normal
Average TVOC (ppm)	548	876.8	922	1.51	8.88	<1,000 mg/Nm^3	As Normal
TNMVOC (ppm)	12.56	20.10	21.13	0.03	3.27	<75 mg/Nm^3	As Normal
O_2 (%)	5.78	5.78	-	-	-	-	As Normal
Temperature (degrees)	465.3	738.45	-	-	-	-	As Normal
CO_2 (%)	11.23	-	-	-	-	-	As Normal
Volumetric Airflow (m^3/hr)	4,654	1,722	1,637	-	-	<3,000	As Normal

Notes:[1] denotes that expanded uncertainty is elevated as the equation has not been validated for use with high temperature sources

Table 2.17. Emission value results for landfill gas utilisation AR10.

AR10	Conc.	Normalised (mgN/m^3)	Oxygen corrected emission concentration to flare (mgN/m^3) 3% ref.	Mass Kg/hr	Expanded uncertainty as percentage of limit value (%)[1]	Emission limit Values	Operating Status
Total NOx [as NO_2] (ppm)	141	289	350	0.52	7.04	<500 mg/Nm^3	As Normal
CO (ppm)	764	955	1,156	1.72	7.93	<1,400 mg/Nm^3	As Normal
Average Hydrogen Chloride (mg/m^3)	0.05	0.06	0.07	0.0001	-	50 mg/Nm^3 (at mass flows >0.3 kg/hr)	As Normal
Average Hydrogen Fluoride (mg/m^3)	0.08	0.11	0.13	0.0002	-	5 mg/Nm^3 (at mass flows >0.05 kg/hr)	As Normal
SO_2 (ppm)	16	45.6	55	0.08	-	-	As Normal
Particulates (mg/m^3)	42.36	57.87	70	0.10	1.66	<130 mg/Nm^3	As Normal
Average TVOC (ppm)	505	808	978	1.45	9.66	<1,000 mg/Nm^3	As Normal
TNMVOC (ppm)	10.58	16.92	20	0.03	3.47	<75 mg/Nm^3	As Normal
O_2 (%)	7.76	7.76	-	-	-	-	As Normal
Temperature (degrees)	455.1	728.25	-	-	-	-	As Normal
CO_2 (%)	10.17	-	-	-	-	-	As Normal
Volumetric Airflow (m^3/hr)	4,801	1,801	1,488	-	-	<3,000	As Normal

Notes:[1] denotes that expanded uncertainty is elevated as the equation has not been validated for use with high temperature sources

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Table 2.18. Emission value results for landfill gas utilisation AR11.

AR11	Conc.	Normalised (mgN/m^3)	Oxygen corrected emission concentration to flare (mgN/m^3) 3% ref.	Mass Kg/hr	Expanded uncertainty as percentage of limit value (%)[1]	Emission limit Values	Operating Status
Total NOx [as NO_2] (ppm)	176	360	389	0.62	7.57	<500 mg/Nm^3	As Normal
CO (ppm)	768	960	1,034	1.66	6.94	<1,400 mg/Nm^3	As Normal
Average Hydrogen Chloride (mg/m^3)	0.46	0.63	0.68	0.001	-	50 mg/Nm^3 (at mass flows >0.3 kg/hr)	As Normal
Average Hydrogen Fluoride (mg/m^3)	0.40	0.55	0.59	0.0010	-	5 mg/Nm^3 (at mass flows >0.05 kg/hr)	As Normal
SO_2 (ppm)	24	68.4	74	0.11	-	-	As Normal
Particulates (mg/m^3)	35.46	48.44	52	0.08	1.38	<130 mg/Nm^3	As Normal
Average TVOC (ppm)	489	782.4	843	1.35	8.17	<1,000 mg/Nm^3	As Normal
TNMVOC (ppm)	8.46	13.53	15	0.024	2.66	<75 mg/Nm^3	As Normal
O_2 (%)	6.14	6.14	-	-	-	-	As Normal
Temperature (degrees)	464	737.15	-	-	-	-	As Normal
CO_2 (%)	11.04	-	-	-	-	-	As Normal
Volumetric Airflow (m^3/hr)	4,691	1,737	1,612	-	-	<3,000	As Normal

Notes:[1] denotes that expanded uncertainty is elevated as the equation has not been validated for use with high temperature sources

2.9.3. Interpretation of Utilisation Emissions

Tables 2.1 to *2.18* present the results of the emission monitoring carried out on the 4 enclosed landfill flares and 11 landfill gas engines located in the utilisation plant at Arthurstown Landfill, Kill, Co. Kildare. The conclusions from the report state the following:

"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^{0}C can release CO from within the structure of the material and cause the recording of erroneous results (Environment Agency, 2002).

Correction of data to 3% & 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 (Environment Agency, 2002)." (OMI 2011)

CO and TVOC emission concentrations were above emission limit values established within Waste licence W0004-004 for Engine AR03 and Engine AR07. All other monitoring of flares and engine stacks showed all readings are in compliance with waste license W0004-004 for 2010.

2.10. 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 March 2010
- ___18th May 2010
- ___10th August 2010

2.10.1. Dust Deposition

Dust deposition results for 2010 are shown in Figure 3.3.1.1. Dust Monitoring 2010.

2.10.2. Interpretation of Dust Deposition Results

The license limit for dust at the facility is 350 mg/m2/day. This was not exceeded during 2010. The highest level recorded was in Q2 with a reading of 275 mg/m2/day at location D3.

2.11. Noise

In compliance with Schedule D (D.4) of the waste licence, noise monitoring was carried during 2010.

The noise monitoring events took place as follows:

Day time monitoring – 15th December 2010
Night time monitoring – 15th December 2010

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 2010
Table A.3.4.2.b	Noise Night-time Monitoring 2010

2.11.1. Interpretation of Noise Results

Event 1
Daytime Event – 15th December 2010
Night-time Event – 15th December 2010

Exceedences = Day 7 Night 5
A total of seven locations were monitored during the day time period. Seven 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 64 dB L_{Aeq} at N2.
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 N2. This was a direct result of early morning vehicle start up in close proximity to the noise meter.

Noise levels are consistent with previous years monitoring.

2.12. Surface Water

The following is a summary of surface water quality findings in 2010. 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 storm water lagoon in the Hartwell River
- SW2 outlet for the on site storm water pond
- SW3 downstream of the outfall from the storm water lagoon in the Hartwell River
- SW4 downstream of Arthurstown Road in the Kill River
- SW5 inlet to the storm water pond (storm and ground waters)

2.12.1. 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). 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 2010
Table A. 3.5.3.b	Surface Water Quarterly 2010
Table A.3.5.4.c	Surface Water Annually 2010

2.12.2. Interpretation of Surface Water Results

During 2010 the surface water quality has remained consistent 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 2010 there were elevated levels of NH_4 Ammonia. This was as a direct result of the large amounts of rainfall eroding parts of the temporary cap area which may lead to small amounts of “leachate breakout” entering the surface water swale. These areas are remediated as soon as they occur.

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 2010.

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 consistent with 2008 & 2009 figures and 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 third quarter of 2010. (3rd August 2010) 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 0.12 Q Rating of Surface Waters 2010.

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 is consistent with last years results. This point is upstream of the Arthurstown surface water discharge point. (note: discharge from ALCRETE Ltd is within 5m upstream of the discharge from Arthurstown Landfill)
Quality at point SW3 is consistent with previous years which indicate that discharges from the surface water retention pond from the landfill are having no impact on the surface water quality at point SW3.
Quality at point SW4 is also consistent with last years results. 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.

The overall bio-diversity noted for the Hartwell River was very good. The results of the biological survey indicate that the quality of water in the Hartwell River is good (using the Q-value system) / excellent (using the LQI interpretation of water quality) upstream and downstream of the landfill.

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 0.2 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.

The waste licence (W004-004), 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 0.3 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.

2.12.3. 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
Figure A.3.6.3.a	2010 Groundwater Annually

2.12.4. 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 10 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.e. Groundwater Annual outlines all exceedances for the annual monitoring event.

Ammonia-N was above the MAC at the following points: MW2 & MW18.
Chloride levels were above the MAC at MW2.
MW2 and MW20 also had elevated levels of conductivity.

Calcium levels were only just over the MAC limit at MW2, MW22 and twice the limit at MW20.
Iron levels were above the MAC limit at MW14, MW18, MW2, MW20, MW22, MW6A, MW8 and MW9.
Lead levels were above the MAC at the following locations, MW14 and MW22
Manganese levels were above the MAC limit at all locations tested namely MW14, MW16, MW18.MW2, MW20, MW22, MW6A, MW8 and MW9.
Nickel levels were only exceeded at MW9.
Potassium levels were only above the MAC at location MW2 & MW20.
Sodium levels only exceeded at location MW2.
Sulphate level was just above the MAC at MW20.
Nitrite levels were above the MAC limit at MW14, MW16, MW22 and MW9.
Total Dissolved Solids were elevated at locations MW2 and MW20.

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).

MW2 and MW3 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 apart from MW2 as mentioned above.

2.13. 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.

2.13.1. Private Wells Results

Copies of the analysis for private wells for 2010 are included in the appendix.

Table or Figure number	Table or Figure Name
Table 3.7.2.a	Private Wells Annual 2010
Figure 3.7.1.b	Private Wells Quarterly 2010

2.13.2. Interpretation of Results

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

All other results for 2010 were below MAC limits.

Quarterly

PW 1 is the only private well that is sampled every quarter. See appendix for quarterly results for PW1 2010.

2.14. Leachate

The waste licence (W004-004), Schedule D.1 Table D.1.states that leachate levels should be recorded for all sumps and collection points on a continuous basis. This continued during 2010. Towards the end of 2010 there were exceptional amounts of rainfall and snow thaw which contributed to high leachate levels within the landfill body.

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

SDCC stores and reviews the results of only the 5 leachate locations required by the waste license. This decision was made during 2009 due to budgetary contraints.

2.14.1. 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. 3.8.2.a	Leachate Annual 2010 (See appendix)
Table 3.8.1.a	Leachate Quarterly 2010 (See appendix)

2.14.2. Interpretation of Leachate Results

Leachate results for 2010 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 contained leachate.
During 2010 treated leachate was discharged to the sewer rising main connection to Kill.
The annual leachate results are enclosed in Appendix 3.8.

2.15. Meteorological Monitoring

Condition 8.10.1 and schedule D.6.1. of the current Waste Licence W0004-004 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 2010 is summarised in Figures below. 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 2010 was approximately 815 mm, (0.815m) consistent with the annual average of 1000mm and 189 mm (7.4 inches) less than the previous years total.

Monthly summaries of meteorological conditions are included in Appendix 3.9 for 2010.

Figures 3.8.1 to 3.8.6 outline the annual meteorological results for 2010.

Monthly Rainfall & Evaporation for 2010.

Fig. 3.8.1- Monthly Rainfall & Evaporation (mm) in 2010

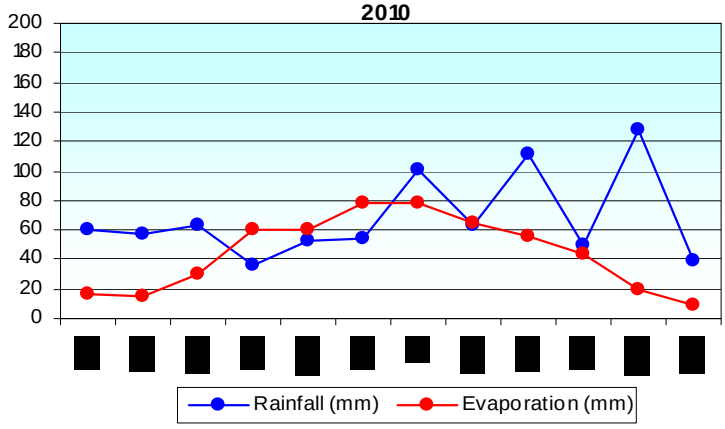
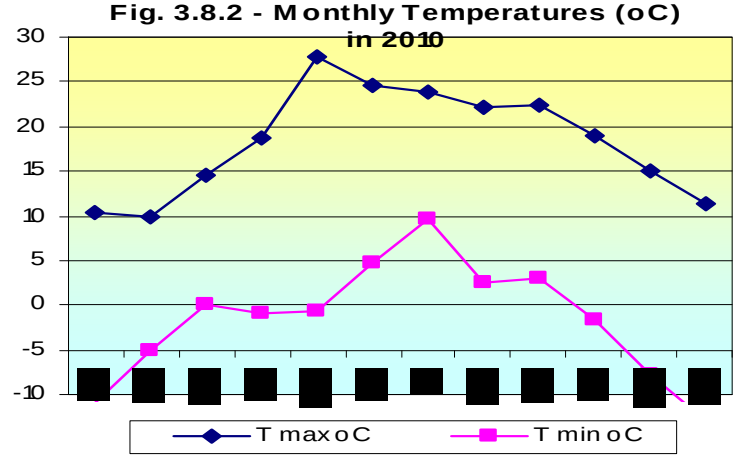


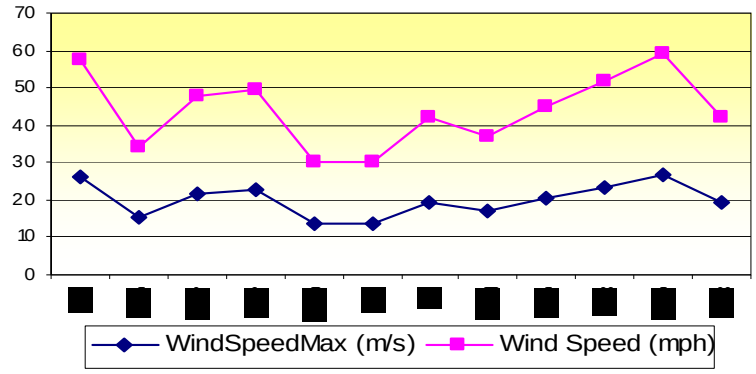
Fig. 3.8.2 - Monthly Temperatures (oC) in 2010



Temperatures (Max and Min) for 2010.

Monthly Max Wind Speeds for 2010.

Fig. 3.8.3 - Monthly Maximum Wind Speed in 2010



Atmospheric Pressure for 2010 (mb)

Fig.3.8.4 - Monthly Atmospheric Pressure (mb) in 2010

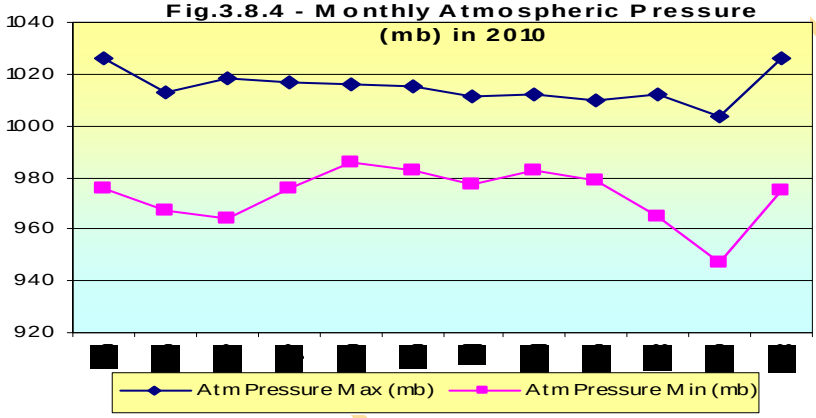
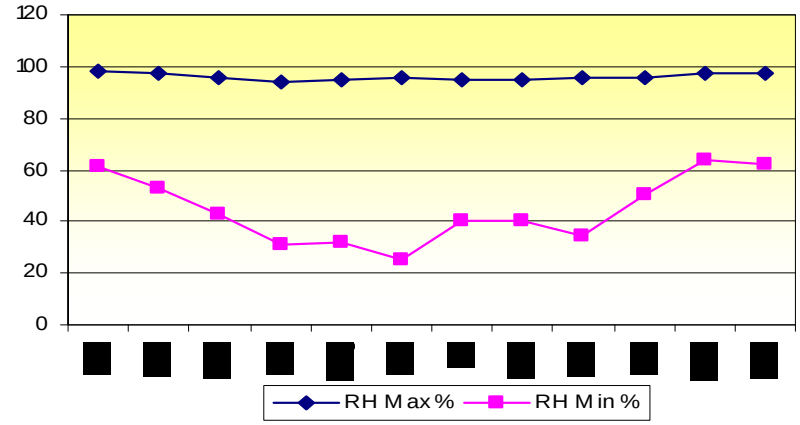
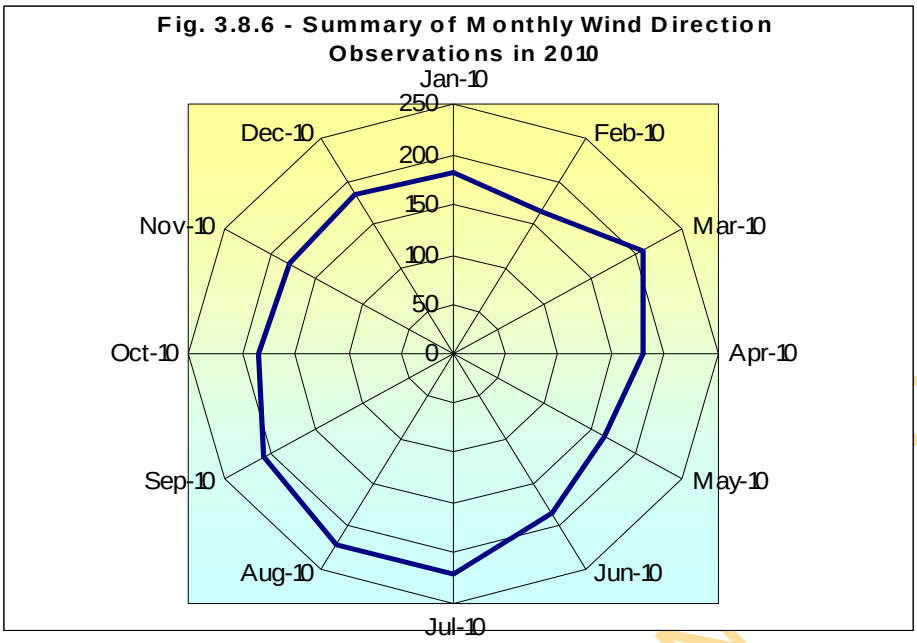


Fig. 3.8.5- Monthly Relative Humidity (%) in 2010



Relative Humidity for 2010. (%)

Wind Direction for 2010.



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 2010 – Actual average for 2010 is 190 degrees)

2.16. 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 11,000 m3/hour (maximum)
b) 2 no. 2,500 m3 per hour enclosed flares both of which can extract gas from the temporary capped areas in cells 11-15.(Currently on stand-by as all gas is now being utilised.)
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 2010.
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) Extraction 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 was used at the working face only and at the discretion of the Facility Manager.

The Facility is now closed since December 21st 2010. Odour control works are ongoing and involve the placement of the temporary clay capping.
Final capping works will proceed as planned in the coming years subject to financial approval and weather permitting.

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 W0004-004 states in condition 8.14.5 that an independent odour assessment is 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, the management staff at Arthurstown is 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 – 31st March 2010
- Q2 – 23rd June 2010
- Q3 – 23rd September 2010
- Q4 – 14th December 2010

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.

2.16.1. Odour Results

The colour odour charts for the landfill that are produced for each quarter are contained in the following four pages.
The colour maps of the site highlight where the most problems arise due to the concentrations measured on the temporary capped areas.
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.

Q1 – 2009	Total Complaints	8
Q2 – 2009	Total Complaints	1
Q3 – 2009	Total Complaints	2
Q4 – 2009	Total Complaints	15

Total Complaints for 2009 was 26.

Q1 – 2010	Total Complaints	5
Q2 – 2010	Total Complaints	9
Q3 – 2010	Total Complaints	4
Q4 – 2010	Total Complaints	20

Total Complaints for 2010 was 38.

The reason for the increase in Q4 2010 was due to the extreme weather conditions experienced in Ireland during the end of November 2010 and start of December 2010. Temperatures were recorded on site of -12.5 degrees and there was also 12 to 16 inches of snowfall. This extreme weather was not conducive to the odour control infrastructure operating at optimum.

Figure 2.1. Capping source "Odour Hog" monitoring within the operating landfill facility (colour scale area indicating TVOC gas colour scale).

Q.3. 2010

Document No. 2010A170(1)

Arthurstown Landfill Facility

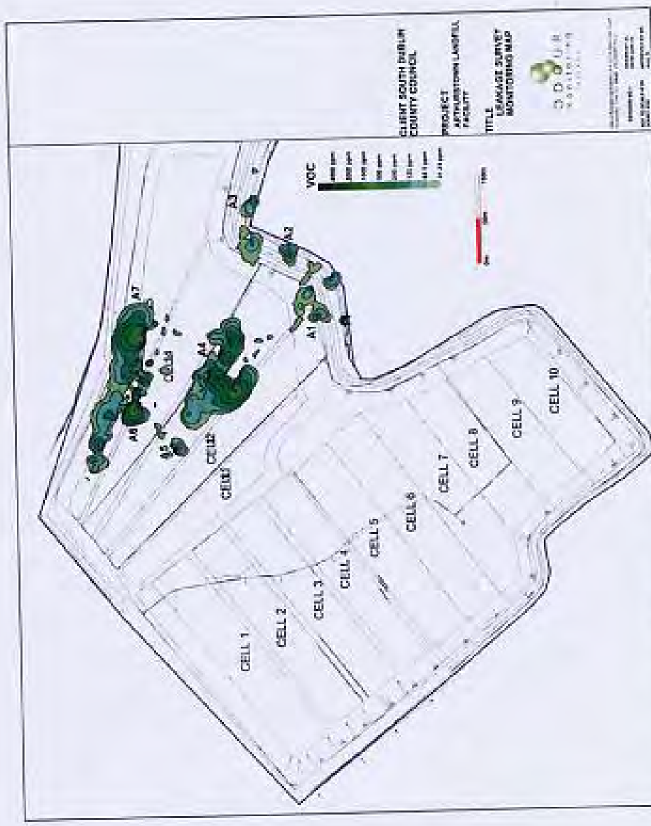


Figure 2.1. Capping source 'Odour Hog' monitoring within the operating landfill facility (colour scale area indicating TVOC gas colour scale). Q.2. 2010.

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Document No. 2010A109(1)

Arthurstown Landfill Facility

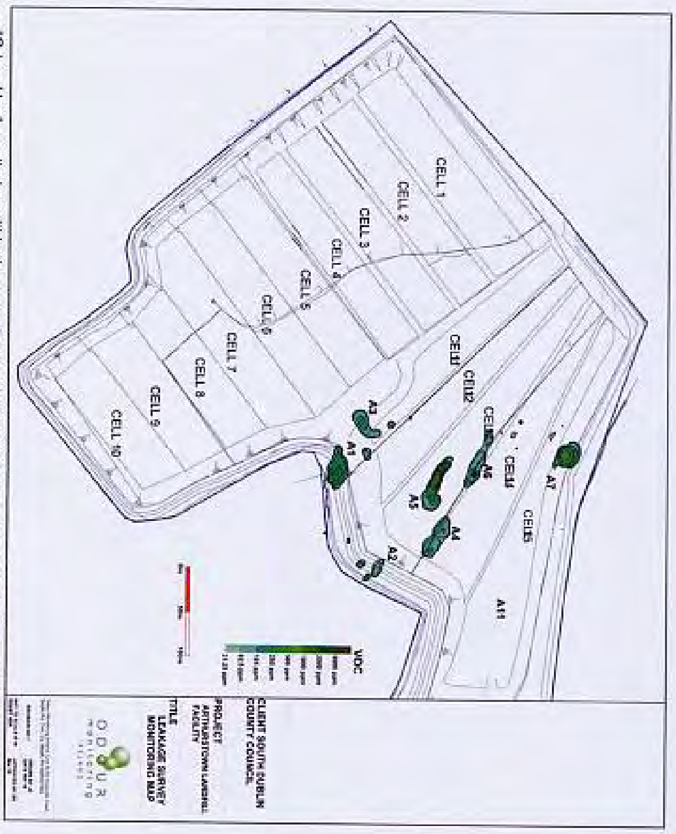

Figure 2.1. Capping source "Odour Hog" monitoring within the operating landfill facility (colour scale area indicating TVOC gas colour scale).

(Q.1. 2010)

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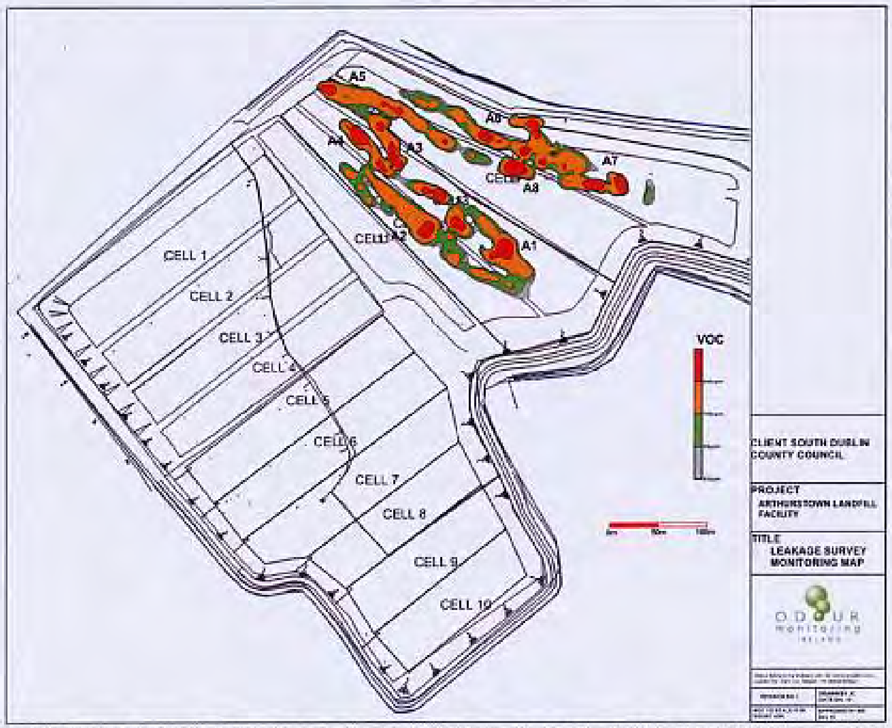


Figure 2.1. Capping source "Odour Hog" monitoring within the operating landfill facility (colour scale area indicating TVOC gas colour scale). (Q.4. 2010)

South Dublin County Council
Arthurstown Landfill

2.17. 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 2010.

87,600,000 m^3 of landfill gas was utilised by the gas extraction system in 2010. **(based on an average of 10,000 m^3 per hour)*
From July 2009 onwards all gas captured was sent to the utilisation plant.
But from time to time the 2 enclosed flares operated by SDCC were switched on during 2010. (Estimated at 50 days operating time at 1,000 m^3 per hour per flare)
Therefore the additional estimated landfill gas captured by flaring during 2010 is estimated at 2,400,000 m^3 of landfill gas.
Total Landfill gas Collected (Captured) 2010 = 90,000,000 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 2010 was 100,000,000 m^3.**

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

- Electricity production from landfill gas in 11 no. engines at the Bioverda compound (Approx. 13 MW)
- Flaring in 2 no. enclosed flares at the Bioverda compound.
- Flaring in 2 no. 2,500m3 /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 available generation capacity is 11,000 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 16,000 m^3/hour.
Note: The current average extraction rate is 10,000 m3 per hour.
During 2009 a third booster station arrived for the 3 additional engines. This brought the extraction rate to 11,000 m3/hour. All gas is now being extracted by the utilisation plant. The 2 no enclosed flares on the temporary capped areas are currently on stand by.

For the purposes of this exercise it is assumed that landfill gas captured at Arthurstown is 42% methane, 38% carbon dioxide and the remainder is made up of other compounds. These figures are based on average readings at the Bioverda compound for 2010.

The table overleaf contains the results for the European PRTR in relation to the Utilisation plant and the enclosed flare units at Arthurstown Landfill.

European PRTR Table Arthurstown Landfill flares and gas utilisation engines only.

Table 1. Table for European-PRTR requirements for Landfill flare and Gas utilisation engines only 2010.

Location	Nitrogen Oxides (NO_x as NO_2) (kg/yr)	Carbon Monoxide (CO) (kg/yr)	Sulphur dioxide (SO_2) (kg/yr)	Total particulates (kg/yr)	TNMVOC's (kg/yr)	Methane (kg/yr)	Carbon dioxide (CO_2) (kg/yr)
Flare 1[2]	1,612	33	2,391	-	173	89	2,929,620
Flare 2[2]	1,572	373	668	-	167	83	2,260,225
Flare 3[1]	945	159	5,710	-	130	47	1,753,697
Flare 4[1]	802	189	5,070	-	108	58	1,371,813
AR01	4,503	20,550	0	1,323	225	17,462	3,559,614
AR02	5,871	14,697	402	1,267	135	13,805	3,299,408
AR03	7,945	40,639	163	849	179	17,812	3,425,705
AR04	3,922	12,957	223	924	91	15,064	3,425,829
AR05	4,055	24,289	199	1,347	281	18,224	3,521,560
AR06	3,812	18,823	654	950	262	18,837	3,832,342
AR07	3,102	36,265	1,095	1,265	395	24,890	3,604,192
AR08	3,855	23,990	969	1,349	206	18,356	3,676,489
AR09	4,297	12,744	1,032	1,048	303	12,920	3,163,594
AR10	4,560	15,064	719	913	267	12,479	2,604,196
AR11	5,489	14,606	1,041	737	206	11,698	3,062,829
Totals	**54,595**	**235,030**	**9,556**	**11,971**	**2,890**	**181,718**	**42,365,603**

Notes: [1] denotes the flares 3 & 4 are operated on standby when gas utilisation engine failure occurs, therefore these re not added to the total emission value for the combustion plant in PRTR reporting.

[2] denotes that the total values reported are based on 24 hr per day 365 days per year operation and for AR01 to AR11 only. If the hours of operation are known through site records then the total actual amount can be calculated by calculating the yearly total to an hourly figure and then multiply by the number of hours operation (e.g. Emissions (kg/yr) / 8760 hrs = kg/hr × hours operation = Total emission in kg/yr).

Estimated Landfill Gas Generation

In summary, 181,718 kg / year of methane and 235,030 kg / year of CO were produced at Arthurstown Landfill during 2010. (as per PRTR Table produced by Odour Monitoring Ireland Ltd. (as per Table 1.)

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 Estimated Electricity Production at Arthurstown Landfill from Landfill Gas.

During 2010 the amount of electricity produced at Arthurstown Landfill by converting the landfill gas via the 11 gas engines is outlined as follows:

Month 2010	MW per month
January	8,567
February	7,843
March	8,641
April	8,585
May	8,335
June	7,457
July	7,776
August	7,661
September	7,472
October	7,726
November	7,997
December	7,893
Total 2010 MW produced	**95,953 MW h**

Table 4.3 Cumulative Quantities of Landfill Gas

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
2010	4,779,021	191,553	100,000,000	20.9	749,626,681	Not included
2009	4,587,468	214,560	116,720,000	25.4	649,626,681	Not included
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 flares on site. Difficult to estimate flows through flares. Also less waste was accepted at Facility.

2.18. 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 ground waters. Considering that groundwater flow is in a generally north-westerly (NW to NNW) direction, monitoring wells can be deemed to be 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 0.4 Calculation of Direct and Indirect Emissions to Groundwater

Location	Direction	Relative Position	Summary of Results since March 1999 - Dec 2010				
			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)	0.18	14.6	838 (Nov'08)	694
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)	0.12	15.74	716 (Nov '10)	665
MW20	150 m S	US	1.7 (Feb '03)	0.06	21.4	2815 (Nov '09)	1885
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)	0.09	11.7	805 (Apr '05)	535
MW2	260 m NE	CG	1.5 (May '01)	0.32	80.28	2363 (Nov'10)	1155
MW17	100 m WSW	CG	0.6 (May '01)	0.14	23.5	2097 (May'07)	1234
MW19	20 m WSW	CG	3.08 (July '07)	0.11	18.6	1204 (Jul'06)	911
MW1	140 m NE	DS	Dry	Dry	Dry	Dry	Dry
MW9	50 m W	DS	1.2 (July '01)	0.09	12.64	738 (Nov'08)	634
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)	0.11	23.10	1042 (Feb'09)	716
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)	0.05	15.6	992 (Nov'08)	741
MW18	170 m N	DS	1.2 (May'01)	0.23	12.8	719 (Nov '10)	650

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 MW2, MW8 and MW18 showed an increase in conductivity levels during 2010. This can be attributed to agricultural activity on the lands adjacent.

Due to the upstream locations of the majority, cross gradient locations of other boreholes and proximity to agricultural activities, it can be assumed that emissions to groundwater are satisfactory for the period 2010.

South Dublin County Council
Arthurstown Landfill

2.19. 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 12-15 were active for all of 2010.

Uncapped Area approx:	80,000 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 and discharged to sewer in 2010 was 105,301 m3.
Results of the water balance calculation estimate that approximately 156,864 m3 of leachate was produced during 2010. The amounts also to be taken away are from the SW2 outfall total for 2010 was 8,117 m^3 and the total amount in storage in leachate lagoons 6,500 m^3.
That leaves a remaining leachate figure of 36,946 m^3.

The difference of 36,946 m^3 can be attributed to the leachate that has been produced 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 and this back log of leachate is now being removed by continuous pumping.
The pumping of the leachate from each cell continued during 2010. The leachate levels are seasonal at Arthurstown with levels normalising during the drier months of April, May, June & July.
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 2010.

Month	Rainfall	Evaporation	Effective Rainfall	Waste Input	Active Area	Intermediate Area (temporarily capped)	Fully Capped Area	Active Infiltration	Intermediate Infiltration *	Capped Infiltration	Active Leachate	Total Predicted Leachate	Cumulative Predicted Leachate	Actual leachate tankered off site	Actual SW/GW discharged to river
		(mm)	(mm)	(tonnes)	(m^2)	(m^2)	(m^2)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(m3)
Jan-10	60.2	16.20	44.0	13,849	80,000	0	151,000	3,520.0	-	-	3520.0	3,520.0	3,520.0	9492.79	315.97
Feb-10	57.8	15.10	42.7	11,803	80,000	0	151,000	3,416.0	-	-	3416.0	3,416.0	6,936.0	12429.67	274.06
Mar-10	63.8	29.80	34.0	14,313	80,000	0	151,000	2,720.0	-	-	2720.0	2,720.0	9,656.0	11690.51	282.5
Apr-10	35.8	60.70	0.0	14,093	80,000	0	151,000	-	-	-	0	-	9,656.0	9353.27	243.1
May-10	52.6	60.20	0.0	13,625	80,000	0	151,000	-	-	-	0	-	9,656.0	7399.36	221.1
Jun-10	54.4	78.80	0.0	14,753	80,000	0	151,000	-	-	-	0	-	9,656.0	5300.31	192.6
Jul-10	100.6	78.20	22.4	11,890	80,000	0	151,000	1,792.0	-	-	1792.0	1,792.0	11,448.0	6729.14	211.8
Aug-10	62.8	64.40	0.0	12,032	80,000	0	151,000	-	-	-	0	-	11,448.0	8294.6	213.9
Sep-10	111.0	55.10	55.9	11,913	80,000	0	151,000	4,472.0	-	-	4472.0	4,472.0	15,920.0	8025.05	219.3
Oct-10	49.4	43.50	5.9	10,577	80,000	0	151,000	472.0	-	-	472.0	472.0	16,392.0	7757.46	251.3
Nov-10	128.2	19.00	109.2	11,952	80,000	0	151,000	8,736.0	-	-	8736.0	8,736.0	25,128.0	11747.16	5133.5
Dec-10	38.4	9.40	29.0	5,643	80,000	0	151,000	2,320.0	-	-	2320.0	2,320.0	27,448.0	7081.57	557.9
Total	**815**	**530**	**343**	**146,443**				**27,448**	**-**	**-**	**27,448**	**27,448**	**156,864**	**105,301**	**8,117.0**

Note: Approx 35,123 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.

3. FACILITY DEVELOPMENT

3.1. Site Survey

A topographical survey of the landfill facility was carried out by the facility management team during February 2011.
The survey is attached as Appendix 5.1.

3.2. Developments Undertaken in 2010.

3.2.1. Capping Works

Capping works commenced during the spring of 2010.

30,000 m^2 of final cap was installed on completion during October 2010.

Further capping works are planned for 2011 but are awaiting financial approval and subject to weather conditions.

3.2.2. Bioverda Power Systems Utilisation Plant

Three new landfill gas 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.
This plant comprises of 11 no. 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.

No further works were carried out during 2010 as the plant is now operating at maximum.

3.2.3. Staff reductions during 2010

There was a reduction in the number of staff at Arthurstown during 2009.
One member of S.D.C.C. left.
3 members of Blessington Plant Staff were made redundant.
This was as result of the reduction in the annual waste intake at Arthurstown Landfill. (From 600,000 tonnes during 2006 to only 191,553 tonnes during 2010.)

3.3. Developments Proposed for 2011.

3.3.1. Capping Works

It is proposed to continue with final capping works in Spring/Summer 2011, weather and budget permitting.
The specified engineering works for this phase will be submitted in due course.

3.4. Restoration Report

3.4.1. Completed Cells

Cells 1-11 are now fully capped and restored.

All cells are now closed. The Landfill no longer accepts waste since 21st December 2010 due to the expiration of the planning permission.

The landfill is now in its restoration and aftercare phase.

3.4.2. Restoration

Further capping took place during 2010.
Additional capping is due to take place again during 2011.

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

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

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

4. ENVIRONMENTAL OBJECTIVES AND TARGETS

4.1. Objectives and Targets

The list of objectives and targets for 2011 will be submitted as part of the EMP revision which will be submitted in the coming weeks.

5. FACILITY MANAGEMENT

5.1. Summary of New Written Procedures

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

5.2. 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 W0004-004 condition number 3.12.3.
Leachate tanks were tested during 2010.

5.3. Reported Incidents and Complaints

5.3.1. Reported Incidents

A summary of reported incidents during 2010 is shown in Table 7.1. Incidents are defined by Condition 1.6 of the current waste licence (W004-004).

There were 22 no. incidences reported to the EPA in 2010. These included:

- 11 no. Gas borehole trigger level incidents
- 1 no. report of groundwater monitoring incident
- 2 no. Elevated Levels at SW2
- 8 no. Leachate Sump level incidents

Table 5.1 Summary of Reported Incidences 2010.

	Incident Date	Cause	Mitigation Measure
Gas borehole trigger levels	280110	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated280110A (submitted to Agency)
	190210	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 190210A (submitted to Agency)
	250310	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 250310A (submitted to Agency)
	280410	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 280410A (submitted to Agency)
	310510	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 310510A (submitted to Agency)
	240610	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 240610A (submitted to Agency)
	210710	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 210710A (submitted to Agency)
	260810	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 260810A (submitted to Agency)
	100910	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 100910A (submitted to Agency)
	271010	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 271010A (submitted to Agency)
	301110	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 301110A (submitted to Agency)

	Incident Date	Cause	Mitigation Measure
Sw2	190410	Elevated Ammonia Levels SW2	Remediate Areas on Temporary Cap. (See Report dated 190410A Submitted to Agency)
SW2	300610	Elevated Ammonia Levels SW2	Remediate Areas on Temporary Cap. (See Report dated 300610A Submitted to Agency)

Table 8.1: Cont'd

	Incident Date	Cause	Mitigation Measure
	310510	Breach of 1m Leachate Level In Leachate Sumps	Continuous Pumping and continuation of finial capping works in time. (Report to Agency ref: 310510A)
Leachate Sumps Levels	050610	Breach of 1m Leachate Level In Leachate Sumps	Continuous Pumping and continuation of finial capping works in time. (Report to Agency ref: 050610A)
	160710	Breach of 1m Leachate Level In Leachate Sumps	Continuous Pumping and continuation of finial capping works in time. (Report to Agency ref: 160710A)
Leachate Sumps Levels	310810	Breach of 1m Leachate Level In Leachate Sumps	Continuous Pumping and continuation of finial capping works in time. (Report to Agency ref: 310810A)
	290910	Breach of 1m Leachate Level In Leachate Sumps	Continuous Pumping and continuation of finial capping works in time. (Report to Agency ref: 290910A)
	291010	Breach of 1m Leachate Level In Leachate Sumps	Continuous Pumping and continuation of finial capping works in time. (Report to Agency ref: 291010A)
Leachate Sumps Levels	251110	Breach of 1m Leachate Level In Leachate Sumps	Continuous Pumping and continuation of finial capping works in time. (Report to Agency ref: 251110A)
	211210	Breach of 1m Leachate Level In Leachate Sumps	Continuous Pumping and continuation of finial capping works in time. (Report to Agency ref: 211210A)

5.3.2. Complaints

There were 38 no. complaints to the facility in 2010.
Figure 8.1 is a graphical summary of complaints.

This represents a massive decrease on the number of complaints made in during the previous years. There were 382 complaints in 2007 and 174 during 2008.
Although the 38 complaints received during 2010 is an increase on the 26 complaints received during 2009.

Some reasons for the decrease in complaints to the facility during latter years 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 land filling 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.
(h) The landfill has now stopped receiving waste due to closure of the site and is now placing the temporary cap in preparation for the final capping works.

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.
While complaints increased again to 38 during 2010, 18 of those were during the month of December 2010. This was due to the exceptional weather during that month with temperatures of -12.5 degrees C on site and 12 to 16 inches of snow fall.

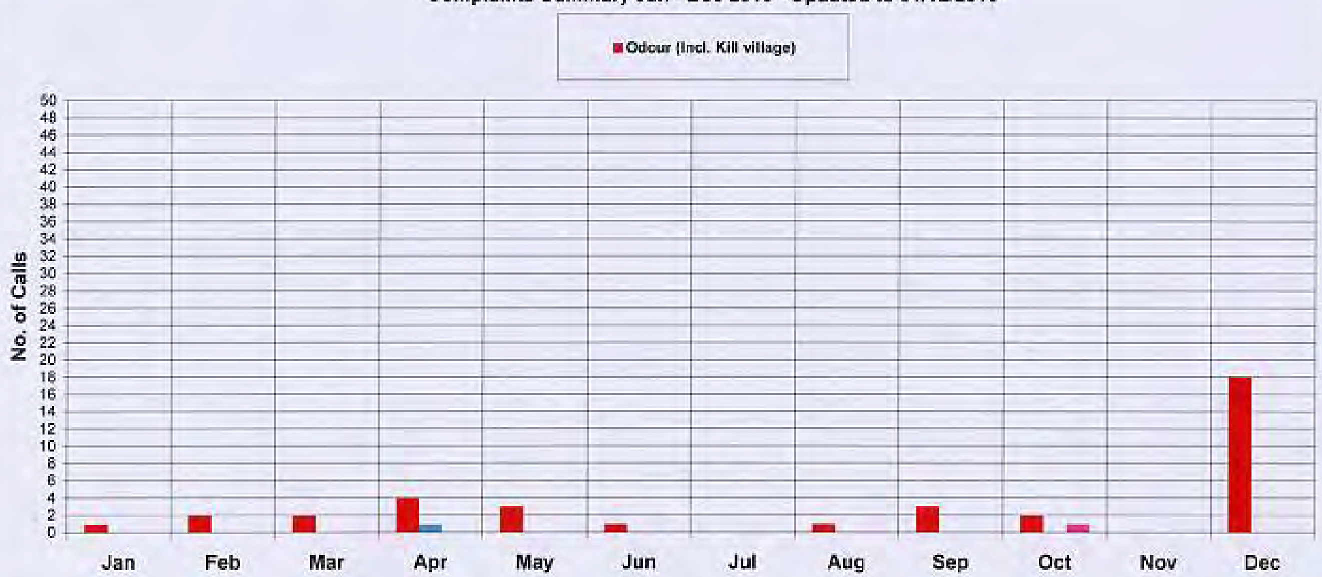
Figure 8.1 Complaints made to Facility in 2010.

Complaints Summary 2010

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Odour (Incl. Kill village)	1	2	2	4	3	1	0	1	3	2	0	18	37
Odour (Kill Village only)	0	0	1	0	0	0	0	0	0	0	0	5	6
Noise (Anywhere)	0	0	0	0	0	0	0	0	0	1	0	0	1
Traffic (Anywhere)	0	0	0	1	0	0	0	0	0	0	0	0	1
Callers	1	2	2	3	3	1	0	1	2	2	0	11	28
Max Calls from 1 Caller	1	1	1	3	1	1	0	1	2	1	0	4	16
Callers on Max	1	2	2	1	3	1	0	1	1	2	0	1	15
Monthly Total Calls	1	2	2	5	3	1	0	1	3	2	0	18	38
Most Frequent Callers				M.McCann					M.McCann			R.McCann	

Updated by M.Heffernan on 04/01/2011

Complaints Summary Jan - Dec 2010 - Updated to 31/12/2010



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5.4. 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 red-tailed Eagle and other cross breeds of falcon. All are proving effective means of deterrent for birds which otherwise could cause nuisance at the site. The bird contractor is no longer on site due to the closure of Arthurstown Landfill.

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 recent years due to the 11 landfill gas engines plus 4 enclosed 2,500 m3/hour flares on site. Currently all gas is now being utilised and two of the enclosed flare units are on stand-by or are activated when deemed necessary by the Facility manager.

See section 3.9 on Odour.

5.5. Report on Staff Training

The following training courses/seminars were attended by the staff at Arthurstown Landfill during 2010.

Table 5.2 Staff Training Log 2010.

Training Course /Seminar	Staff Attendees
None	None

5.6. Non-Compliances at Arthurstown Landfill during 2010.

During 2010 Arthurstown landfill received a total of 1 Non-compliances from the Environmental Protection Agency. They were for the following reasons:

Reason for NC	Number	EPA Site Visit
Leachate Management	1	Yes

Table 5.3 Non-Compliance Log for 2010.

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

The single non compliance during 2010 was as a result of an EPA audit which was carried out on the 23rd February 2010. (Audit ref no: W0004-04/AR01DM)
The non compliance was issued for breach of the 1m leachate levels within the leachate sumps.

On the 27th January 2010 the EPA also issued a fully compliant audit in relation to odour management. (Report ref no: W004-03/10/SI23JH)

5.7. 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 land filling and ancillary activities at Arthurstown during 2010 were in the region of € 3.0 m.
Under the ELRA conditions of the waste license South Dublin County Council have contributed approximately €2.9 million Euro to the aftercare and restoration fund with provision made to add a further €1 million euro over the next year.

Report on Programme for Public Information

In accordance with Waste Licence W0004-004, information is made available on site and submitted to the EPA on a regular basis. During 2010 there were numerous visits conducted at the facility for interested parties including schools and university groups, local and other international visitors including one visitor from the Maldives. Information about the facility is available on the updated website which can be accessed either directly *www.arthurstown.ie*. Site contact numbers are posted at the facility entrance. The website has been updated during 2010 to include the final cap and the utilisation of the landfill gas and a blog of up to date activities.
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 2010 South Dublin County Council had 6 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) and E. Comerford (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.

5.8. 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.

The required committee has recently been formed and funds are currently being distributed.

There was a total of €300,000 to be distributed locally for the community.

During 2010 the committee awarded approximately €200,000 Euro to local community groups and projects in the environs of Kill, Kilteel and Rathmore.

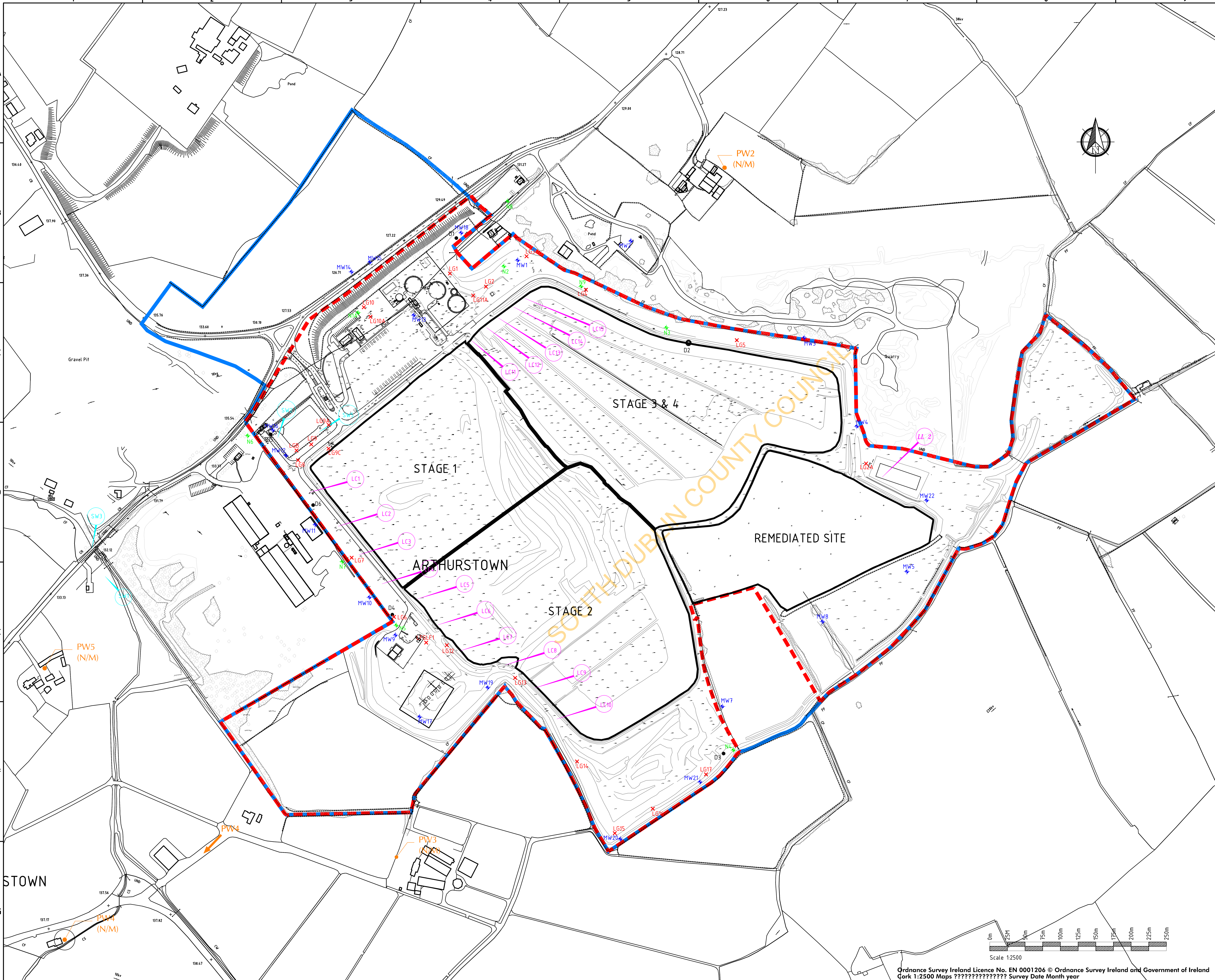
The final meeting of the committee will take place during 2011 to allocate the remainder of the funds.

South Dublin County Council
Arthurstown Landfill

6. ANY OTHER ITEMS

APPENDIX 3.1

Monitoring Locations Drawing



LANDFILL GAS	LEACHATE
LG 1	LC 1
LG 2	LC 2
LG 3	LC 3
LG 4	LC 4
LG 5	L 2
LG 6	LT 1
LG 7	LT 2
LG 8	L B
LG 9	L R
LG 10	LGW
LG 2A	LC11
LG 12	LC12
LG 13	LC13
LG 14	LC14
LG 15	LC15
LG 16	LC 5
LG 17	LC 6
LFGF1	LC 7
LG 9A	LC 8
LG 9B	LC 9
LG 9C	LC 10
LG10A	DUST
LG 11A	D 1
GROUNDWATER	D 2
MW 1	D 3
MW 2	D 4
MW 3	D 5
MW 4	D 6
MW 5	NOISE
MW 6	N1A
MW 6A	N2
MW 7	N3
MW 8	N4
MW 9	N5
MW 10	N6
MW 11	N7
MW 12	N8
MW 13	N9
MW 14	SURFACE WATER
MW 15	
MW16	SW 1
MW 17	SW 2
MW 18	SW 3
MW 19	SW 4
MW 20	SW 5
MW 21	
	PRIVATE WELLS
	PW 1
	PW 2
	PW 3
	PW 4
	PW 5

Rev.	Drawn	Chk'd	App'd	Rev Origin / Date	Description
A	KL	ME	CC	Cork 14.12.06	ISSUE FOR PLANNING

Revision History A

Name of Client
SOUTH DUBLIN COUNTY COUNCIL

Name of Job
ARTHURSTOWN LANDFILL
PLANNING AND EIS

Title of Drawing
ENVIRONMENTAL MONITORING LOCATIONS

Scales Used 1:2500
Dwg. No. 2006-054-03-FIG2.4
Rev. A

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APPENDIX 3.2

Landfill Gas Charts and Tables (Perimeter monitoring wells and Audit Sheet for Landfill Gas Wells)

Table A.3.2.1.x: All Stations, All Parameters for Landfill Gas Perimeter Monthly - AER Sample (Page: 1/5)

Sample Type: Landfill Gas Perimeter Monthly, Year: 2010

Sample Point --- Parameter --- MAC			28-Jan	19-Feb	25-Mar	28-Apr	31-May	24-Jun	21-Jul	26-Aug	10-Sep	27-Oct	30-Nov
			Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11
LG1	Methane (% v/v)	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
	Carbon Dioxide (% v/v)	1.5	1.10	1.60	2.20	1.30	2.90	4.00	2.80	1.8	0.40	0.80	1.20
	Oxygen (% v/v)		19.70	17.00	15.50	17.30	11.00	8.30	11.50	13.5	18.00	16.00	14.50
	Atmospheric Pressure (mb)		1003.00	979.00	979.00	997.00	1003.00	1003.00	988.00	993	994.00	996.00	1000.00
LG2	Methane (% v/v)	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
	Carbon Dioxide (% v/v)	1.5	2.60	0.00	0.00	0.20	0.60	0.60	0.00	0	0.00	0.00	0.00
	Oxygen (% v/v)		4.20	20.90	20.80	19.30	18.10	18.10	20.10	20	19.60	20.10	20.80
	Atmospheric Pressure (mb)		1003.00	979.00	979.00	997.00	1003.00	1003.00	988.00	993	994.00	996.00	1000.00
LG2A	Methane (% v/v)	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
	Carbon Dioxide (% v/v)	1.5	0.40	0.00	1.20	0.50	0.20	0.10	0.00	0	1.10	1.80	2.50
	Oxygen (% v/v)		19.80	20.90	20.80	18.90	19.70	19.90	20.10	20	15.30	12.50	11.00
	Atmospheric Pressure (mb)		1003.00	979.00	979.00	997.00	1003.00	1003.00	988.00	993	994.00	996.00	1000.00
LG3	Methane (% v/v)	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
	Carbon Dioxide (% v/v)	1.5	0.00	0.00	0.00	0.00	0.00	0.60	1.20	2.8	0.20	0.00	0.00
	Oxygen (% v/v)		20.90	20.90	20.80	20.10	20.20	19.30	15.50	12	19.50	20.00	20.80
	Atmospheric Pressure (mb)		1003.00	979.00	979.00	997.00	1003.00	1003.00	988.00	993	994.00	996.00	1000.00
LG4	Methane (% v/v)	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
	Carbon Dioxide (% v/v)	1.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.80
	Oxygen (% v/v)		20.80	21.00	20.80	20.10	19.90	20.30	20.10	20.1	19.60	20.10	18.50
	Atmospheric Pressure (mb)		1003.00	979.00	979.00	997.00	1003.00	1003.00	988.00	993	994.00	996.00	1000.00
LG5	Methane (% v/v)	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
	Carbon Dioxide (% v/v)	1.5	0.20	0.00	0.00	0.00	0.00	1.40	1.80	1.8	0.20	0.00	0.00
	Oxygen (% v/v)		20.50	21.00	20.60	19.80	20.10	17.60	15.50	15.5	19.00	18.50	20.10

Table A.3.2.1.x: All Stations, All Parameters for Landfill Gas Perimeter Monthly - AER Sample (Page: 2/5)

Sample Point --- Parameter --- MAC			28-Jan	19-Feb	25-Mar	28-Apr	31-May	24-Jun	21-Jul	26-Aug	10-Sep	27-Oct	30-Nov
			Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11
LG5	Atmospheric Pressure (mb)		1003.00	979.00	979.00	997.00	1003.00	1003.00	988.00	993	994.00	996.00	1000.00
LG6	Methane (% v/v)	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
	Carbon Dioxide (% v/v)	1.5	2.90	0.00	0.00	4.10	3.90	0.00	0.00	0	0.40	0.80	1.80
	Oxygen (% v/v)		12.20	21.30	20.80	11.10	12.40	20.50	20.10	20.1	19.00	17.50	12.00
	Atmospheric Pressure (mb)		1003.00	979.00	979.00	997.00	1003.00	1003.00	988.00	993	994.00	996.00	1000.00
LG7	Methane (% v/v)	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
	Carbon Dioxide (% v/v)	1.5	0.00	0.00	2.10	2.10	1.30	0.00	0.00	0.8	0.70	0.00	2.40
	Oxygen (% v/v)		20.70	21.20	20.60	17.60	18.40	20.40	19.80	19.1	18.20	19.50	10.00
	Atmospheric Pressure (mb)		1003.00	979.00	979.00	997.00	1003.00	1003.00	988.00	993	994.00	996.00	1000.00
LG8	Methane (% v/v)	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
	Carbon Dioxide (% v/v)	1.5	0.80	1.20	1.80	1.70	0.30	0.30	0.30	0	2.80	3.60	2.80
	Oxygen (% v/v)		19.60	19.00	19.00	17.00	19.40	19.80	20.10	20	14.90	11.00	10.50
	Atmospheric Pressure (mb)		1003.00	979.00	979.00	997.00	1003.00	1003.00	988.00	993	994.00	996.00	1000.00
LG9	Methane (% v/v)	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	1.20	0.00
	Carbon Dioxide (% v/v)	1.5	0.10	0.00	0.00	11.10	2.30	0.00	0.00	0	0.00	0.80	0.40
	Oxygen (% v/v)		20.90	20.80	20.80	2.80	13.90	20.30	19.00	19	19.30	12.50	20.00
	Atmospheric Pressure (mb)		1003.00	979.00	979.00	997.00	1003.00	1003.00	988.00	993	994.00	996.00	1000.00
LG9A	Methane (% v/v)	1	0.00	0.00	2.40	1.00	0.00	0.00	0.00	0	0.00	0.00	3.60
	Carbon Dioxide (% v/v)	1.5	2.40	2.00	1.80	1.70	0.10	0.20	0.00	1.2	5.80	2.80	2.40
	Oxygen (% v/v)		9.40	10.50	8.50	11.30	19.50	19.30	20.00	18.2	10.50	14.50	4.30
	Atmospheric Pressure (mb)		1003.00	979.00	979.00	997.00	1003.00	1003.00	988.00	993	994.00	996.00	1000.00
LG9B	Methane (% v/v)	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	1.30	2.40	0.00
	Carbon Dioxide (% v/v)	1.5	0.10	0.10	0.10	6.50	2.50	0.70	0.00	0	0.20	1.80	0.20
	Oxygen (% v/v)		21.40	21.40	21.40	10.10	15.90	19.70	19.80	20	18.40	13.50	20.50

Table A.3.2.1.x: All Stations, All Parameters for Landfill Gas Perimeter Monthly - AER Sample (Page: 3/5)

Sample Point --- Parameter --- MAC			28-Jan	19-Feb	25-Mar	28-Apr	31-May	24-Jun	21-Jul	26-Aug	10-Sep	27-Oct	30-Nov
			Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11
LG9B	Atmospheric Pressure (mb)		1003.00	979.00	979.00	997.00	1003.00	1003.00	988.00	993	994.00	996.00	1000.00
LG9C	Methane (% v/v)	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
	Carbon Dioxide (% v/v)	1.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
	Oxygen (% v/v)		16.90	21.00	21.00	19.40	12.80	11.20	15.50	18	18.20	20.10	15.90
	Atmospheric Pressure (mb)		1003.00	979.00	979.00	997.00	1003.00	1003.00	988.00	993	994.00	996.00	1000.00
LG10	Methane (% v/v)	1	14.50	14.50	12.80	23.90	14.00	14.10	12.80	15.5	0.00	5.80	0.00
	Carbon Dioxide (% v/v)	1.5	8.50	0.80	4.20	1.20	0.90	0.90	2.20	5	0.00	3.50	0.20
	Oxygen (% v/v)		2.10	14.20	9.00	0.20	0.80	0.40	2.50	1.8	18.90	5.50	20.40
	Atmospheric Pressure (mb)		1003.00	979.00	979.00	997.00	1003.00	1003.00	988.00	993	994.00	996.00	1000.00
LG10A	Methane (% v/v)	1	0.00	0.00	10.50	0.00	0.00	0.00	0.00	2.5	3.60	2.40	3.60
	Carbon Dioxide (% v/v)	1.5	1.60	0.40	3.50	0.00	0.00	3.20	2.80	1.8	4.60	1.80	4.60
	Oxygen (% v/v)		19.50	20.40	11.50	20.10	20.30	15.00	14.20	11.5	9.50	7.20	9.50
	Atmospheric Pressure (mb)		1003.00	979.00	979.00	997.00	1003.00	1003.00	988.00	993	994.00	996.00	1000.00
LG11A	Methane (% v/v)	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
	Carbon Dioxide (% v/v)	1.5	1.50	0.00	0.00	0.00	0.20	0.00	0.00	0	0.00	0.00	0.00
	Oxygen (% v/v)		12.00	21.00	20.60	19.50	19.80	20.40	19.50	20	19.50	20.10	20.80
	Atmospheric Pressure (mb)		1003.00	979.00	979.00	997.00	1003.00	1003.00	988.00	993	994.00	996.00	1000.00
LG11B	Methane (% v/v)	1	0.00	0.00	0.00	0.00			0.00				
	Carbon Dioxide (% v/v)	1.5	0.40	0.30	0.00	0.00							
	Oxygen (% v/v)		19.20	20.10	20.80	19.20							
	Atmospheric Pressure (mb)		1003.00	979.00	979.00	997.00	1003.00	1003.00	988.00	993	994.00	996.00	1000.00
LG12	Methane (% v/v)	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
	Carbon Dioxide (% v/v)	1.5	1.80	0.00	2.40	0.00	0.00	0.00	0.00	0.2	0.00	0.00	0.80
	Oxygen (% v/v)		15.70	21.30	16.00	20.30	19.90	20.50	20.10	19	19.40	20.00	18.50

Table A.3.2.1.x: All Stations, All Parameters for Landfill Gas Perimeter Monthly - AER Sample (Page: 4/5)

Sample Point --- Parameter --- MAC			28-Jan	19-Feb	25-Mar	28-Apr	31-May	24-Jun	21-Jul	26-Aug	10-Sep	27-Oct	30-Nov
			Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11
LG12	Atmospheric Pressure (mb)		1003.00	979.00	979.00	997.00	1003.00	1003.00	988.00	993	994.00	996.00	1000.00
LG13	Methane (% v/v)	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
	Carbon Dioxide (% v/v)	1.5	8.90	0.10	1.80	8.40	0.50	0.50	0.50	1	0.00	0.00	2.80
	Oxygen (% v/v)		8.40	21.20	17.00	7.90	19.10	20.00	20.10	16	19.40	20.00	15.50
	Atmospheric Pressure (mb)		1003.00	979.00	979.00	997.00	1003.00	1003.00	988.00	993	994.00	996.00	1000.00
LG14	Methane (% v/v)	1	0.00	0.00			0.00		0.00				
	Carbon Dioxide (% v/v)	1.5	0.00										
	Oxygen (% v/v)		0.00										
	Atmospheric Pressure (mb)		1003.00	979.00	979.00	997.00	1003.00	1003.00	988.00	993	994.00	996.00	1000.00
LG15	Methane (% v/v)	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
	Carbon Dioxide (% v/v)	1.5	3.10	0.10	1.50	1.20	0.00	0.00	0.00	0	0.00	2.50	1.80
	Oxygen (% v/v)		9.10	20.50	18.20	17.00	19.90	20.30	19.80	19.8	19.70	12.00	11.00
	Atmospheric Pressure (mb)		1003.00	979.00	979.00	997.00	1003.00	1003.00	988.00	993	994.00	996.00	1000.00
LG16	Methane (% v/v)	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
	Carbon Dioxide (% v/v)	1.5	1.60	0.30	1.20	2.30	0.00	0.00	0.00	1.2	0.00	0.00	1.20
	Oxygen (% v/v)		18.20	20.50	18.00	15.10	19.90	19.20	19.20	16.8	19.80	20.10	19.00
	Atmospheric Pressure (mb)		1003.00	979.00	979.00	997.00	1003.00	1003.00	988.00	993	994.00	996.00	1000.00
LG17	Methane (% v/v)	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
	Carbon Dioxide (% v/v)	1.5	4.30	0.00	0.00	1.80	0.00	0.00	0.80	0	0.00	0.00	0.00
	Oxygen (% v/v)		11.70	20.60	20.40	16.50	20.10	20.10	18.00	19	19.80	20.00	20.80
	Atmospheric Pressure (mb)		1003.00	979.00	979.00	997.00	1003.00	1003.00	988.00	993	994.00	996.00	1000.00
LG18	Methane (% v/v)	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
	Carbon Dioxide (% v/v)	1.5	0.00	0.00	0.50	0.00	0.00	0.00	0.50	0	0.20	1.80	1.80
	Oxygen (% v/v)		20.70	20.10	19.20	20.10	19.70	20.20	18.20	19	13.70	14.00	15.00

Table A.3.2.1.x: All Stations, All Parameters for Landfill Gas Perimeter Monthly - AER Sample (Page: 5/5)

Sample Point --- Parameter --- MAC			28-Jan	19-Feb	25-Mar	28-Apr	31-May	24-Jun	21-Jul	26-Aug	10-Sep	27-Oct	30-Nov
			Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11
LG18	Atmospheric Pressure (mb)		1003.00	979.00	979.00	997.00	1003.00	1003.00	988.00	993	994.00	996.00	1000.00

MAC: Maximum Allowed Concentration - (values exceeded are shaded in yellow)

The MAC for methane and carbon dioxide in landfill gas perimeter wells is set by the waste licence.

Occasions where the sampler was unable to record a measurement are indicated in a separate comments table.

South Dublin Co. Co.
County Hall, Tallaght, Dublin 24
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DESIGNED:	South Dublin Co. Co.
DATE:	23.2.11
JOB NUMBER:	DE08-054-04
FILE	C:\FTC\GasModel\Atown new model\CE0713003_Gas Model Rev_8.xls
SHEET	Audit Report

PROJECT: **Arthurstown Landfill - Gas Management Model**
DESCRIPTION: **Audit Report Sheet**

Ref.	*C:\FTC\GasModel\Atown new model\CE0713003_Gas Model Rev_8.xls*	Output

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Ref.	*C:\FTC\GasModel\Atown new model\CE0713003_Gas Model Rev_8.xls*	Output

1.0 Introduction and Purpose

1.1 This worksheet gives details of an internal audit of the landfill gas collection system.

1.2 The audit involved the measuring and recording of gas quality results, and flow and pressure throughout the system.

1.3 Over time, these results will give an insight into the overall performance of the system.

1.4 Various gas parameters have been set, and the readings are compared to these parameters.

1.5 The purpose of this report is to fulfill licence requirements for continuos monitoring and also to develop performance trends for the gas collection system.

Ref.	*C:\FTC\GasModel\Atown new model\CE0713003_Gas Model Rev_8.xls*	Output

2.0 Operational Criteria

2.1 Gas Parameters have been set to define target and trigger levels.

2.2 Target levels are the values that the site management is aiming to achieve, and trigger levels define the allowable variance.

Table 2.1

Gas Parameters	Target	Minimum Trigger Value	Maximum Trigger Value
Good Gas - Utilisation			
CH4 (v/v%)	50	42.5	57.5
CO2 (v/v%)	30	20	40
O2 (v/v%)	1	0.5	1.5
N2 (v/v%)	5	0	10
Bad Gas - Flaring			
CH4 (v/v%)	30	22.5	37.5
CO2 (v/v%)	40	30	20
O2 (v/v%)	8	7.5	8.5
N2 (v/v%)	20	15	10
Fire Monitoring			
CO (ppm)	2	0	4
Temperature (oC)	45	40	50
Perimeter Gas Wells			
CH4 (v/v%)	1	0	2
CO2 (v/v%)	1.5	0	3
Well Performance			
VOC (ppmv)	500	500	550
Dip (depth (m) below ground level)	-5	-5	-8
Cap Pressure			
Below Cap Pressure (mbarg)	-1	0	-2
Well Pressure d/s (mbarg)	-5	-1	-9
Cap Flow			
Gas Well Flow - Zone 1 (m3/hr)	100	20	180
Gas Well Flow - Zone 2 (m3/hr)	100	20	180
Gas Well Flow - Zone 3 (m3/hr)	100	20	180
Gas Well Flow - Zone 4 (m3/hr)	100	20	180
Gas Well Flow - Zone 5 (m3/hr)	100	20	180
Engine Flow			
Engine 1 Flow (m3/hr)	600	150	1,000
Engine 2 Flow (m3/hr)	800	200	1,000
Engine 3 Flow (m3/hr)	800	200	1,000
Engine 4 Flow (m3/hr)	800	200	1,000
Engine 5 Flow (m3/hr)	800	200	1,000
Engine 6 Flow (m3/hr)	800	250	1,000
Engine 7 Flow (m3/hr)	600	150	1,000
Engine 8 Flow (m3/hr)	600	150	1,000
Engine 9 Flow (m3/hr)	600	150	1,000
Engine 10 Flow (m3/hr)	600	150	1,000
Flare Flow			
Flare 1 Flow (m3/hr)	2,500	500	2,500
Flare 2 Flow (m3/hr)	2,500	500	2,500
Flare 3 Flow (m3/hr)	2,500	500	2,500
Flare 4 Flow (m3/hr)	2,500	500	2,500

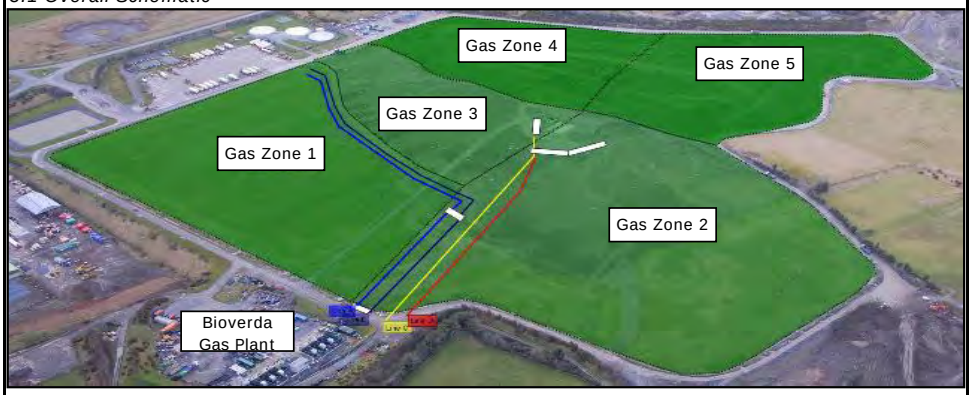
Ref.	C:\FTC\GasModel\Atown new model\CE0713003_Gas Model Rev_8.xls	Output

Gas Parameters	Target	Minimum Trigger Value	Maximum Trigger Value
Manifold 1			
M1 Flow	1,750	1,000	###
M1 CH4 (v/v%)	50	43	58
M1 CO2 (v/v%)	30	20	40
M1 O2 (v/v%)	1	1	2
Manifold 2			
M2 Flow	1,750	1,000	###
M2 CH4 (v/v%)	50	43	58
M2 CO2 (v/v%)	30	20	40
M2 O2 (v/v%)	1	1	2
Manifold 3			
M3 Flow	1,750	1,000	###
M2 CH3 (v/v%)	50	43	58
M3 CO2 (v/v%)	30	20	40
M3 O2 (v/v%)	1	1	2
Manifold 4			
M4 Flow	1,750	1,000	###
M4 CH4 (v/v%)	50	43	58
M4 CO2 (v/v%)	30	20	40
M4 O2 (v/v%)	1	1	2
Manifold 5			
M5 Flow	1,750	1,000	###
M5 CH4 (v/v%)	50	43	58
M5 CO2 (v/v%)	30	20	40
M5 O2 (v/v%)	1	1	2

Ref.	C:\FTC\GasModel\Atown new model\CE0713003_Gas Model Rev_8.xls	Output

3.0 Overview of Facility

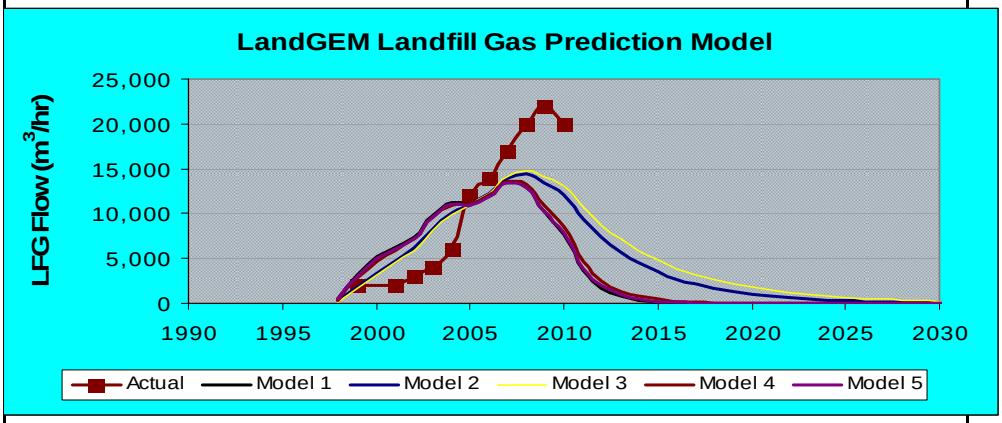
3.1 Overall Schematic



Gas Zones Overview	QA	QT	Wells	QA/Well	QT/Well	μΔP	σΔP	CH4	O2	CO2
Gas Zone 1	#N/A	1,870	39	#N/A	#N/A	2.9	2.1	45	3	26
Gas Zone 2	####	2,541	53	#####	#####	3.3	1.9	43	5	28
Gas Zone 3	####	1,918	40	#####	#####	2.8	1.7	43	6	27
Gas Zone 4	####	1,726	36	#####	#####	3.3	1.9	43	5	28
Gas Zone 5	#N/A	2,397	50	#N/A	#N/A	3.3	2.0	43	5	28
ion	#N/A	10,451	218	#N/A	#N/A	16		43	5	27
Units	*m3/hr*	*m3/hr*		*m3/hr*	*m3/hr*	*mb*	*mb*	*%v/v*	*%v/v*	*%v/v*

Manifold Flow Over Flow - Actual QA

Gas Zone 1	#N/A
Gas Zone 2	#VALUE!
Gas Zone 3	#VALUE!
Gas Zone 4	#VALUE!
Gas Zone 5	#N/A
Summation	#N/A
Units	m3/hr



Ref. C:\FTC\GasModel\Atown new model\CE0713003_Gas Model Rev_8.xls Output

§

4.0 Gas Results

4.1 Gas Zone 1

The following were the results recorded at the various locations:

Manifold

Target Units	Location	CH4 % v/v	O2 % v/v	CO2 % v/v	CO ppm	P d/s mbg	Flow m3/hr
101	M1-L1	#N/A	#N/A	#N/A	#N/A	0	#N/A
102	M1-L2	#N/A	#N/A	#N/A	#N/A	0	#N/A
103	M1-L3	#N/A	#N/A	#N/A	#N/A	0	#N/A
104	M1-L4	#N/A	#N/A	#N/A	#N/A	0	#N/A
105	M1-L5	#N/A	#N/A	#N/A	#N/A	0	#N/A
106	M1-L6	#N/A	#N/A	#N/A	#N/A	0	#N/A
107	M1-L7	#N/A	#N/A	#N/A	#N/A	0	#N/A
108	M1-L8	#N/A	#N/A	#N/A	#N/A	0	#N/A
109	M1-L9	#N/A	#N/A	#N/A	#N/A	0	#N/A
110	M1-L10	#N/A	#N/A	#N/A	#N/A	0	#N/A

Gas Wells

Target Units	Location	CH4 % v/v	O2 % v/v	CO2 % v/v	CO ppm	P d/s mbg	Flow m3/hr
1	113						Check Valve Throttling
2	115	0.00	19.20	0.60	0.00	-	Check Valve Throttling
3	117	0.00	20.30	0.10	####	-62	Check Valve Throttling
4	128	23.70	10.90	19.10	0.00	-10	Check Valve Throttling
5	131	53.60	1.70	41.00	0.00	-28	Check Valve Throttling
6	134						Check Valve Throttling
7	147	25.40	10.00	21.30	0.00	-50	Check Valve Throttling
8	148	58.00	0.00	42.30	0.00	-50	Check Valve Throttling
9	153	30.20	6.30	27.30	0.00	-50	Check Valve Throttling
10	157	51.60	3.50	36.90	0.00	-5	Check Valve Throttling
11	158	57.90	0.00	43.60	8.00	-5	Check Valve Throttling
12	161	53.00	3.70	39.50	0.00	-0.1	Check Valve Throttling
13	175						Check Valve Throttling
14	178	47.80	6.60	37.50	####	-38	Check Valve Throttling
15	181	0.00	20.50	0.10	####	-13	Check Valve Throttling
16	182	0.00	20.50	0.00	####	-35	Check Valve Throttling
17	192	14.80	14.10	11.80	####	-34	Check Valve Throttling
18	195	36.40	0.10	34.00	####	-38	Check Valve Throttling
19	197	55.20	0.00	42.50	0.00	-	Check Valve Throttling
20	199	54.10	0.40	40.90	2.00	-48	30

Ref.	C:\FTC\GasModel\Atown new model\CE0713003_Gas Model Rev_8.xls	Output

4.1 Gas Zone 1

§ The following were the results recorded at the various locations:

Gas Wells Continued

Target Units	Location	CH4 % v/v	O2 % v/v	CO2 % v/v	CO ppm	P d/s mbg	Flow m3/hr
21	216	8.30	16.60	6.80	85.00	-39	Check Valve
22	217	0.00	13.30	0.10	60.00	-22	Check Valve
23	218	40.70	10.20	17.60	213.00	-0.1	Throttling
24	220	36.70	4.70	28.90	56.00	-50	Check Valve
25	221	11.50	14.30	6.70	14.00	-0.1	Throttling
26	595						Check Valve
27	596	0.00	19.80	0.50	0.00	-	Throttling
28	597	24.90	9.90	20.40	10.00	-16	106
29	598	30.50	7.50	24.90	26.00	-17	Check Valve
30	599	25.00	9.80	20.60	46.00	-17	Throttling
31	600	51.10	2.80	39.50	1.00	-15	Check Valve
32	601	47.60	3.60	38.00	0.00	-15	Throttling
33	602	57.30	0.00	42.80	4.00	-15	Check Valve
34	603	44.30	4.00	35.30	0.00	-15	Throttling
35	604	48.70	3.80	37.50	0.00	-5	Check Valve
36	605	42.10	4.20	33.60	0.00	-10	Throttling
37	606	56.70	1.30	40.00	0.00	-10	Check Valve
38	607	59.40	0.00	40.70	0.00	-10	Throttling
39	608						Check Valve
							Throttling

Ref. C:\FTC\GasModel\Atown new model\CE0713003_Gas Model Rev_8.xls Output

4.2 Gas Zone 2

§ The following were the results recorded at the various locations:

Manifold

Target Units	Location	CH4 % v/v	O2 % v/v	CO2 % v/v	CO ppm	P d/s mbg	Flow m3/hr
101	M2-L6R	36.1	5	31.2	0	0	50
102	M2-L5R	29	8.5	23.5	32767	0	135
103	M2-L4R	0	20.1	0.1	32767	0	0
104	M2-L3R	50	4.2	36.9	32767	0	121
105	M2-L2R	50.4	3.8	36.8	0	0	33
106	M2-L1R	52	1.5	38.7	0	0	18
107	M2-250					0	#VALUE!
108	M2-L1L	48.2	4.5	35.2	0	0	84
109	M2-L2L	44.7	6.4	33.7	0	0	42
110	M2-L3L	58.6	0.3	42.1	0	0	43
111	M2-L4L	4.1	18	4.1	32767	0	0
112	M2-L5L	55.8	1	40.1	39	0	10
113	M2-L6L	37.1	5.6	29.3	12	0	46
114	M2-L7L	40.4	5	30.9	0	0	0
115	M2-L8L	32.7	5.8	27.3	0	0	372
116	M2-L9L	34.1	6.8	29.8	13	0	113
117	M2-MF					0	#VALUE!
118	0	#N/A	#N/A	#N/A	#N/A	0	0
119	0	#N/A	#N/A	#N/A	#N/A	0	0

Gas Wells

Target Units	Location	CH4 % v/v	O2 % v/v	CO2 % v/v	CO ppm	P d/s mbg	Flow m3/hr
1	506	23.4	7.5	22.6	####	-73	Check Valve
2	507	23.6	11.9	18.5	0.00	-	Check Valve
3	508						Check Valve
4	509	28.6	9	23.8	0.00	-62	Check Valve
5	510	53.4	2.3	38.8	12.00	-40	37
6	500	41.8	3.2	34.2	8.00	-66	Check Valve
7	501	60.6	0	42.3	262.00	-10	Check Valve
8	502	59.6	0	42.6	69.00	-	Check Valve
9	503	33.4	3.2	30.6	0.00	-7	Check Valve
10	504	11.1	15	8.5	0.00	-6	Check Valve
11	494	0	19.7	0.1	0.00	-	Check Valve
12	495	53.1	2.9	38.7	122.00	-2	62
13	496	57	0.4	41	18.00	-3	Check Valve
14	497	55	2.8	37	2.00	-3	Check Valve
15	498	59.2	0	42.2	40.00	-4	62
16	487						Check Valve
17	488	56	2	38.8	54.00	-68	Check Valve
18	489	57.8	0.9	40.7	32.00	-	Check Valve
19	490	55.2	2.7	37.6	0.00	-78	Check Valve
20	491	0	20.3	0.1	0.00	-	Check Valve
21	492	22.6	12.2	17.3	0.00	-72	Check Valve
22	362	37.5	6.1	29.6	0.00	-	Check Valve
23	363	27.6	10.1	21.5	0.00	-	Check Valve
24	364	35.9	14.3	24.7	0.00	-	Check Valve
25	365	56.3	1.6	42	10.00	-	Check Valve

Ref. C:\FTC\GasModel\Atown new model\CE0713003_Gas Model Rev_8.xls Output

4.2 Gas Zone 2

§ The following were the results recorded at the various locations:

Gas Wells Continued

Target Units	Location	CH4 % v/v	O2 % v/v	CO2 % v/v	CO ppm	P d/s mbg	Flow m3/hr
26	366	17.3	13.4	14	0.00	-	Check Valve
27	369	43.1	4.4	32.8	0.00	-A	Check Valve
28	371	0	20.3	0	0.00	-27	Check Valve
29	372	0	20.3	0	####	-38	Check Valve
30	376	0	20.4	0.1	0.00	-	Check Valve
31	393	0	19.9	0.1	0.00	-	Check Valve
32	396	58.4	4.8	41.6	0.00	-6	Check Valve
33	413	0	20.2	0	0.00	-24	Check Valve
34	415	55.3	0.8	40.5	0.00	-20	Check Valve
35	427	51.7	3	38.7	0.00	-51	Check Valve
36	428	25.6	12.1	20.3	0.00	-52	Check Valve
37	431	0	20.3	0	0.00	-	Check Valve
38	432	0	20.2	0.1	0.00	-50	Check Valve
39	452	0	20.2	0	####	-	Check Valve
40	455	22.7	11.5	18.3	0.00	-50	Check Valve
41	481						Check Valve
42	482						Check Valve
43	483						Check Valve
44	476	54.5	1.7	40.8	58.00	-50	Check Valve
45	477	55	1.4	39.6	55.00	-48	Check Valve
46	478	57.8	0	42.6	37.00	-48	Check Valve
47	479						Check Valve
48	470	0	20.7	0	####	-50	Check Valve
49	471	46.2	3.3	34.9	0.00	-51	Check Valve
50	472	35	5.9	28	0.00	-50	Check Valve
51	473	47.7	4.1	36.5	0.00	-50	Check Valve
52	474	57.8	0.5	41.2	0.00	-50	Check Valve

Ref.	C:\FTC\GasModel\Atown new model\CE0713003_Gas Model Rev_8.xls	Output

4.3 Gas Zone 3

§ The following were the results recorded at the various locations:

Manifold

Target Units	Location	CH4 % v/v	O2 % v/v	CO2 % v/v	CO ppm	P d/s mbg	Flow m3/hr
101	M3-L1	23	9.2	20.1	15	0	110
102	M3-L2	9.7	16.7	8.6	18	0	5
103	M3-L3	32.8	4.7	28.2	18	0	249
104	M3-L4					0	#VALUE!

Gas Wells

Target Units	Location	CH4 % v/v	O2 % v/v	CO2 % v/v	CO ppm	P d/s mbg	Flow m3/hr
1	550	0	20	0.1	0	-69	27
2	551	0	20.3	0	0	-71	27
3	554	0	20.4	0.1	0	-70	Check Valve Throttling
4	555	1.4	20.1	0.7	32767	-70	-23
5	556	0	20.7	0	0	-70	Check Valve Throttling
6	557	19.9	12.6	17.4	0	-70	27
7	559	20.8	9.8	19.4	0	-69	Check Valve Throttling
8	560	0	20.8	0	0	-	Check Valve Throttling
9	561						Check Valve Throttling
10	562	0	20.9	0.1	0	-	Check Valve Throttling
11	563	0	20.8	0.1	0	-	Check Valve Throttling
12	564	0	20.9	0.1	0	-	Check Valve Throttling
13	565	18.1	11.9	20.6	0	-35	Check Valve Throttling
14	566	0	20.5	0.4	0	0.1	-38
15	567	17.5	11.4	15.5	0	-29	27
16	568						Check Valve Throttling
17	569						Check Valve Throttling
18	570	0.6	19.8	0.9	0	-54	Check Valve Throttling
19	571	47.5	0.6	39.2	5	-53	27
20	572	46.5	0.4	37.4	0	-52	2
21	573	15.7	14.6	11.4	0	-40	Check Valve Throttling
22	574	0	20.5	0.2	0	-35	27
23	575	6.9	17.5	6.1	0	-34	Check Valve Throttling
24	576	59.2	0	42	0	-32	Check Valve Throttling
25	577	59.6	0	41.8	0	-22	Check Valve Throttling

Ref.	C:\FTC\GasModel\Atown new model\CE0713003_Gas Model Rev_8.xls	Output

4.3 Gas Zone 3

§ The following were the results recorded at the various locations:

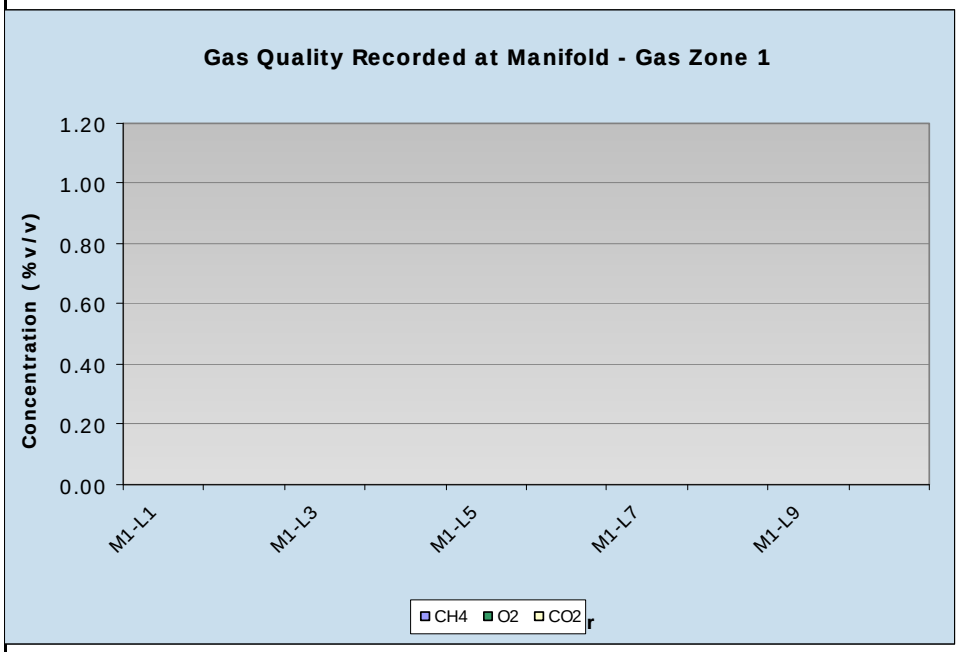
Gas Wells Continued

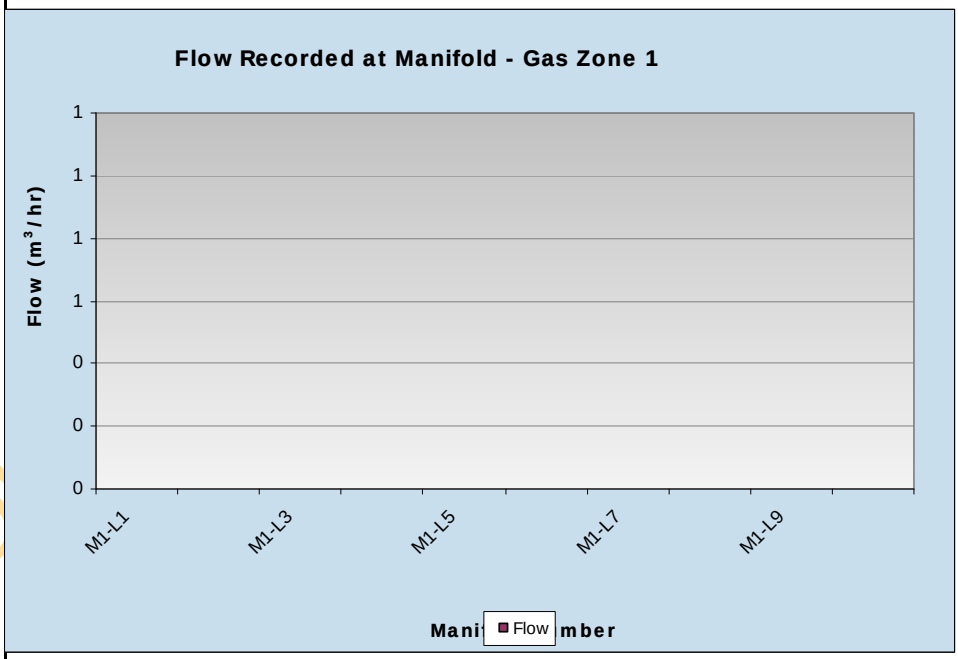
Target Units	Location	CH4 % v/v	O2 % v/v	CO2 % v/v	CO ppm	P d/s mbg	Flow m3/hr
26	578	23.4	8.5	20.4	0	-32	Check Valve Throttling
27	579	8.9	14.9	8.7	0	-32	Check Valve Throttling
28	580	0	20.4	0.3	32767	-32	-48
29	582						Check Valve Throttling
30	583	49.6	5.3	34.4	26	-20	27
31	584	60	0	41.8	7	-21	Check Valve Throttling
32	585	59.4	0.5	43.1	42	-20	27
33	586						Check Valve Throttling
34	587	33.7	7.6	26.5	0	-20	Check Valve Throttling
35	588	59.3	0	41.9	0	-19	2
36	589	48.7	2.8	36.9	3	-20	Check Valve Throttling
37	590						Check Valve Throttling
38	591	58.3	0.5	41.4	83	-29	Check Valve Throttling
39	592						Check Valve Throttling
40	593	23.3	11.6	17.9	0	-30	Check Valve Throttling

Ref.	C:\FTC\GasModel\Atown new model\CE0713003_Gas Model Rev_8.xls	Output

4.5 Trends Analysis - Gas Zone 1

Manifold

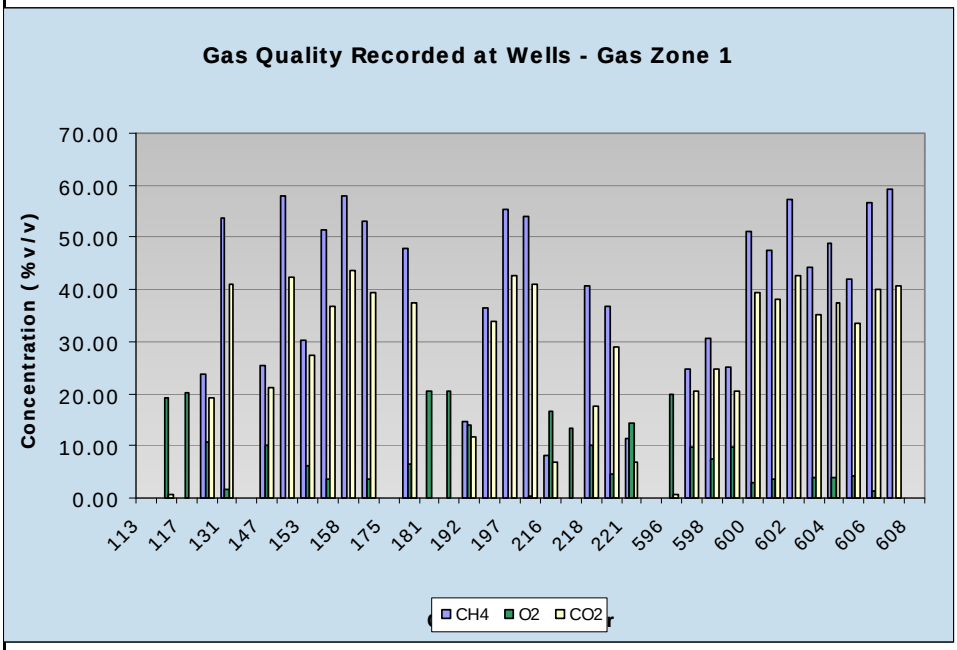


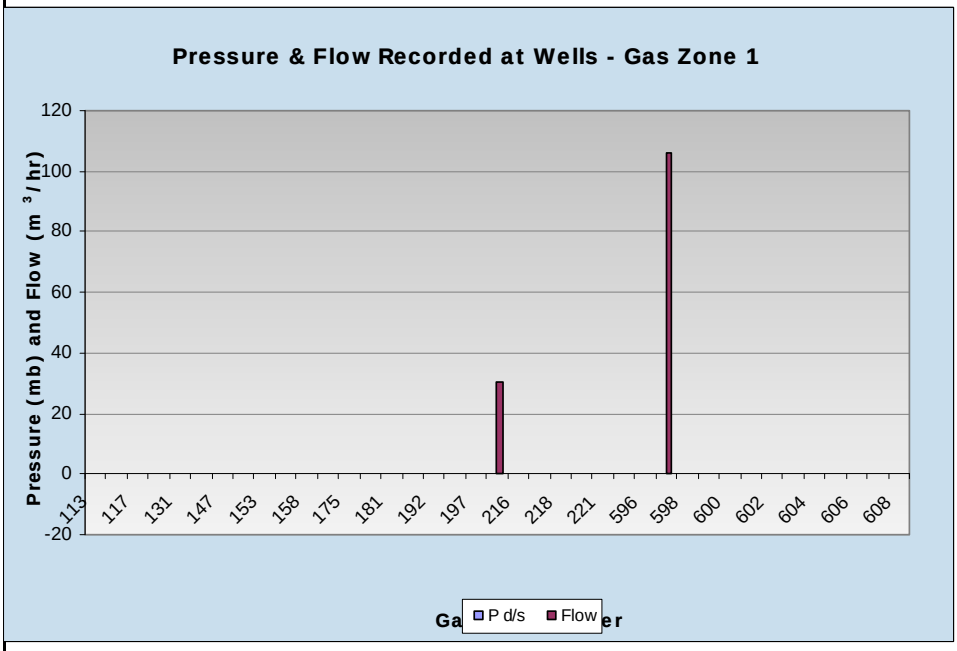


Ref.	C:\FTC\GasModel\Atown new model\CE0713003_Gas Model Rev_8.xls	Output

4.5 Trends Analysis - Gas Zone 1

Gas Wells

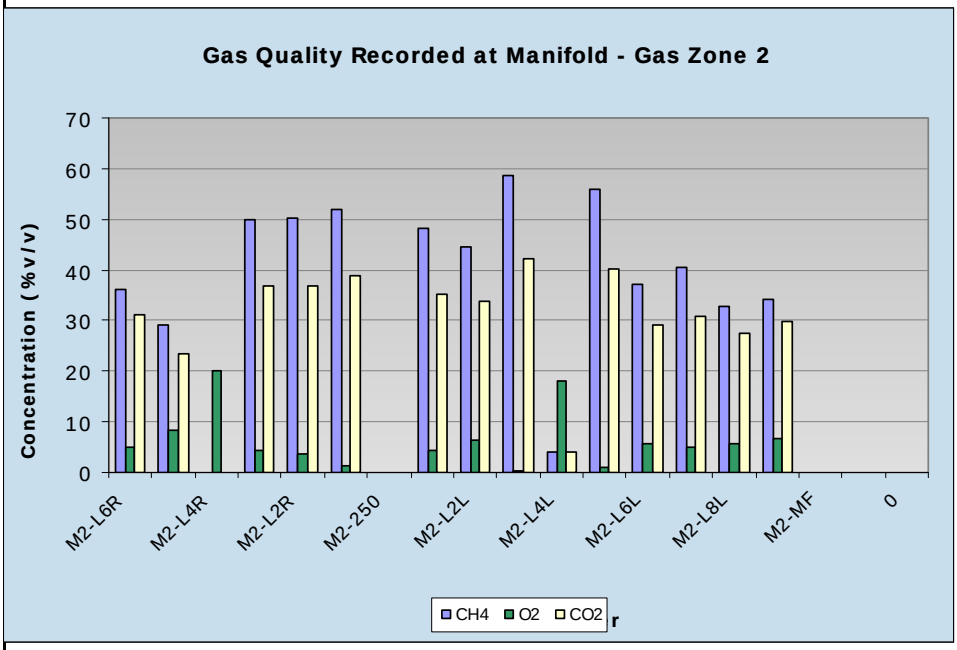


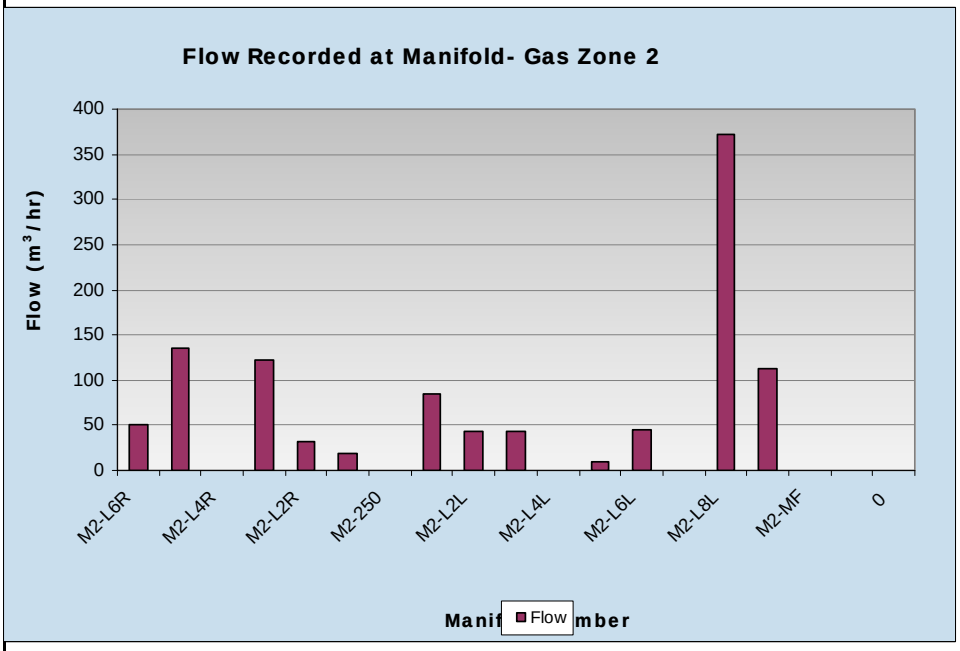


Ref.	C:\FTC\GasModel\Atown new model\CE0713003_Gas Model Rev_8.xls	Output

4.6 Trends Analysis - Gas Zone 2

Manifold

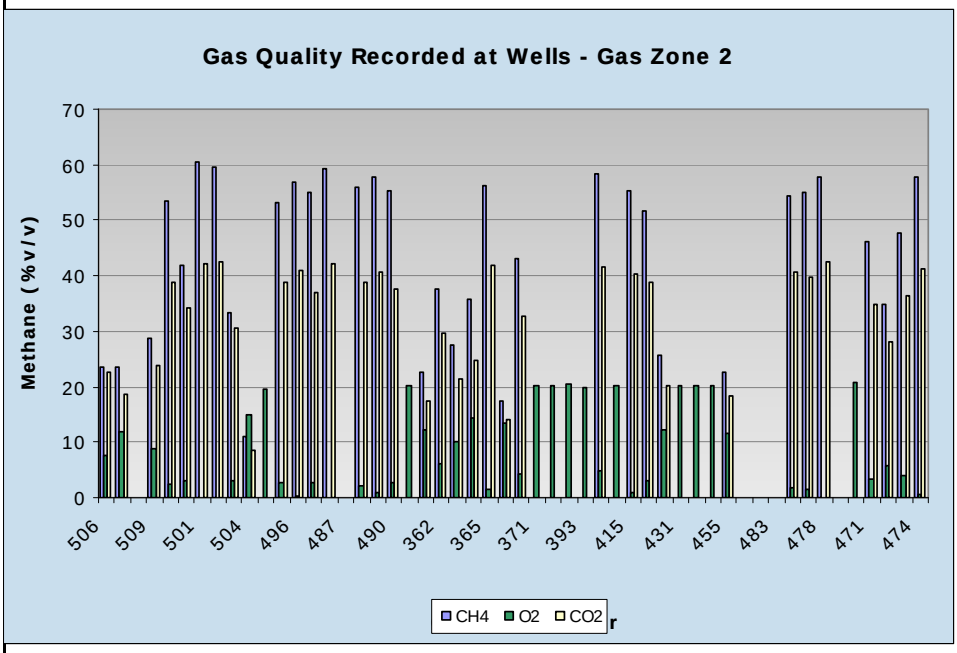


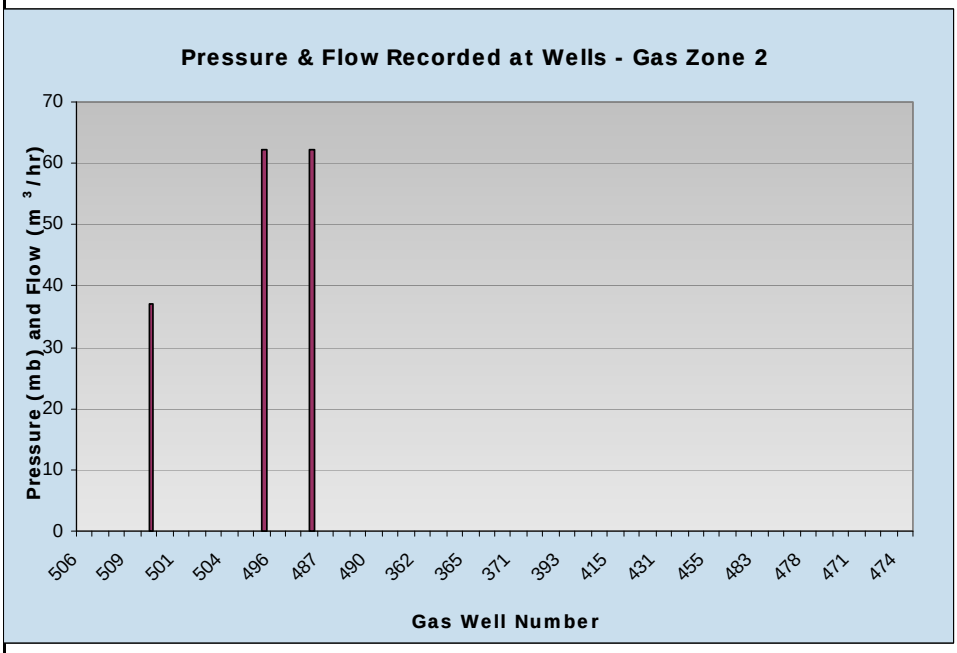


Ref.	C:\FTC\GasModel\Atown new model\CE0713003_Gas Model Rev_8.xls	Output

4.6 Trends Analysis - Gas Zone 2

Gas Wells

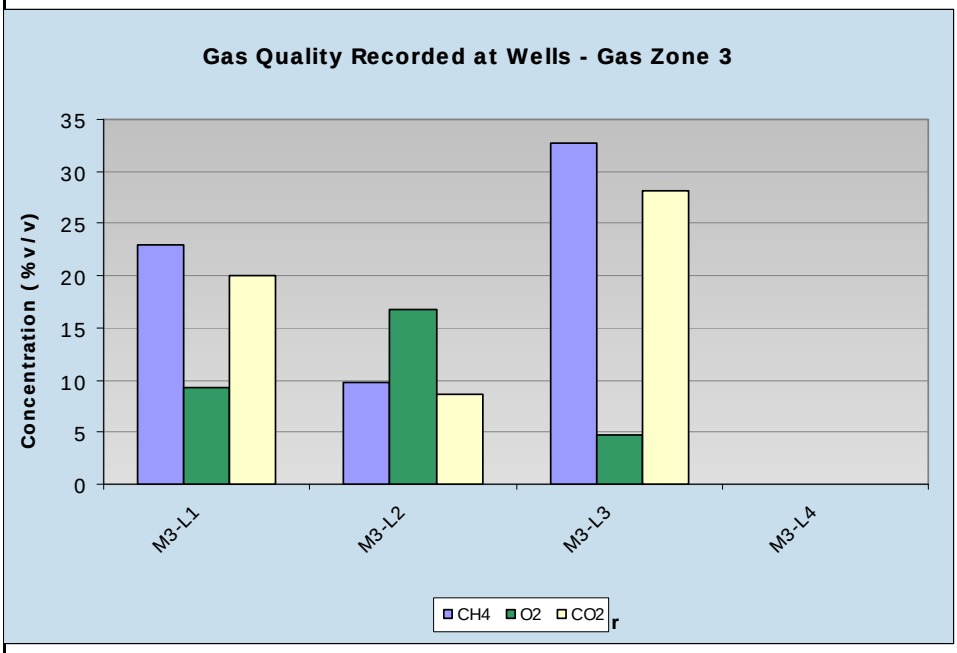


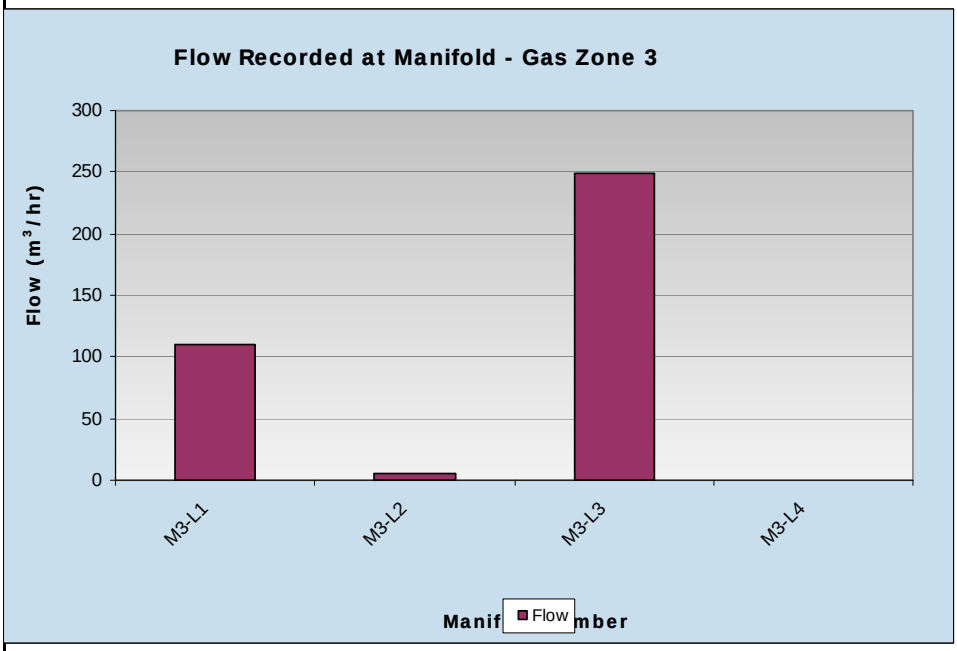


Ref.	C:\FTC\GasModel\Atown new model\CE0713003_Gas Model Rev_8.xls	Output

4.7 Trends Analysis - Gas Zone 3

Manifold

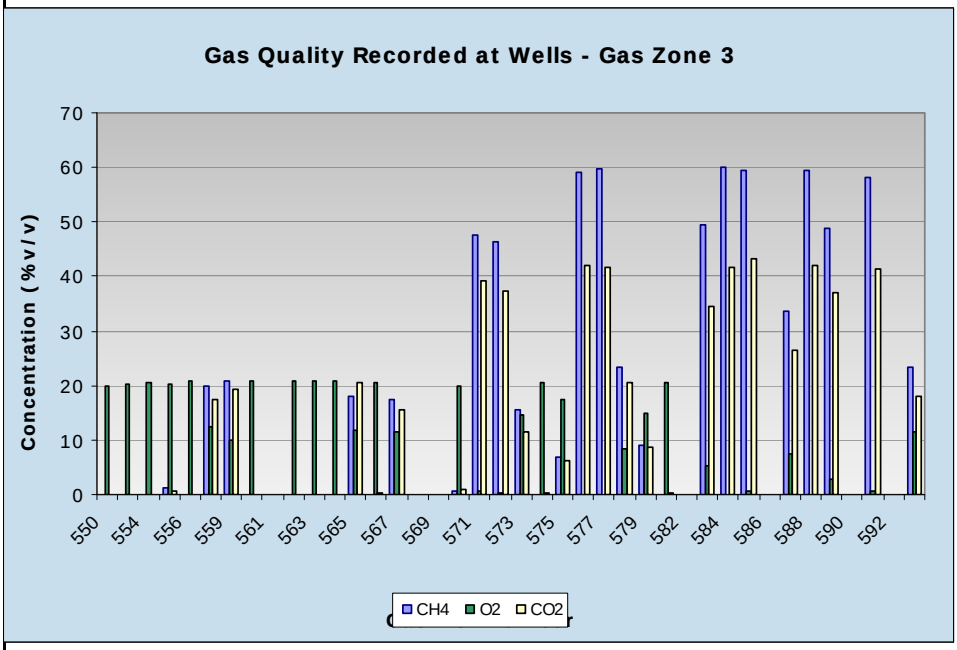


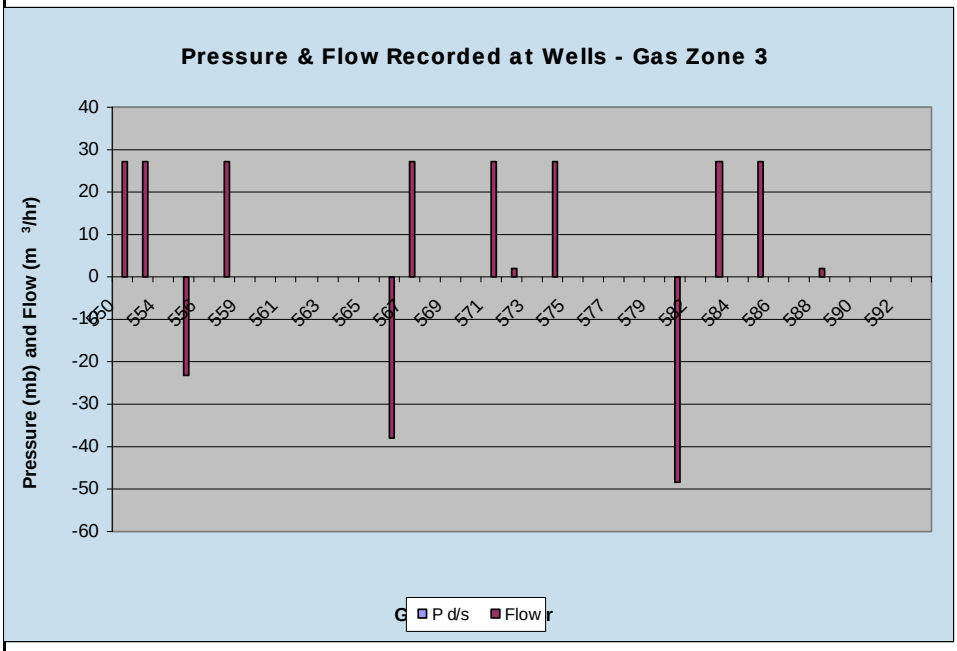


Ref.	C:\FTC\GasModel\Atown new model\CE0713003_Gas Model Rev_8.xls	Output

4.7 Trends Analysis - Gas Zone 3

Gas Wells





Ref.	C:\FTC\GasModel\Atown new model\CE0713003_Gas Model Rev_8.xls	Output

4.10 Non-Compliances

Target Units	on	CH4 % v/v	O2 % v/v	CO2 % v/v	CO ppm	P d/s mbg	Flow m3/hr
1	700	50	1	27	1	2	2.5
2	701	49	2	30	3	1	11.8
3	702	48	3	29	2	0	62.2
4	703	47	7	28	1	2	37.0
5	704	46	8	27	3	2	11.5
6	705	45	9	26	2	1	11.8
7	706	44	8	25	1	0	62.2
8	707	43	5	27	2	2	37.0
9	708	42	8	30	3	1	87.3
10	709	41	6	29	1	0	87.3
11	710	40	6	28	3	2	87.3
12	711	39	8	27	2	2	112.5
13	712	38	5	26	3	1	112.5
14	713	37	4	25	1	0	37.0
15	714	36	8	27	2	2	11.5
16	715	44	2	30	3	2	11.8
17	716	46	3	29	1	1	62.2
18	717	45	1	28	2	0	112.5
19	718	44	1	27	3	2	37.0
20	719	49	2	26	1	2	87.3
21	720	42	5	25	2	1	137.7
22	721	42	8	27	3	0	87.3
23	722	41	8	30	1	2	2.5
24	723	40	5	29	2	1	11.8
25	724	46	1	28	1	1	37.0

APPENDIX 3.3

Dust Charts and Tables

Table A.3.3.x: All Stations, All Parameters for Dust - AER Sample (Page: 1/1)

Sample Type: Dust, Year: 2010

Sample Point --- Parameter --- MAC			30-Mar 1st event	18-May 2nd event	10-Aug 3rd event
D1	Dust Deposition (mg/m2/day)	350	125.00	98.00	108.00
D2	Dust Deposition (mg/m2/day)	350	189.00	69.00	106.00
D3	Dust Deposition (mg/m2/day)	350	194.00	275.00	195.00
D4	Dust Deposition (mg/m2/day)	350	124.00	193.00	205.00
D5	Dust Deposition (mg/m2/day)	350	210.00	270.00	245.00
D6	Dust Deposition (mg/m2/day)	350	110.00	105.00	105.00

MAC: Maximum Allowed Concentration - (values exceeded are shaded in yellow)

The MAC for dust is set by the waste licence.

Occasions where the sampler was unable to record a measurement are indicated in a separate comments table.

Results marked with '<' indicate that it is below the level of detection of the measuring instrument. The levels of detection used may have varied over time depending on the lab or the method of detection used.

APPENDIX 3.4

Noise Charts and Tables

ANNUAL NOISE MONITORING REPORT 2010

ARTHURSTOWN LANDFILL
KILL, CO. KILDARE

LICENCE REGISTER NO. W0004-4

February 2011

ANNUAL NOISE MONITORING REPORT 2010

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Abstract: South Dublin County Council operates Arthurstown Landfill in Kill, Co. Kildare under EPA Waste Licence Reg. No. W0004-03. The waste licence requires that bi-annual noise monitoring is undertaken at 7 no. locations at the site boundary to demonstrate that the facility is complying with the conditions of the licence with regard to noise emissions. Fehily Timoney & Company was retained to carry out one round of noise monitoring and report on the results for the year 2010.

This report details the results of one round of both daytime and night-time noise monitoring carried out at the Arthurstown Landfill during December 2010. The results of the 2009 survey indicate that there has been no significant change in the noise environment at the site when compared with the noise survey results in previous years.

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1. INTRODUCTION

Fehily Timoney & Company (FTC) was commissioned by South Dublin County Council (SDCC) to conduct a singe round of noise monitoring at Arthurstown Landfill, Kill, Co. Kildare in 2010 and report on the results. This survey was carried out in part keeping with the noise monitoring requirements of the waste licence (W0004-4) for the facility as outlined in Schedule D of the licence.

The noise monitoring requirements of the waste licence (as per Table D.4.1) are shown in Table 1.1 below.

Table **1-1**: Noise Requirements Waste License

Parameter	Monitoring Frequency	Analysis Method/Techniques
L_{Aeq} [30 minutes]	Bi-annually	Standard Note 1
L_{A90} [30 minutes]	Bi-annually	Standard Note 1
L_{A10} [30 minutes]	Bi-annually	Standard Note 1
Frequency Analysis (1/3 octave band analysis)	Bi-annually	Standard Note 1

Note 1: International Standards Organisation. ISO 1996.Acoustics – Description & Measurement of Environmental Noise. Parts 1, 2, 3.

This report outlines the methodology employed for the survey and describes the noise environment in the region of Arthurstown Landfill facility at the 7 no. locations requested in the waste licence,. It also provides a comparison with noise monitoring results from previous years.

2. NOISE MONITORING

2.1. Equipment and Measurement Conditions

In part compliance with Schedule D of the waste licence a single round of day and night-time noise monitoring was carried out at the facility during December 2010 when the weather conditions were found to be suitable. The single round of monitoring was undertaken on the 15th December 2010. The noise survey was undertaken at the seven locations outlined in Table D.1.1 of the waste licence (W0004-4) for the site and illustrated on Drawing DE08-054-07_001Rev A, included in Appendix 1.

The noise survey was carried out during the day between the hours of 08:00 and 18:00 for 30 minute intervals at each location. Night-time noise monitoring was carried out between the hours of 22:00 and 08:00 for 15 minute intervals at each location. All measurements were taken in accordance with ISO 1996 (Description and Measurement of Environmental Noise) and the EPA Guidance Note for Noise In Relation To Scheduled Activities, 2nd Edition', (EPA, 2006).

The monitoring was carried out using a Brüel and Kjær 2260 Type 1 Sound Level Meter (SLM)[1] with an outdoor microphone unit Type 4189[2]. The instrument was calibrated prior to commencing the survey using the recommended calibration procedure and a known pure tone noise source (Brüel and Kjær Type 4231[3]). The unit was again calibrated on completion of the survey to record drift during the course of the measurements. Drift is normally associated with battery fade and temperature. The unit had not drifted.

Good measurements require calm conditions to avoid spurious effects on the microphone, particularly at low frequencies. An average wind speed of less than 5 m/s is the preferred limit when noise measurements are being taken, with an upper limit of 7 m/s. Weather conditions during the noise survey were extremely cold but dry and calm and wind speed was observed to be less than 7 m/s for all monitoring periods. Snow and ice were prevalent on-site.

2.2. Measurement Units and Standards

The unit of sound pressure level is the decibel (dB). This is calculated as a logarithm of sound. A change of 10 dB corresponds approximately to halving or doubling the loudness of sound. The use of decibels (A-weighted), dB(A), as the basic unit for general environmental and traffic noise, is widely accepted. Decibels measured on a sound level meter incorporating this frequency weighting differentiates between sounds of different frequencies in a manner similar to the human ear. That is, measurements in dB(A) broadly agree with human beings assessment of loudness. It has been demonstrated that noise levels in dB(A) from a wide range of sources adequately represent loudness.

In order to understand the terms used below, some definitions of the terms used are outlined as follows:

L_{A10} Refers to those noise levels in the top 10th percentile of the sampling period; it is the level which is exceeded for 10% of the measurement period. It is used to determine the intermittent high noise level features of locally generated noise and usually gives an indicator of the level of traffic.

L_{A90} Refers to those noise levels in the lower 90th percentile of the sampling interval; it is the level which is exceeded for 90% of the measurement period. It will therefore exclude the intermittent features of traffic and is used to estimate a background level.

L_{Aeq} The average level recorded over the sampling period. The closer the L_{Aeq} value is to either the L_{A10} or L_{A90} value indicates the relative impact of the intermittent sources and their contribution. The relative spread between the values determines the impact of intermittent sources such as traffic on the background.

L_{Ar} The equivalent continuous A-weighted sound pressure level (L_{AQ}) with specified adjustments/ rating allowance for tonal character and/or impulsiveness of the sound. Only permitted during daytime hours. A Rating Allowance is not permitted to be applied to night-time measurements.

[1] Sound Level Meter - s/n 2168472; Calibration Certificate No. C1005587
[2] Outdoor Microphone - s/n 2625261; Calibration Certificate No. C105587
[3] Calibrator - s/n 2169963; Calibration Certificate No. C1005538

Impulsive noise: a noise of short duration (typically less than one second), the sound pressure level of which is significantly higher than the background.

Tonal noise: A noise source that is concentrated in a narrow band of the frequency spectrum.

2.3. Monitoring Locations

Monitoring was conducted at seven monitoring locations along the site boundary as required under the waste licence for the facility. Noise monitoring locations are shown in Appendix 1 and summarised in Table 2.1.

Table 2-1: Noise Monitoring Locations

Monitoring Location	Description
N1A	Situated to the rear of the site office buildings which is close to the northwest boundary of the site
N2	Situated adjacent to the site boundary to the north of the site and is located close to the leachate treatment plant
N3	Situated adjacent to the northern boundary of the site adjacent to Cell 15
N4	Situated to the south east of the site close to Cell 10
N5	Situated to the west of the site adjacent to the landfill gas flare compound
N6	Situated to the west of the site adjacent to the surface water retention pond
N9 Note 1	Situated on the northern boundary of the site between monitoring points N2 and N3

Note 1 Referred to as "New N7" in Table D.1.1 of the Waste Licence. This monitoring point is located between N2 and N3.

3. DAYTIME NOISE RESULTS

Table 3-1: Daytime Noise Monitoring 15th December 2010

Location	Date	Time	Penalty	$L_{Aeq,30\ mins}$	$L_{Ar,30\ mins}$	$L_{A90,30\ mins}$	$L_{A10,30\ mins}$	Comments
N1A	2010 Dec 15	09:22:13	0	**57**	-	52	59	Very cold and still conditions were observed during monitoring. The dominant noise during the monitoring period consisted of a-typical activity in the yard as morning operations begin. A road sweeper was also cleaning snow from the site entrance and a tanker was loading up in the yard, with its engine in idle. Reversing beacons could be heard from the site. Background noise levels consisted of a distant house or car alarm and birdsong. Distant off-site traffic movements also contributed to background noise levels.
N2	2010 Dec 15	13.05.01	0	**64**	-	40	66	Very cold and still conditions were observed during monitoring. The dominant noise during the monitoring period consists of distant off-site traffic movements. 15 no. vehicles passed the noise meter on-site during the monitoring period. 2 no. trucks emptied stone adjacent to the monitoring location. Additionally a tanker was loading in the marshalling yard with its engine in idle during monitoring.
N3	2010 Dec 15	11:53:56	0	**58**	-	46	56	Very cold and still conditions were observed during monitoring. The dominant noise at this location was the sound of distant off-site traffic movements. A number of site vehicles (7 no.) were recorded directly passing the noise meter during the monitoring period. Background noise consists of some intermittent reverse beacons on the cap and some engine sounds. Birdsong also contributed to background noise levels.
N4	2010 Dec 15	11:16:20	0	**60**	-	41	58	Very cold and still conditions were observed during monitoring. The dominant noise at this location was the sound of distant traffic movement off-site. A passing site vehicle and a hi-mac engine on-site also contribute to the dominant noise environment. Background noise consists of birdsong and flowing water sounds.
N5	2010 Dec 15	10:39:33	0	**63**	-	61	64	Very cold and still conditions were observed during monitoring. The dominant noise at this location was the landfill gas flares and engines on-site and the sound of engines or fans from the adjacent Balcas Ltd. site. Intermittent reversing beacons and loud metallic bangs in the Balcas Ltd. yard were also recorded. Movements of an on-site road sweeper also contributed to the dominant noise.
N6	2010 Dec 15	09:58:34	+5	56	**61**	54	57	Very cold and still conditions were observed during monitoring. The dominant noise during the monitoring period consisted of deliveries to site and vehicle movement in the marshalling yard. A road sweeper was recorded clearing snow and a truck was sitting in Balcas Ltd. yard, adjacent to the Arthurstown facility with its engine in idle during the monitoring period. Background noise levels consisted of birdsong, distant off-site traffic movements and intermittent on-site reverse beacons. Some engines or fans were heard in Balcas Ltd. during monitoring.
N9	2010 Dec 15	12:31:35	0	**56**	-	40	51	Very cold and still conditions were observed during monitoring. The dominant noise environment consisted of distant off-site traffic movement sounds and vehicle movement on the landfill cap. 2 no. site vehicles passed the noise meter during the monitoring period. Background noise consisted of birdsong and intermittent reversing beacons from the cap.

3.1. Assessment of Tonal Components

All noise measurements were subject to a one-third octave band analysis to identify potential tonal components within the noise measured. The results of this analysis are presented in Appendix 2. On analysis tonal components were noted in the noise recorded at N6.

At location N6 the tonal component was recorded at 100 Hz. This is a relatively low frequency and the tonal component was not clearly noticeable or audible to the observer on site during the monitoring period. Taking a conservative approach, in accordance to the guidelines issued by the EPA in the 'Guidance Note for Noise In Relation To Scheduled Activities, 2nd Edition', (2006) a 5 dB penalty has been applied to the recorded L_{Aeq} at the location where the tonal component was identified in the one-third octave analysis to generate a $L_{Ar,30\ minute}$ value.

3.2. Interpretation of Results

Noise emission limits are given in Table C.1 of the waste licence and are reproduced here in Table 3.1.

Table 3-2: Noise Emission Limits

Day dB L_{Aeq}	Night dB L_{Aeq}
55	45

During daytime monitoring, the noise levels recorded at all locations were over the L_{Aeq} emission limit of 55 dB.

N1A and N4 are the two furthest from the active area of the landfill. The locations N2, N3 and N9 are located adjacent to the current active area of the site and are thus not considered representative of the overall noise emissions from the site. Rather they represent a concentration of the loudest emissions from vehicle movements at the active area. Locations N5 and N6 are located adjacent to the Balcas facility on the western boundary of the landfill site and thus are also subject to noise emissions from that facility.

L_{Aeq} noise levels range from 56 – 64 dB during the daytime survey. Background levels recorded, represented by the L_{A90} levels, were in the range from 40 - 61 dB. With the exception of N5 (with a L_{A90} = 61 dB) all L_{A90} levels were under 55 dB.

The correlation between the L_{A90} and the L_{Aeq} levels suggest that noise occurring for 10% of the survey period most influenced the L_{Aeq} levels. Typically L_{A10} levels are associated with traffic movements and for the site would also include the arrival and departure of vehicles depositing in the marshalling yard.

The survey recorded some of the highest noise levels along the eastern boundary of the site at N5 & N6, adjacent to the landfill gas flares and engines. Background (L_{A90}) noise levels at these locations were also high (N5 = 61 dB and N6 = 54 dB). The noise results for N5 & N6 support the observations on-site that this area is influenced by the noise emissions from the adjacent Balcas facility, as well as noise from the landfill engines and flares which are located in this area.

The daytime noise survey recorded high noise levels in the area of locations N2, N3 and N9 with L_{Aeq} levels in the range from 60 – 66 dB. The dominant noise source around N2, N3 and N9 was from distant traffic movements and from site activity. Background levels in this area were below 55 dB, as evidenced by L_{A90} levels ranging from 45 – 54 dB. The L_{A10} levels suggests that the dominant noise source, i.e. the arrival and departure of vehicles depositing at the marshalling yard and the vehicles placing waste in the area, is responsible for the high noise levels. These noise locations are not representative of the overall noise emissions from the site. There are no noise-sensitive locations along this part of the site boundary.

The noise levels at N1A represent the noise in the area of the site entrance and site offices. The L_{A90} recorded at this location was under the 55 dB level. The noise levels at N4 represent the noise to the rear of the site. Noise levels at both locations, N1A and N4 indicate low background levels but the L_{A10} levels have influenced the L_{Aeq} levels, resulting in levels over the 55 dB.

4. NIGHT-TIME NOISE RESULTS

Table 4-1: Night-time Noise Measurements 15th December 2010

Location	Date	Time	$L_{Aeq, 15\ mins}$	$L_{A10, 15\ mins}$	$L_{A90, 15\ mins}$	Comments
N1A	2010 Dec 15	05:07:45	43	41	45	Very cold and still conditions were observed during monitoring. The dominant noise at the monitoring location was from traffic movements outside the site.
N2	2010 Dec 15	07:37:38	**56**	47	54	Very cold and still conditions were observed during monitoring. The dominant noise during monitoring was from traffic movements outside the site. Some site vehicle movement, passing the monitoring location also contributed to noise levels as preparation activity on-site started up early due to snow and frost conditions. Background noise consists of a very faint hum from the electrical lights in the yard audible in the very cold, still conditions.
N3	2010 Dec 15	06:57:42	42	38	42	Very cold and still conditions were observed during monitoring. The dominant noise recorded during the monitoring period was traffic movements outside the site. A single overhead plane was also recorded during the monitoring period. Background noise levels consisted of early morning birdsong.
N4	2010 Dec 15	06:30:24	**45**	43	46	Very cold and still conditions were observed during monitoring. The dominant noise recorded during the monitoring period was traffic movements outside the site.
N5	2010 Dec 15	06:00:41	**54**	53	54	Very cold and still conditions were observed during monitoring. The dominant noise observed during monitoring was from the landfill gas flares and engines on-site and engine sounds from Balcas Ltd. . In the background traffic movement sounds outside the site could be heard along with some noise from lagoon pumps from site.
N6	2010 Dec 15	05:39:10	**48**	47	49	Very cold and still conditions were observed during monitoring. Background noise consisted of distant traffic movement sounds outside the site and distant sound of engines or lagoon pumps from site. Some engine sounds from Balcas Ltd. were also observed.
N9	2010 Dec 15	07:20:09	**46**	41	49	Very cold and still conditions were observed during monitoring. Background noise consists of distant traffic movement outside the site and intermittent birdsong. One overhead plane was recorded during the monitoring period. Site activity started at 07.30 due to snow and frosty conditions (additional preparation required for daily work).

4.1. Assessment of Tonal Components

During the night time survey no tonal or impulsive noises were noticeable or audible based on a subjective assessment by the observer. However all measurements were subject to a one-third octave band analysis to identify potential tonal components within the measured results. The results of this analysis are presented in Appendix 2. The analysis showed that there was a tonal component to the noise recorded at N1A, N2, N3 and N6.

At location N1A, a tonal component was recorded at a frequency of 250 Hz; at N2 the tonal component was recorded at a frequency of 1.2 kHz; at N3 the tonal component was recorded at a frequency of 40 Hz; at N6 a tonal component was recorded at a frequency of 250 Hz. The tonal components at N1A, N3 and N6 were all at a low frequency and not clearly noticeable or audible by the observer during monitoring. Low frequency sound waves have the potential to travel over long distances before they are attenuated, especially under cold conditions. The cold conditions present the potential for temperature inversion enabling low frequency sound waves to travel even further. It is therefore likely tonal elements originated from an off-site noise source.

While the low frequency tonal component was not clearly noticeable or audible to the observer at N2 during the monitoring period, it is a possibility the source was as a result of the atypical start up of the site equipment in preparation for works during the extremely cold conditions. When vehicles engines are started they produce noise emissions at a broad range of frequencies, not typical of noise emissions during normal operations. Such cold conditions and early site preparation works would not typically be representative of noise emissions from the site.

4.2. Interpretation of Results

Noise emission limits are given in Table C.1 of the waste licence and are reproduced here in Table 4.2.

Table 4-2: Noise Emission Limits

Day dB L_{Aeq}	Night dB L_{Aeq}
55	45

During the night-time noise survey, the noise levels at N2, N4, N5, N6 and N9 were above the limit for night-time noise emissions. L_{Aeq} levels were in the range of 45 – 61 dB.

The noise levels along the western boundary of the site, where locations N5 and N6 are located were in the range of 48 – 54 dB, which is consistent with previous monitoring results for these locations. This noise represents the constant noise emissions from both the Balcas facility adjacent to the site and the landfill gas engines and flares, which run on a 24 hour basis.

Noise levels in the area of locations N2, N3 and N9 were generally found to be in the range of 39 – 56 dB (Figure 5.2) with the exception of a high result at N2 in November 2009 due to low-flying aircraft passing throughout the monitoring period, which elevated the L_{Aeq}. In general, this area of the site has a low level of noise during night-time hours as the active area is not in use. During the present monitoring survey earlier than normal morning activity, preparing the site due to the uncharacteristically extreme snow and ice, resulted in louder noise levels being recorded at N2 (L_{Aeq} = 56 dB). The dominant source of noise observed at these monitoring locations is persistent traffic on the N7 road which is approximately 2 km from the site, with site vehicles additionally contributing to levels at N2.

The noise regime at the entrance of the site and the site offices, as represented by location N1A, is below the limit for night-time noise, however a tonal element identified during one-third octave analysis increased the L_{Aeq} during monitoring period but it was not clearly noticeable or audible on-site by the observer. Furthermore, the noise recorded at N4 at the rear of the site was just above the limit for night-time noise and this was due to the dominant sound of persistent road traffic outside the site.

The background levels recorded, as evidenced by the L_{A90}, ranged from 38 – 53 dB were below the limit at N1A, N3, N4 and N9.

5. DISCUSSION

5.1. Comparison with Previous Results

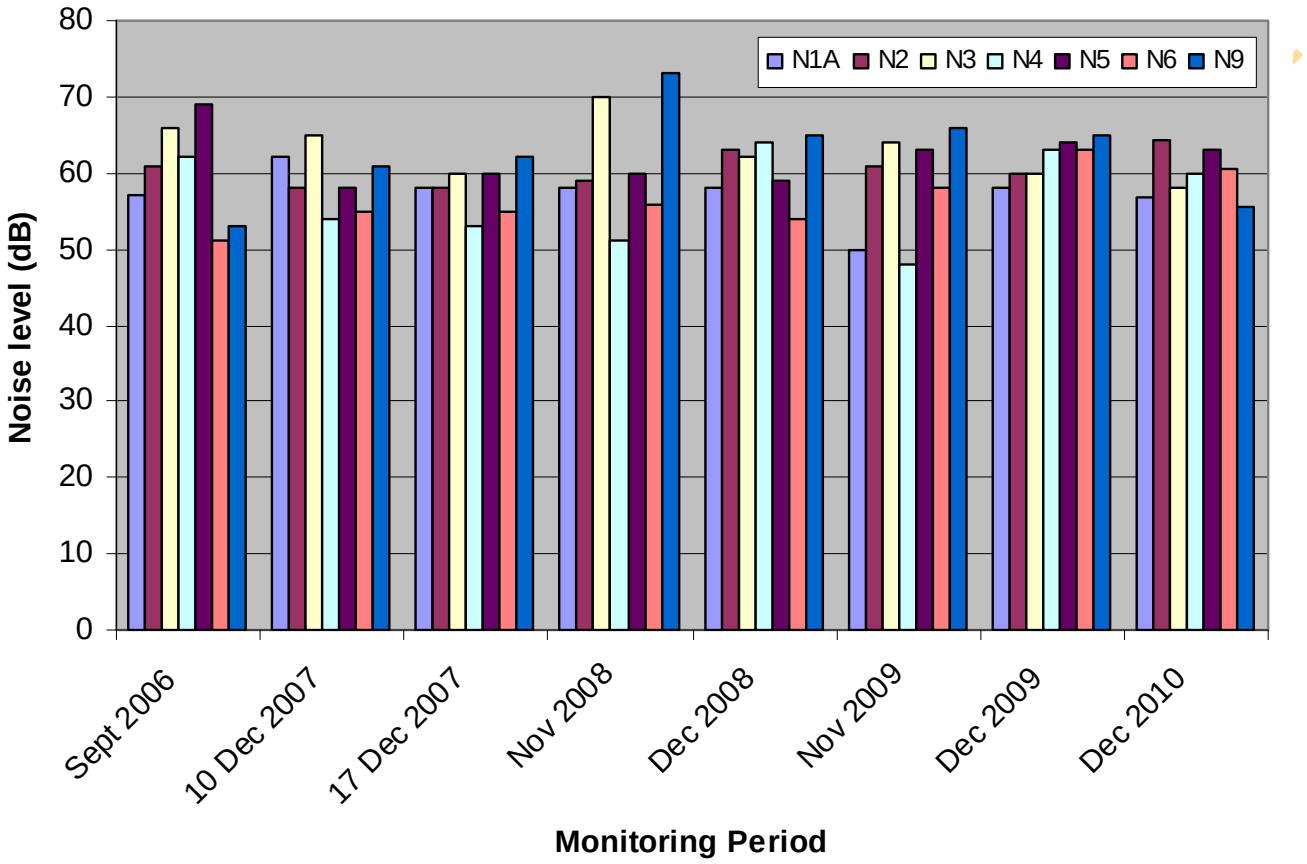

Figure 5.1 Trends in Daytime L_{Aeq} Levels 2006-2009

As can be seen from Figure 5.1 the noise levels at the landfill site have been relatively consistent across all of the monitoring points since September 2006 and some points such as locations N3 and N9 have shown a decrease in noise levels, due mostly to the moving location of the active face as the site fills. As can be seen from the figure, the noise levels at locations N5 and N6 have stayed consistent over the time period indicating the consistent influence of the noise emissions from the adjacent Balcas facility and the on-site landfill gas engines. Overall, the noise environment during the daytime recordings at Arthurstown Landfill has not changed significantly since 2006.

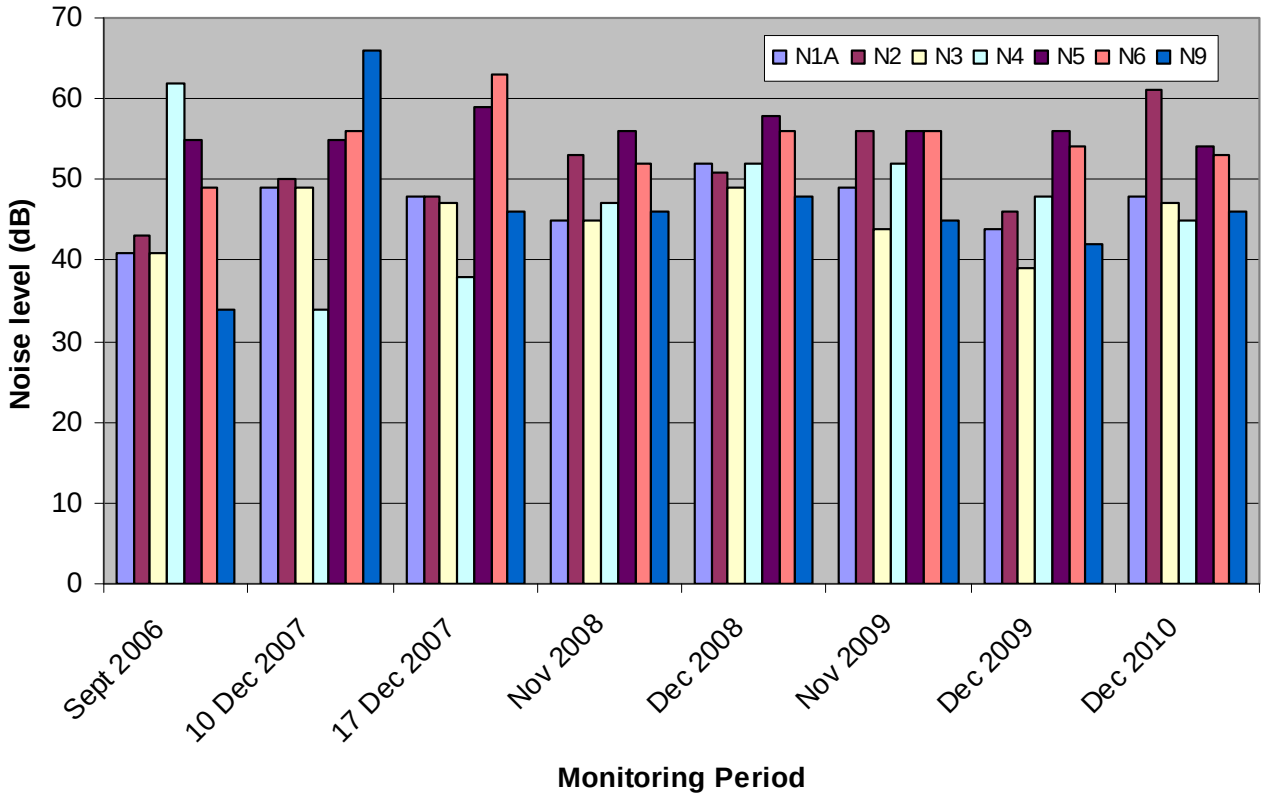

Figure 5.2 Trends in Night-time L_{Aeq} Levels 2006-2009

Figure 5.2 compares the night-time noise environment with that observed in previous years. The trends are similar to that observed for daytime noise levels and the consistency of the noise levels recorded at locations N5 and N6 can be noted. Overall, the noise environment during the night-time recordings at Arthurstown Landfill has not changed significantly since 2006. Levels at N2 during the present monitoring survey are higher than have been noted in the past, however as noted in section 4.2 the monitoring location was influenced by atypical early morning site activity preparing the site for daily works during an extremely uncharacteristic snow event.

Appendix 1

Monitoring Locations Drawing

Appendix 2

1/3 Octave Band Analysis of Noise Monitoring Results




1/3 Octave Band Analysis for Night-time Noise Recorded on 15th December 2010

Hz	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800
ID																		
N1a							42.9	40	44	40	40.2	41.4		40.6	40.8	45.1	47.6	47.5
N2																		
N3					32.2	32.6	37	41.1	42.5	43.8	38.5	37	38.6	40.9	41.3	43.4	45.5	45.2
N4						31.3	34.9	45.6	44.2	41	46.1	47	45.7	44.7	47.7	49	49.3	49.9
N5								40.5	42.8	42.4	47.3	43.2	49.6	58.4	53.4	54	51.7	50.7
N6									39.5					43	43	46.3	46.6	45.7
N9							33	39.4	40.8	37.1	39	36.1	38.2	39	42.3	43.6	44	45.2

Hz	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k	12k
ID												
N1a	46.1	47	44.4	43.9	41.5							
N2												
N3	46.2	48.1	48.5	48.2	47.9	47	45.7	42.9	39.4	35.5	30.6	
N4	50.5	49.6	49.5	47.8	45.5	44.1	41.6	38.7	35.5	32.5		
N5	49.9	49.2	47.8	45.4	44.4	41.9						
N6	45	44.3	43.5	42.1								
N9	46	45.8	45.3	44.2	43.2	42.8	41.5	38.4	34.7	30.7		

1/3 Octave Band Analysis for Night-time Noise Recorded on 15th December 2010

Hz	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800
ID																		
N1a													32.3			34.4	35.8	36
N2					28.1	26.5	32.8	34.8	30.4	30.7	33.3	32.8	35.3	36.2	37.3	41.2	43	45.8
N3					22.4		23	23.8	25.3	27.7	29.5	28.7	31.4	31.1	29.8	30.3	21.3	35
N4					25.6	20	27.8	27.6	27.9	26.6	27.7	27.3	28.2	29	29.5	34.4	38	39.7
N5				21.1	36.8	35.3	33.3	34.8	37.3	44.4	39.9	34.7	42.1	45.2	41	44.9	44.4	42.5
N6					23.9	27.1	27.6	28.8	27.4	29.3	30.6	32.1	41.3	31.2	34.3	40.3	38.6	38.3
N9						23.3	27.8	34.3	34.9	28.8	28.6	29.8	29	32.2	31.8	33.5	37	38.9

Hz	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k	12k
ID												
N1a	34.5	29.6										
N2	47.1	52.2	45.3	43.6	43.4	41.2	37.6	34.8	30.3	26.9	20.8	
N3	32.8	29	23.6	21	22.1	22.9	22.7	19.8	19.5			
N4	37.9	33.1	26.7	19.3								
N5	42.6	41.8	37.4	34.1	33.2	31.6	28.4	24.4				
N6	37.5	35.9	31.2	32.5	31.2	29.2	27	24.5	19.5			
N9	37.5	38.2	31	27.6	27	25.2	22.1					

APPENDIX 3.5

Surface Water Charts and Tables

TABLE 5.3: RESULTS OF METAL ANALYSIS OF SURFACE WATER SAMPLES

Parameter	Surface Water Quality Standard	SW-1	SW-3	SW-5	SW-2	SW-4
		Up-stream	Down-stream	Pond Inlet	Pond Outlet	Kill River
Boron (total) (µg/l)	*2,000*	10	14	45	49	12
Calcium (total) (mg/l)	*200*[Note 2]	94	105	142	135	97
Chromium (total) (µg/l)	*50*	<2	<2	<2	<2	<2
Cadmium (total) (µg/l)	*5*	<2	<2	<2	<2	<2
Copper (total) (µg/l)	*50*	<2	3	4	3	<2
Iron (total) (mg/l)	*0.20*	0.2	**0.8**	**0.8**	**0.6**	0.1
Potassium (total) (mg/l)	*5*	2	2.1	3.7	4.1	1.7
Magnesium (total) (mg/l)	*50*[Note 2]	5.2	5	9	9.1	3.9
Manganese (total) (µg/l)	*50*	16	**139**	**98**	**97**	26
Sodium (total) (mg/l)	*200*[Note 2]	6.3	6.6	15	16	5.4
Nickel (total) (µg/l)	*20*	<2	2	4	4	<2
Lead (total) (µg/l)	*50*	<2	2	4	3	<2
Zinc (total) (µg/l)	*3,000*	11	16	8	13	11
Mercury (total) (µg/l)	*1*	<1	<1	<1	<1	<1

Note 1: *S.I. 294 of 1989: Water Quality Standard = Water Quality Standards set in the European Communities (Quality of Surface Water Intended for the Abstraction of Drinking Water) Regulations, 1989. Limit values for A1 waters are shown.*

***Note 2**: European Communities (Quality of Salmonid Waters) Regulations, 1988 (S.I. No. 293 of 1988)*

< Indicates less than the laboratory detection limit

Results highlighted in bold represent an exceedance of water quality standard.

TABLE 5.4 CALCULATED BIOLOGICAL QUALITY RATING (Q RATING) FOR SURFACE WATERS [Note 1]

Location	SW-1	SW-3	SW-4
Q-Rating	4	4	4

Note 1: All sampling stations classified as Eroding Substrata

Q4. 2010 (Annual)

TABLE 5.2: RESULTS OF CHEMICAL ANALYSIS OF SURFACE WATER SAMPLES

Parameter	Surface Water Quality Standard	SW-1 Up-stream	SW-3 Down-stream	SW-5 Pond Inlet	SW-2 Pond Outlet	SW-4 Kill River
pH (pH units)	*6.0 – 9.0* Note 1	8.2	8.2	7.7	8.0	8.1
Conductivity (µS/cm @ 25°C)	*1000* Note 2	630	640	936	957	595
BOD (TCMP) (mg/l)	*High Status: ≤ 2.2 Good Status: ≤2.6* Note 1	<2	<2	3	2	<2
COD (mg/l)	*40* Note 2	21	27	31	32	29
Ammonia as N (mg/l) (Konelab)	*High Status: ≤ 0.04 Good Status ≤0.065* Note 1	**0.09**	**0.08**	**0.37**	**0.39**	**0.08**
Suspended Solids (mg/)l	*25* Note3	**134**	**70**	**66**	**26**	**161**
Total Alkalinity ($CaC0_3$) (mg/l)	-	299	288	274	266	294
Chloride (mg/l)	*250* Note 2	10.45	12.45	26.02	27.79	9.38
Sulphate (mg/l)	*200* Note 2	14.74	33.00	168.25	185.24	12.67
Total Phosphorous (mg/l)	-	0.05	0.15	0.09	0.11	<0.05
Ortho-phosphate as P (mg/l)	*High Status:≤0.025 Good Status:≤0.035* Note 1	<0.16	<0.16	<0.16	<0.16	<0.16
Nitrate as N (mg/l)	*11.29** Note 2	1.98	2.02	2.07	2.31	0.88
Nitrite (mg/l)	**0.015** Note 3	**0.23**	**0.27**	<0.03	<0.03	**0.24**
TON as N (mg/l)	-	2.27	2.23	2.48	2.86	0.99

Note 1: European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009).

Note 2: S.I. 294 of 1989: Water Quality Standard = Water Quality Standards set in the European Communities (Quality of Surface Water Intended for the Abstraction of Drinking Water) Regulations, 1989. Limit values for A1 waters are shown.

Note 3: European Communities (Quality of Salmonid Waters) Regulations, 1988 (S.I. No. 293 of 1988)

< Indicates less than the laboratory detection limit

WQS = Water Quality Standard

* Converted Water Quality Standard for Nitrite, Nitrate and Ammonia as N (mg/l).

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RESULTS

The results of the investigation carried out by Bord na Móna Technical Services are presented as follows:

Table 5.1: Results of field measurements taken at each surface water sampling station.

Table 5.2: Results of chemical analysis of surface water samples.

TABLE 4.1: RESULTS OF FIELD MEASUREMENTS TAKEN AT EACH SURFACE WATER SAMPLING STATION

Parameter	SW-1	SW-2	SW-3	SW-4	SW-5
Temperature (°C)	16.01	16.4	15.7	17.60	18.1
Dissolved Oxygen (mg/l)	10.23	10.04	10.10	11.24	13.77
Odour / Visual	Clear, no s.s., no odour	Clear, no s.s., no odour	Clear, no s.s., no odour	Clear, no s.s., no odour	Clear, no s.s., no odour

TABLE 4.2: RESULTS OF CHEMICAL ANALYSIS OF SURFACE WATER SAMPLES

Parameter	Surface Water Quality Standard [1]	SW-1 Up-stream	SW-3 Down-stream	SW-5 Pond Inlet	SW-2 Pond Outlet	SW-4 Kill River
pH (pH units)	*6-9*	8.3	8.1	8.1	7.7	8.2
Conductivity uS/cm @ 25°C	-	558	584	840	930	544
BOD (TCMP) mg/l	*5*	3	<2	2	<2	<2
COD mg/l	-	13	12	27	<10	11
Ammonia as N mg/l (Konelab)	*0.8*	0.22	0.06	0.19	0.2	0.07
Suspended Solids mg/l	*25*	5	<5	<5	9	<5
Total Alkalinity ($CaC0_3$) mg/l	-	254	264	297	356	270
Chloride mg/l	-	17	16	45	39	14
Sulphate mg/l	-	15.06	25.64	105.97	102.6	15.05
Total Phosphorous mg/l	-	0.05	0.05	0.08	0.05	0.06
Ortho-phosphate as P mg/l	-	<0.01	<0.01	<0.01	<0.01	0.04
Nitrate as N mg/l	-	2.19	2.25	1.77	2.6	0.84
Nitrite mg/l	*0.015*	<0.02	<0.02	**0.11**	**0.08**	<0.02

Note 1: Water Quality Standard= 1988 Statutory Instrument No. 293, European Communities (Quality of Salmonid Waters) Regulations 1988

Note 2: *Results highlighted in bold represent an exceedance of water quality standard.*

TABLE 4.1: RESULTS OF FIELD MEASUREMENTS TAKEN AT EACH SURFACE WATER SAMPLING STATION

Parameter	SW-1	SW-2	SW-3	SW-4	SW-5
Temperature (°C)	10.7	12.6	10.8	8.9	13.1
Dissolved Oxygen (mg/l)	11.07	11.28	10.22	11.5	16.35
Odour / Visual	Clear, no s.s., no odour	Slightly Cloudy, few s.s., no odour	Clear, no s.s., no odour	Clear, no s.s., no odour	Algal growth, Cloudy, some s.s., no odour

TABLE 4.2: RESULTS OF CHEMICAL ANALYSIS OF SURFACE WATER SAMPLES

Parameter	Surface Water Quality Standard [1]	SW-1	SW-2	SW-3	SW-4	SW-5
pH (pH units)	*6-9*	8.3	7.8	8.2	8.3	7.7
Conductivity uS/cm @ 25^{0}C	-	583	926	595	573	936
BOD (TCMP) mg/l	*5*	<2	<2	<2	<2	<2
COD mg/l	-	<10	12	11	11	12
Ammonia as N mg/l (Konelab)	*0.8*	0.04	0.07	0.04	0.04	0.07
Suspended Solids mg/l	*25*	<5	5	<5	<5	5
Total Alkalinity ($CaC0_3$) mg/l		275	356	293	293	354
Chloride mg/l	-	13	36	14	14	34
Sulphate mg/l	-	14.4	95.75	16.28	15.03	93.90
Total Phosphorous mg/l		<0.05	<0.05	<0.05	<0.05	<0.05
Ortho-phosphate as P mg/l		0.01	<0.01	0.01	0.02	<0.01
Nitrate as N mg/l	-	2.85	3.64	3.01	1.69	3.37
Nitrite mg/l	*0.015*	<0.02	**0.07** *Note2*	<0.02	<0.02	**0.07** *Note2*

Note 1: Water Quality Standard= 1988 Statutory Instrument No. 293, European Communities (Quality of Salmonid Waters) Regulations 1988
Note 2: *Results highlighted in bold represent an exceedance of water quality standard.*

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TABLE 4.1: RESULTS OF FIELD MEASUREMENTS TAKEN AT EACH SURFACE WATER SAMPLING STATION

Parameter	SW-1	SW-2	SW-3	SW-4	SW-5
Temperature (^{0}C)	4.1	4.1	4.1	4.2	4.4
Dissolved Oxygen (mg/l)	10.64	9.83	10.71	11.04	9.36
Odour / Visual	Clear, few s.s., no odour	Clear, few s.s., no odour	Clear, few s.s., no odour	Clear, few s.s., no odour	Cloudy, few s.s., no odour

TABLE 4.2: RESULTS OF CHEMICAL ANALYSIS OF SURFACE WATER SAMPLES

Parameter	Surface Water Quality Standard [1]	SW-1	SW-2	SW-3	SW-4	SW-5
pH (pH units)	*6-9*	8.3	7.5	8.1	8.2	7.5
Conductivity µS/cm @ 25^{0}C	-	622	1036	631	617	1000
BOD (TCMP) mg/l	*5*	<2	<2	<2	<2	<2
COD mg/l	-	10	26	12	13	15
Ammonia as N mg/l (Konelab)	*0.8*	0.36	2.9	0.13	0.1	0.98
Suspended Solids mg/l	*25*	5	7	<5	5	8
Total Alkalinity ($CaC0_3$) mg/l		274	344	288	298	375
Chloride mg/l	-	14	36.5	14.24	15.04	33.71
Sulphate mg/l	-	13.2	121.07	14.91	15.15	109.19
Total Phosphorous mg/l		<0.05	<0.05	<0.05	<0.05	<0.05
Ortho-phosphate as P mg/l		<0.16	<0.16	<0.16	<0.16	<0.16
Nitrate as N mg/l	-	2.93	6.61	2.97	1.92	5.87
Nitrite mg/l	*0.015*	<0.03	<0.03	<0.03	<0.03	<0.03

Note 1: Water Quality Standard= 1988 Statutory Instrument No. 293, European Communities (Quality of Salmonid Waters) Regulations 1988

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TABLE 5.5 COUNTS OF MACROINVERTEBRATES SPECIES PER SAMPLE STATION WITH REVISED BMWP AND ASPT SCORES

Species	SW-1	SW-3	SW-4
Gammarus spp	31	19	30
Baetidae	>100	>100	>100
Lymnaeidae	1	1	2
Limnius spp.	1		1
Nemoura spp.	1	1	1
Isoperla spp.			
Ecdyonuridae	4	7	10
Rhyacophilidae	1		
Simulidae	4	2	3
Chironomidae	2	3	7
Oligochaeta			
Odontoceridae	1	1	3
Sericostomatidae			
Assellus spp.	3	5	
Hydropsychida		1	2
Dicranota spp.			
Polycentropus flavomaculatus			
Glossophonia complanata			
Limnephilus spp			
Tipula spp	1		3
Number Of Taxa	**12**	**10**	**10**
Revised BMWP Score	67.8	64.7	70.3
ASPT Score	5.65	6.47	7.03

Calculations are habitat specific (riffle) using revised BMWP score method.

TABLE 5.6 REVISED BMWP SCORES, ASPT SCORES AND LQI INTERPRETATION; RESULTS SUMMARY

Sampling Station	BMWP Score	ASPT Score	X Rating*	Y rating	OQR	LQI	LQI Interpretation
SW-1	67.8	5.65	4	6	5	A	Excellent Quality
SW-3	64.7	6.47	4	7	5.5	A+	Excellent Quality
SW-4	70.3	7.03	4	7	5.5	A+	Excellent Quality

*- X value is calculated on the basis of a Habitat Rich Riffle.

APPENDIX 3.6

Groundwater Charts and Tables

TABLE 4.2(B): RESULTS OF CHEMICAL ANALYSIS AT EACH GROUNDWATER MONITORING BOREHOLE

Parameter	MW-14	MW-16	MW-18	MW-20	MW-22	*GTV Note1 IGV Note2*
pH (pH units)	7.5	7.5	7.8	7.0	7.8	*≥ 6. -≤9.5*
Temperature (°C)	13.3	12.0	11.4	10.3	11.8	-
Odour	Slight odour	No odour	No odour	No odour	No odour	-
Visual	Black/carbon beads, some suspended solids	Clear, no suspended solids	Grey, high suspended solids	Red, some suspended solids	Grey/cloudy, some suspended solids	-
Conductivity (uS/cm)	654	718	719	**2,560**	529	*0 – 1875*[1]
Ammonia as N (mg/l)	0.11	0.08	**0.28**	<0.02	0.10	*0.05 – 0.136*[1*]
Chloride (mg/l)	6.50	14.63	13.99	27.12	11.99	*24 – 187.5*[1]
Nitrate as N (mg/l)	0.36	0.35	0.48	2.0	0.25	*8.47*[1*]
Nitrite (mg/l)	**0.25**	**0.78**	0.06	<0.03	**0.29**	*0.11*[1*]
TON (mg/l)	0.46	0.35	1.05	2.72	<0.2	-
Cyanide (mg/)	<0.01	<0.01	<0.01	<0.01	<0.01	*0.0375*[1]
Fluoride (mg/l)	0.11	<0.1	0.12	<0.1	<0.1	*1.0*[2]
Sulphate (mg/l)	16.74	20.58	49.88	**888.90**	20.56	*187.5*[1]
Total Alkalinity (mg/l)	292	338	291	396	242	-
Total P (mg/l)	0.07	0.07	0.23	0.28	0.39	-
Total Dissolved Solids (mg/l)	168	238	370	1810	244	-
TOC (mg/l)	5.40	2.40	3.60	6.60	2.00	-

Note 1: GTV = Groundwater Threshold Values refers to "*European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010)*". "Threshold Values" have been established for pollutants that are causing a risk to groundwater bodies. Exceedance of a relevant threshold value at a representative monitoring point triggers further investigation to confirm whether the criteria for poor groundwater chemical status are being met.

Note 2: Guide Values refers to EPA Guideline Values for the Protection of Groundwater in Ireland, IGV = Interim Guideline Value. Note these standards are presented for guideline purposes only, therefore, due care should be exercised in cross-referencing these standards with the groundwater results obtained

* Converted GTV for Ammonia as N mg/l, Nitrate as N mg/l and Nitrite as N mg/l.

Bold font indicates exceedances above the EC Drinking Water Standards

< Indicates less than the laboratory detection limit

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TABLE 4.3(A): RESULTS OF METAL SCREENING OF GROUNDWATER SAMPLES

Parameter	MW-2	MW-6 (A)	MW-8	MW-9	GTV Note1 IGV Note2
Sodium mg/l	214	7.3	9.7	12	150[1]
Potassium mg/l	7	0.3	0.6	1	50[2]
Magnesium mg/l	14	8	12	16	5[2]
Calcium mg/l	201	112	107	86	200[2]
Boron µg/l	18	14	10	20	750[1]
Cadmium µg/l	<2	<2	<2	<2	3.75[1]
Chromium µg/l	<2	<2	<2	<2	37.5[1]
Copper µg/l	2	<2	<2	<2	1500[1]
Iron mg/l	0.4	1.3	5.3	4.6	0.2 mg/l [2]
Lead µg/l	2	4	<2	5	18.75[1]
Manganese µg/l	140	230	231	74	50[2]
Nickel µg/l	2	<2	<2	2	15[1]
Zinc µg/l	44	8	9	21	100[2]
Mercury µg/l	<1	<1	<1	<1	0.75[1]

TABLE 4.3(B): RESULTS OF METAL SCREENING OF GROUNDWATER SAMPLES

Parameter	MW-14	MW-16	MW-18	MW-20	MW-22	GTV Note1 IGV Note2
Sodium mg/l	9.5	12	24	47	12	150[1]
Potassium mg/l	1.1	1.2	2.2	6	0.8	5[2]
Magnesium mg/l	7	16	16	42	23	5[2]
Calcium mg/l	139	96	117	523	284	200[2]
Boron µg/l	19	16	38	357	14	750[1]
Cadmium µg/l	<2	<2	<2	<2	<2	3.75[1]
Chromium µg/l	<2	<2	<2	<2	3	37.5[1]
Copper µg/l	5	<2	7	3	9	1500[1]
Iron mg/l	5.0	<0.1	1.0	5.4	2.7	0.2 mg/l [2]
Lead µg/l	13	<2	9	<2	13	18.75[1]
Manganese µg/l	322	1,473	1,115	912	4,778	50[2]
Nickel µg/l	6	<2	5	6	4	15[1]
Zinc µg/l	71	18	32	31	75	100[2]
Mercury µg/l	<1	<1	<1	<1	<1	0.75[1]

Note 1:GTV=Groundwater Threshold Values refers to "*European Communities Environmental Objectives (Groundwater) Regulations, 2010*". "Threshold Values" have been established for pollutants that are causing a risk to groundwater bodies. Exceedance of a relevant threshold value at a representative monitoring point triggers further investigation to confirm whether the criteria for poor groundwater chemical status are being met.

Note 2: Guide Values refers to EPA Guideline Values for the Protection of Groundwater in Ireland, IGV = Interim Guideline Value. Note these standards are presented for guideline purposes only, therefore, due care should be exercised in cross-referencing these standards with the groundwater results obtained

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TABLE 4.2(A): RESULTS OF CHEMICAL ANALYSIS AT EACH GROUNDWATER MONITORING BOREHOLE

Parameter	MW-2	MW-6 (A)	MW-8	MW-9	GTV^{Note1} IGV^{Note2}
pH (pH units)	7.3	7.3	7.7	7.8	≥ 6. -≤9.5
Temperature (°C)	11.4	10.6	11.5	11.3	-
Odour	Strong odour	No odour	No odour	No odour	-
Visual	Grey brown, some suspended solids	Clear, few suspended solids	Faint yellow, no suspended solids	Clear / slightly grey, no suspended solids	-
Conductivity (uS/cm)	**2,363**	671	716	628	*0 – 1875*[1]
Ammonia as N (mg/l)	**0.55**	<0.02	0.07	0.04	*0.05 – 0.136*[1*]
Chloride (mg/l)	**474.96**	14.81	20.48	12.47	*24 – 187.5*[1]
Nitrate as N (mg/l)	3.30	1.57	0.06	<0.05	*8.47*[1*]
Nitrite (mg/l)	<0.03	<0.03	<0.03	0.26	*0.11*[1*]
TON (mg/l)	3.68	1.61	<0.2	<0.2	-
Cyanide (mg/)	<0.01	<0.01	<0.01	<0.01	*0.0375*[1]
Fluoride (mg/l)	<0.1	<0.1	<0.1	0.1	*1.0*[2]
Sulphate (mg/l)	113.80	12.70	12.65	20.42	*187.5*[1]
Total Alkalinity (mg/l)	358	351	333	282	-
Total P (mg/l)	0.15	0.08	<0.05	0.19	-
Total Dissolved Solids (mg/l)	1,422	340	498	254	-
TOC (mg/l)	5.40	2.70	2.00	1.90	-

Note 1: GTV = Groundwater Threshold Values refers to "*European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010)*". "Threshold Values" have been established for pollutants that are causing a risk to groundwater bodies. Exceedance of a relevant threshold value at a representative monitoring point triggers further investigation to confirm whether the criteria for poor groundwater chemical status are being met.

Note 2: Guide Values refers to EPA Guideline Values for the Protection of Groundwater in Ireland, IGV = Interim Guideline Value. Note these standards are presented for guideline purposes only, therefore, due care should be exercised in cross-referencing these standards with the groundwater results obtained

* Converted GTV for Ammonia as N mg/l, Nitrate as N mg/l and Nitrite as N mg/l.

Bold font indicates exceedances above the EC Drinking Water Standards

< Indicates less than the laboratory detection limit

TABLE 4.2(B): RESULTS OF CHEMICAL ANALYSIS AT EACH GROUNDWATER MONITORING BOREHOLE

Parameter	MW-14	MW-16	MW-19	MW-20	MW-22	GTV [Note1] IGV [Note2]
pH (pH units)	7.9	7.5	7.3	7.7	8.0	≥6. -≤9.5
Temperature (°C)	13.3	12.0	11.4	10.3	11.8	-
Odour	Slight odour	No odour	No odour	No odour	No odour	-
Visual	Cloudy grey, some suspended solids	Clear, no suspended solids	Cloudy, no suspended solids	Light Brown, some suspended solids	Grey/Cloudy, some suspended solids	-
Conductivity uS/cm	519	756	821	1371	510	0 – 1875
Ammonia as N mg/l	**0.25**	0.1	0.05	<0.02	0.09	0.05 – 0.136*
Chloride mg/l	13	14	19	39	12	24 – 187.5
Nitrate as N mg/l	<0.2	0.47	0.9	2.18	<0.2	8.47*
Nitrite mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	0.11*
TON mg/l	<0.2	0.46	0.84	2.17	<0.2	-
Sodium mg/l	24	13	11	18	12	150
Potassium mg/l	1.7	1.4	0.6	0.5	1.4	5
TOC mg/l	0.57	0.82	0.76	1.51	0.78	-

Note 1: GTV = Groundwater Threshold Values refers to "*European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010)*". "Threshold Values" have been established for pollutants that are causing a risk to groundwater bodies. Exceedance of a relevant threshold value at a representative monitoring point triggers further investigation to confirm whether the criteria for poor groundwater chemical status are being met.

Note 2: Guide Values refers to EPA Guideline Values for the Protection of Groundwater in Ireland, IGV = Interim Guideline Value. Note these standards are presented for guideline purposes only, therefore, due care should be exercised in cross-referencing these standards with the groundwater results obtained

* Converted GTV for Ammonia as N mg/l, Nitrate as N mg/l and Nitrite as N mg/l.

Bold font indicates exceedances above the EC Drinking Water Standards

< Indicates less than the laboratory detection limit

TABLE 4.2(A): RESULTS OF CHEMICAL ANALYSIS AT EACH GROUNDWATER MONITORING BOREHOLE

Parameter	MW-2	MW-6 (A)	MW-8	MW-9	GTV Note 1 IGV Note 2
pH (pH units)	7.0	7.4	7.7	7.6	≥ 6. -≤9.5
Temperature (°C)	11.4	10.6	11.5	11.3	-
Odour	No odour	No odour	No odour	No odour	-
Visual	Clear, no suspended solids	Clear, few suspended solids	Faint yellow, no suspended solids	Clear, no suspended solids	-
Conductivity uS/cm	**1896**	705	654	615	0 – 1875
Ammonia as N mg/l	**0.15**	0.03	0.05	0.07	0.05 – 0.136*
Chloride mg/l	**388**	15	17	12	24 – 187.5
Nitrate as N mg/l	5.4	1.94	0.28	<0.2	8.47*
Nitrite mg/l	<0.02	<0.02	<0.02	<0.02	0.11*
TON mg/l	5.4	1.93	0.27	<0.2	-
Sodium mg/l	**193**	7.4	7.4	12	150
Potassium mg/l	**7.1**	0.4	0.6	1.1	5
TOC mg/l	3.10	0.72	0.68	0.39	-

Note 1: GTV = Groundwater Threshold Values refers to "*European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010)*". "Threshold Values" have been established for pollutants that are causing a risk to groundwater bodies. Exceedance of a relevant threshold value at a representative monitoring point triggers further investigation to confirm whether the criteria for poor groundwater chemical status are being met.

Note 2: Guide Values refers to EPA Guideline Values for the Protection of Groundwater in Ireland, IGV = Interim Guideline Value. Note these standards are presented for guideline purposes only, therefore, due care should be exercised in cross-referencing these standards with the groundwater results obtained

* Converted GTV for Ammonia as N mg/l, Nitrate as N mg/l and Nitrite as N mg/l.

Bold font indicates exceedances above the EC Drinking Water Standards

< Indicates less than the laboratory detection limit

TABLE 4.2(B): RESULTS OF CHEMICAL ANALYSIS AT EACH GROUNDWATER MONITORING BOREHOLE

Parameter	MW-14	MW-16	MW-19	MW-20	MW-22	GTV Note1 IGV Note2
pH (pH units)	7.7	7.5	7.1	7.2	7.8	≥6. - ≤9.5
Temperature (°C)	9.1	12.9	13.3	9.9	9.8	-
Odour	Foul odour	No odour	No odour	No odour	No odour	-
Visual	Light brown, high suspended solids	Clear, no suspended solids	Cloudy, few suspended solids	Cloudy/Brown, few suspended solids	Clear, few suspended solids	-
Conductivity uS/cm	606	695	910	1281	511	0 – 1875[1]
Ammonia as N mg/l	**0.17**	0.06	<0.02	<0.02	<0.02	0.05 – 0.136[1*]
Chloride mg/l	20	14	21	32	11	24 – 187.5[1]
Nitrate as N mg/l	0.37	0.7	2.04	**13**	<0.2	8.47[1*]
Nitrite mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	0.11[1*]
TON mg/l	0.38	0.7	2.04	13	<0.2	-
Sodium mg/l	29	14	14	24	13	150[1]
Potassium mg/l	2.0	1.6	0.7	1.4	0.8	5[2]
TOC mg/l	0.68	0.84	0.61	1.45	0.39	-

Note 1: GTV = Groundwater Threshold Values refers to "*European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010)*". "Threshold Values" have been established for pollutants that are causing a risk to groundwater bodies. Exceedance of a relevant threshold value at a representative monitoring point triggers further investigation to confirm whether the criteria for poor groundwater chemical status are being met.

Note 2: Guide Values refers to EPA Guideline Values for the Protection of Groundwater in Ireland, IGV = Interim Guideline Value. Note these standards are presented for guideline purposes only, therefore, due care should be exercised in cross-referencing these standards with the groundwater results obtained

* Converted GTV for Ammonia as N mg/l, Nitrate as N mg/l and Nitrite as N mg/l.

Bold font indicates exceedances above the EC Drinking Water Standards

< Indicates less than the laboratory detection limit

Parameter	MW-2	MW-6 (A)	MW-8	MW-9	GTV Note1 IGV Note2
pH (pH units)	7.1	7.3	7.6	7.4	≥6. - ≤9.5
Temperature (°C)	9.1	8.9	11.2	11.2	-
Odour	No odour	Slight odour	No odour	No odour	-
Visual	Cloudy, few suspended solids	Light brown, few suspended solids	Cloudy, few suspended solids	Clear, no suspended solids	-
Conductivity uS/cm	**1883**	715	596	599	0 – 1875[1]
Ammonia as N mg/l	0.04	0.06	<0.02	0.04	0.05 – 0.136[1*]
Chloride mg/l	**345**	12	7	12	24 – 187.5[1]
Nitrate as N mg/l	5.5	1.69	0.35	<0.2	8.47[1*]
Nitrite mg/l	<0.02	<0.02	<0.02	<0.02	0.11[1*]
TON mg/l	5.5	1.69	0.35	<0.2	-
Sodium mg/l	**169**	8.2	6	13	150[1]
Potassium mg/l	**7.6**	0.4	0.4	1.2	5[2]
TOC mg/l	2.97	0.61	0.59	0.41	-

Note 1: GTV = Groundwater Threshold Values refers to "*European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010)*". "Threshold Values" have been established for pollutants that are causing a risk to groundwater bodies. Exceedance of a relevant threshold value at a representative monitoring point triggers further investigation to confirm whether the criteria for poor groundwater chemical status are being met.

Note 2: Guide Values refers to EPA Guideline Values for the Protection of Groundwater in Ireland, IGV = Interim Guideline Value. Note these standards are presented for guideline purposes only, therefore, due care should be exercised in cross-referencing these standards with the groundwater results obtained

* Converted GTV for Ammonia as N mg/l, Nitrate as N mg/l and Nitrite as N mg/l.

Bold font indicates exceedances above the EC Drinking Water Standards

< Indicates less than the laboratory detection limit

TABLE 4.2(B): RESULTS OF CHEMICAL ANALYSIS AT EACH GROUNDWATER MONITORING BOREHOLE

Parameter	MW-14	MW-16	MW-19	MW-20	MW-22	Guideline Values IGV[a]
pH (pH units)	7.5	7.2	7.0	7.1	7.8	*6.5-9.5*
Temperature (°C)	15.8	15.4	16.8	17	14	-
Odour	No odour	No odour	No odour	No odour	No odour	-
Visual	Clear, few suspended solids	Clear, no suspended solids	Cloudy, few suspended solids	Cloudy/Brown, few suspended solids	Clear, few suspended solids	-
Conductivity µS/cm	795	724	808	**2362**	547	*1,000*
Ammonia as N mg/l	0.1	**0.15**	0.02	0.09	**0.16**	*0.12 Note1*
Chloride mg/l	**48**	14	19	**73**	14	*30*
Nitrate as N mg/l	0.8	0.54	0.98	2.09	0.58	*5.65 Note1*
Nitrite mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	*0.03 Note1*
TON mg/l	0.8	0.54	0.98	2.1	<1	-
Sodium mg/l	33	15	13	81	14	*150*
Potassium mg/l	2.7	1.8	0.6	4.4	1	*5*
TOC mg/l	1.77	1.19	0.89	4.52	1.60	-

Note1: Converted Interim Guideline Values for Ammonia as N mg/l Nitrate as N mg/l and Nitrite as N mg/l.
Note2: * Analysis could not be carried out due to sample matrix interference

TABLE 4.2(A): RESULTS OF FIELD MEASUREMENTS TAKEN AT EACH GROUNDWATER MONITORING BOREHOLE

Parameter	MW-2	MW-6 (A)	MW-8	MW-9	Guideline Values IGV*
pH (pH units)	7.2	7.4	7.7	7.9	*6.5-9.5*
Temperature (°C)	9.5	15.4	16.4	17.8	-
Odour	No odour	No odour	No odour	No odour	-
Visual	Clear, few suspended solids	Light brown, few suspended solids	Clear/Cloudy, few suspended solids	Clear, no suspended solids	-
Conductivity ∝S/cm	1163	735	579	601	*1,000*
Ammonia as N mg/l	<0.02	0.04	0.04	0.04	0.12 Note1
Chloride mg/l	134	14	4.71	14	*30*
Nitrate as N mg/l	5.6	2.14	0.29	<0.2	*5.65* Note1
Nitrite mg/l	<0.02	<0.02	<0.02	<0.02	*0.03* Note1
TON mg/l	6	2.14	0.3	<0.2	-
Sodium mg/l	63	8.3	3.9	15	*150*
Potassium mg/l	8.4	0.4	0.3	1.3	*5*
TOC mg/l	2.91	0.85	0.96	0.77	-

Note1: Converted Interim Guideline Values for Ammonia as N mg/l, Nitrate as N mg/l and Nitrite as N mg/l.
Note2: * Analysis could not be carried out due to sample matrix interference

Bold font indicates exceedances above the EC Drinking Water Standards

< Indicates less than the laboratory detection limit

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TABLE 4.4: RESULTS OF MICROBIOLOGICAL ANALYSIS OF GROUNDWATER SAMPLES

Borehole I.D	Total Coliforms (cfu/100 ml)	E.Coli (cfu/100 ml)
MW-2	>100	>100
MW-6A	>100	>100
MW-8	>100	0
MW-9	>100	0
MW-14	>100	>100
MW-16	0	0
MW-18	>100	>100
MW-20	>100	0
MW-22	>100	0

Note: Micro-analysis was conducted by Independent Micro Laboratories.

APPENDIX 3.7

Private Wells (Groundwater) Charts and Tables

Private Well Results

TABLE 4.5: RESULTS OF CHEMICAL ANALYSIS OF PRIVATE WELL SAMPLES

Parameter	*Water Quality Standard MAC* [Note 2]	PW-1	PW-2	PW-3	PW-4	PW-5
pH (pH units)	*6.5-9.5*	7.5	7.7	7.4	7.6	7.6
Odour	-	None	None	None	None	None
Visual	-	Clear, No visible Suspended Solids	Clear, No visible Suspended Solids	Clear, No visible Suspended Solids	Clear, No visible Suspended Solids	Clear, No visible Suspended Solids
Conductivity µS/cm	*1500*	899	570	874	765	797
Ammonia as N mg/l	*0.23* [Note 3]	0.04	0.05	0.04	<0.02	0.07
Total Phosphorus mg/l	-	<0.05	0.11	<0.05	0.08	<0.05
Total Alkalinity $CaCO_3$ mg/l	-	377	280	344	297	370
**TOC mg/l	-	2.70	1.60	2.10	1.80	2.40
*Cyanide mg/l	*0.05*	<0.01	<0.01	<0.01	<0.01	<0.01
Fluoride mg/l	*1.0*	<0.1	0.13	<0.1	<0.1	<0.1
Chloride mg/l	*250*	32.73	13.66	73.25	38.67	13.24
Sulphate mg/l	*250*	32.73	10.71	26.17	22.48	15.41
Nitrate mg/l	*11.29* [Note 4]	3.69	<0.05	2.96	5.64	1.10
Nitrite mg/l	*0.02* [Note 5]	<0.03	**0.29**	<0.03	<0.03	**0.50**
Total Oxidised Nitrogen[1]	-	3.88	<0.2	3.11	5.3	1.04
Total Dissolved Solids mg/l	*1000*	308	320	484	420	444
*Calcium mg/l	*200*	136	74	96	89	121
*Sodium mg/l	*150*	22	13	33	39	7.5
*Magnesium mg/l	*50*	13	14	22	13	7.1
*Potassium mg/l	*12*	7.5	6.8	1.5	0.6	0.4
*Chromium µg/l	*50*	<2	<2	<2	<2	<2
*Manganese µg/l	*50*	<2	**66**	7	<2	<2
*Nickel µg/l	*20*	<2	<2	<2	<2	10
*Copper µg/l	*2,000*	4	<2	24	30	2
*Zinc µg/l	*5,000*	26	37	36	39	12
*Cadmium µg/l	*5*	<2	<2	<2	<2	<2
*Lead µg/l	*10*	<2	<2	<2	<2	<2
*Iron mg/l	*0.2*	<0.1	**2.1**	<0.1	<0.1	<0.1
*Boron µg/l	*1,000*	39	11	15	11	15
*Mercury µg/l	*1*	<1	<1	<1	<1	<1

Note 1: Total Oxidised Nitrogen results are calculated from the addition of the Nitrite-N and Nitrate-N results.

TABLE 4.3 RESULTS OF SAMPLE TAKEN FROM PRIVATE WELL		
Parameter	PW-1	MAC Note 1
pH (pH units)	7.1	6.5→9.5
Temperature (°C)	8.1	-
Odour	None	-
Visual	Clear, very few s.s.	-
Dissolved Oxygen mg/l	8.23	-
Conductivity ∝S/cm	860	2500
Ammonia as N mg/l (ISE)	0.09	0.23 Note 2
Chloride mg/l	40	250
Nitrate as N mg/l	5.9	11.3
Nitrite mg/l	<0.02	0.15
Total Oxidised Nitrogen	5.9	-
Sodium mg/l	22	200
Potassium mg/l	8.4	-
TOC mg/l	1.11	-

Note 1: MAC values are taken from Water Quality Standard = Water Quality Standards set in S.I No. 278 of 2007. European Communities (Drinking Water) (No.2) Regulations, 2007

Note 2: Water Quality Standard for Ammonium (NH_4^+) is 0.3mg/l. As the Ammonical Nitrogen results given are expressed as Ammonia as N, the standard is converted to Ammoniacal Nitrogen (mg/l N) i.e. NH_4^+ divided by 1.285

TABLE 4.3 RESULTS OF SAMPLE TAKEN FROM PRIVATE WELL		
Parameter	**PW-1**	**MAC** [Note 1]
pH (pH units)	7.2	**6.5→ 9.5**
Temperature (°C)	7.2	-
Odour	None	-
Visual	Clear	-
Dissolved Oxygen mg/l	8.67	-
Conductivity µS/cm	857	**2500**
Ammonia as N mg/l (ISE)	0.07	***0.23*** [Note 2]
Chloride mg/l	36	**250**
Nitrate as N mg/l	5.2	**11.3**
Nitrite mg/l	<0.02	**0.15**
Total Oxidised Nitrogen	5.2	-
Sodium mg/l	23	**200**
Potassium mg/l	8.5	-
TOC mg/l	1.06	-

Note 1: MAC values are taken from Water Quality Standard = Water Quality Standards set in S.I No. 278 of 2007. European Communities (Drinking Water) (No.2) Regulations, 2007

Note 2: Water Quality Standard for Ammonium (NH_4^+) is 0.3mg/l. As the Ammonical Nitrogen results given are expressed as Ammonia as N, the standard is converted to Ammoniacal Nitrogen (mg/l N) i.e. NH_4^+ divided by 1.285

Private Well Results

TABLE 4.3 RESULTS OF SAMPLE TAKEN FROM PRIVATE WELL		
Parameter	**PW-1**	**MAC** [Note 1]
pH (pH units)	7.0	**6.5→9.5**
Temperature (°C)	6.2	-
Odour	None	-
Visual	Clear	-
Dissolved Oxygen mg/l	8.67	-
Conductivity ∝S/cm	850	**2500**
Ammonia as N mg/l (ISE)	0.08	*0.23* [Note 2]
Chloride mg/l	27	**250**
Nitrate as N mg/l	4.76	**11.3**
Nitrite mg/l	<0.02	**0.15**
Total Oxidised Nitrogen	4.76	-
Sodium mg/l	21	**200**
Potassium mg/l	9.5	-
TOC mg/l	1.32	-

Note 1: MAC values are taken from Water Quality Standard = Water Quality Standards set in S.I No. 278 of 2007. European Communities (Drinking Water) (No.2) Regulations, 2007

Note 2: Water Quality Standard for Ammonium (NH_4^+) is 0.3mg/l. As the Ammonical Nitrogen results given are expressed as Ammonia as N, the standard is converted to Ammoniacal Nitrogen (mg/l N) i.e. NH_4^+ divided by 1.285

MAC Maximum Admissible Concentration. Note these standards are presented for guideline purposes only and do not relate specifically to groundwater quality standards. Therefore, due care should be exercised in cross-referencing these standards with the groundwater results obtained. Figures in bold indicate values over their MAC values.

Note 2: Water Quality Standard = Water Quality Standards set in S.I No. 278 of 2007. European Communities (Drinking Water) (No.2) Regulations, 2007

Note 3: Water Quality Standard for Ammonium (NH_4^+) is 0.3mg/l. As the Ammonical Nitrogen results given are expressed as Ammonia as N, the standard is converted to Ammoniacal Nitrogen (mg/l N) i.e. NH_4^+ divided by 1.285

Note 4: Water Quality Standard = Water Quality Standards set in the European Communities (Quality of Surface Water Intended for the Abstraction of Drinking Water) Regulations, 1989. Limit values for A2 waters are shown.

Note 5: European Communities (Quality of Salmonid Waters) Regulations, 1988 (S.I. No. 293 of 1988)

* Analysis subcontracted to Alcontrol

** Analysis subcontracted to City Analysts

TABLE 4.6: RESULTS OF MICROBIOLOGICAL ANALYSIS OF PRIVATE WELL SAMPLES

Borehole I.D	*Water Quality Standard MAC* Note 1	Total Coliforms (cfu/100 ml)	E.Coli (cfu/100 ml)
PW-1	***0***	**66**	**2**
PW-2	***0***	0	0
PW-3	***0***	**11**	**5**
PW-4	***0***	**>100**	**15**
PW-5	***0***	**29**	**6**

MAC Maximum Admissible Concentration. Note these standards are presented for guideline purposes only and do not relate specifically to groundwater quality standards. Therefore, due care should be exercised in cross-referencing these standards with the groundwater results obtained. Figures in bold indicate values over their MAC values.

Note 1: Water Quality Standard = Water Quality Standards set in S.I No. 278 of 2007. European Communities (Drinking Water) (No.2) Regulations, 2007

Note 2: Samples subcontracted to Eclipse laboratories

APPENDIX 3.8

Leachate Charts and Tables

Leachate Results

TABLE 4.4 (A): RESULTS OF CHEMICAL ANALYSIS OF LEACHATE SAMPLES

Parameter	LC-1	LC-8	LC-11	LL	LBT
pH (pH units)	7.8	7.8	7.8	7.7	7.4
Conductivity (uS/cm)	31900***	28400	37200***	24520	27720
Temperature (° C)	19.4	21.5	19.3	12.7	23.3
Odour	Strong Odour	Strong Odour	Strong Odour	Strong Odour	Medium Odour
Visual Inspection	Black	Brown	Dark Brown	Black	Black
BOD_5 – TCMP (mg/l)	300	150	3725	395	17
COD (mg/l)	5605	4280	14300	4095	2760
Ammonia-N (mg/l)	2525***	2425	3682***	2041	361
Chloride (mg/l)	3031.01	2847.63	3430.04	2100.16	2995.07
Nitrate-N (mg/l)	<0.05	<0.05	0.3	0.23	3138.60***
Nitrite-N (mg/l)	<0.03	<0.03	<0.03	<0.03	<0.03
Calcium (mg/l)	52	49	56	72	52
Iron (mg/l)	2.7	3.3	5	2.5	4.7
Potassium (mg/l)	727	744	986	618	817
Sodium (mg/l)	1110	1096	1524	923	2902

Notes:
< = Less Than
*** = Outside accredited range.

Leachate Results

TABLE 4.4 (A): RESULTS OF CHEMICAL ANALYSIS OF LEACHATE SAMPLES

Parameter	LC-1	LC-8	LC-11	LL	LBT
pH (pH units)	7.9	7.6	7.8	7.8	7.9
Conductivity (uS/cm)	25840	21570	36200***	25430	23880
Temperature (° C)	24.9	25.3	20.9	9.9	19.5
Odour	Strong Odour	Strong Odour	Strong Odour	Strong Odour	Medium Odour
Visual Inspection	Black	Brown	Dark Brown	Black	Black
BOD_3 – TCMP (mg/l)	164	141	8625	631	8
COD (mg/l)	3910	3275	17580	4520	2376
Ammonia-N (mg/l)	2112	1755	3341	2241	12
Chloride (mg/l)	2406	1968	3312	2148	2336
Nitrate-N (mg/l)	<0.05	<0.05	<0.05	0.13	2371.31***
Nitrite-N (mg/l)	<0.03	<0.03	<0.03	<0.03	<0.03
Calcium (mg/l)	62	76	76	91	63
Iron (mg/l)	3	-	5.9	3	3
Potassium (mg/l)	839	669	1247	874	901
Sodium (mg/l)	1342	1073	1939	1276	2985

Notes:
< = Less Than
*** = Outside accredited range.

Leachate Results

TABLE 4.4: RESULTS OF CHEMICAL ANALYSIS OF LEACHATE SAMPLES

Parameter	LC-1	LC-8	LC-11	LL	LBT
pH (pH units)	7.8	7.8	7.7	7.7	7.2
Conductivity (µS/cm)	23110	21850	33900***	25840	20670
Temperature (° C)	30.5	29.5	24.1	10.7	26.2
Odour	Medium Odour	Strong Odour	Strong Odour	Strong Odour	Strong Odour
Visual Inspection	Brown	Brown	Black	Black	Brown
BOD_5 – TCMP (mg/l)	165	168	6838	463	18
COD (mg/l)	3360	3293	16263	4585	2006
Ammonia-N (mg/l)	23	1886	12	20	1.18
Chloride (mg/l)	2044	1926	3128	2416	2010
Nitrate-N (mg/l)	1.38	1.34	2.25	1.38	1809.68***
Nitrite-N (mg/l)	<0.15	<0.15	<0.15	<0.15	<0.15
Calcium (mg/l)	62	67	83	71	64
Iron (mg/l)	5	7.3	8.5	3.2	4.5
Potassium (mg/l)	743	679	940	704	664
Sodium (mg/l)	1390	1274	1952	1327	2857

Notes:
< = Less Than
*** = Outside accredited range.

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Leachate Results (Annual)

TABLE 4.7 (A): RESULTS OF LABORATORY ANALYSIS OF LEACHATE SAMPLES

Parameter	LC-1	LC-8	LC-11	LL	LBT
pH (pH units)	7.7	7.8	7.8	7.7	6.1
Conductivity (uS/cm)	25230	26860	24660	26385	24600
Temperature (° C)	24.1	15.1	23.2	17.9	15.8
Odour	Foul Odour	Strong Odour	Strong Odour	Strong Odour	No Odour
Visual Inspection	Brown/black	Brown	Brown	Black/brown	Black
BOD_5 – TCMP (mg/l)	160	150	1950	130	12
COD (mg/l)	3600	4130	7140	3953	2515
Ammonia-N (mg/l)	2471	2377	2344	2164	15
Chloride (mg/l)	2784.72	2587.34	2319.66	2466.90	2643.14
Fluoride (mg/l)	0.73	0.68	12.95	0.56	0.12
Orthophosphate (mg/l)	23.35	26.01	24.95	24.76	9.40
Nitrate-N (mg/l)	0.17	<0.05	0.17	0.08	3163.62
Nitrite-N (mg/l)	<0.03	<0.03	<0.03	<0.03	<0.03
Sulphate (mg/l)	53.77	84.93	31.49	48.40	107.01
TON (mg/l)	<0.2	<0.2	<0.2	<0.2	2434***
Calcium (mg/l)	60	55	47	52	53
Iron (mg/l)	2.4	4.6	3.5	2.2	3.1
Potassium (mg/l)	736	750	684	728	631
Sodium (mg/l)	1217	1147	1140	1239	2102
Magnesium (mg/l)	34	29	33	34	33
Total Chromium	328	321	364	329	270
Manganese (µg/l)	189	271	238	184	266
Nickel (µg/l)	321	278	253	322	226
Copper (µg/l)	28	28	185	25	23
Zinc (µg/l)	173	236	300	184	244
Cadmium (µg/l)	<2	<2	<2	<2	<2
Lead (µg/l)	14	16	23	17	15
Boron (µg/l)	2257	1883	2626	2726	1890
Mercury (µg/l)	<1	<1	<1	<1	<1
Cyanide	<1	<1	<1	<1	<1
Beryllium (µg/l)	<2	26.01	<2	<2	<2
Aluminium(µg/l)	1176	<2	1666	1207	1303
Cobalt (µg/l)	55	1479	47	57	42
Arsenic (µg/l)	128	50	122	130	86
Selenium (µg/l)	9	79	9	11	8
Silver (µg/l)	<2	7	<2	<2	<2
Tin (µg/l)	70	<2	88	70	46
Antimony (µg/l)	9	134	14	10	9
Barium (µg/l)	265	8	295	269	260

Notes: < = Less Than *** = Outside accredited range.

APPENDIX 3.9

Meteorological Monitoring

Date	Evap	Rain	Temp (oC)			RH %			Atm P (mb)			NR (W/m2)			Indoor Temp (oC)			Wind Dir			Wind Speed (m/s)		
	(mm)	(mm)	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min
01/01/2010	0.7	0.6	-2.4	-0.5	-4.7	94	96	91	994	999	992	-6	90	-82	21.3	22.8	20.8	164	360	1	1.2	4.1	0.0
02/01/2010	0.1	0.0	-1.7	1.9	-6.5	93	96	85	1002	1005	998	-12	114	-143	20.3	21.2	19.4	167	360	1	1.8	6.9	0.0
03/01/2010	0.2	1.2	1.0	3.0	-3.0	76	93	67	1007	1009	1005	-45	22	-160	21.2	22.9	20.5	101	360	1	3.0	10.5	0.0
04/01/2010	0.6	0.0	-1.5	0.1	-5.4	87	95	78	1005	1009	997	-15	4	-53	21.3	22.1	19.8	185	360	10	1.6	5.4	0.0
05/01/2010	0.2	0.2	-1.7	0.7	-4.8	93	96	85	992	997	990	-33	316	-200	20.4	22.6	19.4	198	360	1	1.4	5.5	0.0
06/01/2010	0.1	0.2	-2.8	1.0	-9.5	86	95	69	995	1000	990	-17	40	-73	21.7	23.3	20.4	111	360	1	2.2	11.1	0.0
07/01/2010	0.4	0.0	-5.9	-1.6	-10.4	94	96	91	1001	1004	999	-7	63	-74	21.8	22.5	21.2	191	335	75	1.4	4.0	0.0
08/01/2010	0.1	0.0	-6.7	1.9	-11.0	94	97	91	1010	1015	1004	-31	263	-126	21.7	23.8	20.6	170	360	1	0.4	7.0	0.0
09/01/2010	0.0	0.0	-4.9	0.6	-10.1	93	96	89	1014	1015	1013	-25	62	-200	21.6	22.8	20.7	134	360	1	0.7	10.0	0.0
10/01/2010	0.0	9.0	0.8	2.7	-1.7	87	95	73	1008	1013	1003	-21	8	-200	22.4	22.7	22.1	86	360	1	3.2	11.1	0.0
11/01/2010	0.5	2.8	2.0	2.9	0.9	84	91	75	1001	1003	998	-23	10	-70	23.4	24.8	22.6	134	360	1	3.0	10.6	0.0
12/01/2010	0.5	3.2	2.3	3.4	0.9	83	93	76	984	998	976	-19	11	-71	23.4	24.2	22.8	152	249	20	8.8	23.4	0.9
13/01/2010	0.8	1.0	2.8	5.8	0.2	86	93	81	980	982	978	-5	99	-54	24.1	25.6	23.2	163	360	1	2.9	15.6	0.0
14/01/2010	0.5	0.2	3.0	6.6	-1.3	89	96	76	986	990	982	-20	100	-60	24.9	26.1	24.2	190	354	7	2.7	12.0	0.0
15/01/2010	0.5	8.0	8.9	10.4	5.9	85	92	78	986	989	980	-22	52	-90	24.1	25.3	23.2	188	281	108	8.6	25.2	1.8
16/01/2010	1.2	15.4	7.0	9.8	3.4	85	91	77	981	988	976	-35	44	-84	24.9	25.6	24.5	193	327	84	5.1	26.0	0.7
17/01/2010	1.0	0.0	5.3	8.1	3.3	82	88	74	997	1002	988	-28	33	-59	24.4	25.7	23.5	195	314	97	4.8	10.0	1.7
18/01/2010	1.0	0.0	6.8	9.6	2.4	85	88	78	1005	1007	1002	-29	11	-60	25.6	27.9	24.5	189	308	98	3.8	10.0	0.0
19/01/2010	0.9	0.6	5.9	7.4	2.3	80	91	70	998	1006	988	-21	46	-76	25.5	26.2	24.8	167	360	1	6.4	25.0	0.0
20/01/2010	1.2	2.0	4.9	7.7	1.1	89	94	79	993	997	987	-23	87	-84	25.0	26.4	24.2	185	360	1	3.2	17.9	0.0
21/01/2010	0.6	7.6	7.6	10.4	0.3	84	93	77	992	997	987	-31	29	-80	25.0	25.5	24.4	180	275	104	6.6	19.6	0.3
22/01/2010	1.0	1.4	5.5	9.9	0.5	88	94	75	999	1006	989	-31	45	-58	25.2	26.5	23.4	205	358	2	2.0	9.1	0.0
23/01/2010	0.6	0.4	1.9	3.4	0.5	95	96	93	1007	1008	1006	4	53	-55	24.1	24.7	23.7	217	360	1	1.0	2.9	0.0
24/01/2010	0.1	0.0	0.6	2.6	-0.9	97	97	96	1009	1012	1008	0	92	-62	23.4	24.8	22.2	210	359	2	1.8	6.0	0.0
25/01/2010	0.1	0.2	1.8	6.7	-1.9	93	98	79	1017	1022	1012	1	135	-99	26.0	27.9	24.9	174	360	1	1.0	5.1	0.0
26/01/2010	0.3	0.0	3.5	7.6	-0.8	78	91	61	1025	1026	1022	-14	61	-64	24.7	25.6	24.1	196	360	1	1.4	4.4	0.0
27/01/2010	0.7	0.6	5.8	8.6	4.0	90	95	80	1017	1026	1010	-4	19	-56	25.3	26.2	24.7	236	360	1	2.8	9.8	0.3
28/01/2010	0.6	2.2	4.6	6.8	2.1	91	95	85	1001	1010	985	-8	97	-57	25.8	26.2	25.4	256	360	1	2.6	8.2	0.1
29/01/2010	0.4	3.0	3.7	7.3	-0.1	87	96	64	985	987	980	-9	122	-80	25.2	25.8	23.1	226	360	1	3.6	12.7	0.3
30/01/2010	1.0	0.2	-0.4	4.1	-3.0	88	96	69	989	990	986	-34	74	-65	21.5	22.8	20.3	236	360	1	1.5	5.2	0.0
31/01/2010	0.4	0.2	-0.1	3.8	-2.2	91	96	76	992	997	990	-15	180	-62	20.0	20.9	19.5	240	360	1	1.8	9.4	0.0
	Sum	**Sum**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**
Monthly	16.2	60.2	1.8	10.4	-11.0	88	98	61	999	1026	976	-19	316	-200	23.4	27.9	19.4	182	360	1	3.0	26.0	0.0

Date	Evap	Rain	Temp (oC)			RH %			Atm Pr (mb)			NR (W/m2)			Indoor Temp (oC)			Wind Dir			Wind Speed (m/s)		
	(mm)	(mm)	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min
01/02/2010	0.3	0.2	2.2	6.2	-1.2	89	96	76	998	1000	995	-3	135	-52	20.8	23.7	18.7	207	358	3	3.0	8.7	0.0
02/02/2010	0.6	6.2	6.0	9.8	3.8	90	95	74	990	995	987	1	146	-31	24.4	25.8	23.3	210	360	1	3.7	10.9	0.0
03/02/2010	0.9	6.0	4.8	8.2	2.1	89	94	82	989	992	986	-13	71	-54	23.2	24.6	22.1	160	360	1	2.7	10.5	0.0
04/02/2010	0.5	7.0	7.2	9.8	2.5	83	88	73	980	988	973	-36	67	-83	21.8	22.4	21.3	175	285	20	5.8	15.4	0.0
05/02/2010	1.2	2.6	6.4	9.5	4.8	81	89	64	978	987	974	-27	80	-74	22.2	24.5	21.2	156	360	1	3.6	11.5	0.0
06/02/2010	1.2	0.0	3.6	5.7	0.7	95	96	83	1000	1008	987	-3	115	-59	22.2	22.8	21.9	146	360	1	1.1	5.8	0.0
07/02/2010	0.2	0.2	4.0	7.5	-0.9	86	97	74	1006	1008	1003	-12	159	-200	21.7	22.7	21.0	134	360	1	2.4	8.1	0.0
08/02/2010	0.6	0.6	3.0	4.1	1.2	81	91	69	1001	1003	1000	-14	126	-68	21.6	22.7	21.1	96	360	1	2.9	11.3	0.0
09/02/2010	0.7	0.2	2.3	5.1	-0.2	79	90	63	1002	1005	1000	-12	103	-67	23.7	25.0	22.7	68	360	1	1.9	9.5	0.0
10/02/2010	0.7	0.2	0.3	4.9	-3.5	83	93	61	1006	1010	1004	-22	149	-76	24.2	25.4	23.6	114	360	1	1.1	9.1	0.0
11/02/2010	0.4	0.0	-0.2	6.5	-5.2	82	93	60	1011	1012	1010	-23	135	-68	23.8	26.1	22.1	144	360	1	0.9	5.2	0.0
12/02/2010	0.4	0.0	1.6	6.3	-2.2	88	94	71	1012	1013	1011	-7	119	-59	23.4	24.4	22.6	134	360	1	1.1	7.2	0.0
13/02/2010	0.4	1.0	1.8	4.8	-0.4	87	95	67	1011	1013	1009	0	151	-62	21.6	22.8	20.9	111	360	1	0.8	5.2	0.0
14/02/2010	0.3	0.8	2.2	5.1	-1.1	89	94	81	1004	1009	999	-1	109	-53	20.2	20.9	19.6	215	360	1	1.4	4.8	0.0
15/02/2010	0.3	2.8	4.1	7.0	1.1	91	95	79	989	999	980	-5	88	-64	21.1	22.6	20.3	241	360	1	2.6	13.5	0.3
16/02/2010	0.5	0.2	1.7	5.9	-0.7	86	95	69	975	980	972	-13	183	-66	22.2	24.3	20.4	187	339	89	2.8	6.9	0.5
17/02/2010	0.7	0.0	1.8	6.4	-1.8	79	93	53	974	976	973	-22	188	-70	23.0	25.5	22.0	103	360	1	1.6	6.7	0.0
18/02/2010	0.8	0.0	-0.1	6.4	-3.6	87	96	60	977	979	976	-6	243	-59	22.2	23.9	20.9	178	360	1	0.8	5.8	0.0
19/02/2010	0.4	0.0	0.6	3.6	-1.0	91	96	76	980	981	979	-3	58	-78	21.9	22.9	21.2	230	360	1	1.8	6.0	0.0
20/02/2010	0.4	1.6	0.6	4.6	-1.8	87	96	66	980	982	977	3	234	-60	21.2	22.1	20.6	202	360	2	2.1	7.1	0.0
21/02/2010	0.6	4.6	-0.6	0.6	-3.6	93	96	87	975	977	974	-14	330	-108	20.7	21.0	20.4	202	360	1	1.2	3.8	0.0
22/02/2010	0.1	2.0	-0.3	4.9	-4.6	84	96	66	974	976	972	-4	348	-76	20.7	22.6	19.2	98	360	1	1.9	9.7	0.0
23/02/2010	0.6	4.4	1.5	2.5	0.5	78	92	66	974	976	969	-17	54	-105	22.4	24.0	21.4	101	360	1	3.4	10.4	0.0
24/02/2010	0.7	3.6	3.7	5.8	1.9	94	95	90	970	974	967	8	95	-17	24.1	24.8	23.5	239	360	1	1.7	9.1	0.0
25/02/2010	0.2	6.6	0.8	2.4	-0.3	92	96	86	971	974	968	-15	37	-200	23.3	23.9	22.3	213	360	1	0.8	3.4	0.0
26/02/2010	0.1	6.8	2.3	5.3	-0.2	91	95	83	973	977	969	-1	164	-89	23.8	24.2	23.4	210	357	17	2.6	9.3	0.3
27/02/2010	0.4	0.2	3.5	8.5	0.9	82	93	60	975	977	973	-6	258	-73	22.8	23.6	22.0	136	360	1	2.1	5.9	0.0
28/02/2010	0.9	0.0	1.0	5.5	-1.2	93	96	85	979	988	973	-2	122	-58	22.5	23.1	22.1	209	360	1	1.0	3.5	0.0
	Sum	**Sum**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**
Monthly	15.1	57.8	2.4	9.8	-5.2	87	97	53	988	1013	967	-10	348	-200	22.4	26.1	18.7	165	360	1	2.1	15.4	0.0

Date	Evap	Rain	Temp (oC)			RH %			Atm Pr (mb)			NR (W/m2)			Indoor Temp (oC)			Wind Dir			Wind Speed (m/s)		
	(mm)	(mm)	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min
12/03/2010	1.0	0.0	5.9	10.5	3.2	78	94	56	1011	1015	1008	4	189	-50	23.4	24.5	22.8	160	360	1	2.0	8.9	0.0
13/03/2010	1.1	0.0	5.9	9.1	3.9	76	87	62	1017	1018	1015	2	48	-38	22.9	23.3	22.6	256	360	1	1.7	7.4	0.0
14/03/2010	0.9	0.0	5.9	13.4	1.1	77	93	44	1017	1018	1015	-4	173	-54	23.0	24.7	21.9	252	360	1	2.0	9.8	0.0
15/03/2010	1.6	0.0	5.5	11.1	2.2	72	90	44	1012	1016	1010	-4	176	-53	23.4	24.8	22.3	214	360	1	2.7	8.9	0.0
16/03/2010	1.7	0.0	5.5	8.3	0.6	73	83	64	1005	1010	999	-9	66	-51	23.1	24.1	22.3	182	277	108	4.6	13.2	0.7
17/03/2010	1.4	0.0	9.8	13.3	7.8	81	90	64	998	1000	996	1	150	-51	24.2	25.7	23.1	194	310	104	6.2	14.9	1.9
18/03/2010	2.0	1.2	10.4	12.4	9.1	81	89	67	989	996	983	-1	119	-55	24.9	25.9	24.4	202	341	9	7.8	21.7	0.8
19/03/2010	1.9	1.4	7.9	9.9	5.4	75	91	60	990	993	985	-8	89	-56	25.1	25.7	24.1	172	360	2	3.3	14.2	0.0
21/03/2010	1.8	0.0	8.3	14.5	2.7	71	87	43	996	998	994	1	196	-65	24.2	26.0	22.9	201	352	89	4.6	14.8	0.8
22/03/2010	2.8	6.0	8.0	10.8	4.7	77	93	61	994	999	989	3	304	-95	24.3	25.7	23.3	221	360	1	5.7	19.2	0.5
23/03/2010	1.7	0.6	7.1	9.3	4.5	75	86	62	993	999	987	-9	77	-78	23.4	24.4	22.8	187	272	108	4.4	12.4	0.0
24/03/2010	1.5	3.8	9.3	13.0	6.9	79	92	49	983	986	979	7	435	-74	23.9	26.4	22.6	198	351	2	4.3	14.0	0.2
25/03/2010	2.2	6.8	8.7	11.7	5.8	81	93	57	979	984	975	13	360	-80	24.5	25.9	23.5	144	360	1	3.3	9.8	0.0
26/03/2010	1.6	3.8	8.4	13.3	5.5	80	92	56	978	983	975	10	271	-57	24.3	25.9	23.5	197	360	1	2.9	9.3	0.0
27/03/2010	1.7	0.0	7.5	13.0	3.2	76	94	46	989	993	983	6	300	-66	23.1	24.0	22.4	258	360	1	2.9	13.4	0.0
28/03/2010	1.9	0.0	7.2	12.0	4.2	73	92	44	991	993	987	7	243	-61	22.7	24.3	21.6	222	360	1	2.2	7.2	0.1
29/03/2010	1.6	11.6	6.1	10.3	3.7	86	94	68	978	987	970	-6	101	-55	22.9	23.5	22.1	139	360	1	3.1	13.5	0.0
30/03/2010	1.0	21.4	1.1	4.0	0.1	95	96	93	967	971	964	-14	58	-200	23.4	24.6	22.4	254	360	1	3.5	17.7	0.0
31/03/2010	0.2	7.2	2.3	7.2	0.0	81	96	56	981	989	971	19	394	-200	24.5	27.7	22.5	265	360	1	5.1	17.7	0.7
	Sum	**Sum**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**
Monthly	29.8	63.8	6.9	14.5	0.0	78	96	43	993	1018	964	1	435	-200	23.8	27.7	21.6	206	360	1	3.8	21.7	0.0

Date	Evap	Rain	Temp (oC)			RH %			Atm P (mb)			NR (W/m2)			Indoor Temp (oC)			Wind Direction			Wind Speed (m/s)		
	(mm)	(mm)	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min
01/04/2010	1.4	0.2	3.9	9.9	-0.1	78	92	49	988	990	985	12	329	-92	25.8	28.1	24.4	223	350	97	3.4	9.2	0.4
02/04/2010	1.6	4.4	5.4	9.8	2.7	82	87	61	979	985	976	-5	424	-85	25.0	26.3	24.1	172	339	41	3.8	14.0	0.2
03/04/2010	1.5	1.4	4.8	11.6	-0.6	82	93	54	984	992	979	16	412	-66	25.0	26.2	23.8	208	360	1	1.9	12.4	0.0
04/04/2010	1.2	0.8	4.9	9.8	0.2	75	93	47	996	998	992	14	278	-76	25.2	26.5	24.0	244	360	3	3.8	14.2	0.2
05/04/2010	1.8	2.4	9.5	12.5	6.9	82	89	67	992	995	990	14	264	-55	24.7	25.5	24.2	214	301	108	9.4	22.6	2.7
06/04/2010	2.1	16.4	8.3	11.7	6.2	86	93	68	990	998	986	-3	258	-73	24.7	26.7	23.7	224	360	1	5.7	20.8	0.2
07/04/2010	1.5	0.0	7.4	14.2	2.6	77	94	47	1006	1012	998	23	333	-66	25.2	27.0	23.7	270	360	1	2.2	9.0	0.0
08/04/2010	1.8	0.0	9.3	14.6	5.1	74	90	50	1014	1016	1011	13	236	-54	25.2	26.9	23.6	231	360	1	2.5	7.2	0.0
09/04/2010	1.9	0.0	10.2	14.2	6.3	66	84	46	1016	1017	1015	9	165	-51	24.3	25.9	23.2	203	320	105	3.1	9.5	0.4
10/04/2010	2.3	0.0	11.3	17.6	4.3	54	75	31	1016	1017	1015	5	200	-80	23.9	26.8	22.3	195	355	43	2.2	7.5	0.0
11/04/2010	2.9	0.0	10.7	17.6	3.9	62	87	38	1015	1016	1013	23	214	-73	24.6	28.0	23.0	102	360	1	2.0	8.1	0.0
12/04/2010	2.5	0.0	9.4	14.8	4.3	65	88	44	1014	1015	1012	17	286	-60	24.8	26.9	23.6	83	360	1	2.0	8.1	0.0
13/04/2010	1.9	0.0	8.4	13.3	3.3	70	92	36	1012	1013	1011	22	223	-70	25.0	28.1	23.4	88	360	1	2.5	8.8	0.0
14/04/2010	2.1	0.0	7.0	10.7	3.3	72	90	54	1010	1011	1008	23	324	-77	23.8	26.6	22.1	75	360	1	2.8	10.0	0.0
15/04/2010	1.5	0.0	5.6	9.9	0.9	83	94	65	1011	1013	1009	-2	263	-70	22.2	24.3	20.7	93	360	1	2.3	10.6	0.0
16/04/2010	0.9	0.0	9.1	17.0	1.4	66	92	38	1013	1015	1010	17	225	-64	23.0	27.6	20.5	140	360	1	1.7	8.7	0.0
17/04/2010	2.0	0.0	10.2	17.5	4.4	63	83	38	1006	1010	1001	10	174	-58	24.7	28.6	22.4	203	360	1	2.2	7.1	0.0
18/04/2010	2.6	0.0	8.2	14.8	2.5	70	89	44	1001	1002	1000	4	267	-69	25.1	26.7	23.7	142	360	1	1.1	6.3	0.0
19/04/2010	1.2	0.0	7.8	13.2	2.6	70	90	41	1003	1004	1002	7	238	-61	24.9	27.3	23.5	137	360	1	1.6	7.9	0.0
20/04/2010	1.5	0.0	6.7	12.3	1.5	65	88	42	1006	1008	1003	5	295	-72	23.9	25.6	22.5	193	360	1	1.7	6.8	0.0
21/04/2010	1.5	0.0	6.0	12.7	-0.9	62	86	35	1007	1008	1006	19	255	-71	21.2	23.1	18.5	101	360	1	1.5	7.1	0.0
22/04/2010	1.6	0.0	7.4	14.3	1.3	61	83	37	1003	1006	1000	17	251	-63	21.4	23.5	19.8	135	360	1	1.8	7.0	0.0
23/04/2010	1.9	0.0	10.2	15.8	5.5	52	67	39	998	1001	997	29	255	-52	21.6	23.6	20.2	210	327	98	3.4	10.6	0.2
24/04/2010	3.3	0.0	10.9	16.3	5.0	67	84	38	997	998	996	12	201	-83	21.4	22.2	20.4	200	360	1	3.4	12.2	0.0
25/04/2010	3.1	6.0	12.4	18.8	10.1	80	90	46	999	1005	995	32	439	-166	21.6	23.1	20.6	215	360	1	3.4	11.7	0.0
26/04/2010	3.1	0.0	12.5	17.9	9.2	76	89	51	1008	1010	1005	25	354	-58	22.5	25.5	21.0	218	336	96	3.2	9.0	0.4
27/04/2010	2.6	0.0	11.8	13.9	9.9	75	87	55	1006	1010	1002	11	305	-101	22.2	23.2	21.3	203	280	108	5.5	15.8	0.4
28/04/2010	2.6	0.6	13.2	16.6	10.4	76	90	59	997	1002	995	29	287	-125	22.1	23.6	20.8	207	311	105	6.4	15.9	1.3
29/04/2010	2.8	0.4	10.9	14.9	8.3	75	92	50	994	996	991	26	346	-98	22.6	23.9	21.6	251	360	1	2.5	7.8	0.3
30/04/2010	2.0	3.2	9.3	13.1	7.1	84	88	72	991	993	990	13	507	-75	21.9	22.8	21.1	223	360	1	2.5	8.7	0.1
	Sum	**Sum**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**
Monthly	60.7	35.8	8.8	18.8	-0.9	72	94	31	1002	1017	976	15	507	-166	23.6	28.6	18.5	180	360	1	3.1	22.6	0

Date	Evap	Rain	Temp oC			RH %			Atm P (mb)			NR (W/m2)			Indoor Temp oC			Wind Dir			Wins Speed (m/s)		
	(mm)	(mm)	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min
01/05/2010	1.1	4.0	8.4	13.4	5.4	83	93	59	994	997	993	31	525	-67	21.4	22.9	20.2	154	360	1	2.0	7.0	0.0
02/05/2010	1.3	1.4	7.5	10.4	3.9	79	92	60	1003	1008	997	15	558	-74	20.9	21.9	20.2	68	360	1	2.2	8.1	0.1
03/05/2010	1.1	0.0	7.3	14.7	1.4	69	92	42	1012	1016	1008	25	400	-72	20.6	23.8	18.8	113	360	1	1.6	9.3	0.0
04/05/2010	1.6	0.0	8.5	14.2	2.4	71	86	52	1015	1016	1013	12	208	-64	21.2	22.2	19.9	182	360	1	1.8	7.7	0.0
05/05/2010	1.5	6.0	11.0	17.4	7.5	85	94	64	1008	1013	1003	21	408	-34	21.8	23.5	20.5	207	360	1	1.5	6.3	0.0
06/05/2010	1.2	10.4	10.6	13.8	8.9	87	95	67	1000	1003	999	24	388	-48	22.7	25.4	21.6	95	360	1	2.6	9.5	0.0
07/05/2010	1.3	1.8	8.4	11.3	5.1	76	92	53	1001	1002	999	36	431	-75	22.7	24.5	21.5	70	360	1	3.3	11.7	0.0
08/05/2010	1.7	0.0	8.5	12.7	3.4	65	90	39	1002	1003	1002	48	316	-76	22.2	25.8	20.6	67	360	1	3.6	12.6	0.0
09/05/2010	2.5	0.0	8.2	13.8	1.0	69	93	49	1000	1002	998	49	327	-69	22.1	23.9	20.5	116	360	1	1.9	8.9	0.0
10/05/2010	1.6	0.6	6.6	10.4	2.4	74	88	60	1000	1002	999	22	546	-70	22.1	22.9	21.1	83	360	1	2.5	12.0	0.0
11/05/2010	1.3	0.8	5.7	11.5	-0.7	73	91	41	1000	1002	999	28	410	-69	21.0	22.9	19.2	140	360	1	1.5	9.5	0.0
12/05/2010	1.4	3.8	5.5	10.6	0.1	77	94	53	1001	1002	1000	41	457	-144	21.5	24.9	19.6	97	360	1	1.7	8.9	0.0
13/05/2010	1.1	4.6	8.0	13.0	3.2	74	94	51	995	1000	990	31	335	-76	20.7	22.3	19.9	209	345	7	4.2	12.3	0.0
14/05/2010	2.1	0.8	10.0	15.8	5.7	77	95	45	994	1000	990	43	414	-62	21.8	25.6	19.9	255	360	1	2.0	8.9	0.0
15/05/2010	2.0	0.0	10.0	16.1	4.2	67	91	42	1000	1002	998	34	393	-68	22.8	25.0	21.3	257	360	1	2.7	11.3	0.0
16/05/2010	2.4	0.0	10.1	16.6	4.2	70	91	45	1001	1006	998	31	408	-69	22.8	25.7	21.2	279	360	1	2.4	10.7	0.1
17/05/2010	2.3	0.0	10.9	17.5	4.8	68	89	42	1008	1011	1006	22	319	-63	23.2	25.2	21.5	225	360	1	2.0	5.6	0.0
18/05/2010	2.3	1.2	11.7	15.1	8.0	77	89	63	1010	1011	1009	18	274	-51	23.1	24.0	22.2	208	309	99	4.5	12.2	0.5
19/05/2010	2.1	0.8	15.2	21.0	10.9	82	92	60	1010	1013	1008	38	493	-88	23.6	27.2	21.9	222	357	96	2.8	11.8	0.0
20/05/2010	2.3	0.2	18.2	23.8	13.7	79	93	58	1015	1016	1013	42	319	-47	26.4	32.7	23.8	190	360	1	1.6	4.3	0.0
21/05/2010	2.0	0.0	17.4	23.0	11.2	74	93	51	1015	1016	1014	35	236	-52	27.8	32.1	25.4	212	360	1	1.9	8.2	0.0
22/05/2010	2.5	0.0	19.0	26.4	10.1	65	86	46	1013	1014	1011	33	279	-53	28.1	30.2	26.2	168	360	1	1.1	5.1	0.0
23/05/2010	2.4	0.0	19.7	27.7	11.7	65	88	37	1008	1011	1004	37	280	-53	28.6	31.9	26.8	200	360	1	1.6	8.1	0.0
24/05/2010	3.7	0.0	14.3	20.2	9.7	74	95	45	1002	1004	1000	38	458	-70	27.4	30.1	24.7	90	360	1	1.9	6.6	0.0
25/05/2010	2.3	0.0	10.5	15.6	4.7	71	89	51	999	1001	998	45	312	-72	25.8	28.3	24.2	62	360	1	2.6	9.1	0.0
26/05/2010	2.1	0.0	10.3	17.0	4.9	63	87	32	997	998	996	38	313	-76	24.6	28.0	23.1	81	360	1	2.2	9.4	0.0
27/05/2010	2.7	0.4	10.0	17.6	3.8	67	89	35	996	997	994	22	306	-80	23.7	25.2	22.6	263	360	1	2.6	11.2	0.0
28/05/2010	2.9	0.0	10.5	15.5	4.7	71	93	47	997	999	995	35	413	-66	23.3	24.2	22.0	232	360	3	2.6	9.2	0.1
29/05/2010	2.1	7.6	12.0	16.2	8.9	83	94	70	990	995	986	45	570	-76	22.8	23.8	22.1	150	360	1	2.4	11.3	0.0
30/05/2010	1.3	0.0	12.5	18.8	5.9	68	94	42	999	1003	994	36	335	-62	23.5	25.6	22.0	241	360	1	1.8	7.4	0.0
31/05/2010	2.2	8.2	13.5	17.9	8.4	57	91	41	1003	1005	1000	30	340	-190	23.5	24.7	22.3	180	360	1	3.5	13.6	0.0
	Sum	**Sum**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**
Monthly	60.2	52.6	11.0	27.7	-0.7	73	95	32	1003	1016	986	33	570	-190	23.3	32.7	18.8	165	360	1	2.3	13.6	0.0

Date	Evap	Rain	Temp oC			RH %			Atm P (mb)			NR (W/m2)			Indoor Temp oC			Wind Dir			Wind Speed (m/s)		
	(mm)	(mm)	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min
01/06/2010	3.1	16.8	14.1	21.1	8.6	79	95	47	1000	1004	997	54	478	-80	24.3	26.6	22.6	245	360	1	2.0	8.7	0.0
02/06/2010	2.5	0.0	15.4	23.0	9.8	73	92	44	1006	1007	1004	46	344	-60	25.7	28.2	24.1	221	360	1	1.8	6.4	0.0
03/06/2010	2.8	0.0	16.3	21.3	9.3	63	85	43	1005	1007	1002	41	289	-65	26.4	29.1	24.9	169	334	6	3.3	10.6	0.0
04/06/2010	3.7	0.0	17.4	21.9	13.2	62	79	48	1002	1003	1000	36	269	-63	26.0	28.9	24.4	196	352	55	3.2	9.7	0.3
05/06/2010	3.8	0.0	16.8	23.4	10.9	68	88	46	1002	1004	1001	32	269	-50	25.7	27.1	24.5	247	360	1	1.6	7.1	0.0
06/06/2010	2.6	11.8	13.6	17.2	11.3	85	93	64	999	1001	997	9	180	-50	25.0	26.5	24.3	209	360	1	1.1	5.0	0.0
07/06/2010	0.9	9.4	13.4	16.8	11.9	79	92	55	991	998	985	3	161	-62	23.3	24.9	22.5	150	360	1	3.3	11.5	0.0
08/06/2010	2.2	2.0	13.4	16.2	11.8	89	95	78	985	988	983	48	313	-37	22.7	23.7	22.1	72	360	1	2.4	8.1	0.0
09/06/2010	1.1	0.2	13.1	15.6	11.7	87	94	76	991	997	987	14	304	-33	23.0	23.6	22.6	68	360	1	3.3	12.6	0.0
10/06/2010	1.2	0.0	12.3	16.6	8.7	79	88	61	998	1000	996	26	272	-60	22.8	26.4	21.6	65	360	1	3.8	11.0	0.0
11/06/2010	2.2	0.0	12.8	21.1	5.9	77	94	55	998	1001	997	17	311	-64	23.9	27.3	22.3	205	360	1	1.8	10.6	0.0
12/06/2010	2.0	0.0	14.6	20.8	10.8	63	79	43	1003	1004	1001	48	356	-37	25.0	26.7	23.7	233	360	1	2.0	8.0	0.0
13/06/2010	3.0	6.0	12.2	17.6	9.7	84	93	56	1000	1003	997	25	481	-120	24.9	26.1	24.1	227	360	1	2.4	11.4	0.0
14/06/2010	1.9	0.0	12.3	17.3	7.2	78	92	57	1007	1012	1002	36	445	-62	24.2	26.5	22.9	141	360	1	1.7	7.3	0.0
15/06/2010	1.6	0.0	14.6	21.7	6.3	66	88	42	1014	1015	1012	46	334	-63	25.2	29.6	23.1	133	360	1	1.3	5.9	0.0
16/06/2010	2.3	0.0	17.0	22.7	9.4	66	87	47	1012	1015	1010	38	320	-60	26.6	27.8	25.1	186	360	1	1.1	4.2	0.0
17/06/2010	1.9	0.0	16.2	20.7	12.3	78	92	62	1009	1010	1008	35	333	-54	26.8	28.8	25.1	125	360	1	1.6	7.0	0.0
18/06/2010	1.6	0.0	15.6	20.5	11.0	76	93	47	1007	1009	1005	18	240	-75	27.1	28.1	26.1	150	360	1	1.5	7.5	0.0
19/06/2010	1.9	0.0	12.5	19.2	5.3	68	89	42	1006	1007	1005	41	365	-72	25.9	29.0	24.4	111	360	1	2.0	9.7	0.0
20/06/2010	2.5	0.0	14.7	23.5	4.7	61	91	29	1007	1008	1007	44	267	-91	25.8	29.9	23.8	192	360	1	1.3	6.8	0.0
21/06/2010	2.8	0.0	17.6	24.7	8.2	59	88	25	1006	1007	1005	41	229	-78	27.1	31.5	25.1	211	360	1	2.3	8.9	0.0
22/06/2010	4.6	0.0	16.8	22.1	11.1	68	88	43	1006	1007	1005	39	300	-51	27.1	29.1	25.7	214	357	1	3.3	9.6	0.1
23/06/2010	3.8	0.0	16.7	21.1	12.7	75	88	55	1004	1006	1003	17	327	-115	26.0	26.9	25.2	225	357	2	3.4	10.2	0.3
24/06/2010	3.0	0.0	16.3	21.4	12.2	71	91	51	1004	1005	1003	21	401	-49	26.1	27.7	25.0	234	360	1	2.0	7.0	0.0
25/06/2010	2.4	0.0	17.0	21.1	13.7	73	82	51	1002	1004	1000	11	333	-73	25.7	26.9	25.0	203	356	92	2.5	7.9	0.2
26/06/2010	2.9	0.0	17.5	22.6	14.2	69	87	41	999	1000	998	27	275	-57	24.8	27.5	23.6	202	339	108	4.7	13.6	0.9
27/06/2010	4.8	0.4	18.1	24.3	14.3	64	88	32	1000	1002	998	40	372	-77	24.4	27.6	22.9	226	353	2	4.4	12.3	0.3
28/06/2010	5.8	5.6	16.0	18.8	13.1	85	94	75	1001	1003	999	19	267	-57	24.2	26.0	23.3	213	360	1	4.2	13.1	0.2
29/06/2010	1.7	2.2	17.1	22.3	12.5	73	96	44	1003	1005	1000	54	418	-56	24.8	26.7	23.4	240	360	1	1.5	6.9	0.0
30/06/2010	2.4	0.0	17.6	21.6	14.9	70	84	56	1000	1004	994	28	283	-108	25.7	26.4	25.1	204	317	103	4.2	12.3	0.6
	Sum	**Sum**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**
Monthly	78.8	54.4	15.3	24.7	4.7	73	96	25	1002	1015	983	32	481	-120	25.2	31.5	21.6	184	360	1	2.5	13.6	0.0

Date	Evap	Rain	Temp oC			RH %			Atm P (mb)			NR (W/m2)			Indoor Temp (oC)			Wind Dir			Wind Speed (m/s)		
	(mm)	(mm)	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min
01/07/2010	3.6	3.6	17.6	22.6	14.7	75	90	48	989	994	987	41	439	-93	25.3	26.7	24.2	208	347	13	6.5	17.5	1.2
02/07/2010	4.8	0.2	16.0	20.8	13.0	72	87	52	991	997	988	26	304	-115	25.1	26.3	23.8	222	360	10	4.8	15.3	0.7
03/07/2010	3.7	0.0	15.6	21.1	11.5	67	84	43	1001	1002	997	36	348	-61	24.9	26.3	23.6	227	360	1	3.9	11.6	0.7
04/07/2010	4.1	0.6	16.5	21.3	12.6	71	92	47	998	1003	993	44	490	-78	24.7	26.2	23.5	246	360	3	6.3	19.2	0.5
05/07/2010	4.4	0.2	14.3	20.3	9.9	70	90	45	1007	1011	1003	15	399	-120	24.7	26.0	23.3	261	360	1	2.6	12.6	0.2
06/07/2010	2.9	0.0	13.9	17.1	10.0	79	88	64	1005	1011	998	22	261	-80	23.9	25.7	22.7	207	328	100	5.3	18.1	0.3
07/07/2010	2.4	1.0	16.7	21.5	13.6	66	91	40	998	999	997	45	339	-58	24.6	26.6	23.4	248	358	1	4.1	14.4	0.6
08/07/2010	4.2	2.6	14.2	17.9	12.2	76	90	55	999	1000	998	2	168	-104	25.1	25.9	24.2	212	351	91	3.5	9.5	0.3
09/07/2010	2.5	14.2	16.0	18.4	13.7	87	94	71	997	998	995	17	327	-68	24.2	25.0	23.8	201	358	1	3.4	14.7	0.1
10/07/2010	1.7	10.4	17.4	18.7	16.2	88	92	82	995	997	989	4	283	-62	24.2	24.7	23.8	207	345	101	4.9	14.7	1.1
11/07/2010	1.4	1.0	14.6	20.0	10.3	71	91	46	997	1000	989	40	387	-55	23.9	25.2	22.7	251	359	1	3.3	14.2	0.0
12/07/2010	3.2	0.0	15.1	20.5	10.3	71	88	46	998	1000	996	24	388	-52	24.0	25.1	22.9	124	360	1	1.4	5.5	0.0
13/07/2010	2.0	5.4	14.4	17.6	11.9	80	93	66	990	996	984	17	319	-81	24.2	24.7	23.5	113	360	1	2.4	12.7	0.0
14/07/2010	1.5	1.6	16.3	19.9	12.4	79	92	63	979	984	977	54	571	-121	24.6	27.8	23.4	149	360	1	3.6	12.3	0.0
15/07/2010	2.4	3.0	14.7	19.1	10.4	83	92	65	979	982	977	35	495	-94	25.2	26.1	24.4	207	360	1	3.4	12.6	0.0
16/07/2010	2.1	25.6	13.5	18.6	9.6	80	95	54	987	996	977	52	561	-92	24.3	25.7	23.2	274	360	1	3.5	13.1	0.2
17/07/2010	2.5	1.6	14.0	20.0	10.7	75	87	45	1000	1003	996	39	537	-105	23.5	25.0	22.6	235	360	1	3.6	13.6	0.0
18/07/2010	3.5	7.6	16.7	19.7	13.8	89	93	79	1001	1002	999	15	242	-53	23.8	24.6	23.2	212	329	101	5.4	14.0	1.4
19/07/2010	1.6	10.4	17.2	19.7	15.0	85	92	70	998	1002	996	22	525	-63	24.1	25.4	23.4	208	360	92	4.8	14.2	0.7
20/07/2010	2.2	0.4	16.4	21.8	13.2	74	90	51	993	996	989	37	404	-98	24.3	26.6	23.0	199	360	1	2.2	7.1	0.0
21/07/2010	2.7	5.6	14.3	18.3	12.7	85	92	63	988	991	987	13	422	-69	24.6	25.7	23.3	220	360	1	1.4	6.0	0.0
22/07/2010	1.2	0.6	13.7	15.9	12.3	89	94	78	998	1004	991	25	314	-35	24.1	24.9	23.1	104	360	1	1.7	7.6	0.0
23/07/2010	0.8	0.0	15.6	21.1	11.7	74	93	45	1005	1006	1004	42	348	-33	24.1	25.9	22.8	195	360	1	1.2	6.2	0.0
24/07/2010	1.9	1.0	16.3	23.5	13.2	84	92	60	1004	1006	1003	22	356	-55	24.7	27.6	23.5	231	360	1	3.0	8.7	0.1
25/07/2010	2.8	0.0	16.7	21.2	13.7	86	92	76	1004	1004	1003	16	252	-28	24.7	25.9	24.0	261	360	1	2.4	8.4	0.2
26/07/2010	1.4	0.4	19.0	23.9	15.8	83	95	65	1003	1004	1002	38	397	-43	25.6	27.2	24.4	271	360	1	3.0	9.5	0.4
27/07/2010	2.4	0.6	16.6	21.6	13.1	77	93	52	1002	1003	1001	39	509	-64	26.3	29.1	25.4	269	360	1	2.9	9.3	0.2
28/07/2010	2.9	0.2	15.4	19.9	12.4	78	92	58	1003	1004	1002	37	456	-46	25.0	25.8	24.0	275	360	1	2.5	10.5	0.1
29/07/2010	2.2	0.0	15.3	20.0	12.8	78	86	61	1003	1004	1001	15	261	-32	25.1	25.8	24.3	277	360	1	1.6	6.3	0.0
30/07/2010	1.7	2.0	16.4	19.7	13.9	86	92	79	996	1001	994	10	201	-64	25.1	25.8	24.4	237	360	1	2.9	9.2	0.2
31/07/2010	1.3	0.8	14.8	19.3	12.2	83	91	66	995	997	994	36	510	-131	24.5	25.4	23.7	262	360	1	2.7	12.2	0.0
	Sum	**Sum**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**
Monthly	78.2	100.6	15.6	23.9	9.6	78.7	95.4	39.7	997	1011	977	28	571	-131	24.6	29.1	22.6	220	360	1	3.4	19.2	0.0

Date	Evap	Rain	Temp oC			RH %			Atm P (mb)			NR (W/m2)			Indoor Temp (oC)			Wind Direction			Wind Speed (m/s)		
	(mm)	(mm)	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min
01/08/2010	1.9	0.6	14.9	18.9	12.3	81	91	64	999	1002	997	20	297	-98	24.6	25.4	23.7	247	360	1	1.3	5.5	0.0
02/08/2010	1.3	0.2	13.9	17.9	8.8	81	93	62	1004	1005	1002	11	214	-61	24.4	25.1	23.7	196	360	1	1.3	4.9	0.0
03/08/2010	1.2	2.8	14.6	18.8	10.6	83	94	66	999	1002	996	26	295	-56	23.9	24.4	23.0	258	360	1	2.6	8.4	0.3
04/08/2010	1.7	14.2	14.0	19.9	10.6	81	95	53	995	998	992	49	523	-88	24.3	27.3	22.9	241	360	1	2.6	12.6	0.0
05/08/2010	2.4	0.0	15.1	21.0	11.7	75	90	47	997	998	996	28	380	-66	24.9	26.3	23.7	257	360	1	2.6	8.9	0.3
06/08/2010	2.9	2.4	15.0	17.5	13.3	85	93	74	993	996	992	24	480	-51	24.5	25.6	23.9	228	359	23	3.9	11.7	0.3
07/08/2010	1.6	1.2	15.3	19.7	13.4	82	94	62	1000	1006	994	37	506	-137	24.1	25.0	23.4	250	360	1	2.3	9.5	0.0
08/08/2010	1.9	0.0	15.8	21.5	12.1	72	90	49	1004	1007	1000	33	342	-43	25.0	28.3	23.6	234	360	1	1.9	7.5	0.0
09/08/2010	2.4	0.8	15.8	20.2	11.2	74	93	46	996	1000	994	35	410	-66	25.1	27.7	23.9	246	360	1	3.4	10.4	0.3
10/08/2010	3.2	0.0	14.4	22.2	10.2	72	88	40	993	997	992	20	366	-61	24.9	27.7	23.4	256	360	1	3.0	11.4	0.1
11/08/2010	3.8	0.0	14.1	19.7	9.2	78	93	59	999	1002	997	12	292	-102	24.7	26.3	23.3	248	360	1	2.0	10.1	0.0
12/08/2010	1.8	0.0	13.7	17.5	10.2	79	92	65	1005	1008	1002	8	209	-62	23.9	25.2	23.2	254	360	1	2.4	9.4	0.0
13/08/2010	1.5	0.0	13.8	19.9	11.4	74	82	54	1008	1008	1007	12	285	-28	23.7	25.2	22.8	253	360	1	2.1	7.3	0.0
14/08/2010	2.3	0.0	14.3	20.2	10.5	73	87	52	1007	1008	1006	30	346	-68	24.1	26.7	22.9	131	360	1	1.8	7.7	0.0
17/08/2010	1.5	2.4	15.0	19.9	12.5	80	95	50	996	997	994	37	455	-44	24.5	25.6	23.7	263	360	1	2.4	8.6	0.0
18/08/2010	2.5	4.4	13.8	19.6	11.3	81	92	52	991	994	989	25	378	-174	24.2	25.7	23.1	236	360	1	3.1	12.8	0.3
19/08/2010	2.7	2.2	14.6	18.0	11.3	82	88	59	989	992	985	7	307	-59	23.3	24.1	22.5	195	302	66	4.1	13.6	0.8
20/08/2010	2.5	2.6	18.0	21.5	12.2	75	91	50	990	997	985	27	420	-66	24.6	27.6	23.5	234	360	5	5.0	15.1	0.6
21/08/2010	3.8	0.0	15.3	20.5	12.1	75	85	59	998	999	997	4	302	-92	24.2	25.4	23.1	231	360	1	3.3	9.3	0.4
22/08/2010	2.7	5.2	15.1	21.4	11.9	78	92	49	996	999	989	15	295	-119	24.0	25.6	23.0	218	360	1	2.8	8.1	0.0
23/08/2010	2.9	17.8	13.2	17.6	10.4	85	95	55	985	989	983	28	488	-97	24.4	26.3	23.5	248	360	1	2.8	15.3	0.0
24/08/2010	2.1	3.8	12.5	17.8	10.0	84	91	69	991	998	987	8	482	-81	23.2	24.4	22.1	254	360	1	3.6	16.8	0.1
25/08/2010	1.8	0.0	12.0	17.8	7.2	80	93	52	996	998	994	27	465	-70	23.0	24.9	21.9	122	360	1	2.0	8.1	0.0
26/08/2010	1.9	0.0	12.2	18.1	7.7	82	94	58	994	994	993	20	342	-64	23.7	27.2	22.2	84	360	1	1.7	8.9	0.0
27/08/2010	1.6	0.0	13.0	19.8	7.6	76	94	43	1000	1005	994	21	305	-56	23.9	25.3	22.6	226	360	1	1.4	9.0	0.0
28/08/2010	2.0	0.0	13.1	18.9	8.1	78	93	57	1006	1007	1005	11	372	-97	23.7	24.7	22.5	265	360	1	2.9	11.2	0.2
29/08/2010	2.2	2.2	12.7	17.0	6.2	73	92	40	1006	1010	1003	24	443	-68	23.6	26.4	22.4	201	360	1	2.8	11.9	0.0
30/08/2010	2.7	0.0	10.5	19.0	2.6	75	92	47	1011	1012	1010	14	236	-70	23.4	26.9	21.2	148	360	1	1.4	5.8	0.0
31/08/2010	1.7	0.0	12.7	20.2	5.1	72	91	45	1009	1011	1007	6	154	-61	23.8	25.6	22.3	195	359	3	1.8	6.2	0.0
	Sum	**Sum**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**
Monthly	64.4	62.8	14.1	22.2	2.6	78	95	40	999	1012	983	21	523	-174	24.1	28.3	21.2	221	360	1	2.6	16.8	0.0

Date	Evap	Rain	Temp oC			RH %			Atm P (mb)			NR (W/m2)			Indoor Temp oC			Wind Dir			Wind Speed (m/s)		
	(mm)	(mm)	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min
01/09/2010	2.2	0.0	14.9	19.7	9.7	67	81	45	1005	1007	1003	9	194	-59	24.1	26.5	22.6	165	324	86	3.0	7.8	0.0
02/09/2010	3.2	0.0	16.3	22.3	10.0	58	86	34	1004	1005	1003	8	188	-69	25.0	28.3	22.8	163	360	1	2.7	7.0	0.0
03/09/2010	3.9	0.0	15.4	21.8	8.9	69	88	37	1003	1005	1001	8	173	-65	25.4	28.0	23.5	180	360	1	1.9	8.8	0.0
04/09/2010	2.9	0.0	16.0	18.0	14.1	80	93	68	1001	1002	1000	-5	171	-119	24.5	26.2	23.9	194	360	1	2.7	9.8	0.0
05/09/2010	1.5	0.0	16.2	17.9	14.3	84	90	77	996	1001	989	13	245	-97	23.4	23.8	22.9	166	359	1	4.3	19.3	0.0
06/09/2010	1.6	0.0	14.9	17.0	13.0	89	96	78	984	989	979	-35	91	-116	22.6	22.9	22.1	165	360	1	5.0	20.4	0.0
07/09/2010	1.3	0.0	13.4	16.7	12.2	87	94	71	980	983	979	3	342	-78	22.8	24.0	21.8	211	356	80	3.3	7.9	0.3
08/09/2010	1.4	0.0	14.9	19.0	12.3	81	91	64	986	992	982	7	316	-96	23.3	25.8	21.8	216	359	1	3.2	10.1	0.2
09/09/2010	2.0	0.0	15.0	19.4	12.4	82	93	59	997	999	992	19	301	-94	24.3	26.0	23.1	225	357	76	3.4	14.3	0.3
10/09/2010	2.4	0.0	17.5	20.3	15.2	87	93	75	994	996	992	8	393	-53	24.6	25.9	23.8	221	360	1	3.9	13.1	0.0
11/09/2010	1.7	0.8	14.1	19.5	10.2	87	94	63	996	1003	992	9	414	-126	24.4	25.3	23.6	242	360	1	2.6	12.0	0.1
12/09/2010	1.9	0.4	12.8	18.6	8.9	84	95	56	1008	1010	1003	16	316	-60	23.2	24.2	22.2	241	360	1	2.6	8.7	0.2
13/09/2010	2.0	10.4	15.6	19.4	12.5	89	94	82	1003	1009	1000	0	72	-51	22.9	23.8	22.1	235	360	2	5.3	16.4	1.0
14/09/2010	1.3	15.6	14.5	17.4	9.5	81	94	56	998	1000	996	13	276	-124	23.8	25.3	23.0	250	360	1	4.7	16.4	0.4
15/09/2010	2.6	0.0	12.1	16.6	9.1	80	90	67	997	999	995	1	241	-66	22.4	23.5	21.4	258	360	1	3.7	13.0	0.4
16/09/2010	1.8	1.0	12.1	17.7	9.5	82	93	52	999	1002	998	14	257	-93	22.5	24.1	21.6	226	360	1	1.8	8.8	0.0
17/09/2010	1.7	0.0	9.7	15.2	5.5	81	94	54	1004	1006	1002	3	341	-67	22.5	23.5	21.4	239	360	1	1.4	8.3	0.0
18/09/2010	1.2	5.4	10.5	13.2	5.5	86	93	73	1002	1006	998	0	229	-54	20.9	22.4	20.4	217	343	7	3.5	11.2	0.7
19/09/2010	1.1	16.6	13.7	17.3	12.4	90	94	83	994	998	991	-2	140	-53	20.6	21.4	20.1	226	360	3	3.8	10.1	0.4
20/09/2010	1.0	0.2	15.2	19.9	12.8	83	93	65	995	998	991	6	268	-59	21.7	23.8	20.5	230	360	2	3.4	11.2	0.2
21/09/2010	2.1	0.0	15.6	18.4	13.1	77	87	61	999	999	998	6	232	-53	22.9	24.0	21.9	202	297	108	4.6	13.7	0.6
22/09/2010	2.7	45.6	15.9	19.5	13.3	86	96	69	994	998	990	15	255	-62	23.3	24.6	22.6	209	359	1	4.7	12.7	0.4
23/09/2010	2.0	10.8	12.9	17.0	10.9	94	96	79	989	992	988	7	256	-49	23.4	24.1	22.9	224	360	1	2.2	9.5	0.1
24/09/2010	0.8	0.0	10.0	14.3	4.1	77	94	50	999	1004	992	9	297	-66	22.0	23.2	21.1	115	360	1	2.0	9.4	0.0
25/09/2010	1.6	0.0	8.0	12.0	2.9	76	90	59	1006	1007	1004	1	260	-60	20.2	21.5	19.5	143	360	1	1.2	7.6	0.0
26/09/2010	0.8	0.0	9.8	15.6	6.8	69	80	51	1003	1006	1001	10	162	-46	20.1	21.6	19.1	186	360	1	1.0	5.4	0.0
27/09/2010	1.2	0.0	10.3	18.2	4.2	74	91	52	999	1001	998	-12	150	-67	25.0	29.1	18.8	171	360	1	2.2	5.4	0.0
28/09/2010	2.0	2.6	12.7	16.5	6.8	83	94	67	997	999	996	-12	147	-89	25.6	26.8	24.7	186	360	2	2.8	10.7	0.0
29/09/2010	1.4	1.6	12.2	18.7	8.1	84	95	56	997	998	995	14	326	-56	25.9	27.5	24.8	242	360	1	1.8	6.4	0.1
30/09/2010	1.7	0.0	12.0	15.5	9.0	81	89	64	993	998	984	-8	192	-83	25.3	26.7	24.1	200	277	131	4.1	11.8	0.7
	Sum	**Sum**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**
Monthly	55.1	111.0	13.5	22.3	2.9	81	96	34	997	1010	979	4	414	-126	23.3	29.1	18.8	205	360	1	3.1	20.4	0.0

Date	Evap	Rain	Temp oC			RH %			Atm Pr (mb)			NR (W/m2)			Indoor Temp oC			Wind Dir			Wind Speed (m/s)		
	(mm)	(mm)	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min
01/10/2010	1.9	2.6	13.3	16.0	9.5	76	91	54	979	984	974	-5	294	-107	25.4	26.6	24.6	228	358	5	4.4	12.7	0.7
02/10/2010	2.5	1.0	12.2	14.3	9.7	77	85	70	981	983	977	-13	138	-82	24.0	25.4	23.5	206	287	108	5.3	13.6	0.9
03/10/2010	1.9	0.2	12.4	17.1	9.7	80	91	58	977	982	974	-5	248	-63	24.2	26.0	23.1	226	360	5	2.7	7.7	0.3
04/10/2010	1.9	0.2	11.9	15.5	8.6	81	91	63	978	982	973	-15	162	-82	24.4	25.8	23.4	213	342	96	5.3	20.3	1.2
05/10/2010	2.1	0.4	12.3	15.4	10.3	73	85	51	977	980	974	-12	138	-138	24.5	26.4	23.2	220	350	96	5.2	16.1	0.5
06/10/2010	2.9	0.6	11.4	15.9	7.8	76	86	59	984	993	979	-18	197	-98	24.3	26.0	23.1	222	357	9	4.1	13.3	0.8
07/10/2010	2.2	0.0	13.8	16.7	11.0	74	86	58	995	997	993	-12	112	-73	24.5	26.3	23.3	180	293	53	5.5	15.7	1.2
08/10/2010	2.8	0.0	16.5	19.0	13.5	81	89	72	995	997	992	-2	146	-73	24.8	26.2	23.8	153	226	83	7.3	17.5	2.3
09/10/2010	2.4	0.0	15.1	18.0	12.6	81	89	70	998	999	997	0	182	-59	25.1	26.1	24.4	100	360	1	3.9	12.4	0.0
10/10/2010	2.0	0.0	12.7	13.8	12.0	86	90	82	999	1003	997	-14	55	-71	23.8	24.7	23.2	88	360	1	3.1	10.3	0.0
11/10/2010	0.9	0.0	12.3	15.9	9.7	79	93	58	1005	1007	1003	-31	125	-109	23.7	25.7	22.4	83	360	1	3.0	12.0	0.0
12/10/2010	1.8	0.0	9.8	15.4	3.6	85	95	67	1007	1007	1006	-18	131	-87	23.6	25.6	21.6	94	360	1	1.8	7.1	0.0
13/10/2010	1.0	0.0	8.8	10.2	4.7	93	95	90	1007	1008	1006	-8	52	-60	22.9	23.9	22.2	79	360	1	1.1	7.0	0.0
14/10/2010	0.2	0.0	9.3	11.1	8.1	83	93	73	1008	1009	1007	0	47	-16	23.3	23.7	23.0	99	360	1	0.9	5.3	0.0
15/10/2010	0.4	0.0	10.1	14.4	6.4	85	94	71	1007	1009	1005	-5	141	-56	23.0	23.9	22.1	193	360	1	1.3	7.1	0.0
16/10/2010	0.7	0.0	8.0	14.4	3.8	83	96	50	1009	1011	1006	-13	206	-57	22.8	24.1	21.9	122	360	1	1.1	5.9	0.0
17/10/2010	0.9	0.0	8.3	12.8	2.6	84	93	69	1009	1012	1007	-10	114	-71	21.4	22.8	20.5	214	359	2	2.6	8.2	0.0
18/10/2010	1.0	0.4	10.5	13.1	8.7	84	92	72	1004	1007	1000	-5	85	-51	21.7	22.6	21.0	258	360	1	3.0	10.4	0.4
19/10/2010	1.1	1.8	7.6	11.9	2.3	85	94	68	1000	1004	998	-13	139	-109	22.1	23.4	21.0	232	360	1	2.3	10.5	0.0
20/10/2010	0.9	0.2	4.6	10.4	-0.6	79	96	52	1007	1009	1004	-11	190	-114	21.7	23.5	20.5	224	360	1	1.7	7.3	0.0
21/10/2010	1.0	0.0	7.6	12.1	3.9	80	92	65	1006	1007	1004	-10	120	-54	20.7	21.6	19.7	228	360	11	3.0	8.0	0.4
22/10/2010	1.2	4.0	8.5	11.3	5.9	87	92	73	996	1004	989	-21	69	-61	20.2	21.0	19.6	222	360	1	4.3	13.2	0.3
23/10/2010	1.1	1.2	7.2	11.7	5.4	89	95	70	990	996	987	-3	213	-56	20.3	21.7	19.7	207	360	1	1.7	8.6	0.0
24/10/2010	0.7	0.2	3.9	11.5	-1.7	83	95	56	1004	1011	996	-18	130	-102	19.8	21.5	18.5	143	360	1	1.0	7.2	0.0
25/10/2010	0.7	0.0	6.7	10.8	0.1	74	93	58	1009	1011	1002	-20	78	-81	19.1	20.3	18.2	186	311	84	4.7	16.8	0.0
26/10/2010	1.6	5.2	13.4	17.0	9.8	88	94	75	996	1002	991	-10	124	-89	21.3	24.3	19.1	217	347	35	6.8	19.5	1.5
27/10/2010	1.7	4.4	10.8	13.5	9.0	83	93	71	994	996	992	-30	127	-73	23.5	24.2	22.8	225	349	68	4.6	11.7	0.7
28/10/2010	1.4	1.0	11.0	14.6	7.3	85	89	78	989	993	979	-19	94	-68	22.2	23.1	21.6	212	301	108	6.7	23.6	1.3
29/10/2010	1.5	26.0	10.1	14.6	6.6	91	96	80	972	980	965	-27	30	-69	22.6	23.3	22.1	226	360	1	5.1	20.8	0.0
30/10/2010	1.0	0.0	8.2	12.2	5.7	83	91	70	976	978	973	-29	79	-68	21.5	22.6	20.7	188	306	30	3.4	9.6	0.0
	Sum	**Sum**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**
Monthly	43.5	49.4	10.3	19.0	-1.7	82	96	50	995	1012	965	-13	294	-138	22.7	26.6	18.2	183	360	1	3.6	23.6	0.0

Date	Evap	Rain	Temp oC			RH %			Atm Pr (mb)			NR (W/m2)			Indoor Temp oC			Wind Dir			Wind Speed (m/s)		
	(mm)	(mm)	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min
02/11/2010	1.2	14.8	10.6	12.3	9.3	88	93	83	987	989	983	-25	15	-64	22.9	23.5	22.4	237	359	2	5.4	16.5	0.8
03/11/2010	0.9	4.4	10.3	14.2	8.1	90	94	85	992	993	988	-13	53	-73	23.6	24.8	22.7	225	360	2	3.5	13.3	0.0
04/11/2010	0.7	13.6	14.4	15.1	12.0	92	94	90	994	999	991	-10	28	-40	24.4	24.7	24.2	241	352	5	5.9	14.8	1.2
05/11/2010	0.7	3.2	9.7	12.1	8.1	88	93	82	1002	1003	999	-21	25	-60	22.7	24.1	21.6	238	358	37	2.9	12.1	0.0
06/11/2010	0.7	6.2	5.4	8.1	2.5	94	96	89	1001	1004	997	-9	142	-62	20.4	21.6	19.2	224	360	1	1.8	13.0	0.0
07/11/2010	0.2	13.0	3.9	5.8	1.8	91	96	76	990	999	960	-16	79	-84	18.3	19.4	16.4	205	360	1	4.1	22.9	0.0
08/11/2010	0.7	13.8	5.8	7.5	3.8	90	95	82	951	960	947	-21	93	-133	17.3	19.9	15.6	164	360	1	3.3	26.7	0.0
09/11/2010	0.5	20.6	6.0	9.0	0.5	85	93	74	969	982	953	-29	261	-94	20.9	22.1	19.9	81	360	1	3.9	18.7	0.0
10/11/2010	0.9	0.6	2.8	8.0	-2.2	85	96	69	984	986	977	-21	104	-78	20.6	22.3	19.6	206	360	1	3.1	12.8	0.0
12/11/2010	1.5	0.2	7.7	9.1	5.7	82	90	71	973	975	968	-28	89	-82	21.2	21.7	21.0	247	359	2	4.5	19.6	0.8
13/11/2010	1.1	3.0	5.1	7.5	3.6	86	91	73	974	975	972	-22	59	-67	20.7	21.2	20.1	214	325	99	3.6	9.6	0.9
14/11/2010	0.8	0.0	3.5	7.5	0.6	87	94	71	979	988	973	-30	109	-66	20.9	23.2	19.7	211	360	83	1.9	5.9	0.0
15/11/2010	0.5	0.0	4.8	8.4	1.6	84	90	75	995	1002	988	-32	124	-69	21.0	22.5	19.8	208	348	5	2.6	7.0	0.3
16/11/2010	0.7	0.8	7.6	9.9	3.7	76	85	66	996	1002	983	-28	32	-120	20.8	21.3	20.4	191	277	108	6.1	19.1	1.3
17/11/2010	1.6	10.4	9.2	10.4	7.3	78	91	64	977	983	976	-48	30	-133	20.3	21.0	19.8	185	281	97	7.6	26.9	1.0
18/11/2010	1.7	0.2	8.3	10.2	5.4	84	88	77	980	988	975	-28	86	-70	20.7	22.6	19.7	213	326	93	5.1	14.3	0.7
19/11/2010	1.1	0.0	7.3	11.0	4.5	81	86	67	992	995	988	-34	21	-73	22.4	24.2	21.5	163	360	1	2.6	6.9	0.0
20/11/2010	1.1	0.0	7.2	8.8	3.8	87	94	83	998	1001	995	-15	31	-73	21.4	22.0	20.7	72	360	1	2.0	8.2	0.0
21/11/2010	0.4	3.0	3.9	6.4	0.6	89	93	74	1001	1001	1000	-20	70	-64	19.7	20.8	19.0	69	360	1	1.8	9.3	0.0
22/11/2010	0.5	7.8	3.1	6.2	-0.2	93	95	92	999	1000	997	-7	73	-58	20.4	24.0	17.4	101	360	1	0.8	6.1	0.0
23/11/2010	0.1	0.4	3.9	7.1	2.4	94	96	91	1000	1001	999	-10	138	-57	24.7	26.2	23.1	147	360	1	0.8	5.7	0.0
24/11/2010	0.1	0.0	2.4	5.7	-1.5	93	96	86	998	1000	998	-21	71	-95	22.8	23.9	21.8	200	360	1	0.9	5.9	0.0
25/11/2010	0.1	2.0	0.2	4.3	-3.7	88	95	65	1000	1001	998	-23	87	-66	20.6	22.5	19.0	180	360	1	1.4	7.7	0.0
26/11/2010	0.4	0.2	1.3	4.2	-1.9	90	95	78	994	998	991	-20	97	-66	20.7	22.1	19.7	257	360	1	1.8	8.6	0.0
27/11/2010	0.3	1.2	-0.8	2.8	-2.9	86	95	65	993	995	991	-28	174	-200	21.0	22.7	20.4	159	360	1	1.4	13.2	0.0
28/11/2010	0.4	0.0	-4.3	-1.5	-6.6	94	96	91	991	994	990	-11	27	-79	20.5	21.6	19.8	172	360	1	0.9	4.4	0.0
29/11/2010	0.1	0.2	-3.1	0.7	-7.9	95	97	93	998	1001	994	-18	81	-199	19.9	21.8	18.5	103	360	1	0.7	7.0	0.0
30/11/2010	0.0	8.6	-0.3	2.7	-2.8	90	96	72	1002	1003	1000	-30	97	-200	21.0	22.0	20.3	117	360	1	2.5	13.6	0.0
	Sum	Sum	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min
Monthly	19.0	128.2	4.8	15.1	-7.9	88	97	64	990	1004	947	-22	261	-200	21.1	26.2	15.6	180	360	1	3.0	26.9	0.0

Date	Evap	Rain	Temp oC			RH%			Atm Pr (mb)			NR (W/m2)			Indoor Temp oC			Wind Dir			Wind Speed (m/s)		
	(mm)	(mm)	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min
01/12/2010	0.4	0.0	-2.7	-0.7	-7.1	93	96	79	1000	1002	998	-12	18	-78	20.2	20.8	19.6	97	360	1	1.3	7.7	0.0
02/12/2010	0.2	0.0	-3.3	-0.3	-9.0	94	96	92	1000	1001	999	-3	277	-150	20.1	20.4	19.7	134	360	1	0.8	6.0	0.0
03/12/2010	0.1	0.0	-2.7	1.1	-11.0	90	97	69	992	1000	986	-37	73	-200	19.4	20.8	18.5	204	305	108	3.7	11.5	0.5
04/12/2010	0.5	13.8	0.8	2.6	-1.2	94	96	91	987	991	985	-6	18	-58	22.2	23.1	20.8	202	360	1	1.4	7.4	0.0
05/12/2010	0.1	0.2	-1.4	-0.6	-2.8	97	97	96	991	992	990	-4	26	-39	22.8	23.2	22.6	223	360	2	1.4	4.3	0.0
06/12/2010	0.1	0.0	-3.1	1.5	-9.6	90	97	75	986	990	984	-33	1	-116	22.7	24.7	21.8	208	360	1	1.9	6.7	0.0
07/12/2010	0.3	4.0	-1.0	1.9	-7.6	92	95	83	990	996	986	-28	11	-200	22.8	23.6	22.3	122	360	1	1.2	12.4	0.0
08/12/2010	0.1	0.2	-6.8	-1.6	-10.5	93	97	88	1004	1013	996	-31	-1	-61	23.5	25.6	22.5	196	360	2	1.4	4.0	0.0
09/12/2010	0.1	3.4	0.8	3.4	-5.0	92	96	85	1017	1018	1013	-2	26	-99	23.4	24.6	22.5	214	356	14	2.3	6.4	0.0
10/12/2010	0.3	0.6	3.7	4.9	2.4	95	96	93	1018	1019	1016	11	39	-12	23.9	24.7	22.1	220	336	88	2.1	5.0	0.0
11/12/2010	0.2	1.4	3.0	4.8	-0.1	96	97	95	1013	1016	1009	7	58	-47	19.9	22.1	18.3	201	335	80	1.2	3.7	0.0
12/12/2010	0.1	0.2	3.2	6.7	-0.2	88	97	73	1009	1010	1008	-36	48	-82	17.9	19.9	16.5	121	360	1	1.6	7.4	0.0
13/12/2010	0.4	0.0	3.0	5.5	-1.8	78	93	68	1012	1016	1010	-21	28	-69	20.1	22.0	19.2	153	350	1	1.7	7.1	0.0
14/12/2010	0.5	0.0	2.2	5.0	-1.1	86	94	71	1021	1025	1016	-12	48	-57	21.1	22.6	20.0	143	360	1	0.6	2.7	0.0
15/12/2010	0.2	0.6	2.3	3.8	0.6	94	96	92	1024	1026	1017	1	47	-34	21.0	21.6	20.4	233	360	1	0.9	5.2	0.0
16/12/2010	0.1	1.6	3.0	6.6	-2.6	88	95	77	1001	1017	994	-22	270	-71	21.2	22.2	20.1	254	360	1	3.4	15.4	0.2
17/12/2010	0.6	0.0	-1.5	0.0	-2.9	93	95	89	986	994	976	-17	92	-65	19.3	20.4	17.9	276	360	1	2.7	9.1	0.2
18/12/2010	0.2	0.0	-3.2	-0.7	-7.3	92	95	88	976	978	975	-20	17	-65	20.7	21.5	19.4	247	360	1	1.6	7.8	0.0
19/12/2010	0.1	0.4	-2.2	2.7	-7.3	81	93	62	980	983	978	-41	34	-137	19.6	21.5	18.5	108	360	1	1.1	4.8	0.0
20/12/2010	0.3	0.0	-4.4	-0.2	-7.6	92	95	84	985	988	983	-30	16	-57	20.8	21.9	19.9	176	360	1	0.5	3.6	0.0
21/12/2010	0.0	0.0	-6.4	-0.8	-11.1	94	97	91	988	990	988	-1	105	-35	21.4	22.1	20.8	194	360	1	0.6	3.2	0.0
22/12/2010	0.0	0.0	-6.3	-1.0	-11.7	94	97	90	995	999	990	6	292	-57	21.8	23.2	21.0	177	360	1	0.6	3.4	0.0
23/12/2010	0.1	0.2	-5.2	-0.1	-11.0	95	97	91	1002	1006	999	0	312	-189	21.7	22.5	20.9	192	360	1	0.4	2.9	0.0
24/12/2010	0.0	0.0	-7.9	-2.9	-12.8	93	97	90	1009	1011	1006	10	117	-45	21.7	23.1	20.4	196	360	1	1.2	3.4	0.0
25/12/2010	0.1	0.0	-5.8	0.5	-10.4	93	97	82	1012	1014	1011	8	332	-147	21.1	23.2	19.9	191	284	101	1.7	6.3	0.0
26/12/2010	0.2	5.2	3.8	5.2	0.0	77	86	70	1003	1011	994	-33	14	-200	21.1	21.4	20.8	200	270	108	6.7	18.5	0.9
27/12/2010	1.1	6.6	7.3	8.8	5.0	85	89	80	988	994	985	-18	21	-76	21.7	23.0	20.8	197	279	125	7.7	19.2	1.7
28/12/2010	1.1	0.0	9.7	11.4	8.1	87	92	81	990	995	985	-10	55	-53	23.9	24.6	22.9	212	277	131	4.2	10.5	1.1
29/12/2010	0.9	0.0	9.2	10.2	7.6	88	91	82	999	1004	995	-12	16	-52	23.4	24.3	22.4	193	360	1	3.4	10.2	0.0
30/12/2010	0.7	0.0	7.9	10.7	5.7	92	95	85	1007	1009	1004	-15	24	-63	21.8	22.3	20.8	96	360	1	1.6	8.5	0.0
31/12/2010	0.3	0.0	6.7	7.9	4.7	80	94	70	1011	1012	1009	-2	20	-13	19.9	20.8	19.1	138	332	12	1.5	4.7	0.0
	Sum	**Sum**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**
Monthly	9.4	38.4	0.1	11.4	-12.8	90	97	62	1000	1026	975	-13	332	-200	21.4	25.6	16.5	185	360	1	2.0	19.2	0.0

APPENDIX 5.1

Discharge to Sewer Results for 2010
Quarterly Reports

TelLab

ANALYSIS OF AQUEOUS SAMPLES.

Date Sampled:26.10.2010
Date Received: 26.10.2010
Date Analysis Commenced:26.10.2010
Our Ref.:WS-28328& COWT34891/2010,10-43347
Your Ref : Arthurstown
Certificate No. L/10/2337

Semi Volatile Organic Compounds ug/l ++

	Sample ID	Balance Tank
Determinand	Lab ID	91971
Aniline	µg/l	<1.0
Bis(2-chloroethyl)ether	µg/l	<1.0
Phenol	µg/l	<1.0
2-Chlorophenol	µg/l	<1.0
Benzyl Alcohol	µg/l	<1.0
2-Methylphenol	µg/l	<1.0
3& 4-Methylphenol	µg/l	<1.0
2,4-dimethylphenol	µg/l	<1.0
Bis-(dichloroethoxy)methane	µg/l	<1.0
2,4-Dichlorophenol	µg/l	<1.0
1,2,4-Trichlorobenzene	µg/l	<1.0
Naphthalene	µg/l	<1.0
4-Chloro-3-methylphenol	µg/l	<1.0
2-Methylnaphthalene	µg/l	<1.0
Hexachlorocyclopentadiene	µg/l	<1.0
2,4,6 Trichlorophenol	µg/l	<1.0
2,4,5 Trichlorophenol	µg/l	<1.0
2-Chloronaphthalene	µg/l	<1.0
2-Nitroaniline	µg/l	<1.0
1,4-dinitrobenzene	µg/l	<1.0
Dimethyl phthalate	µg/l	<1.0
1,3-dinitrobenzene	µg/l	<1.0
Acenaphthylene	µg/l	<1.0
2,6-Dinitrotoluene	µg/l	<1.0
1,2-Dinitrobenzene	µg/l	<1.0
3-Nitroaniline	µg/l	<1.0
Acenaphthene	µg/l	<1.0
Dibenzofuran	µg/l	<1.0
2,4-Dinitrotoluene	µg/l	<1.0
4-Nitrophenol	µg/l	<1.0
2,3,4,6-Tetrachlorophenol	µg/l	<1.0
2,3,5,6-Tetrachlorophenol	µg/l	<1.0
Diethylphthalate	µg/l	<1.0
Fluorene	µg/l	<1.0
4-Chlorophenyl phenyl ether	µg/l	<1.0
4-Nitroaniline	µg/l	<1.0
Diphenylamine/4,6-Dinitro-2-methylphenol	µg/l	<1.0
Azobenzene	µg/l	<1.0
4-Bromophenyl phenyl ether	µg/l	<1.0
Hexachlorobenzene	µg/l	<1.0
Pentachlorophenol	µg/l	<1.0
Phenanthrene	µg/l	<1.0
Anthracene	µg/l	<1.0
Carbazole	µg/l	<1.0
Di-n-butylphthalate	µg/l	<1.0
Benzyl butyl phthalate	µg/l	<1.0
Bis(2-ethylhexyl)ester	µg/l	<1.0
Fluoranthene	µg/l	<1.0
Pyrene	µg/l	<1.0
Benzo(a)anthracene	µg/l	<1.0
Chrysene	µg/l	<1.0
Di-n-octyl phthalate	µg/l	<1.0
Benzo(b)fluoranthene	µg/l	<1.0
Benzo(k)fluoranthene	µg/l	<1.0
Benzo(a)pyrene	µg/l	<1.0
Indeno(1,2,3-cd)pyrene	µg/l	<1.0
Dibenz(a,h)anthracene	µg/l	<1.0
Benzo(ghi)perylene	µg/l	<1.0

Concentrations expressed as ug/l (ppb)
unless stated otherwise

** = INAB Accredited Tests ++ = Subcontracted Tests n/a = Non-INAB Accredited Tests
The above results relate only to the sample tested
This report should not be regenerated except in full and with the consent of T.E. Laboratories Ltd.

T.E. Laboratories

TelLab

ANALYSIS OF AQUEOUS SAMPLES.

Date Sampled:26.10.2010
Date Received: 26.10.2010
Date Analysis Commenced:26.10.2010
Our Ref.:WS-26328& COV/734891/2010,10-43347
Your Ref : Arthurstown
Certificate No. L/10/2337

Volatile Organic Compounds ug/l ++

Determinand	Sample ID / Lab ID	Balance Tank / #1971
Total VOC's	ug/l	100
1,1 Dichloroethylene	ug/l	< 1
Methylene Chloride	ug/l	< 1
Trans-1,2-dichloroethylene	ug/l	< 1
1,1-dichloroethane	ug/l	< 1
2,2-dichloropropane+1,2-dichloroethylene	ug/l	< 1
Bromochloromethane	ug/l	< 1
Chloroform	ug/l	< 1
1,1,1-trichloroethane	ug/l	< 1
1,1-dichloropropene	ug/l	< 1
Carbon tetrachloride	ug/l	< 1
Benzene	ug/l	< 1
1,2-dichloroethane	ug/l	< 1
Trichloroethylene	ug/l	< 1
1,2-dichloropropane	ug/l	< 1
Dibromomethane	ug/l	< 1
Bromodichloromethane	ug/l	< 1
cis-1,3-dichloropropene	ug/l	< 1
Toluene	ug/l	< 1
trans-1,3-dichloropropene	ug/l	< 1
1,1,2-trichloroethane	ug/l	< 1
Tetrachloroethylene	ug/l	< 1
1,3-dichloropropane	ug/l	< 1
Dibromochloromethane	ug/l	< 1
1,2-dibromoethane	ug/l	< 1
Chlorobenzene	ug/l	< 1
1,1,1,2-tetrachloroethane	ug/l	< 1
Ethylbenzene	ug/l	< 1
m+p-Xylene	ug/l	< 1
o-Xylene	ug/l	< 1
Styrene	ug/l	< 1
Bromoform	ug/l	< 1
Isopropylbenzene	ug/l	< 1
Bromobenzene	ug/l	< 1
1,2,3-trichloropropane	ug/l	< 1
n-propylbenzene	ug/l	< 1
2-chlorotoluene	ug/l	< 1
1,3,5-trimethylbenzene	ug/l	< 1
4-chlorotoluene	ug/l	< 1
Tert-butylbenzene	ug/l	< 1
1,2,4-trimethylbenzene	ug/l	100
sec-butylbenzene	ug/l	< 1
p-isopropyltoluene	ug/l	< 1
1,3-dichlorobenzene	ug/l	< 1
1,4-dichlorobenzene	ug/l	< 1
n-butylbenzene	ug/l	< 1
1,2-dichlorobenzene	ug/l	< 1
1,2-dibromo-3-chloropropane	ug/l	< 1
1,2,4-trichlorobenzene	ug/l	< 1
Hexachlorobutadiene	ug/l	< 1
Naphthalene	ug/l	< 1
1,2,3-trichlorobenzene	ug/l	< 1

Concentrations expressed as ug/l (ppb)
unless stated otherwise

** = INAB Accredited Tests ++ = Subcontracted Tests n/a = Non-INAB Accredited Tests

The above results relate only to the sample tested.
This report should not be regenerated except in full and with the consent of T.E. Laboratories Ltd.

T.E. Laboratories

TelLab

ANALYSIS OF AQUEOUS SAMPLE.

Date Sampled:26.10.2010
Date Received: 26.10.2010
Date Analysis Commenced:26.10.2010
Our Ref.:WS-28328& COV/734891/2010,10-43347
Your Ref : Arthurstown
Certificate No. L/10/2337

DETERMINAND	Sample ID Lab ID	Balance Tank 91971
Alkalinity	n/a	400
Ammonia as NH_3	n/a	2.1
Ammoniacal Nitrogen	n/a	1.7
Arsenic (ug/l)	++	150
BOD	n/a	28
Cadmium (ug/l)	n/a	<0.1
Chloride	**	2755
Chromium (ug/l)	**	513
COD	n/a	3230
Copper	**	<0.05
Cyanide	n/a	0.02
Fluoride	**	<2.5
Kjeldhal Nitrogen	n/a	37
Lead (ug/l)	**	19
Magnesium	**	114
Manganese	**	0.54
Mercury (ug/l)	++	<0.05
Nickel	**	0.57
Nitrate as N	n/a	2723
Nitrite as N	**	<5
Orthophosphate as P	**	34
pH	**	6.5
Selenium (ug/l)	++	<3
Sulphate	**	147
Suspended Solids	n/a	770
TOC	n/a	842
Zinc	**	0.53
Faecal Coliforms **(cfu/100mls)**	n/a	**>100**
Total Coliforms **(cfu/100mls)**	n/a	**13**

Concentrations are expressed as mg/l (ppm)
unless otherwise specified.

** = INAB Accredited Tests ++ = Subcontracted Tests n/a = Non-INAB Accredited Tests

The above results relate only to the sample tested.
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T.E. Laboratories

TelLab

ANALYSIS OF AQUEOUS SAMPLES.

Date Sampled:13.07.2010
Date Received: 13.07.2010
Date Analysis Commenced:13.07.2010
Our Ref.:WS-27569, COV/709398/2010, 10-39793
Your Ref : Arthurstown
Certificate No. L/10/1533

ORGANOCHLORINE PESTICIDES (ng/l) ++

Determinand	Sample ID Lab ID	Balance Tank 89744
123 Trichlorobenzene	++	<2000
124 TCB	++	<2000
135 Trichlorobenzene	++	<2000
Aldrin	++	<800
Endosulphan A	++	<800
HCH - alpha	++	<600
Endosulphan B	++	<800
HCH - beta	++	<600
Alpha-Chlordane	++	<800
Dichlobenil	++	<400
Dieldrin	++	<800
Endrin	++	<800
HCH - gamma	++	<600
Heptachlor Epoxide	++	<400
Hexachlorobenzene	++	<400
Hexachlorobutadiene	++	<1400
Isodrin	++	<800
DDE (op)	++	<400
DDE (pp)	++	<400
TDE (op)	++	<400
TDE (pp)	++	<400
DDT (op)	++	<400
DDT (pp)	++	<400
Tecnazene	++	<2000
Gamma Chlordane	++	<400
Triallate	++	<2000
Trifluralin	++	<8000

Concentrations expressed as ng/l
unless stated otherwise

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T.E. Laboratories

TelLab

ANALYSIS OF AQUEOUS SAMPLES.

Date Sampled:13.07.2010
Date Received: 13.07.2010
Date Analysis Commenced:13.07.2010
Our Ref.:WS-27569, COV/709398/2010, 10-39793
Your Ref : Arthurstown
Certificate No. L/10/1533

Semi Volatile Organic Compounds ug/l ++

Determinand	Sample ID / Lab ID	Balance Tank / 89744
Aniline	ug/l	<1.0
Bis(2-chloroethyl)ether	ug/l	<1.0
Phenol	ug/l	<1.0
2-Chlorophenol	ug/l	<1.0
Benzyl Alcohol	ug/l	<1.0
2-Methylphenol	ug/l	<1.0
3& 4-Methylphenol	ug/l	<1.0
2,4-dimethylphenol	ug/l	<1.0
Bis-(dichloroethoxy)methane	ug/l	<1.0
2,4-Dichlorophenol	ug/l	<1.0
1,2,4-Trichlorobenzene	ug/l	<1.0
Naphthalene	ug/l	<1.0
4-Chloro-3-methylphenol	ug/l	<1.0
2-Methylnaphthalene	ug/l	<1.0
Hexachlorocyclopentadiene	ug/l	<1.0
2,4,6 Trichlorophenol	ug/l	<1.0
2,4,5 Trichlorophenol	ug/l	<1.0
2-Chloronaphthalene	ug/l	<1.0
2-Nitroaniline	ug/l	<1.0
1,4-dinitrobenzene	ug/l	<1.0
Dimethyl phthalate	ug/l	<1.0
1,3-dinitrobenzene	ug/l	<1.0
Acenaphthylene	ug/l	<1.0
2,6-Dinitrotoluene	ug/l	<1.0
1,2-Dinitrobenzene	ug/l	<1.0
3-Nitroaniline	ug/l	<1.0
Acenaphthene	ug/l	<1.0
Dibenzofuran	ug/l	<1.0
2,4-Dinitrotoluene	ug/l	<1.0
4-Nitrophenol	ug/l	<1.0
2,3,4,6-Tetrachlorophenol	ug/l	<1.0
2,3,5,6-Tetrachlorophenol	ug/l	<1.0
Diethylphthalate	ug/l	<1.0
Fluorene	ug/l	<1.0
4-Chlorophenyl phenyl ether	ug/l	<1.0
4-Nitroaniline	ug/l	<1.0
Diphenylamine/4,6-Dinitro-2-methylphenol	ug/l	<1.0
Azobenzene	ug/l	<1.0
4-Bromophenyl phenyl ether	ug/l	<1.0
Hexachlorobenzene	ug/l	<1.0
Pentachlorophenol	ug/l	<1.0
Phenanthrene	ug/l	<1.0
Anthracene	ug/l	<1.0
Carbazole	ug/l	<1.0
Di-n-butylphthalate	ug/l	<1.0
Benzyl butyl phthalate	ug/l	<1.0
Bis(2-ethylhexyl)ester	ug/l	<1.0
Fluoranthene	ug/l	<1.0
Pyrene	ug/l	<1.0
Benzo(a)anthracene	ug/l	<1.0
Chrysene	ug/l	<1.0
Di-n-octyl phthalate	ug/l	<1.0
Benzo(b)fluoranthene	ug/l	<1.0
Benzo(k)fluoranthene	ug/l	<1.0
Benzo(a)pyrene	ug/l	<1.0
Indeno(1,2,3-cd)pyrene	ug/l	<1.0
Dibenz(a,h)anthracene	ug/l	<1.0
Benzo(ghi)perylene	ug/l	<1.0

Concentrations expressed as ug/l (ppb)
unless stated otherwise

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T.E. Laboratories

TelLab

ANALYSIS OF AQUEOUS SAMPLES.

Date Sampled:13.07.2010
Date Received: 13.07.2010
Date Analysis Commenced:13.07.2010
Our Ref.:WS-27569, COV/709398/2010, 10-39793
Your Ref.: Arthurstown
Certificate No. L/10/1533

Volatile Organic Compounds ug/l ++

	Sample ID	Balance Tank
Determinand	**Lab ID**	**89744**
Total VOC's	ug/l	< 1
1,1 Dichloroethylene	ug/l	< 1
Methylene Chloride	ug/l	< 1
Trans-1,2-dichloroethylene	ug/l	< 1
1,1-dichloroethane	ug/l	< 1
2,2-dichloropropane+1,2-dichloroethylene	ug/l	< 1
Bromochloromethane	ug/l	< 1
Chloroform	ug/l	< 1
1,1,1-trichloroethane	ug/l	< 1
1,1-dichloropropene	ug/l	< 1
Carbon tetrachloride	ug/l	< 1
Benzene	ug/l	< 1
1,2-dichloroethane	ug/l	< 1
Trichloroethylene	ug/l	< 1
1,2-dichloropropane	ug/l	< 1
Dibromomethane	ug/l	< 1
Bromodichloromethane	ug/l	< 1
cis-1,3-dichloropropene	ug/l	< 1
Toluene	ug/l	< 1
trans-1,3-dichloropropene	ug/l	< 1
1,1,2-trichloroethane	ug/l	< 1
Tetrachloroethylene	ug/l	< 1
1,3-dichloropropane	ug/l	< 1
Dibromochloromethane	ug/l	< 1
1,2-dibromoethane	ug/l	< 1
Chlorobenzene	ug/l	< 1
Ethylbenzene	ug/l	< 1
1,1,1,2-tetrachloroethane	ug/l	< 1
m+p-Xylene	ug/l	< 1
o-Xylene	ug/l	< 1
Styrene	ug/l	< 1
Bromoform	ug/l	< 1
Isopropylbenzene	ug/l	< 1
Bromobenzene	ug/l	< 1
1,2,3-trichloropropane	ug/l	< 1
n-propylbenzene	ug/l	< 1
2-chlorotoluene	ug/l	< 1
1,3,5-trimethylbenzene	ug/l	< 1
4-chlorotoluene	ug/l	< 1
Tert-butylbenzene	ug/l	< 1
1,2,4-trimethylbenzene	ug/l	< 1
sec-butylbenzene	ug/l	< 1
1,3-dichlorobenzene	ug/l	< 1
p-isopropyltoluene	ug/l	< 1
1,4-dichlorobenzene	ug/l	< 1
n-butylbenzene	ug/l	< 1
1,2-dichlorobenzene	ug/l	< 1
1,2-dibromo-3-chloropropane	ug/l	< 1
1,2,4-trichlorobenzene	ug/l	< 1
Hexachlorobutadiene	ug/l	< 1
Naphthalene	ug/l	< 1
1,2,3-trichlorobenzene	ug/l	< 1

Concentrations are expressed as ug/l (ppb)
unless otherwise specified.

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T.E. Laboratories

TelLab

ANALYSIS OF AQUEOUS SAMPLE.

Date Sampled:13.07.2010
Date Received: 13.07.2010
Date Analysis Commenced:13.07.2010
Our Ref.:WS-27569, COV/709398/2010, 10-39793
Your Ref : Arthurstown
Certificate No. L/10/1533

DETERMINAND	Sample ID Lab ID	Balance Tank 89744
Alkalinity	n/a	495
Ammonia as NH_3	n/a	1.8
Ammoniacal Nitrogen	n/a	1.5
Arsenic (ug/l)	++	72
BOD	n/a	54
Cadmium (ug/l)	**	0.97
Chloride	**	2685
Chromium (ug/l)	**	490
COD	n/a	2956
Copper	**	<0.05
Cyanide	n/a	0.02
Fluoride	**	<0.5
Kjeldhal Nitrogen	n/a	62
Lead (ug/l)	**	8.7
Magnesium	**	112
Manganese	**	0.46
Mercury (ug/l)	++	<0.05
Nickel	**	0.48
Nitrate as N	n/a	2688
Nitrite as N	**	<0.30
Orthophosphate as P	**	40
pH	**	7.7
Selenium (ug/l)	++	<3
Sulphate	**	102
Suspended Solids	n/a	340
TOC	n/a	884
Zinc	**	0.46
Faecal Coliforms **(cfu/10mls)**	n/a	**34**
Total Coliforms **(cfu/10mls)**	n/a	**>100**

Concentrations are expressed as mg/l (ppm)
unless otherwise specified.

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T.E. Laboratories

TelLab

ANALYSIS OF AQUEOUS SAMPLES.

Date Sampled:27.04.2010
Date Received: 27.04.2010
Date Analysis Commenced:27.04.2010
Our Ref.:WS-26984, COV/690378/2010 & 10-37835
Your Ref : Arthurstown
Certificate No. L/10/0922

Determinand	Sample ID Lab ID	Balance Tank 88096
123 Trichlorobenzene		<120
124 TCB		<120
135 Trichlorobenzene		<120
Aldrin		<120
Endosulphan A		<120
HCH - alpha		<40
Endosulphan B		<120
HCH - beta		<40
Alpha-Chlordane		<40
Dichlobenil		244
Dieldrin		<120
Endrin		<120
HCH - gamma		<40
Heptachlor Epoxide		<40
Hexachlorobenzene		<40
Hexachlorobutadiene		<40
Isodrin		<120
DDE (op)		<40
DDE (pp)		<40
TDE (op)		<40
TDE (pp)		<40
DDT (op)		<40
DDT (pp)		<40
Tecnazene		<200
Gamma Chlordane		<40
Triallate		<200
Trifluralin		<200

Concentrations expressed as ng/l
unless stated otherwise

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T.E. Laboratories

TelLab

ANALYSIS OF AQUEOUS SAMPLES.

Date Sampled:27.04.2010
Date Received: 27.04.2010
Date Analysis Commenced:27.04.2010
Our Ref.:WS-26984, COWI/90378/2010 & 10-37835
Your Ref : Arthurstown
Certificate No. L/10/0922

Semi Volatile Organic Compounds ug/l ++

	Sample ID	Balance Tank
Determinand	Lab ID	88096
Aniline	µg/l	<1.0
Bis(2-chloroethyl)ether	µg/l	<1.0
Phenol	µg/l	<1.0
2-Chlorophenol	µg/l	<1.0
Benzyl Alcohol	µg/l	<1.0
2-Methylphenol	µg/l	<1.0
3& 4-Methylphenol	µg/l	<1.0
2,4-dimethylphenol	µg/l	<1.0
Bis-(dichloroethoxy)methane	µg/l	<1.0
2,4-Dichlorophenol	µg/l	<1.0
1,2,4-Trichlorobenzene	µg/l	<1.0
Naphthalene	µg/l	<1.0
4-Chloro-3-methylphenol	µg/l	<1.0
2-Methylnaphthalene	µg/l	<1.0
Hexachlorocyclopentadiene	µg/l	<1.0
2,4,6 Trichlorophenol	µg/l	<1.0
2,4,5 Trichlorophenol	µg/l	<1.0
2-Chloronaphthalene	µg/l	<1.0
2-Nitroaniline	µg/l	<1.0
1,4-dinitrobenzene	µg/l	<1.0
Dimethyl phthalate	µg/l	<1.0
1,3-dinitrobenzene	µg/l	<1.0
Acenaphthylene	µg/l	<1.0
2,6-Dinitrotoluene	µg/l	<1.0
1,2-Dinitrobenzene	µg/l	<1.0
3-Nitroaniline	µg/l	<1.0
Acenaphthene	µg/l	<1.0
Dibenzofuran	µg/l	<1.0
2,4-Dinitrotoluene	µg/l	<1.0
4-Nitrophenol	µg/l	<1.0
2,3,4,6-Tetrachlorophenol	µg/l	<1.0
2,3,5,6-Tetrachlorophenol	µg/l	<1.0
Diethylphthalate	µg/l	<1.0
Fluorene	µg/l	<1.0
4-Chlorophenyl phenyl ether	µg/l	<1.0
4-Nitroaniline	µg/l	<1.0
Diphenylamine/4,6-Dinitro-2-methylphenol	µg/l	<1.0
Azobenzene	µg/l	<1.0
4-Bromophenyl phenyl ether	µg/l	<1.0
Hexachlorobenzene	µg/l	<1.0
Pentachlorophenol	µg/l	<1.0
Phenanthrene	µg/l	<1.0
Anthracene	µg/l	<1.0
Carbazole	µg/l	<1.0
Di-n-butylphthalate	µg/l	<1.0
Benzyl butyl phthalate	µg/l	<1.0
Bis(2-ethylhexyl)ester	µg/l	<1.0
Fluoranthene	µg/l	<1.0
Pyrene	µg/l	<1.0
Benzo(a)anthracene	µg/l	<1.0
Chrysene	µg/l	<1.0
Di-n-octyl phthalate	µg/l	<1.0
Benzo(b)fluoranthene	µg/l	<1.0
Benzo(k)fluoranthene	µg/l	<1.0
Benzo(a)pyrene	µg/l	<1.0
Indeno(1,2,3-cd)pyrene	µg/l	<1.0
Dibenz(a,h)anthracene	µg/l	<1.0
Benzo(ghi)perylene	µg/l	<1.0

Concentrations expressed as ug/l (ppb)
unless stated otherwise

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T.E. Laboratories

TelLab

ANALYSIS OF AQUEOUS SAMPLES.

Date Sampled:27.04.2010
Date Received: 27.04.2010
Date Analysis Commenced:27.04.2010
Our Ref.:WS-26984, COV/690378/2010 & 10-37835
Your Ref : Arthurstown
Certificate No. L/10/0922

Volatile Organic Compounds ug/l ++

	Sample ID	Balance Tank
Determinand	Lab ID	38095
Total VOC's	ug/l	<1
1,1 Dichloroethylene	ug/l	<1
Methylene Chloride	ug/l	<1
Trans-1,2-dichloroethylene	ug/l	<1
1,1-dichloroethane	ug/l	<1
2,2-dichloropropane+1,2-dichloroethylene	ug/l	<1
Bromochloromethane	ug/l	<1
Chloroform	ug/l	<1
1,1,1-trichloroethane	ug/l	<1
Carbon tetrachloride + 1,1-dichloropropene	ug/l	<1
Benzene	ug/l	<1
1,2-dichloroethane	ug/l	<1
Trichloroethylene	ug/l	<1
1,2-dichloropropane	ug/l	<1
Dibromomethane	ug/l	<1
Bromodichloromethane	ug/l	<1
cis-1,3-dichloropropene	ug/l	<1
Toluene	ug/l	<1
trans-1,3-dichloropropene	ug/l	<1
1,1,2-trichloroethane	ug/l	<1
Tetrachloroethylene	ug/l	<1
1,3-dichloropropane	ug/l	<1
Dibromochloromethane	ug/l	<1
1,2-dibromoethane	ug/l	<1
Chlorobenzene	ug/l	<1
Ethylbenzene+1,1,1,2-tetrachloroethane	ug/l	<1
m+p-Xylene	ug/l	<1
o-Xylene	ug/l	<1
Styrene	ug/l	<1
Bromoform	ug/l	<1
Isopropylbenzene	ug/l	<1
Bromobenzene	ug/l	<1
1,2,3-trichloropropane	ug/l	<1
n-propylbenzene	ug/l	<1
2-chlorotoluene	ug/l	<1
1,3,5-trimethylbenzene	ug/l	<1
4-chlorotoluene	ug/l	<1
Tert-butylbenzene	ug/l	<1
1,2,4-trimethylbenzene	ug/l	<1
sec-butylbenzene	ug/l	<1
1,3-dichlorobenzene+p-isopropyltoluene	ug/l	<1
1,4-dichlorobenzene	ug/l	<1
n-butylbenzene	ug/l	<1
1,2-dichlorobenzene	ug/l	<1
1,2-dibromo-3-chloropropane	ug/l	<1
1,2,4-trichlorobenzene	ug/l	<1
Hexachlorobutadiene	ug/l	<1
Naphthalene	ug/l	<1
1,2,3-trichlorobenzene	ug/l	<1

Concentrations expressed as ug/l (ppb)
unless stated otherwise

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T.E. Laboratories

TelLab

ANALYSIS OF AQUEOUS SAMPLE.

Date Sampled:27.04.2010
Date Received: 27.04.2010
Date Analysis Commenced:27.04.2010
Our Ref.:WS-26984, COV\690378/2010 & 10-37835
Your Ref : Arthurstown
Certificate No. L/10/0922

	Sample ID	Balance Tank
DETERMINAND	**Lab ID**	**88096**
Alkalinity	n/a	500
Ammonia as NH_3	n/a	0.38
Ammoniacal Nitrogen	n/a	0.31
Arsenic (ug/l)	++	65
BOD	n/a	26
Cadmium (ug/l)	n/a	1.2
Chloride	**	2068
Chromium	**	0.38
COD	n/a	1994
Copper	**	<0.05
Cyanide	n/a	0.02
Fluoride	**	<5
Kjeldhal Nitrogen	n/a	45
Lead (ug/l)	n/a	12
Magnesium	**	104
Manganese	**	0.49
Mercury (ug/l)	++	<0.05
Nickel	**	0.41
Nitrate as N	n/a	2095
Nitrite as N	**	<3.04
Orthophosphate as P	**	28
pH	**	7.9
Selenium (ug/l)	++	<3
Sulphate	**	231
Suspended Solids	n/a	152
TOC	n/a	660
Zinc	**	0.25
Faecal Coliforms **(cfu/20mls)**	n/a	**4**
Total Coliforms **(cfu/20mls)**	n/a	**>100**

Concentrations are expressed as mg/l (ppm)
unless otherwise specified.

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T.E. Laboratories

TelLab

ANALYSIS OF AQUEOUS SAMPLES.

Date Sampled:05.01.2010
Date Received: 05.01.2010
Date Analysis Commenced:05.01.2010
Our Ref.:WS-26176, COV/662545/2010,10-34360
Your Ref : Arthurstown
Certificate No. L/10/0117

ORGANOCHLORINE PESTICIDES (ng/l) ++

Determinand	Sample ID Lab ID	Balance Tank 85638
123 Trichlorobenzene		<120
124 TCB		<120
135 Trichlorobenzene		<120
Aldrin		<120
Endosulphan A		<120
HCH - alpha		<40
Endosulphan B		<120
HCH - beta		<40
Alpha-Chlordane		<40
Dichlobenil		654
Dieldrin		<120
Endrin		<120
HCH - gamma		<40
Heptachlor Epoxide		<40
Hexachlorobenzene		<40
Hexachlorobutadiene		<40
Isodrin		<120
DDE (op)		<40
DDE (pp)		<40
TDE (op)		<40
TDE (pp)		<40
DDT (op)		<40
DDT (pp)		<40
Tecnazene		<200
Gamma Chlordane		<40
Triallate		<200
Trifluralin		<200

Concentrations expressed as ng/l
unless stated otherwise

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T.E. Laboratories

TelLab

ANALYSIS OF AQUEOUS SAMPLES.

Date Sampled:05.01.2010
Date Received: 05.01.2010
Date Analysis Commenced:05.01.2010
Our Ref :WS-26176, COV/982545/2010,10-34360
Your Ref : Arthurstown
Certificate No. L/10/0117

Semi Volatile Organic Compounds ug/l ++

	Sample ID	Balance Tank
Determinand	Lab ID	85638
Aniline	µg/l	<1.0
Bis(2-chloroethyl)ether	µg/l	<1.0
Phenol	µg/l	1.5
2-Chlorophenol	µg/l	<1.0
Benzyl Alcohol	µg/l	<1.0
2-Methylphenol	µg/l	<1.0
3& 4-Methylphenol	µg/l	<1.0
2,4-dimethylphenol	µg/l	<1.0
Bis-(dichloroethoxy)methane	µg/l	<1.0
2,4-Dichlorophenol	µg/l	<1.0
1,2,4-Trichlorobenzene	µg/l	<1.0
Naphthalene	µg/l	<1.0
4-Chloro-3-methylphenol	µg/l	<1.0
2-Methylnapthalene	µg/l	<1.0
Hexachlorocyclopentadiene	µg/l	<1.0
2,4,6 Trichlorophenol	µg/l	<1.0
2,4,5 Trichlorophenol	µg/l	<1.0
2-Chloronaphthalene	µg/l	<1.0
2-Nitroaniline	µg/l	<1.0
1,4-dinitrobenzene	µg/l	<1.0
Dimethyl phthalate	µg/l	<1.0
1,3-dinitrobenzene	µg/l	<1.0
Acenaphthylene	µg/l	<1.0
2,6-Dinitrotoluene	µg/l	<1.0
1,2-Dinitrobenzene	µg/l	<1.0
3-Nitroaniline	µg/l	<1.0
Acenaphthene	µg/l	<1.0
Dibenzofuran	µg/l	<1.0
2,4-Dinitrotoluene	µg/l	<1.0
4-Nitrophenol	µg/l	<1.0
2,3,4,6-Tetrachlorophenol	µg/l	<1.0
2,3,5,6-Tetrachlorophenol	µg/l	<1.0
Diethylphthalate	µg/l	<1.0
Fluorene	µg/l	<1.0
4-Chlorophenyl phenyl ether	µg/l	<1.0
4-Nitroaniline	µg/l	<1.0
Diphenylamine/4,6-Dinitro-2-methylphenol	µg/l	<1.0
Azobenzene	µg/l	<1.0
4-Bromophenyl phenyl ether	µg/l	<1.0
Hexachlorobenzene	µg/l	<1.0
Pentachlorophenol	µg/l	<1.0
Phenanthrene	µg/l	<1.0
Anthracene	µg/l	<1.0
Carbazole	µg/l	<1.0
Di-n-butylphthalate	µg/l	<1.0
Benzyl butyl phthalate	µg/l	<1.0
Bis(2-ethylhexyl)ester	µg/l	<1.0
Fluoranthene	µg/l	<1.0
Pyrene	µg/l	<1.0
Benzo(a)anthracene	µg/l	<1.0
Chrysene	µg/l	<1.0
Di-n-octyl phthalate	µg/l	<1.0
Benzo(b)fluoranthene	µg/l	<1.0
Benzo(k)fluoranthene	µg/l	<1.0
Benzo(a)pyrene	µg/l	<1.0
Indeno(1,2,3-cd)pyrene	µg/l	<1.0
Dibenz(a,h)anthracene	µg/l	<1.0
Benzo(ghi)perylene	µg/l	<1.0

Concentrations expressed as ug/l (ppb)
unless stated otherwise

** = INAB Accredited Tests ++ = Subcontracted Tests n/a = Non-INAB Accredited Tests
The above results relate only to the sample tested
This report should not be regenerated except in full and with the consent of T.E. Laboratories Ltd.

T.E. Laboratories

TelLab

ANALYSIS OF AQUEOUS SAMPLES.

Date Sampled 05.01.2010
Date Received: 05.01.2010
Date Analysis Commenced:05.01.2010
Our Ref.:WS-26176, COVI552545/2010,10-34360
Your Ref : Arthurstown
Certificate No. L/10/0117

Volatile Organic Compounds ug/l ++

	Sample ID	Balance Tank
Determinand	Lab ID	85638
Total VOC's	ug/l	< 1
1,1 Dichloroethylene	ug/l	< 1
Methylene Chloride	ug/l	< 1
Trans-1,2-dichlorcethylene	ug/l	< 1
1,1-dichloroethane	ug/l	< 1
2,2-dichloropropane+1,2-dichloroethylene	ug/l	< 1
Bromochloromethane	ug/l	< 1
Chloroform	ug/l	< 1
1,1,1-trichloroethane	ug/l	< 1
Carbon tetrachloride + 1,1-dichloropropene	ug/l	< 1
Benzene	ug/l	< 1
1,2-dichloroethane	ug/l	< 1
Trichloroethylene	ug/l	< 1
1,2-dichloropropane	ug/l	< 1
Dibromomethane	ug/l	< 1
Bromodichloromethane	ug/l	< 1
cis-1,3-dichloropropene	ug/l	< 1
Toluene	ug/l	< 1
trans-1,3-dichloropropene	ug/l	< 1
1,1,2-trichloroethane	ug/l	< 1
Tetrachloroethylene	ug/l	< 1
1,3-dichloropropane	ug/l	< 1
Dibromochloromethane	ug/l	< 1
1,2-dibromoethane	ug/l	< 1
Chlorobenzene	ug/l	< 1
Ethylbenzene+1,1,1,2-tetrachloroethane	ug/l	< 1
m+p-Xylene	ug/l	< 1
o-Xylene	ug/l	< 1
Styrene	ug/l	< 1
Bromoform	ug/l	< 1
Isopropylbenzene	ug/l	< 1
Bromobenzene	ug/l	< 1
1,2,3-trichloropropane	ug/l	< 1
n-propylbenzene	ug/l	< 1
2-chlorotoluene	ug/l	< 1
1,3,5-trimethylbenzene	ug/l	< 1
4-chlorotoluene	ug/l	< 1
Tert-butylbenzene	ug/l	< 1
1,2,4-trimethylbenzene	ug/l	< 1
sec-butylbenzene	ug/l	< 1
1,3-dichlorobenzene+p-isopropyltoluene	ug/l	< 1
1,4-dichlorobenzene	ug/l	< 1
n-butylbenzene	ug/l	< 1
1,2-dichlorobenzene	ug/l	< 1
1,2-dibromo-3-chloropropane	ug/l	< 1
1,2,4-trichlorobenzene	ug/l	< 1
Hexachlorobutadiene	ug/l	< 1
Naphthalene	ug/l	< 1
1,2,3-trichlorobenzene	ug/l	< 1

Concentrations expressed as ug/l (ppb)
unless stated otherwise

** = INAB Accredited Tests ++ = Subcontracted Tests n/a = Non-INAB Accredited Tests

The above results relate only to the sample tested.
This report should not be regenerated except in full and with the consent of T.E. Laboratories Ltd.

T.E. Laboratories

TelLab

ANALYSIS OF AQUEOUS SAMPLE.

Date Sampled:05.01.2010
Date Received: 05.01.2010
Date Analysis Commenced:05.01.2010
Our Ref.:WS-26176, COV/652545/2010,10-34360
Your Ref : Arthurstown
Certificate No. L/10/0117

DETERMINAND	Sample ID Lab ID	Balance Tank 85638
Alkalinity	n/a	645
Ammonia as NH4	n/a	0.86
Ammoniacal Nitrogen	n/a	0.67
Arsenic (ug/l)	++	U/S see note 1
BOD	n/a	35
Cadmium (ug/l)	n/a	1.0
Chloride	n/a	2227
Chromium	n/a	0.40
COD	n/a	2370
Copper	n/a	<0.05
Cyanide	n/a	0.03
Fluoride	n/a	<2.5
Kjeldhal Nitrogen	n/a	67
Lead (ug/l)	n/a	8.2
Magnesium	n/a	111
Manganese	n/a	0.46
Mercury (ug/l)	++	U/S see note 1
Nickel	n/a	0.39
Nitrate as N	n/a	2072
Nitrite as N	n/a	3.7
Orthophosphate as P	n/a	<8.16
pH	n/a	7.2
Selenium (ug/l)	++	U/S see note 1
Sulphate	n/a	239
Suspended Solids	n/a	362
TOC	n/a	647
Zinc	n/a	0.37
Faecal Coliforms **(cfu/10mls)**	n/a	**>100**
Total Coliforms **(cfu/10mls)**	n/a	**>100**

Concentrations are expressed as mg/l (ppm)
unless otherwise specified.

** = INAB Accredited Tests ++ = Subcontracted Tests n/a = Non-INAB Accredited Tests

The above results relate only to the sample tested
This report should not be regenerated except in full and with the consent of T.E. Laboratories Ltd.

Note 1 - Unable to analyse as the sample is reacting with the sodium borohydride used in the method.

T.E. Laboratories

TelLab

ANALYSIS OF AQUEOUS SAMPLES.

Date Sampled:26.10.2010
Date Received: 26.10.2010
Date Analysis Commenced:26.10.2010
Our Ref.:WS-28328& COV/734891/2010,10-43347
Your Ref : Arthurstown
Certificate No. L/10/2337

ORGANOCHLORINE PESTICIDES (ng/l) ++

	Sample ID	Balance Tank
Determinand	Lab ID	91971
123 Trichlorobenzene	++	<100
124 TCB	++	<100
135 Trichlorobenzene	++	<100
Aldrin	++	<40
Endosulphan A	++	<40
HCH - alpha	++	<30
Endosulphan B	++	<40
HCH - beta	++	<30
Alpha-Chlordane	++	<40
Dichlobenil	++	640
Dieldrin	++	<40
Endrin	++	<40
HCH - gamma	++	<30
Heptachlor Epoxide	++	<20
Hexachlorobenzene	++	<20
Hexachlorobutadiene	++	<70
Isodrin	++	<40
DDE (op)	++	<20
DDE (pp)	++	<20
TDE (op)	++	<20
TDE (pp)	++	<20
DDT (op)	++	<20
DDT (pp)	++	<20
Tecnazene	++	<100
Gamma Chlordane	++	<20
Triallate	++	<100
Trifluralin	++	<300

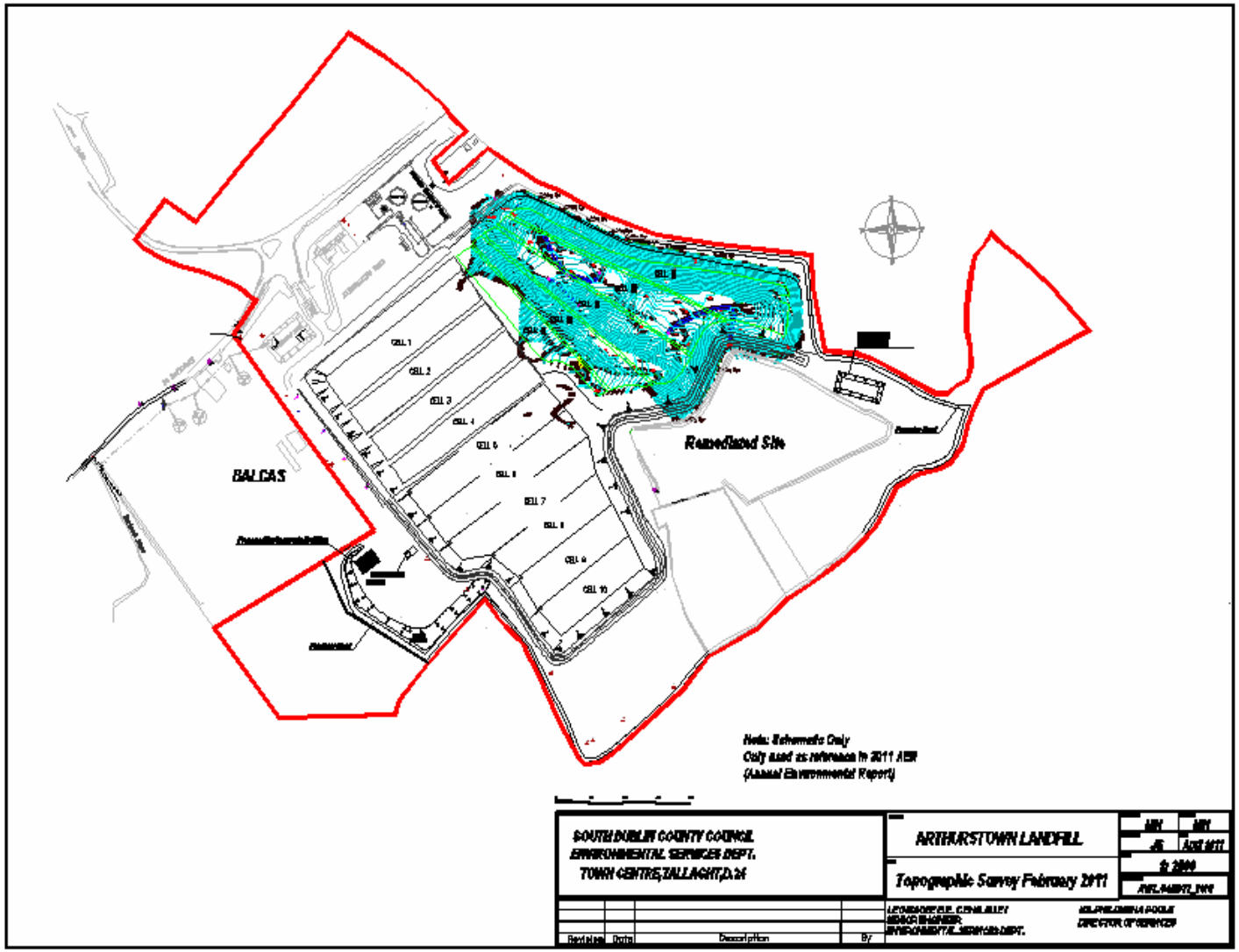
Concentrations expressed as ng/l
unless stated otherwise

** = INAB Accredited Tests ++ = Subcontracted Tests n/a = Non-INAB Accredited Tests
The above results relate only to the sample tested
This report should not be regenerated except in full and with the consent of T.E. Laboratories Ltd.

T.E. Laboratories

APPENDIX 6.1

Topographical Survey


CELL 1
CELL 2
CELL 3
CELL 4
CELL 5
CELL 6
CELL 7
CELL 8
CELL 9
CELL 10
BALCAS
Remediated Site
Note: Schematic Only
Only used as reference in 2011 AER
(Annual Environmental Report)
SOUTH DUBLIN COUNTY COUNCIL
ENVIRONMENTAL SERVICES DEPT.
TOWN CENTRE,TALLAGHT,D.24
ARTHURSTOWN LANDFILL
Topographic Survey February 2011

South Dublin County Council
Arthurstown Landfill

APPENDIX 7.1

PRTR Returns for 2010

| PRTR# : W0004 | Facility Name : Arthurstown Landfill | Filename : W0004_2010(1).xls | Return Year : 2010 |

Guidance to completing the PRTR workbook

AER Returns Workbook

Version 1.1.11

REFERENCE YEAR	2010

1. FACILITY IDENTIFICATION

Parent Company Name	South Dublin County Council
Facility Name	Arthurstown Landfill
PRTR Identification Number	W0004
Licence Number	W0004-04

Waste or IPPC Classes of Activity

No.	class_name
3.5	Specially engineered landfill, including placement into lined discrete cells which are capped and isolated from one another and the environment.
3.1	Deposit on, in or under land (including landfill).
3.4	Surface impoundment, including placement of liquid or sludge discards into pits, ponds or lagoons.
3.6	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.
3.7	##

Address 1	Arthurstown
Address 2	Kill
Address 3	Co. Kildare
Address 4	
Country	Ireland
Coordinates of Location	-8.10013 54.5569
River Basin District	GBNIIENW
NACE Code	3821
Main Economic Activity	Treatment and disposal of non-hazardous waste
AER Returns Contact Name	John Smith (W0004)
AER Returns Contact Email Address	arthurstownlandfill@eircom.net
AER Returns Contact Position	Facility Manager
AER Returns Contact Telephone Number	045 877674
AER Returns Contact Mobile Phone Number	086 8371729 086 3860942
AER Returns Contact Fax Number	045 877849
Production Volume	0.0
Production Volume Units	
Number of Installations	0
Number of Operating Hours in Year	0
Number of Employees	0
User Feedback/Comments	
Web Address	

2. PRTR CLASS ACTIVITIES

Activity Number	Activity Name
5(d)	Landfills
5(c)	Installations for the disposal of non-hazardous waste
5(d)	Landfills

3. SOLVENTS REGULATIONS (S.I. No. 543 of 2002)

Is it applicable?	No
Have you been granted an exemption ?	
If applicable which activity class applies (as per Schedule 2 of the regulations) ?	
Is the reduction scheme compliance route being used ?	

4.1 RELEASES TO AIR Link to previous years emissions data | PRTR# : W0004 | Facility Name : Arthurstown Landfill | Filename : W0004_2010(1).xls | Return Year : 2010 | 19/04/2011 09:51

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SECTION A : SECTOR SPECIFIC PRTR POLLUTANTS

RELEASES TO AIR					Please enter all quantities in this section in KGs												
POLLUTANT		METHOD													QUANTITY		
			Method Used		Flare 1	Flare 2	Flare 3	Flare 4	AR01	AR02	AR03	AR04	AR05-AR11			
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	Emission Point 2	Emission Point 3	Emission Point 4	Emission Point 5	Emission Point 6	Emission Point 7	Emission Point 8	Emission Point 9	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
08	Nitrogen oxides (NOx/NO2)	C	OTH	Flue gas analyser, Testo 350/454 MXL	1612.0	1572.0	945.0	802.0	4503.0	5871.0	7945.0	3922.0	29170.0	56342.0	0.0	0.0
02	Carbon monoxide (CO)	C	OTH	Flue gas analyser, Testo 350/454 MXL	33.0	373.0	159.0	189.0	20550.0	14697.0	40639.0	12957.0	145781.0	235378.0	0.0	0.0
11	Sulphur oxides (SOx/SO2)	C	OTH	Flue gas analyser, Testo 350/454 MXL	2391.0	668.0	5710.0	5070.0	0.0	402.0	163.0	223.0	5700.0	20327.0	0.0	0.0
07	Non-methane volatile organic compounds (NMVOC)	C	ALT	EN 13526:2002	173.0	167.0	130.0	108.0	225.0	135.0	179.0	91.0	1920.0	3128.0	0.0	0.0
01	Methane (CH4)	C	ALT	EN 13526:2002	89.0	83.0	47.0	58.0	17462.0	13805.0	17812.0	15064.0	117404.0	181824.0	0.0	0.0
03	Carbon dioxide (CO2)	C	OTH	Flue gas analyser, Testo 350/454 MXL	2929620.0	2260225.0	1753697.0	1371813.0	3559614.0	3299408.0	3425705.0	3425829.0	20156202.0	#########	0.0	0.0

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

SECTION B : REMAINING PRTR POLLUTANTS

RELEASES TO AIR					Please enter all quantities in this section in KGs												
POLLUTANT		METHOD													QUANTITY		
			Method Used		Flare 1	Flare 2	Flare 3	Flare 4	AR01	AR02	AR03	AR04	AR05-AR11			
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	Emission Point 2	Emission Point 3	Emission Point 4	Emission Point 5	Emission Point 6	Emission Point 7	Emission Point 8	Emission Point 9	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
					0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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

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

RELEASES TO AIR					Please enter all quantities in this section in KGs												
POLLUTANT		METHOD													QUANTITY		
			Method Used		Flare 1	Flare 2	Flare 3	Flare 4	AR01	AR02	AR03	AR04	AR05-AR11			
Pollutant No.	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	Emission Point 2	Emission Point 3	Emission Point 4	Emission Point 5	Emission Point 6	Emission Point 7	Emission Point 8	Emission Point 9	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
244	**Total Particulates**	C	ALT	ISO9096:2003	0.0	0.0	0.0	1323.0	1267.0	849.0	924.0	7609.0	11972.0	0.0	0.0	

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

Additional Data Requested from Landfill operators

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

Landfill: Arthurstown Landfill

Please enter summary data on the quantities of methane flared and / or utilised	T (Total) kg/Year	M/C/E	Method Used: Method Code	Method Used: Designation or Description	Facility Total Capacity m3 per hour	
Total estimated methane generation (as per site model)	29253600.0	C	Prediction model	Prediction model	N/A	
Methane flared	13835856.0	M	Measured at flares	Measured at flares	4600.0	(Total Flaring Capacity)
Methane utilised in engine/s	54085599.0	M	Measured at engines	Measured at engines	5700.0	(Total Utilising Capacity)
Net methane emission (as reported in Section A above)	-38667855.0	C			N/A	

4.2 RELEASES TO WATERS Link to previous years emissions data | PRTR# : W0004 | Facility Name : Arthurstown Landfill | Filename : W0004_2010(1).xls | Return Year : 2010 | 19/04/2011 09:51

SECTION A : SECTOR SPECIFIC PRTR POLLUTANTS

Data on ambient monitoring of storm/surface water or groundwater, conducted as part of your licence requirements, should NOT be submitted under AER / PRTR Reporting as this only concerns Releases from your facility

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

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

SECTION B : REMAINING PRTR POLLUTANTS

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

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

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

RELEASES TO WATERS					Please enter all quantities in this section in KGs			
POLLUTANT					QUANTITY			
			Method Used					
Pollutant No.	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
					0.0	0.0	0.0	0.0

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

4.3 RELEASES TO WASTEWATER OR SEWER

Link to previous years emissions data

SECTION A : PRTR POLLUTANTS

OFFSITE TRANSFER OF POLLUTANTS DESTINED FOR WASTE-WATER TREATMENT OR SEWER					Please enter all quantities in this section in KGs			
POLLUTANT		METHOD			QUANTITY			
			Method Used					
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
					0.0	0.0	0.0	0.0

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

SECTION B : REMAINING POLLUTANT EMISSIONS (as required in your Licence)

OFFSITE TRANSFER OF POLLUTANTS DESTINED FOR WASTE-WATER TREATMENT OR SEWER					Please enter all quantities in this section in KGs			
POLLUTANT		METHOD			QUANTITY			
			Method Used					
Pollutant No.	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
					0.0	0.0	0.0	0.0

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

4.4 RELEASES TO LAND Link to previous years emissions data | PRTR# : W0004 | Facility Name : Arthurstown Landfill | Filename : W0004_2010(1).xls | Return Year : 2010 | 19/04/2011 09:51

SECTION A : PRTR POLLUTANTS

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

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

SECTION B : REMAINING POLLUTANT EMISSIONS (as required in your Licence)

RELEASES TO LAND					Please enter all quantities in this section in KGs		
POLLUTANT		METHOD			QUANTITY		
			Method Used				
Pollutant No.	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year
					0.0	0.0	0.0

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

5. ONSITE TREATMENT & OFFSITE TRANSFERS OF WASTE | PRTR# : W0004 | Facility Name : Arthurstown Landfill | Filename : W0004_2010(1).xls | Return Year : 2010 | 19/04/2011 09:51

Please enter all quantities on this sheet in Tonnes 3

Transfer Destination	European Waste Code	Hazardous	Quantity (Tonnes per Year)	Description of Waste	Waste Treatment Operation	Method Used		Location of Treatment	Haz Waste : Name and Licence/Permit No of Next Destination Facility Non Haz Waste: Name and Licence/Permit No of Recover/Disposer	Haz Waste : Address of Next Destination Facility Non Haz Waste: Address of Recover/Disposer	Name and License / Permit No. and Address of Final Recoverer / Disposer (HAZARDOUS WASTE ONLY)	Actual Address of Final Destination i.e. Final Recovery / Disposal Site (HAZARDOUS WASTE ONLY)
						M/C/E	Method Used					
Within the Country	19 07 03	No	17510.0	landfill leachate other than those mentioned in 19 07 02	D9	M	Weighed	Onsite in Ireland	Obertstown Wastewater Treatment Plant,"."	Obertstown Wastewater Treatment Plant,Naas,".",County Kildare,Ireland		
Within the Country	19 07 03	No	87791.0	landfill leachate other than those mentioned in 19 07 02	D9	M	Weighed	Onsite in Ireland	Ringsend Wastewater Treatment Plant,"."	Dublin City Council,Ringsend Wastewater Treatment Plant,".",Dublin,Ireland		

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

Link to previous years waste data
Link to previous years waste summary data & percentage change

----- Original Message -----
From: <aerreturns@epa.ie>
To: <arthurstownlandfill@eircom.net>
Sent: Wednesday, April 20, 2011 8:01 AM
Subject: AER / PRTR Emissions Data VERIFICATION OF ACCEPTANCE (W0004_2010.xml)

Thank you,

Your AER / PRTR Emissions Data submission has been accepted by our data system.

You may now proceed to print your submitted emissions and waste transfers information for insertion into your Full AER report. The Full AER Report must be submitted in BOTH hardcopy (paper) form (Only Applicable to Urban Waste Water Treatment Plants) and electronic (PDF) form.

Please retain the receipt / tracking number below in case of future queries about this submission and in case a request is made by an authorised person in this regard.

bb2ce977525abe52793185d286cbaba1