ROSCOMMON COUNTY COUNCIL
Comhairle Chontae Roscomáin

ROSCOMMON LANDFILL ENVIRONMENTAL MONITORING

Annual Environmental Report 2009

March 2010

RPS Consulting Engineers

MGE0016CR0010

DOCUMENT CONTROL SHEET

Client	Roscommon County Council					
Project Title	Roscommon Landfill Waste Licence Compliance					
Document Title	Annual Environmental Report for 2009					
Document No.	MGE0016RP0036D01					
This Document Comprises	DCS	TOC	Text	List of Tables	List of Figures	No. of Appendices
	1	1	20	1	1	3

Rev.	Status	Author(s)	Reviewed By	Approved By	Office of Origin	Issue Date
D01	Draft	M.C.S	M.W.	M.W.	Galway	Mar '10

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

1. INTRODUCTION

Roscommon Landfill is operated by Roscommon County Council in accordance with Waste Licence Register No. W0073-01 issued by the EPA. In accordance with Condition 5.2 of the Licence, acceptance of waste for disposal at the landfill ceased on December 31st 2001. The reporting period for the purposes of this Annual Environmental Report (AER) is January 1st 2009 to December 31st 2009.

This Annual Environmental Report (AER) has been prepared in accordance with the conditions of the Waste Licence and the EPA "Draft Guidance on Environmental Management Systems and Reporting to the Agency, 1999".

2. SITE DESCRIPTION

Roscommon Landfill is located in the townland of Killarney, approximately 3km north east of Roscommon town on the N63 Longford Road. The total area of waste covers an area of approximately 5 hectares. Landfilling commenced at this location in the early 1970's. The landfill has always operated on a "dilute and disperse" principle. Initially filling of the landfill took place in the area between the road and the present culvert. In 1981, filling commenced to the south and the west of this culverted stream. A halting site was built at the facility in 1980. Landfilling at the facility ceased on December 31st 2001. When the landfill was active the principal activity was the deposit of domestic, commercial and industrial non-hazardous waste.

It is estimated that up to 170,000 tonnes of waste were deposited at the site over its lifetime. A Recycling Centre is in operation at the site which accepts recyclables such as paper, glass and cardboard (see Table 3.1). Domestic waste is also accepted for disposal which is transferred to Ballaghaderreen Landfill.

3. QUANTITY AND COMPOSITION OF WASTE

Table 3.1 and **Figure 3.1** outline the quantities of waste accepted for recovery during the reporting period at the Recycling Centre. A total of 1,627.7 tonnes of material was recovered in 2009. The total amount of material accepted for recycling in 2008 at the Recycling Centre

amounted to 876.56 tonnes. Therefore in 2009 there was a 46.1% increase in the amount of waste recycled at the Recycling Centre in comparison with 2008. The waste is collected for recycling by Rehab, KMK Metals Recycling Ltd. (WO 113-02), Indaver (WO 36-02), Textiles Recycling Ltd, Airpack and Barna Waste. Rehab collect glass, KMK Metals collect WEEE waste, Textile Recycling Ltd. collect textiles and Indaver collect household hazardous waste. Barna Waste collect all other waste.

Table 3.2 and **Figure 3.2** provide figures for the total tonnage of waste accepted for disposal in previous years. These figures regarding waste intake at the facility are highly approximate as there was no weighbridge on site until shortly before closure in 2001. Data on the composition of the waste for these years is unavailable.

Table 3.1 Quantity and Composition of Waste Received for Recovery at the Recycling Centre in 2009

Waste Type	EWC Code	Waste Collector	Waste Quantities (Tonnes)
Cardboard, Newspaper, Glossy Magazines, Milk Cartons	200101 / 200199	Barna Waste	328.2
PET 1, PET 2, Metal Cans, Aluminium Cans	150102 / 150104	Barna Waste	13.68
Waste Electrical & Electronic Equipment	200135*; 200307	KMK Metals Recycling Ltd.	164.39
Batteries	200133*; 200134	Barna Waste	9.42
Household hazardous	200127*	Indaver/ Barna Waste	4.419
Aeroboard	150102	Barna Waste	2.66
Textiles	200111	Textile Recycling Ltd./ Barna Waste	22.9
Clear Glass	200102	REHAB	1,023.41
Metals	200139	Barna Waste	31.18
Wood	200138	Barna Waste	27.44
Total Tonnage			**1627.7**

Figure 3.1 Waste Intake for 2008

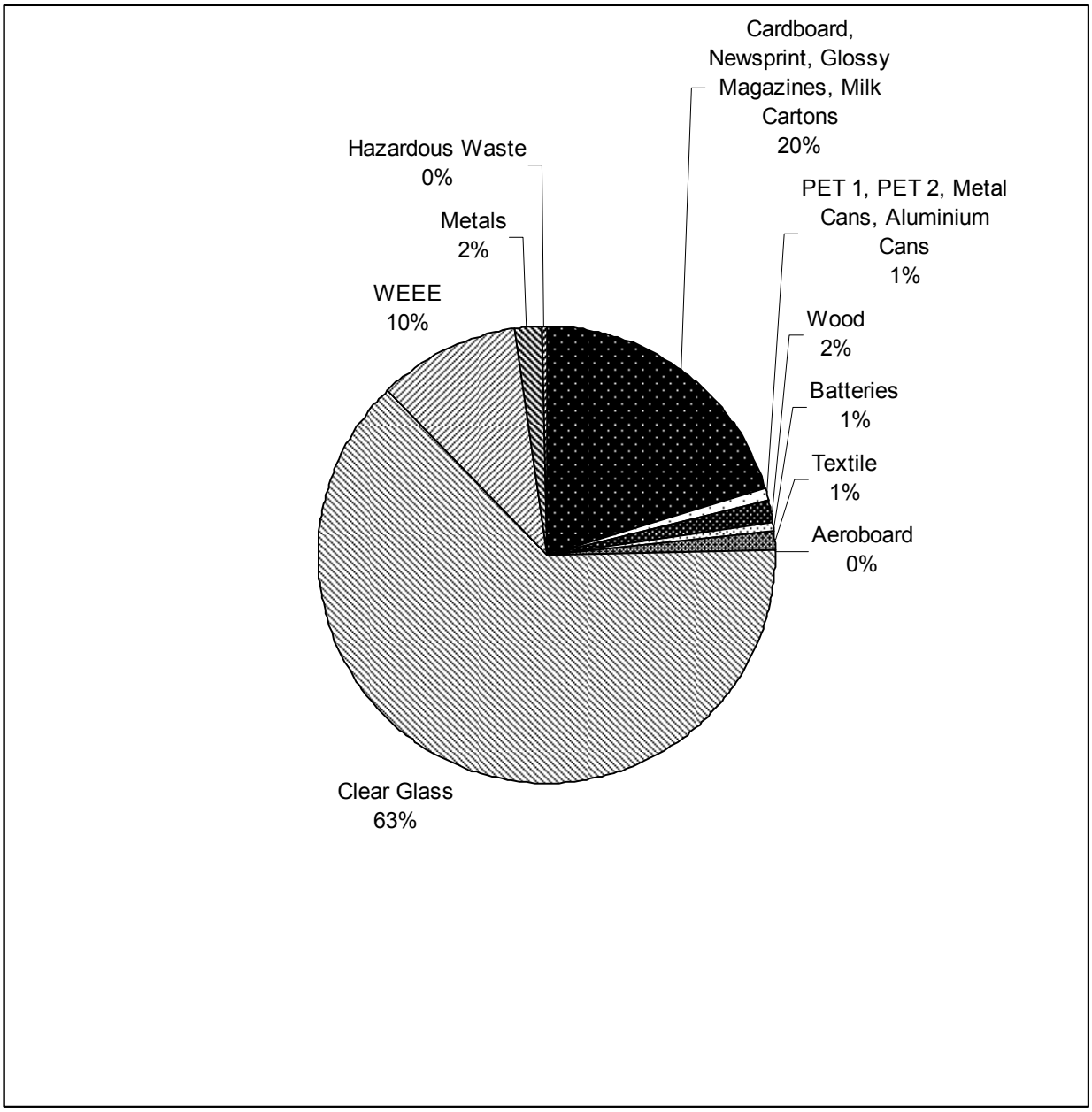
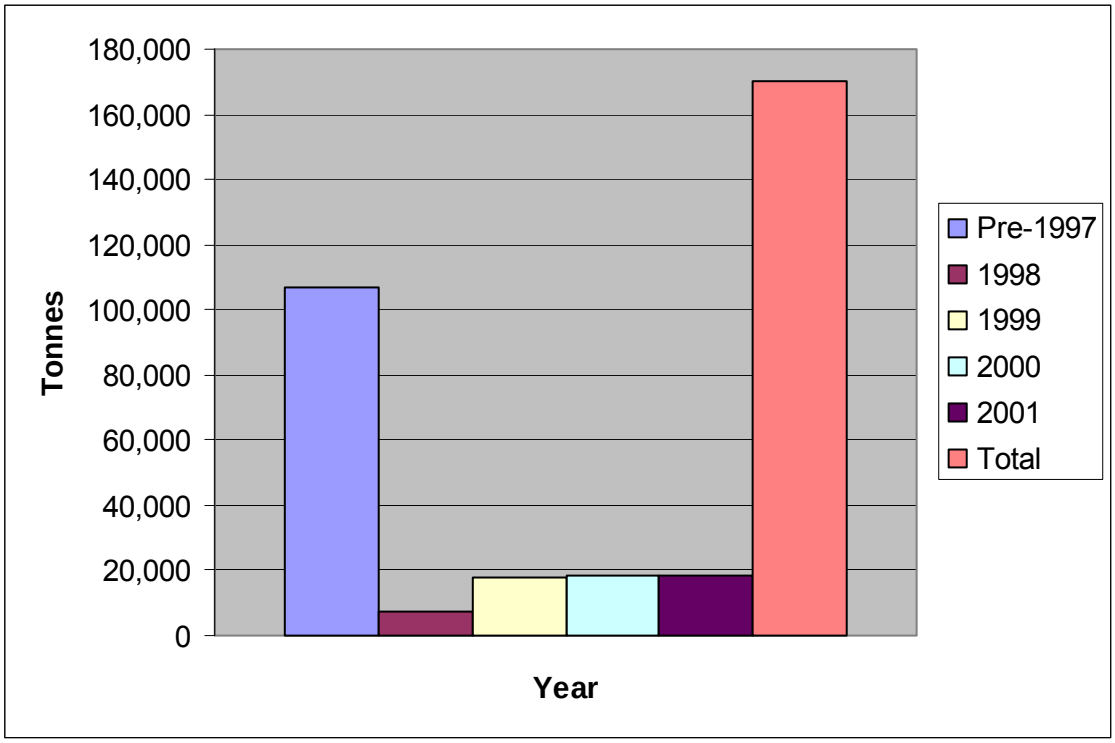


Table 3.2 Total Estimated Waste Intake at Roscommon Landfill up to Close of Facility in 2001

Year	Approximate Waste intake (tonnes)
To end 1997	107,000 (estimate)
1998	7,535
1999	18,000
2000	18,360
2001	18,727
Total	**170,000 (approx)**

Figure 3.2 Waste Intake for Years Up to Close of Facility in 2001



4. ENVIRONMENTAL MONITORING

During the reporting period of 2004, it was agreed with the EPA that, as the landfill was closed and fully capped, the scale and scope of the Environmental Monitoring Programme could be reduced to reflect the level of current operations at the facility. A site plan showing the revised monitoring locations is included in **Appendix A**.

The following sections summarise the environmental monitoring undertaken at Roscommon Landfill during the reporting period (2009). The Waste Licence for Roscommon Landfill requires that biannual monitoring be carried out in respect of surface water, ground water, leachate and gas. A letter dated the 8th January 2008 was sent to the EPA North Western Regional Office of Environmental Enforcement on behalf of Roscommon County Council. The letter requested a review of the licence. Roscommon County Council suggested that the extent and frequency of monitoring could be decreased in 2008. In this regard it was proposed that quarterly reporting should be reduced to biannual reporting. The EPA agreed the review of the licence in this respect. For the first half of 2009, Roscommon County Council were unable to retrieve groundwater samples due to a malfunction with the pump. For the second half of 2009, sampling of groundwater, surface water and leachate locations was carried out in January 2010 due to staff shortages in the period July to December 2009.

4.1 SURFACE WATER

For each half of 2009, samples of surface water were taken by Roscommon County Council from 3 no. monitoring locations. In June 2009 samples were taken from SW1, SW3, & SW7 and in January 2010 samples were taken from SW2, SW3 and SW7 (see DG0001F08 in Appendix A). All results are tabulated within **Appendix B**. Those parameters which are required to be analysed on an annual basis were monitored in January 2010. The results were compared with the European Community (Quality of Surface Water intended for Abstraction of Drinking Water) Regulations, 1989 (S.I. No. 294 of 1989) and the Fresh Water Fish Directive 78/659/EEC. The following interpretation summarises the overall surface water quality. More detailed interpretations can be found within the biannual monitoring reports which were submitted to the EPA.

4.1.1 Interpretation and Non-compliance

Throughout the sampling period (Jan-Dec 2009) the main exceedances of standards were caused by elevated concentrations of ammonia, chemical oxygen demand (COD), biological oxygen demand (BOD), suspended solids, iron and manganese and lowered levels of dissolved oxygen at sampling point SW3.

Ammonia concentrations fluctuated through the year with a maximum concentration of 0.755 mg/l at SW3 during the second half of 2009 (H2 '08). SW1 sampling results were below the limit of 0.2 mg/l on both sampling occasions. Concentrations were elevated above the 1989 Regulations limit of 0.2 mg/l at SW7 and SW3 on both sampling occasions. The mean level of ammonia recorded for the first half of 2009 was 0.15 mg/l and this increased to 0.40 mg/l for the second half of 2009. Overall levels of ammonia have decreased from a mean concentration of 0.43mg/l in 2008 to a mean concentration of 0.275 mg/l for 2009.

The **COD** levels were above the limit of 40 mg/l set for water classified as A3 at sampling point SW3 and SW7 in H1 '09. SW1 was compliant with the limit value on this occasion. The COD levels exceeded the limit value at SW7 in H2 '09. The COD level at SW2 and SW3 was within the limit value for this sampling period. The maximum concentration was recorded at SW3 during the 1st half of 2009 with a level of 61 mg/l. The mean COD level recorded in H2 '09 was 39.07 mg/l. This figure is similar to the mean COD concentration recorded in the first half of 2009 (42.43 mg/l) and has decreased substantially since the second half of 2008 (69.3 mg/l).

Dissolved oxygen concentrations at SW2 and SW7 were compliant with the standard for H1 and H2 of 2009. The level of dissolved oxygen reported at SW3 in the first half of 2009 was poor (2.58mg/l). The level of dissolved oxygen at sampling location SW3 in H2 '09 did not meet the requirements of the Category A1 or A2 parameters however it does meet the requirements of the Category A3 parameters as specified in the EC (Quality of Surface Water Intended for the Abstraction of Drinking Water) Regulations 1989. The level of DO recorded at this sampling point in 2008 was also low (4.49 mg/l).

The level of **Suspended Solids** at SW2 and SW3 monitoring points are compliant in this monitoring period within the required limit of 25 mg/l as set by the FW Fish Directive 78/659/EEC on both sampling occasions. The level of suspended solids in SW7 exceeded the

limit in H2 ’09 at 44.4 mg/l, but was below the required limit in H1 ‘09 at 12.8 mg/l. The concentrations recorded at SW1 and SW7 were compliant in H1 and H2 ’08.

BOD levels at SW3 and SW7 were 8.31 mg/l and 5.44mg/l respectively for H1 ’09 which are above the recommended upper limit of 5mg/l. When compared to the previous two rounds of sampling in 2008 the level of BOD at these sampling points is elevated. BOD levels were below the standard limit of 5mg/l at all sampling points for both halves of 2008. A level of 0.44mg/l was recorded at SW1 for H1 ‘09. This is well below the upper limit of 5 mg/l. BOD levels were below the standard limit of 5mg/l at all sampling points for the second half of 2009.

All of the sampling points were below the limit for **pH, Chloride, Temperature and Electrical Conductivity.**

A visual inspection of the water quality showed that there was no odour evident at any time. Plant growth was consistent for SW3 throughout the year, while weed growth was noted in SW7 in H1 ’09. No discolouration of water was noted at any monitoring point on either occasion. Weed growth and water discolouration at SW3 and SW7 has been noted on previous inspections.

Annual sampling of a range of other parameters was also carried out in January 2010. The concentrations of cadmium, chromium, copper, lead, magnesium, mercury, phenols, potassium, sodium, sulphate, total phosphorus and zinc were under the 1989 Regulations limits. The majority of results were concurrent with those recorded for the second half of 2008. However, levels of zinc have increased from a mean of 8.1 µg/l in 2008 to 37.93 µg/l for this monitoring period. The only exceeding parameters were manganese at SW3 and iron at SW7 which were above the relevant standards.

The standard limit on manganese is 50 µg/l. Levels recorded for this parameter were 64.1 µg/l at SW3. SW3 also exceeded the limit in last year’s monitoring (2008) at 85 µg/l. The mean manganese level has decreased from 54.67 µg/l in the second half of 2008 to 42.93 µg/l for this monitoring period. There has been a consistent drop in the mean level of manganese levels since 2007.

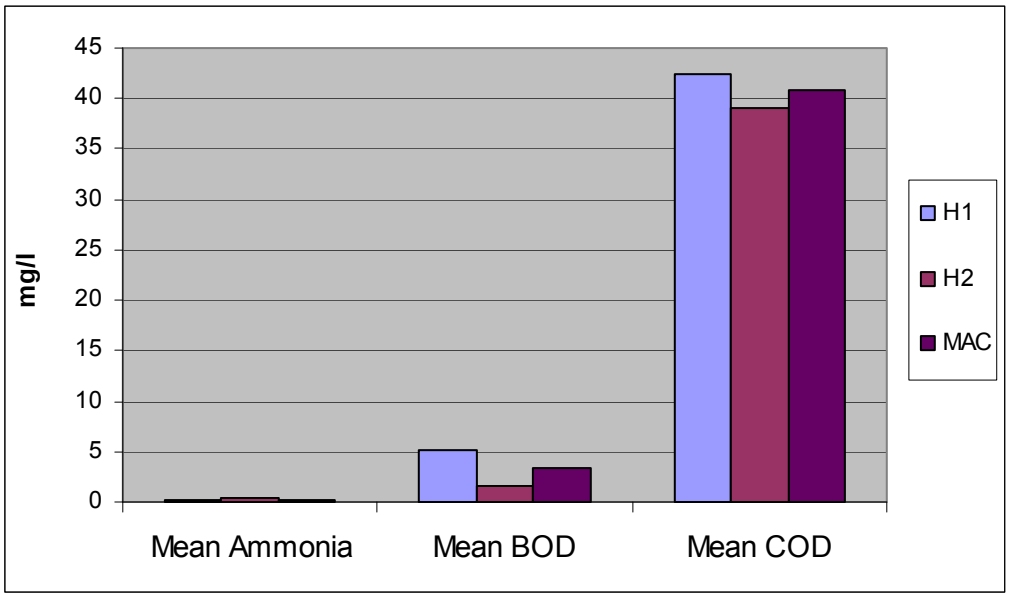
The standard limit on iron is 200 µg/l. The concentration of iron recorded at SW7 has increased from 141 µg/l in 2008 to 236.6 µg/l for this monitoring period. The mean iron level has increased from 101.1 µg/l in 2008 to 179.6 µg/l for this monitoring period.

A summary of the mean concentrations of the key parameters for surface water for the reporting period can be seen in **Figure 4.1**.

4.1.2 Proposals

As the landfill is now capped and the leachate interceptor drain and abstraction system is preventing lateral migration of leachate into the stream, it is likely that contamination in the watercourses is as a result of accumulated contaminants in the banks of the streams. This contamination should decrease over time.

Figure 4.1 Mean Concentrations of Key Parameters for Surface Water for the Reporting Period



4.2 GROUNDWATER

Groundwater monitoring points are situated both upgradient and downgradient of the landfill. The locations of these points are shown on drawing **DG0001-01F08** in **Appendix A**. The groundwater sampling points GW2, GW4 and GW6 were analysed for the suite of parameters

agreed with the Agency. Due to a malfunction with the pump used to retrieve groundwater samples, Roscommon County Council was unable to obtain groundwater samples from GW2, GW4 and GW6 for H1 '09. The following interpretations summarise the overall water quality for H2 '09, the results of which are contained within **Appendix B**. Those parameters which require to be analysed on an annual basis were monitored in January 2010. Detailed interpretations can be found within the biannual monitoring reports which were submitted to the EPA.

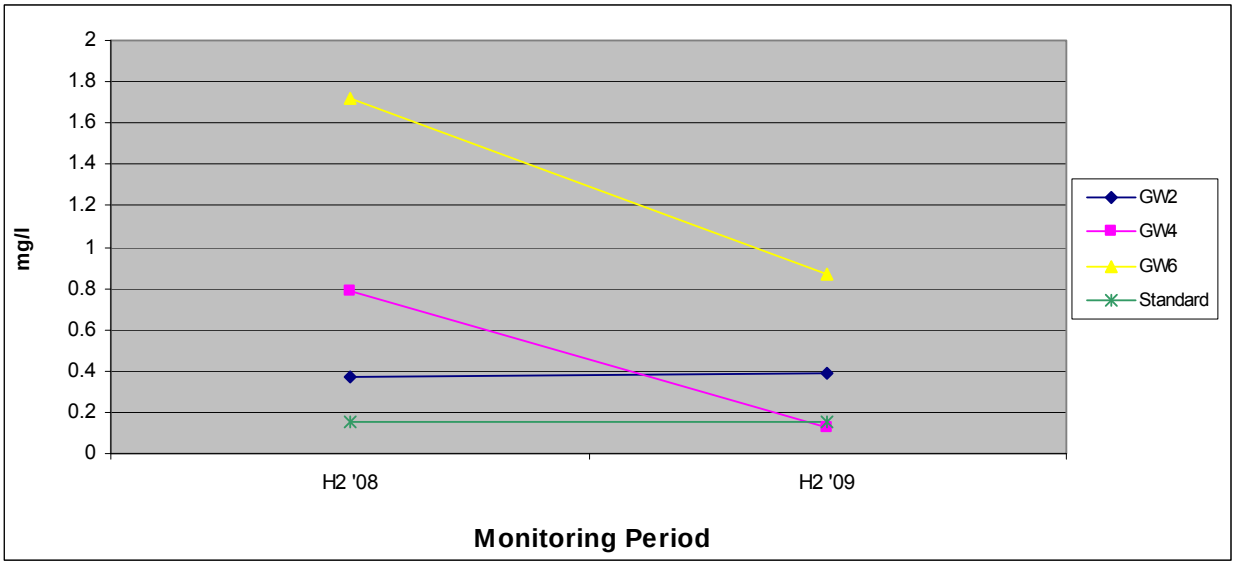
4.2.1 Interpretation and Non-Compliance

The interim guideline value for **Ammonia** is 0.15 mg/l. The ammonia level at GW2 (0.39mg/l) and GW6 (0.87mg/l) exceeded the guideline value for the second half of 2009. GW6 has also been non compliant in H1 and H2, 2008. Sampling point GW2 was non compliant in H2, 2008 but was compliant with the guideline value in H1, 2008. GW4 was compliant for the second half of 2009 and was non compliant in H1 and H2 of 2008. The results for the second half of 2009 ranged from 0.13 – 0.87 mg/l. The highest value of 0.87 mg/l was recorded at GW6 in the second half of 2009 and is lower than the highest level of ammonia recorded at this sampling point in 2008 (2.89 mg/l). A summary of the results obtained in H2 '09 compared against results obtained in H2 '08 can be seen in **Figure 4.2**.

The interim guideline for **Dissolved Oxygen** concentration is that there should be no abnormal change. The minimum, maximum and mean concentrations for DO for H2 '09 this monitoring period were 21.4, 25.5 and 22.80 mg/l, while the minimum, maximum and mean concentrations for H2, 2008 were 2.1, 4.33 and 3.4 mg/l. There has been a significant change in dissolved oxygen concentration at all three sampling points.

Values for **Electrical Conductivity**, **Temperature and pH** were within the guideline limits at all sampling points on all sampling occasions.

Figure 4.2 Ammonia Levels in Groundwater for the Reporting Period



Additional parameters were tested in the second half of 2009. The concentrations of cadmium, chromium, copper, lead, magnesium, mercury, phenols, potassium, sodium, sulphate and zinc were all below the standard guideline values set. Most results are elevated when compared to those recorded for H2, 2008.

The mean concentration of zinc in this monitoring period has increased from 13 µg/l in H2 ’08 to 22.10 µg/l. The mean concentration of sodium has increased from 15.4 mg/l in H2 ‘08 to 47.89 mg/l for this sampling period. The level of total phosphorus at GW4 and GW6 exceeded the standard limit with a concentration of 0.043 mg/l and 0.057 mg/l respectively. The concentration of total phosphorus at GW2 is within the standard limit. Total phosphorus at GW4 and GW6 were not tested for in H2 ’08.

Concentrations of manganese were above the limit of 50 µg/l at all three locations. The recorded values at GW2, GW4 and GW6 were 113 µg/l, 97.8 µg/l and 149.6 µg/l respectively. The concentration of manganese at GW2, GW4 and GW6 also exceeded the guideline limit in H2 ’08. The iron level at all three locations exceeded the standard of 200 µg/l in this monitoring period, with a concentration of 1409 ug/l at GW2, 2590 ug/l at GW4 and 1112 ug/l at GW6. Iron and manganese occur naturally from the weathering of iron and manganese bearing minerals and rocks. In addition, many complex reactions which occur naturally in ground formations can

give rise to many soluble forms of iron, which will therefore be present in waters passing through such formations. However, such elevated iron and manganese levels may also be attributed to pollution from organic wastes. Chloride was not tested in H2, 2009.

Groundwater levels are tabulated in **Appendix B**. Levels were recorded in January 2010. On comparing groundwater levels recorded for this monitoring period with those recorded in H2, 2008, levels have decreased at sampling points GW4 (by 0.25 m) and GW6 (by 0.15 m). The groundwater level at GW1 has remained consistent with a level of 1.0m recorded in H2 '08 and H2 '09.

4.2.2 Proposals

Leachate abstraction is ongoing from the leachate interceptor drain and from leachate boreholes in the waste body reducing infiltration of leachate to groundwater. As the landfill is capped, there is a minimum amount of leachate being generated. The combined effect of these measures should demonstrate a continual improvement in the quality of the groundwater over time.

4.3 LEACHATE

Samples of leachate were taken by Roscommon County Council from the 3 no. chambers situated on the leachate interceptor drain and at the leachate lagoon (see **DG0001F08** in **Appendix A**). The results of this analysis are contained within **Appendix B**. The following interpretation summarises the overall leachate quality. More detailed interpretations can be found within the biannual monitoring reports which were submitted to the EPA.

4.3.1 Interpretation and Non-compliance

Levels in each leachate chamber increased by a similar magnitude between H1 '08 and H2 '08. Leachate levels rose in LMH1 by 0.3metre and in LMH3 by 0.7 metre between H1 '09 and H2 '09. Levels in these chambers increased by a similar magnitude between H1 '08 and H2 '08. The leachate level dropped in LMH2 by 0.4 metres from H1 '09 to H2 '09. The leachate level rose in chamber LMH2 by 0.7 in 2008. The operation of a leachate pumping system installed by Roscommon County Council during the summer of 2004 is set to automatically maintain leachate levels in the landfill and in the interceptor drain.

Most of the parameters measured were at the lower end of the expected range of values for leachate (**Table 4.1**). However, levels of manganese, iron, and zinc were higher than would be expected of an older landfill. There was an overall decrease in the strength of the leachate over the reporting period (**Figure 4.3**).

Figure 4.4 shows the change in BOD/COD ratio over the reporting period. A maximum value of 0.21 was recorded in the first half of 2009. The BOD/COD ratio is typically assumed to drop from 0.8 to 0.1 over a 30 year period. A BOD/COD ratio of less than 0.25 is typical of the methanogenic phase leachate. The maximum value of 0.21 for BOD/COD is typical of the methanogenic phase leachate. Other contaminants analysed are within the scale in terms of leachate strength as defined in the EPA Landfill Site Design Manual.

Table 4.1 Comparison of Typical Leachate Composition Values and Values at Roscommon Landfill

Determinant	Unit	High values (young landfill)	Low values (old landfill)	Values at Roscommon Landfill for H2 2009
pH	-	6-8	6-8	7.32
Conductivity	µS/cm	5,000-20,000	2,500-10,000	712.3
COD	mg/l	8,000-12,000	4,000-6,000	59.23
BOD_5	mg/l	7,000-10,000	2,000-3,000	2.39
Tot – P	mg/l	10-25	1-5	0.2
Chloride	mg/l	1,000-5,000	100-1,000	19.05
Magnesium	mg/l	50-1,500	10-50	10.87
Potassium	mg/l	500-1,500	50-200	13.16
Chromium	mg/l	<1	<0.1	0.33*
Manganese	mg/l	<5	<0.5	941.07
Iron	mg/l	10-150	1-5	477.97
Copper	mg/l	<1	<1	2
Zinc	mg/l	10	1-5	119.7
Cadmium	mg/l	<0.1	<0.01	BLD
Mercury	mg/l	<0.01	<0.001	0.03
Lead	mg/l	1-2	<1	0.1*

BLD – Below Limits of Detection
***These values are from LMH3 only. Levels were below limits of detection at LMH1 and LMH2.**

Figure 4.3 Mean Concentrations of Key Leachate Parameters Over the Reporting Period

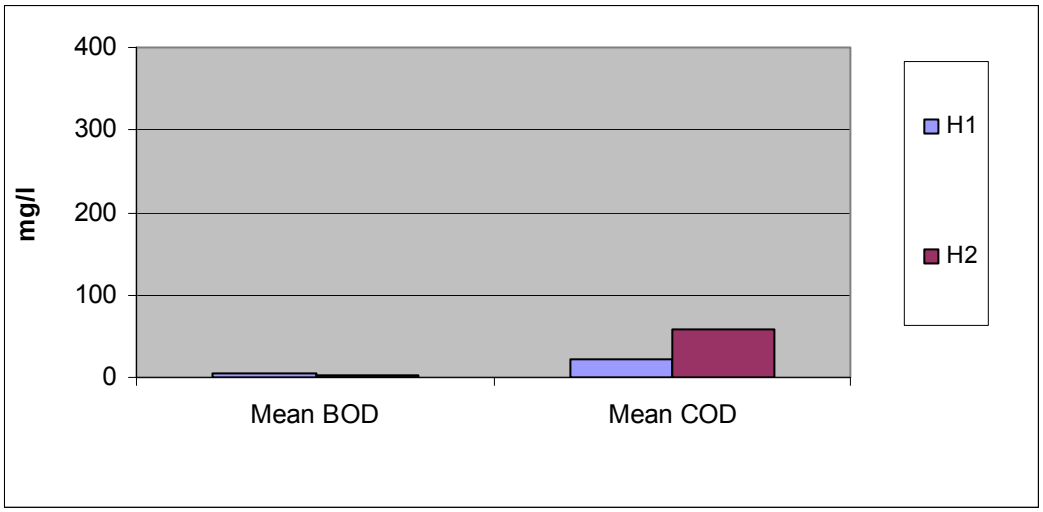
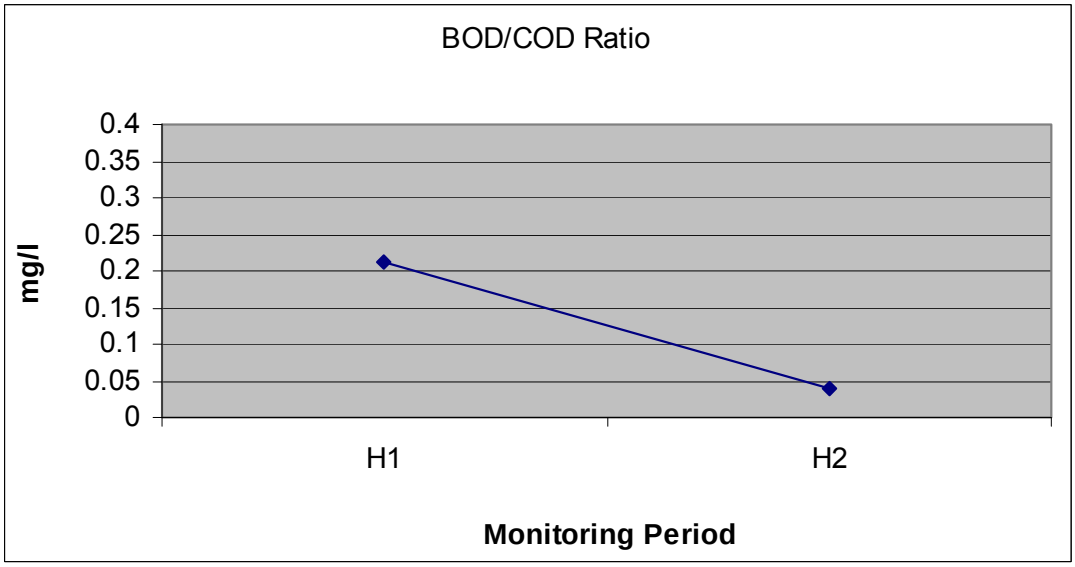


Figure 4.4 BOD/COD Ratio in Leachate over the Reporting Period



4.3.2 Proposals

Monitoring of leachate will continue in 3 no. leachate chambers on the interceptor drain as agreed with the EPA.

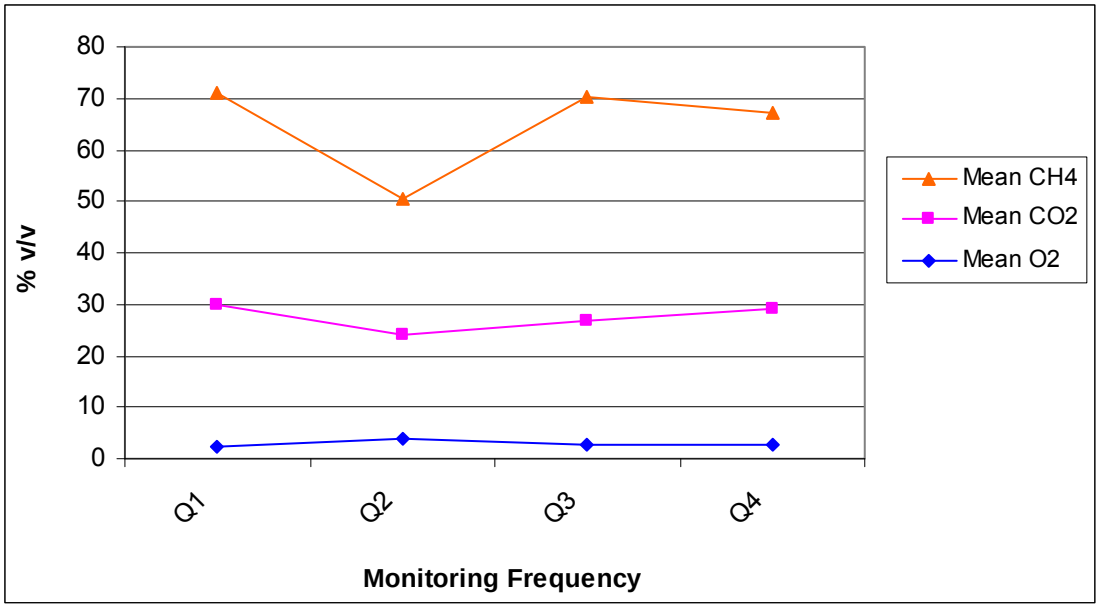
4.4 DUST

As the facility is a closed and capped landfill and since no construction work is ongoing at the site, it was agreed with the EPA in 2004 that dust monitoring could cease at the facility.

4.5 LANDFILL GAS

Roscommon County Council undertakes landfill gas monitoring on a quarterly basis at 10 no. gas extraction boreholes as shown on DG0001F08 (**Appendix A**). Analysis was performed on each sample for methane (CH_4), carbon dioxide (CO_2), oxygen (O_2), temperature and pressure, the results of which are contained in **Appendix B**. The quality of landfill gas varies somewhat throughout the year with methane concentrations varying between 24.1% and 84% v/v and carbon dioxide concentrations between 23% v/v and 38.6% v/v. Mean oxygen levels remain fairly constant throughout the monitoring period. **Figure 4.5** provides a summary of the mean concentrations of the main components of the landfill gas over the monitoring period.

Figure 4.5 Summary of Mean Concentrations of Main Components of Landfill Gas

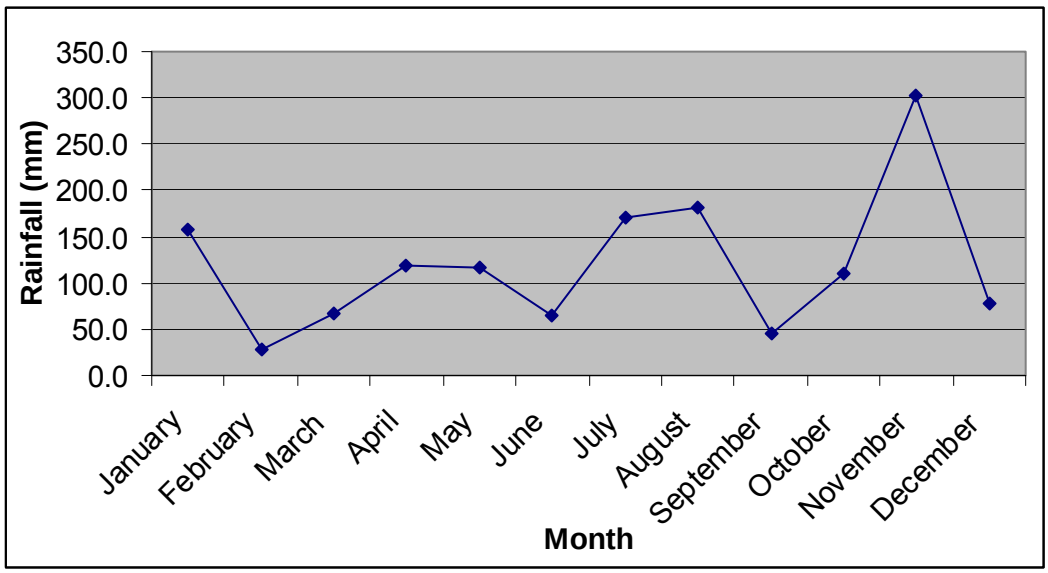


4.6 METEOROLOGICAL DATA

The daily meteorological data for 2009 from Knock Airport weather station can be seen in Appendix C. This includes rainfall, wind speed, min and max temperature, relative humidity and pressure data.

Figure 4.6 illustrates monthly rainfall data for 2009. A total of 1436.5 mm of rain fell at Knock Airport in 2009.

Figure 4.6 Monthly Rainfall Data for 2009 from Knock Airport Weather Station



5. MASS BALANCE OF SPECIFIED SUBSTANCES

5.1 RESOURCE AND ENERGY CONSUMPTION SUMMARY

8,370 units of electricity were used during the reporting period.

5.2 EMISSIONS TO GROUNDWATER

The landfill operated on a ‘’dilute and disperse’’ basis with no leachate containment measures put in place whereby the leachate generated was allowed to drain into surface and groundwater, becoming diluted and attenuated. The layers of peat and marl below the waste appear to have been effectively acting as a natural liner. The quality of the groundwater should improve as the landfill is capped and leachate abstraction continues in the leachate interceptor drain being provided around the landfill perimeter.

5.3 MONTHLY WATER BALANCE CALCULATION AND INTERPRETATION

Monthly rainfall data obtained from the nearest Met Eireann weather station at Knock, Co. Mayo estimated that the site received approximately 1436.5 mm of rainfall for the year 2009.

Prior to capping, it is estimated that, on average, approximately 22,700 m^3 of leachate was generated on an annual basis at Roscommon Landfill. Records for 2009 indicate that 899.12 m^3 of leachate were tankered to Roscommon WWTP in the period.

5.4 LANDFILL GAS VOLUMES

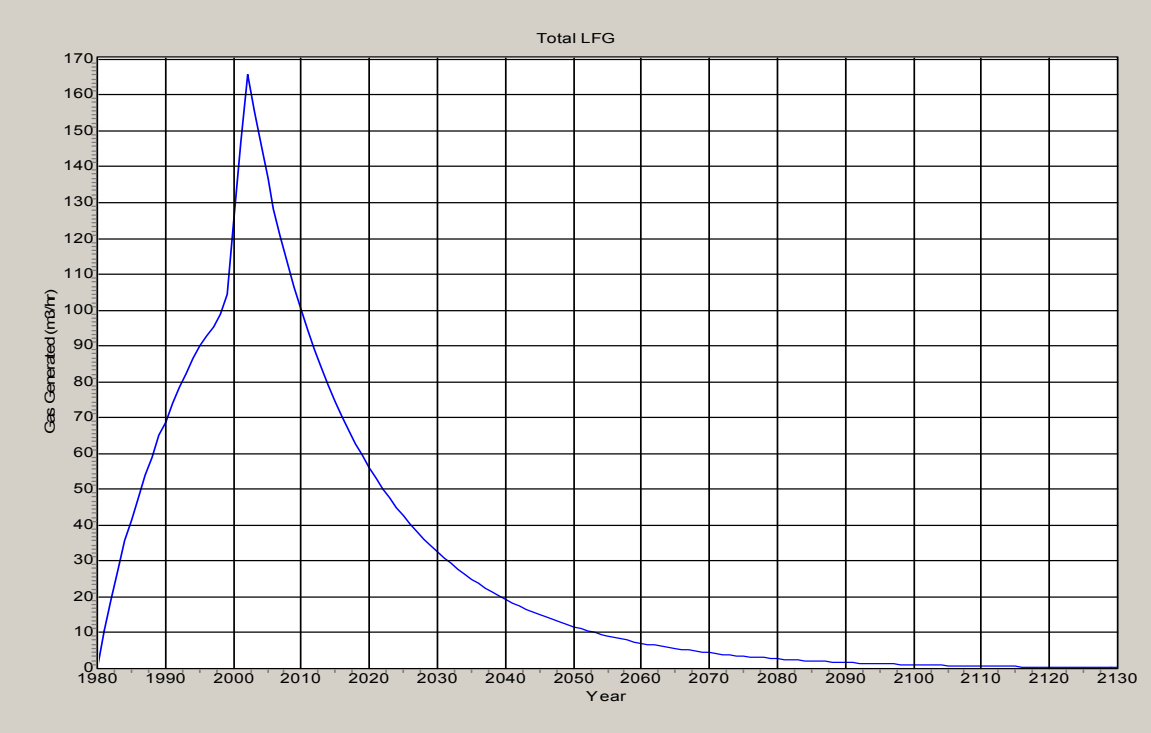
Under optimum conditions one tonne of degradable waste can theoretically produce 400-500m^3 of landfill gas (including moisture content). In practical terms the rate at which landfill gas which may be collected for utilisation purposes may be much lower.

It is estimated that the waste disposed of in Roscommon Landfill contains on average 50% biodegradable waste. It is therefore assumed that the gas production is approximately 200 Nm^3 of gas per tonne of waste over a 30 year period.

Gas volumes have been estimated using GASSIM, a gas modelling programme developed by the UK Environment Agency. Total bulk landfill gas generated is estimated at 120m^3/hr, equating to 1.05 million m^3/yr. The estimated rate of gas generation at this landfill since 1980 is graphed in **Figure 5.1**.

A 100 m^3/hr enclosed gas flare, 10 no. landfill gas extraction wells and connecting pipework were installed at the landfill in 2003. The gas management system was commissioned during the summer of 2004.

Figure 5.1 Estimated Total Gas Generation from Roscommon Landfill



6. SITE DEVELOPMENT WORKS

6.1 DEVELOPMENT WORKS DURING THE REPORTING PERIOD

As part of the new servicing contract with Barna Waste a new slab was constructed to facilitate compactor skips.

During 2008 external contractors serviced the flare. Details of the report pertaining to this have not yet been circulated. Irish Biotech Systems (IBS) were commissioned in mid 2008 to maintain the flare under a new contract. They also contributed to balancing the gas field to prolong the flare operation hours.

6.2 PROPOSED DEVELOPMENT WORKS

There are no proposals for works at the facility for 2009.

7. PROCEDURES

A revised Environmental Management Plan (EMP) for the facility was issued in December 2004.

8. STAFFING AT ROSCOMMON LANDFILL

Table 8.1 shows the site management structure at Roscommon Landfill.

Table 8.1 Site Management Structure at Roscommon Landfill

Position		Employee Contact details
Director of Services Mr Tommy Ryan		Environmental Section, Roscommon County Council, Courthouse, Roscommon. Telephone No: 090 6637100 Fax No: 090 6637108
Senior Executive Officer Mr. Pat Murtagh		Environmental Section, Roscommon County Council, Courthouse, Roscommon.
Senior Staff Officer Sarah Scott	Senior Executive Engineer Mr. John Mockler	Environmental Section, Roscommon County Council, Courthouse, Roscommon.
Facility Manager Mr. Noel Martin		Environmental Section, Roscommon County Council, Courthouse, Roscommon.
Deputy Facility Manager/Landfill Caretaker Mr. Joe Casey		Environmental Section, Roscommon County Council, Courthouse, Roscommon.
Site Operatives Mr. Martin Kiernan		Environmental Section, Roscommon County Council, Courthouse, Roscommon.

9. REVIEW OF NUISANCE CONTROLS

9.1 LITTER ABATEMENT

As waste is no longer being accepted at the site and all landfilled waste is covered, there is no litter problem at the facility. The Recycling Centre is continuously maintained and monitored by Council operatives and all recyclables are deposited into covered, lockable containers. Any loose litter around the facility and its environs is collected.

9.2 NOISE AND DUST

With the closure of the landfill, there is no heavy machinery and little heavy vehicular traffic to the site. Noise and dust do not pose any problems and monitoring ceased in 2004 with the agreement of the Agency.

9.3 VERMIN CONTROL

Capping of the landfill has included the installation of a geosynthetic clay liner tying into the leachate interceptor drain around the waste, thus forming a continuous barrier around the main waste body. This barrier is augmented by a clay cover which is 1m thick resulting in little or no access to the waste for nuisances such as vermin or birds. In addition, Roscommon County Council employs ECOLAB to operate a vermin control programme. During the summer months, AOK pest control are engaged in the control of flies for Roscommon County Council.

9.4 ODOUR

As waste is no longer being accepted at the site and any landfilled waste is covered, there is no odour problem at the facility. The gas flare treats landfill gas at the facility.

10. REPORTS ON FINANCIAL PROVISIONS

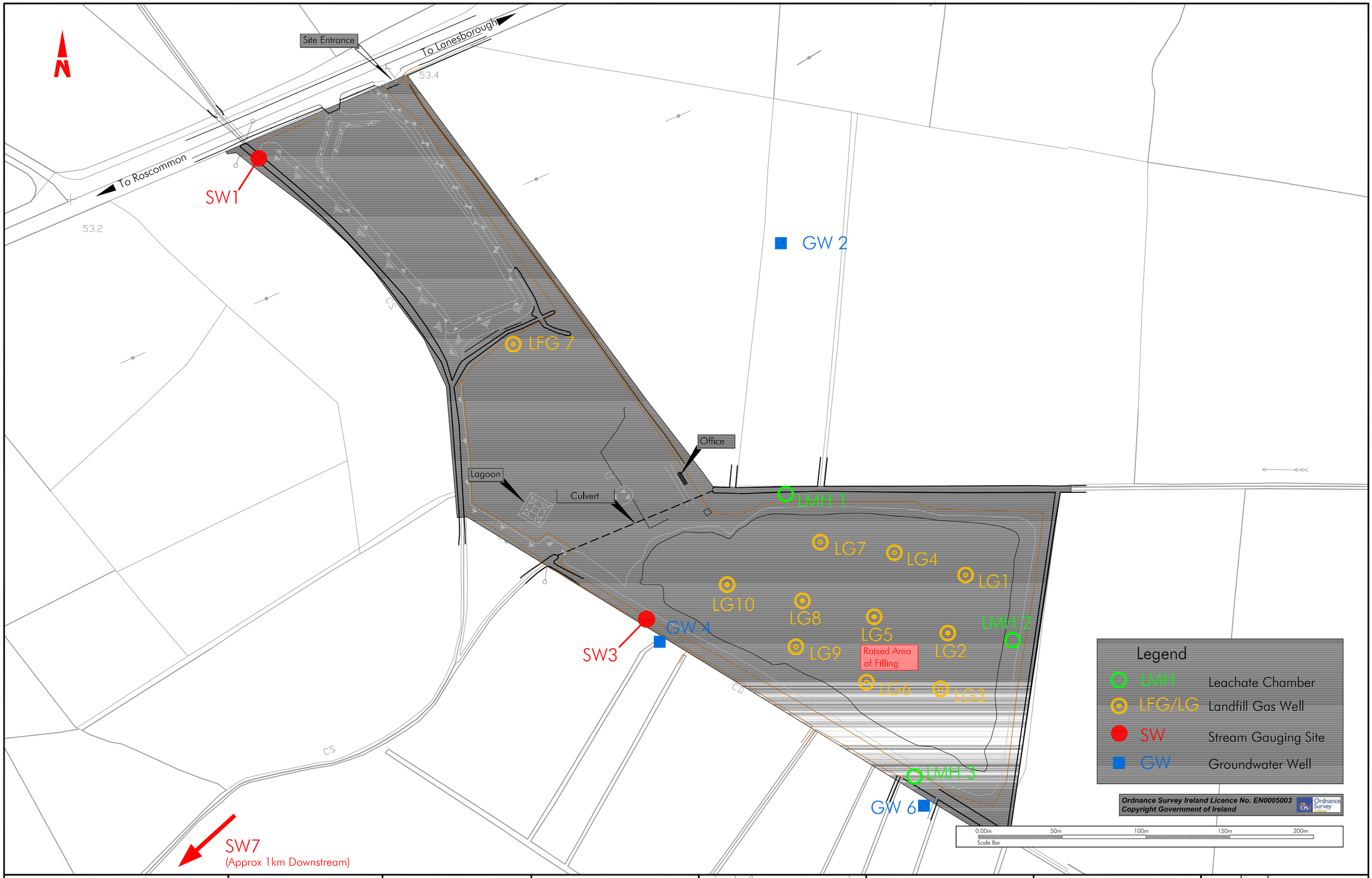
Roscommon County Council allocates funding on an annual basis from general resources. The funding will be maintained in an amount always sufficient to underwrite the current Restoration and Aftercare Plan in accordance with Condition 11 of the Waste Licence.

11. ENVIRONMENTAL INCIDENTS AND COMPLAINTS

No incidents or complaints were reported for the year 2009.

APPENDIX A

SITE LAYOUT LOCATIONS OF MONITORING POINTS (DG0001-01F08)



Roscommon County Council
Comhairle Chontae Roscomáin
Mr. T.Ryan
Roscommon County Council,
Court House,
Roscommon.
Tel: (090) 6637100 Fax: (090) 6637108

CONNAUGHT
managing our waste better

RPS Consulting Engineers
RPS Consulting Engineers, Lyrr Building, IDA Business & Technology Park, Mervue, Galway, Ireland.
T: +353 91 534100 - F: +353 91 534199
E: ireland@rpsgroup.ie W: www.rpsgroup.com/ireland

NOTES

1. This drawing is the property of RPS-Consulting Engineers, it is a confidential document and must not be copied, used, or its content divulged without prior written consent.
2. All Levels refer to Ordnance Survey Datum, Malin Head.
3. DO NOT SCALE, use figured dimensions only, if in doubt ask.

No.	Date	By	Amendment / Issue	App.
F08	06.09.07	C.N.	Final Issue	W.M.

Roscommon County Council

Roscommon Landfill Environmental Monitoring

Title: Site Layout Locations of Monitoring Points

Drawn by:	C.N.	Job No:	MGE0016
Checked by:	S.A.	File No:	MGE0016DG0001
Approved by:	A.F	Drg. No:	DG0001-01
Scale:	1:2000@A3	Rev:	F08
Date:	May.'03		

APPENDIX B

Monitoring Results

Surface Water Results

Roscommon County Council,

Roscommon Landfill

Date of Monitoring : 23rd June 2009

Sampling point	Ammonia mg/l N	BOD mg/l	COD mg/l	Chloride mg/l CL	Conductivity @ 20°C	DO mg/l	pH	Suspended Solids mg/l	Temperature °C
SW1	0.039	1.45	6.3	16.3	779	8.40	7.77	2.80	16.3
SW3	0.212	8.31	61.0	30.8	740	2.58	7.41	23.20	21.3
SW7	0.213	5.44	60.0	31.6	780	8.20	7.51	12.80	15.9
Standard	0.20	5.00	40.00	250.00	1000.00	100% >7[2S] 100% >5[2C]	5.5-8.5[1]	25.00	25.00
Mean	0.15	5.07	42.43	26.23	766.33	6.39	7.56	12.93	17.83
Min	0.039	1.45	6.30	16.30	740.00	2.58	7.41	2.80	15.90
Max	0.213	8.31	61.00	31.60	780.00	8.40	7.77	23.20	21.30

[1]Surface Water Regulations 1989 A1 unless otherwise specified

[2]Freshwater Fish Directive 78/659/EEC as amended

[2S]Freshwater Fish Directive 78/659/EEC as amended (Salmon)

[2C]Freshwater Fish Directive 78/659/EEC as amended (Cyprinid)

Leachate Results

Roscommon County Council,

Roscommon Landfill

Date of Monitoring : 23rd June 2009

Sampling point	Ammonia mg/l N	BOD mg/l	COD mg/l	Chloride mg/l CL	Conductivity @ 20°C	Depth mbgl	pH	Temperature °C
LMH1	44.20	3.34	49.00	76.40	1561	2.9	6.99	13.0
LMH2	5.34	2.68	11.00	33.10	1048	2.0	6.81	17.8
LMH3	7.23	8.70	9.00	34.90	764	2.4	7.56	15.7
Mean	18.92	4.91	23.00	48.13	1124.33	2.43	7.12	15.50
Min	5.34	2.68	9.00	33.10	764.00	2.00	6.81	13.00
Max	44.20	8.70	49.00	76.40	1561.00	2.90	7.56	17.80

Mean	18.92	4.91	23.00	48.13	1124.33	2.43	7.12	15.50

Surface Water Visual Inspection/Odour Results

Roscommon County Council,

Roscommon Landfill **Licence No. 73-01**

Date of Monitoring : 23rd June 2009
Weather Conditions : Dry and Sunny

Surface water Monitoring Point	Time	Results / Findings
SW1	12.05	Clear, No Odour
SW3	11.30	Weed Growth
SW7	11.40	Weed Growth

Roscommon Landfill Gas Monitoring. January-June 2009

Quarterly Analysis : Date : 8th January 2009

Sampling Pt	Time	Temp	CH_4	CO_2	O_2	Atm Pressure
		(˚C)	(% v/v)	(% v/v)	(% v/v)	(m/bars)
LFG 1	10.30	6.1	69.8	32.8	0.6	991
LFG 2	10.32	5.9	66.9	32.9	0	991
LFG 3	10.34	5.7	64.8	35.6	0.1	991
LFG 4	10.36	5.4	69.2	33.4	0	991
LFG 5	10.38	6	73.1	30.9	0.9	991
LFG 6	10.40	6.2	72.7	28.5	0.3	991
LFG 7	10.42	5.7	84	26.4	0.5	991
LFG 8	10.44	5.8	65.4	38.6	2.1	991
LFG 9	10.46	5.5	73.3	31.5	0.8	991
LFG 10	10.50	6	72.6	36.5	0.3	991
Site Office	11.00		0	1	21.4	
		Mean	**71.18**	**29.8273**	**2.45**	

Quarterly Analysis : Date : 26th May 2009

Sampling Pt	Time	Temp	CH_4	CO_2	O_2	Atm Pressure
		(˚C)	(% v/v)	(% v/v)	(% v/v)	(m/bars)
LFG 1	10.00	12.5	48.5	27.3	1.9	1008
LFG 2	10.02	12.8	52.6	27.4	0.8	1008
LFG 3	10.04	11.9	43.5	25.9	2.6	1008
LFG 4	10.06	13	66.8	31.1	0.6	1008
LFG 5	10.08	12.6	24.1	11.6	10.6	1008
LFG 6	10.10	12.2	51.2	28.1	0.7	1008
LFG 7	10.12	11.8	64.9	25.6	0.2	1008
LFG 8	10.14	12.7	32.6	28.4	0.3	1008
LFG 9	10.16	12.2	55.5	29.6	0.7	1008
LFG 10	10.18	13.1	63.8	30.7	1.6	1008
Site Office	10.25		0	1	24.2	
		Mean	**50.35**	**24.2455**	**4.02**	

Overall results	CH_4	CO_2	O_2
	(%v/v)	(%v/v)	(%v/v)
Mean	60.77	26.95	3.24
Min	24.10	11.60	0.00
Max	84.00	38.60	10.60

Surface Water Results

Roscommon County Council,

Roscommon Landfill

Date of Monitoring : 20th January 2010

Sampling point	Ammonia mg/l N	BOD mg/l	COD mg/l	Chloride mg/l CL	Conductivity @ 20°C	DO % Sat	pH	Suspended Solids mg/l	Temperature °C	Cadmium ug/l	Chromium ug/l	Copper ug/l	Iron ug/l	Lead ug/l	Magnesium mg/l	Manganese ug/l	Mercury ug/l	Potassium mg/l	Sulphate mg/l	Sodium mg/l	Total Phosphorus mg/l	Phenols mg/l	Zinc ug/l
SW2	0.043	1.06	27.3	15.4	601	70.00	7.47	0.40	6.5	0.1	BLD	3	114.4	BLD	8.86	25.3	0.03	3.07	7.26	10.97	0.049	BLD	26.9
SW3	**0.755**	2.24	36.3	14.1	526	48.80	7.35	2.80	5.4	BLD	BLD	4	187.8	BLD	7.63	**64.1**	0.03	2.51	13.28	9.54	0.045	BLD	27.8
SW7	**0.393**	1.42	**53.6**	13.8	565	63.00	7.33	**44.40**	6.2	0.1	1	3	**236.6**	0.3	7.6	39.4	BLD	2.55	12.04	8.8	0.06	BLD	59.1

Leachate Results

Roscommon County Council,

Roscommon Landfill

Date of Monitoring : 20th January 2010

Sampling point	Ammonia mg/l N	BOD mg/l	COD mg/l	Chloride mg/l CL	Conductivity @ 20°C	Depth mbgl	pH	Temperature °C	Cadmium ug/l	Chromium ug/l	Copper ug/l	Iron ug/l	Lead ug/l	Magnesium mg/l	Manganese ug/l	Mercury ug/l	Potassium mg/l	Sulphate mg/l	Sodium mg/l	Total Phosphorus mg/l	Zinc ug/l
LMH1	27.03	1.61	72.70	32.46	869	2.60	7.49	5.8	Bld	Bld	3	952.7	Bld	15.41	2277	0.02	25.4	7.36	30.56	0.043	28.9
LMH2	1.08	1.05	54.90	9.89	589	2.40	7.23	5.5	Bld	Bld	Bld	357	Bld	9.6	214.1	0.04	8.56	1.44	12.57	0.034	278
LMH3	1.79	4.51	50.10	14.80	679	1.70	7.25	6.5	Bld	1	3	124.2	0.3	7.6	332.1	0.02	5.52	2.1	11.31	0.511	52.2

Ground Water Results

Roscommon County Council,

Roscommon Landfill

Date of Monitoring : 20th January 2010

Sampling point	Ammonia mg/l N	Cadmium µg/l	Chromium µg/l	Conductivity @ 20°C	Copper µg/l	Levels mbgl	DO mg/l	Iron µg/l	Lead µg/l	Magnesium mg/l	Manganese µg/l	Mercury µg/l	pH	Phenols µg/l	Potassium mg/l	Sodium mg/l	Sulphate mg/l SO_4	Temperature °C	Total Phosphorus mg/l P	Zinc µg/l
GW2	0.39	0.10	BLD	776	21	1	21.4	1409	0.3	15.7	113	BLD	7.17	BLD	2.21	12.27	28.05	9.6	0.021	7.7
GW4	0.13	BLD	BLD	861	BLD	0.8	25.5	2590	BLD	17.4	97.8	0.02	7.06	0.013	2.33	115.75	17.21	10.5	0.043	23.9
GW6	0.87	0.10	BLD	806	BLD	0.6	21.5	1112	0.6	17.3	149.6	0.03	6.99	BLD	2.33	15.66	BLD	10.2	0.057	34.7

Standard	0.20	5.00	40.00	250.00	1000.00	A1>60% A2>50% A3>30%	5.5-8.5[1]	25.00	25.00	5	50	50	200	50	-	50	1	-	200	-	0.5	0.0005	3000
Mean	0.40	1.57	39.07	14.40	564.00	60.60	7.38	15.87	6.03	0.07	0.33	3.33	179.60	0.10	8.03	42.93	0.02	2.71	10.86	9.77	0.05	0.00	37.93
Min	0.043	1.06	27.30	13.75	526.00	48.80	7.33	0.40	5.40	0.10	1.00	3	114.40	0.30	7.60	25.30	0.03	2.51	7.26	8.80	0.05	0.00	26.90
Max	0.755	2.24	53.60	15.37	601.00	70.00	7.47	44.40	6.50	0.10	1.00	4	236.60	0.30	8.86	64.10	0.03	3.07	13.28	10.97	0.06	0.00	59.10

[1]Surface Water Regulations 1989 A1 unless otherwise specified

	Ammonia mg/l N	BOD mg/l	COD mg/l	Chloride mg/l CL	Conductivity @ 20°C	Depth mbgl	pH	Temperature °C	Cadmium ug/l	Chromium ug/l	Copper ug/l	Iron ug/l	Lead ug/l	Magnesium mg/l	Manganese ug/l	Mercury ug/l	Potassium mg/l	Sulphate mg/l	Sodium mg/l	Total Phosphorus mg/l	Zinc ug/l
Mean	9.97	2.39	59.23	19.05	712.33	7.32	7.32	5.93	0.00	0.33	2.00	477.97	0.10	10.87	941.07	0.03	13.16	3.63	18.15	0.20	119.70
Min	1.08	1.05	50.10	9.89	589.00	1.70	7.23	5.50	0.00	1.00	3.00	124.20	0.30	7.60	214.10	0.02	5.52	1.44	11.31	0.03	28.90
Max	27.03	4.51	72.70	32.46	869.00	2.60	7.49	6.50	0.00	1.00	3.00	952.70	0.30	15.41	2277.00	0.04	25.40	7.36	30.56	0.51	278.00

	Ammonia mg/l N	Cadmium µg/l	Chromium µg/l	Conductivity @ 20°C	Copper µg/l	Levels mbgl	DO mg/l	Iron µg/l	Lead µg/l	Magnesium mg/l	Manganese µg/l	Mercury µg/l	pH	Phenols µg/l	Potassium mg/l	Sodium mg/l	Sulphate mg/l SO_4	Temperature °C	Total Phosphorus mg/l P	Zinc µg/l
Standard	0.15	5.00	30.00	1000.00	30.00	-	No abnormal change	200.00	10.00	50000.00	50.00	1.00	6.5-9.5	0.50	5.00	150.00	200.00	25.00	0.03	100.00
Mean	0.46	0.07	0.00	814.33	7.00	0.83	22.80	1703.67	0.30	16.80	120.13	0.02	7.07	0.00	2.29	47.89	15.09	10.10	0.04	22.10
Min	0.13	0.10	0.00	776.00	21.00	0.60	21.40	1112.00	0.30	15.70	97.80	0.02	6.99	0.01	2.21	12.27	17.21	9.60	0.02	7.70
Max	0.87	0.10	0.00	861.00	21.00	1.10	25.50	2590.00	0.60	17.40	149.60	0.03	7.17	0.01	2.33	115.75	28.05	10.50	0.06	34.70

	Ammonia mg/l N	BOD mg/l	COD mg/l	Chloride mg/l CL	Conductivity @ 20°C	Depth mbgl	pH	Temperature °C	Cadmium ug/l	Chromium ug/l	Copper ug/l	Iron ug/l	Lead ug/l	Magnesium mg/l	Manganese ug/l	Mercury ug/l	Potassium mg/l	Sulphate mg/l	Sodium mg/l	Total Phosphorus mg/l	Zinc ug/l
Mean	9.97	2.39	59.23	19.05	712.33	7.32	7.32	5.93	#DIV/0!	1.00	3.00	477.97	0.30	10.87	941.07	0.03	13.16	3.63	18.15	0.20	119.70

	Ammonia mg/l N	Cadmium µg/l	Chromium µg/l	Conductivity @ 20°C	Copper µg/l	Levels mbgl	DO mg/l	Iron µg/l	Lead µg/l	Magnesium mg/l	Manganese µg/l	Mercury µg/l	pH	Phenols µg/l	Potassium mg/l	Sodium mg/l	Sulphate mg/l SO_4	Temperature °C	Total Phosphorus mg/l P	Zinc µg/l
Mean	0.46	0.10	-	814.33	21.00	0.83	22.80	1703.67	0.45	16.80	120.13	0.03	7.07	0.013	2.29	47.89	22.63	10.10	0.04	22.10

Surface Water Visual Inspection/Odour Results

Roscommon County Council,

Roscommon Landfill **Licence No. 73-01**

Date of Monitoring : 20th January 2010
Weather Conditions : Dry and Mild

Surface water Monitoring Point	Time	Results / Findings
SW2	12.20	Partly Overgrown, No Odour
SW3	11.00	Partly Overgrown, No Odour
SW7	10.50	Clear, No Odour

Roscommon Landfill Gas Monitoring. July-December 2009

Quarterly Analysis : Date : 24th September 2009

Sampling Pt	Time	Temp	CH_4	CO_2	O_2	Atm Pressure
		(˚C)	(% v/v)	(% v/v)	(% v/v)	(m/bars)
LFG 1	12.05	11.9	67.5	33.7	0.1	1019
LFG 2	12.3	11.5	69.2	30.2	0.6	1019
LFG 3	12.32	10.9	64.4	28.1	0.4	1019
LFG 4	12.34	12.2	65.8	29.8	0.5	1019
LFG 5	12.1	10.5	69.8	31.6	0.4	1019
LFG 6	12.12	11.5	74.8	26.5	0.4	1019
LFG 7	12.14	11.8	78.7	22	0.5	1019
LFG 8	12.16	11.5	65.8	35	0.3	1019
LFG 9	12.18	12	74.1	26.6	0	1019
LFG 10	12.2	10.9	72.2	29.3	0	1019
Site Office	12.4		0	1	25	1019
		Mean	**70.23**	**26.7091**	**2.56**	

Quarterly Analysis : Date : 10th December 2009

Sampling Pt	Time	Temp	CH_4	CO_2	O_2	Atm Pressure
		(˚C)	(% v/v)	(% v/v)	(% v/v)	(m/bars)
LFG 1	11.05	8.5	63.5	34.5	0.5	1016
LFG 2	11.3	8.9	70.2	30.5	0.3	1016
LFG 3	11.32	9	65.8	34.5	0.5	1016
LFG 4	11.34	7.9	69.4	29.5	0.4	1016
LFG 5	11.1	8.2	71.2	31	0.4	1016
LFG 6	11.12	8.4	63.7	28.5	0.6	1016
LFG 7	11.14	9	66.6	33.6	0.4	1016
LFG 8	11.16	8.6	68.5	34.2	0.5	1016
LFG 9	11.18	7.8	63.8	29.6	0.3	1016
LFG 10	11.2	9	70.1	32.4	0	1016
Site Office	11.4		0	1	25	1016
		Mean	**67.28**	**29.0273**	**2.63**	

Overall results	CH_4 (%v/v)	CO_2 (%v/v)	O_2 (%v/v)
Mean	68.76	27.78	2.60
Min	63.50	22.00	0.00
Max	78.70	35.00	0.60

2009

Sampling point	Cadmium ug/l	Chromium ug/l	Copper ug/l	Iron ug/l	Lead ug/l	Magnesium mg/l	Manganese ug/l	Mercury ug/l	Potassium mg/l	Sulphate mg/l	Sodium mg/l	Phenols mg/l	Total Phosphorus mg/l	Zinc ug/l
SW2	0.1	BLD	3	114.4	BLD	8.86	25.3	0.03	3.07	7.26	10.97	BLD	0.049	26.9
SW3	BLD	BLD	4	187.8	BLD	7.63	64.1	0.03	2.51	13.28	9.54	BLD	0.045	27.8
SW7	0.1	1	3	236.6	0.3	7.6	39.4	BLD	2.55	12.04	8.8	BLD	0.06	59.1
				179.6	0.1	8.0	42.9	0.0	2.7	10.9	9.8	0.0	0.1	37.9

2008

Sampling point	Cadmium µg/l	Chromium µg/l	Copper µg/l	Iron µg/l	Lead µg/l	Magnesium mg/l	Manganese µg/l	Mercury µg/l	Potassium mg/l	Sulphate mg/l SO_4	Sodium mg/l	Phenols µg/l	Total Phosphorus mg/l P	Zinc µg/l		
SW2	BLD	1.00	7.00	38.20	BLD	7.10	24.10	BLD	2.40	8.97	10.00	BLD	0.03	8.30		
SW3	BLD	BLD	7.00	141.00	BLD	7.50	85.00	BLD	2.40	20.74	10.90	BLD	0.03	7.50		
SW7	BLD	BLD	6.00	124.00	BLD	7.60	54.90	BLD	2.80	18.15	9.20	0.01	0.05	8.60		
			drop	101.1	0.0	7.4	54.7	0.0	2.5	16.0	10.0	0.0	0.0	8.1		

2009 2nd half

Sampling point	Ammonia mg/l N	BOD mg/l	COD mg/l	Chloride mg/l CL	Conductivity @ 20°C	DO % Sat	pH	Suspended Solids mg/l	Temperature °C
SW2	0.043	1.06	27.3	15.4	601	70.00	7.47	0.40	6.5
SW3	**0.755**	2.24	36.3	14.1	526	48.80	7.35	2.80	5.4
SW7	**0.393**	1.42	**53.6**	13.8	565	63.00	7.33	**44.40**	6.2

2009 1st half

Sampling point	Ammonia mg/l N	BOD mg/l	COD mg/l	Chloride mg/l CL	Conductivity @ 20°C	DO mg/l	pH	Suspended Solids mg/l	Temperature °C
SW1	0.039	1.45	6.3	16.3	779	8.40	7.77	2.80	16.3
SW3	0.212	8.31	61.0	30.8	740	2.58	7.41	23.20	21.3
SW7	0.213	5.44	60.0	31.6	780	8.20	7.51	12.80	15.9
SW7	high	low	low	low	low			high	low

2008

Sampling point	Ammonia mg/l N	BOD mg/l	COD mg/l	Chloride mg/l CL	Conductivity @ 20°C	DO mg/l	pH	Suspended Solids mg/l	Temperature °C
SW2	0.09	0.74	44.00	17.30	653.00	7.97	7.73	2.00	6.70
SW3	0.67	1.59	90.00	19.76	591.00	4.49	7.51	7.00	5.80
SW7	0.41	0.65	74.00	16.48	613.00	6.68	7.66	1.00	6.20
SW7	lower	higher	lower	lower	lower			higher	

2009

Sampling point	Ammonia mg/l N	Cadmium µg/l	Chromium µg/l	Conductivity @ 20°C	Copper µg/l	Levels mbgl	DO mg/l	Iron µg/l	Lead µg/l	Magnesium mg/l	Manganese µg/l	Mercury µg/l	pH	Phenols µg/l	Potassium mg/l	Sodium mg/l	Sulphate mg/l SO_4	Temperature °C	Total Phosphorus mg/l P
GW2	0.39	0.10	BLD	776	21	1	21.4	1409	0.3	15.7	113	BLD	7.17	BLD	2.21	12.27	28.05	9.6	0.021
GW4	0.13	BLD	BLD	861	BLD	0.8	25.5	2590	BLD	17.4	97.8	0.02	7.06	0.013	2.33	115.75	17.21	10.5	0.043
GW6	0.87	0.10	BLD	806	BLD	0.6	21.5	1112	0.6	17.3	149.6	0.03	6.99	BLD	2.33	15.66	BLD	10.2	0.057
MEAN	0.46	0.07	0.00	814.33	7.00	0.83	22.80	1703.67	0.30	16.80	120.13	0.02	7.07	0.00	2.29	47.89	15.09	10.10	0.04

2008

Sampling point	Ammonia mg/l N	Cadmium µg/l	Chromium µg/l	Conductivity @ 20°C	Copper µg/l	Levels mbgl	DO mg/l	Iron µg/l	Lead µg/l	Magnesium mg/l	Manganese µg/l	Mercury µg/l	pH	Phenols µg/l	Potassium mg/l	Sodium mg/l	Sulphate mg/l SO_4	Temperature °C	Total Phosphorus mg/l P
GW2	0.37	BLD	BLD	793.00	8.00	1.00	2.10	52.70	BLD	16.20	93.50	BLD	7.12	BLD	2.20	12.60	31.24	9.30	0.01
GW4	0.79	0.10	3.20	823.00	7.00	0.55	4.33	106.00	BLD	16.40	104.00	BLD	7.21	BLD	2.40	16.60	23.11	9.10	NT
GW6	1.72	BLD	1.80	843.00	6.00	0.45	3.78	308.00	BLD	12.90	129.00	BLD	7.19	BLD	1.20	17.00	0.99	9.70	NT
MEAN	0.96	0.03	1.67	819.67	7.00	0.67	3.40	155.57	0.00	15.17	108.83	0.00	7.17	0.00	1.93	15.40	18.45	9.37	0.00
	low	high		low		high	high	high		high	high				high	high	low	high	
						same							same						

2009

Cadmium ug/l	Chromium ug/l	Copper ug/l	Iron ug/l	Lead ug/l	Magnesium mg/l	Manganese ug/l	Mercury ug/l	Potassium mg/l	Sulphate mg/l	Sodium mg/l	Total Phosphorus mg/l	Zinc ug/l
Bld	Bld	3	952.7	Bld	15.41	2277	0.02	25.4	7.36	30.56	0.043	28.9
Bld	Bld	Bld	357	Bld	9.6	214.1	0.04	8.56	1.44	12.57	0.034	278
Bld	1	3	124.2	0.3	7.6	332.1	0.02	5.52	2.1	11.31	0.511	52.2
0.00	0.33	2.00	477.97	0.10	10.87	941.07	0.03	13.16	3.63	18.15	0.20	119.70

2008

Cadmium µg/l	Chromium µg/l	Copper µg/l	Iron µg/l	Lead µg/l	Magnesium mg/l	Manganese µg/l	Mercury µg/l	Potassium mg/l	Sulphate mg/l SO_4	Sodium mg/l	Total Phosphorus mg/l P	Zinc µg/l
BLD	4.30	7.00	6447.00	BLD	20.70	780.00	BLD	34.60	BLD	67.00	0.43	13.00
BLD	1.20	6.00	10930.00	BLD	7.80	763.00	BLD	3.90	BLD	10.10	0.07	4.80
0.10	1.60	6.00	36.80	0.30	11.50	1162.00	BLD	11.60	5.48	28.80	0.04	9.60
0.03	2.37	6.33	5804.60	0.10	13.33	901.67	0.00	16.70	1.83	35.30	0.14	6.85
dec	dec	dec	dec		dec	dec/inc	inc	dec	inc	dec	inc	inc

APPENDIX C

Meteorological Data

Knock Airport								
Year	Month	Day	Rainfall (mm)	Wind Speed (Knots)	Relative Humidity (%)	MSL Pressure (hPa)	Max. Temp. (Degrees Celsius)	Min. Temp. (Degrees Celsius)
2009	1	1	0.0	11.9	97	1028.6	1.7	0.5
2009	1	2	0.0	9.7	88	1030.5	2.9	0.2
2009	1	3	0.0	6.1	85	1029.8	1.5	-0.3
2009	1	4	0.4	4.1	97	1023.6	3.8	0.3
2009	1	5	0.0	6.6	97	1025.3	2.8	-1.8
2009	1	6	0.0	4.5	89	1028.9	-0.1	-3.8
2009	1	7	0.0	4.5	94	1027.1	2.9	-2.8
2009	1	8	0.0	7.6	95	1025.8	2.6	-2.5
2009	1	9	0.0	12.0	88	1022.4	5	-1.5
2009	1	10	2.5	21.4	91	1010.8	7.8	1.6
2009	1	11	15.2	21.7	97	1000.5	10.6	7.7
2009	1	12	1.9	8.7	90	1000.6	8.5	2.8
2009	1	13	0.4	4.2	97	1007.4	5.4	-0.3
2009	1	14	11.6	15.7	98	999.5	9.7	-1.4
2009	1	15	1.0	16.7	92	994.1	9.5	3.2
2009	1	16	3.1	12.7	94	998.1	8.5	2.9
2009	1	17	13.5	17.2	88	987.2	6.2	-0.3
2009	1	18	11.6	12.4	91	984.7	3.5	-0.4
2009	1	19	7.3	11.1	93	974.4	3.2	-0.9
2009	1	20	9.0	11.7	91	984.3	3.2	-0.3
2009	1	21	10.0	10.8	99	987.2	8.8	-0.6
2009	1	22	4.6	13.7	88	976.4	9.2	1.1
2009	1	23	2.9	8.9	92	978.3	5.5	-0.4
2009	1	24	5.6	10.1	96	981.8	3.9	-0.1
2009	1	25	22.9	7.6	91	973.1	5.9	0.2
2009	1	26	4.5	10.5	89	998.7	7.2	2.4
2009	1	27	2.2	5.5	96	1006.3	8	1.9
2009	1	28	0.0	9.5	98	1010.0	8	2
2009	1	29	4.1	19.7	94	1000.7	8.3	3.6
2009	1	30	10.4	13.0	97	998.0	9.6	4.8
2009	1	31	13.2	6.6	99	1002.7	6	4.6
2009	2	1	0.1	12.3	88	1011.6	4.7	0
2009	2	2	0.0	9.5	85	1009.8	1.9	-2.3
2009	2	3	2.5	12.5	91	992.2	1.9	-1.2
2009	2	4	0.8	11.6	88	993.0	4.4	0.2
2009	2	5	0.2	12.6	84	997.8	2.4	-1.2
2009	2	6	1.0	8.8	89	1000.5	4.3	-1.1
2009	2	7	1.4	6.9	80	1005.2	3.3	-0.8
2009	2	8	2.6	7.6	92	998.5	5.3	-2.1
2009	2	9	0.9	4.6	95	996.1	3.8	-0.6
2009	2	10	0.9	7.5	93	1007.3	5.9	-0.6
2009	2	11	0.1	6.7	94	1019.8	7.7	1.1

2009	2	12	0.5	7.9	97	1024.7	9.9	2.1
2009	2	13	0.3	4.9	94	1025.2	9.4	4.2
2009	2	14	0.3	7.3	95	1025.6	8.4	4.3
2009	2	15	0.2	6.8	96	1026.8	9.6	4.3
2009	2	16	0.1	7.1	94	1027.1	9.6	4.2
2009	2	17	0.0	4.8	91	1029.6	8.8	3.1
2009	2	18	0.4	6.5	92	1026.5	6.3	5
2009	2	19	3.6	5.2	90	1029.8	8.3	2.5
2009	2	20	0.0	5.4	89	1032.3	8.6	0.9
2009	2	21	0.2	10.8	91	1032.3	10.2	4.6
2009	2	22	1.0	9.2	95	1031.6	10	5.7
2009	2	23	1.0	7.5	98	1029.5	9.3	5.8
2009	2	24	0.1	5.1	92	1028.1	8.7	5.2
2009	2	25	1.4	9.2	85	1027.0	8.8	3.7
2009	2	26	1.3	12.9	90	1022.8	9.5	3.7
2009	2	27	0.4	10.9	93	1016.9	8.9	6.1
2009	2	28	6.0	10.5	97	1007.2	9.7	4.7
2009	3	1	1.9	9.3	90	1008.8	8.7	2.1
2009	3	2	1.0	11.8	93	1012.6	9.2	2.2
2009	3	3	6.8	10.3	92	992.6	4.4	-1.6
2009	3	4	4.2	6.6	98	981.3	2.2	-2.3
2009	3	5	2.9	8.5	87	997.7	6.5	-0.9
2009	3	6	1.7	10.4	91	1003.2	8.8	0.7
2009	3	7	5.2	13.7	91	1000.9	10.4	1.6
2009	3	8	7.2	15.4	85	998.8	5	-0.2
2009	3	9	8.1	13.3	87	1006.7	7.8	2.4
2009	3	10	1.3	7.2	90	1010.5	9.8	4.6
2009	3	11	4.9	14.2	98	1016.0	10.5	7.1
2009	3	12	0.1	10.6	80	1018.3	10.4	3.5
2009	3	13	2.0	13.4	95	1009.5	9.2	3.6
2009	3	14	1.3	15.8	76	1016.8	10.4	5.1
2009	3	15	0.0	9.3	89	1028.6	9.2	5.1
2009	3	16	1.3	8.2	95	1030.0	8.9	6.1
2009	3	17	0.1	9.3	85	1032.0	13.2	4.9
2009	3	18	0.0	7.5	76	1029.5	15.6	2.1
2009	3	19	0.0	9.8	85	1026.6	13.9	0.5
2009	3	20	0.0	9.7	85	1027.2	13	2.8
2009	3	21	0.0	8.5	82	1035.3	11.1	4.2
2009	3	22	0.0	10.5	83	1035.5	12.1	5.2
2009	3	23	0.9	16.4	79	1024.9	9	2.3
2009	3	24	0.5	13.0	87	1018.8	10.9	2
2009	3	25	1.3	18.1	79	1009.8	10.1	4.9
2009	3	26	4.2	19.8	80	1001.0	9.1	3.2
2009	3	27	6.9	17.1	83	999.0	7.5	1.9
2009	3	28	0.9	13.8	65	1011.7	6.4	1.2
2009	3	29	1.3	9.9	94	1009.1	9	0.8
2009	3	30	0.0	7.7	89	1017.2	12.9	6.1

2009	3	31	0.3	5.9	90	1021.4	12.9	6
2009	4	1	0.0	7.3	84	1022.1	11.7	5.9
2009	4	2	0.0	9.5	73	1019.5	14.8	2.1
2009	4	3	8.3	9.1	97	1011.8	10.6	2.9
2009	4	4	1.6	11.1	79	1017.2	10	3.5
2009	4	5	0.4	11.8	82	1016.6	10.5	3
2009	4	6	3.9	15.4	87	1000.3	10.3	4.4
2009	4	7	16.3	13.0	94	993.4	8.7	3.7
2009	4	8	1.1	12.0	78	999.5	10.7	4.3
2009	4	9	18.9	11.8	97	992.1	10.3	4.5
2009	4	10	4.5	6.6	88	998.9	8.2	2.1
2009	4	11	1.6	6.5	86	1007.2	11	1.6
2009	4	12	0.0	6.9	80	1011.7	12.3	2.2
2009	4	13	17.1	9.0	96	1003.9	10.7	5.9
2009	4	14	1.0	8.1	87	1005.7	12.2	4.4
2009	4	15	1.7	8.5	93	1010.2	9.9	5.1
2009	4	16	0.0	12.6	73	1009.4	15.9	8
2009	4	17	0.0	10.5	83	1013.8	10.4	6.3
2009	4	18	0.0	8.8	74	1020.2	14.7	5.5
2009	4	19	0.0	8.1	77	1023.9	14.5	3.3
2009	4	20	0.8	7.0	89	1026.6	14.4	7.6
2009	4	21	1.2	7.5	76	1026.3	13.3	6
2009	4	22	3.0	12.8	86	1019.8	12.6	3.3
2009	4	23	6.8	6.5	87	1015.7	12.6	5.5
2009	4	24	8.6	6.1	92	1009.7	9.7	5.2
2009	4	25	0.8	13.8	86	1007.3	10.4	5.4
2009	4	26	5.2	9.4	93	1003.6	9.8	5
2009	4	27	3.6	8.1	84	995.0	10.6	1.9
2009	4	28	0.9	8.0	86	1004.2	12.2	4.3
2009	4	29	8.8	6.8	91	1002.1	11.6	7.2
2009	4	30	1.7	8.0	77	1010.5	13.8	5.7
2009	5	1	5.0	14.6	80	1016.1	12.7	4.7
2009	5	2	3.3	9.6	79	1025.8	12.5	3.4
2009	5	3	2.0	11.1	82	1029.5	10.8	2.1
2009	5	4	1.6	15.6	98	1022.7	11.4	6.8
2009	5	5	8.0	18.1	99	1017.6	11.8	8.8
2009	5	6	8.6	16.1	96	1009.9	11.1	5.3
2009	5	7	6.1	17.3	86	1001.7	9.3	4.1
2009	5	8	4.2	16.9	82	1002.6	10.7	4.6
2009	5	9	4.3	10.6	82	1010.0	11.8	3.8
2009	5	10	0.0	4.3	71	1020.4	14.6	4.5
2009	5	11	0.0	11.5	60	1024.7	15.5	5.5
2009	5	12	0.0	12.7	70	1023.3	13.6	4.2
2009	5	13	0.4	12.2	80	1014.9	14.5	4.9
2009	5	14	5.7	7.2	99	1008.7	11.6	8.2
2009	5	15	14.0	8.5	97	1000.1	10.1	4.5
2009	5	16	13.2	13.0	92	989.6	10.5	4.5

2009	5	17	5.2	10.8	93	995.1	10.2	4.5
2009	5	18	2.5	5.5	88	1000.6	12.1	6.7
2009	5	19	2.5	5.3	90	1008.5	12.8	5.6
2009	5	20	2.7	6.8	81	1013.3	13.8	5.2
2009	5	21	2.8	9.0	83	1013.1	13.2	5.4
2009	5	22	4.1	7.2	93	1011.4	16.4	7.6
2009	5	23	10.2	10.4	84	1014.0	13.3	6.6
2009	5	24	0.1	11.8	93	1017.7	12	6
2009	5	25	3.8	9.9	89	1015.0	13.2	6.1
2009	5	26	0.9	13.3	78	1016.0	12.5	4.5
2009	5	27	4.6	15.8	99	1015.3	13	7.8
2009	5	28	0.1	10.2	92	1027.8	14.9	9.8
2009	5	29	0.0	11.4	84	1025.9	19.9	10.3
2009	5	30	0.5	9.0	81	1023.3	21.4	10.9
2009	5	31	0.0	6.6	64	1027.1	22.7	11.3
2009	6	1	0.0	5.6	65	1027.6	23.7	11.2
2009	6	2	0.0	4.8	60	1027.5	25.2	13.2
2009	6	3	0.0	6.3	68	1024.2	20.7	12.6
2009	6	4	0.0	6.1	72	1019.6	18.7	8
2009	6	5	0.0	10.3	65	1013.2	13.8	5.8
2009	6	6	0.5	10.7	71	1008.4	12.4	4.9
2009	6	7	0.0	6.6	74	1007.2	13.9	5.8
2009	6	8	0.2	8.3	66	1008.6	15.5	7.3
2009	6	9	0.0	6.3	68	1011.6	15.1	6.5
2009	6	10	0.0	6.6	74	1012.9	14.6	6.6
2009	6	11	0.0	5.2	65	1019.1	15.5	6
2009	6	12	11.8	8.4	89	1016.7	16.2	7.5
2009	6	13	2.5	8.5	85	1014.8	17.5	9.4
2009	6	14	2.0	6.5	82	1015.9	17.7	9.3
2009	6	15	0.4	4.6	79	1016.1	18.1	9.9
2009	6	16	6.0	8.3	84	1017.8	18.5	9.4
2009	6	17	12.0	13.0	82	1010.3	14.8	8.2
2009	6	18	4.6	15.3	84	1013.5	13.7	8.3
2009	6	19	0.0	13.5	78	1022.5	13.5	8
2009	6	20	0.8	11.0	81	1026.8	16.2	10.2
2009	6	21	0.4	7.3	96	1027.1	17	10.9
2009	6	22	0.0	4.7	81	1028.8	20.9	13.2
2009	6	23	0.0	7.4	75	1027.1	23.9	14.3
2009	6	24	2.3	9.5	67	1020.7	22.5	12.4
2009	6	25	0.0	9.7	72	1014.9	20.8	10.7
2009	6	26	6.4	8.4	87	1012.5	19.7	13.6
2009	6	27	0.1	6.0	81	1014.2	22.1	13.6
2009	6	28	4.5	10.1	82	1013.5	20.8	11.6
2009	6	29	1.0	5.5	78	1015.1	21.3	12.6
2009	6	30	8.9	8.8	94	1017.6	17.7	11.1
2009	7	1	3.0	2.7	95	1019.8	19.7	13.6
2009	7	2	0.2	8.2	95	1015.3	19.9	15.9

2009	7	3	5.3	8.6	82	1008.5	19.3	12.1
2009	7	4	19.5	9.0	87	1005.4	18.3	10.8
2009	7	5	7.1	7.4	88	1001.8	18.6	9.9
2009	7	6	16.1	9.5	92	1003.1	16.9	11.9
2009	7	7	0.2	12.7	82	1010.8	17	10
2009	7	8	0.1	8.9	75	1018.0	16	10.1
2009	7	9	0.0	6.6	72	1019.8	16.6	10.2
2009	7	10	3.9	6.3	86	1015.4	14.3	8.2
2009	7	11	8.6	12.2	98	1002.9	16.9	13.1
2009	7	12	0.6	12.4	80	999.7	17.2	11
2009	7	13	15.2	6.6	95	1000.8	14.5	9.8
2009	7	14	4.9	4.5	91	1002.0	17.6	8.2
2009	7	15	7.2	6.0	88	1009.2	17	11.4
2009	7	16	1.2	7.0	82	1015.7	17.2	9.4
2009	7	17	0.0	11.5	77	1016.5	16.8	9.2
2009	7	18	3.3	5.5	91	1011.3	14	10.6
2009	7	19	6.8	7.9	89	1009.0	15.8	9.4
2009	7	20	2.1	8.2	89	1009.5	17.1	9.6
2009	7	21	9.2	10.0	94	996.2	17.6	10.1
2009	7	22	1.0	8.3	91	992.5	16.7	8.2
2009	7	23	12.6	6.4	96	998.2	13.6	11
2009	7	24	2.2	6.4	89	1009.2	17.1	10.5
2009	7	25	3.1	8.0	85	1016.5	18.1	8.4
2009	7	26	12.4	16.1	93	1003.9	15.6	11.4
2009	7	27	3.4	10.9	83	1006.3	16.3	10.5
2009	7	28	6.4	13.2	92	1004.4	14.8	10.5
2009	7	29	1.7	9.7	80	1007.5	17.1	9.3
2009	7	30	6.1	9.0	79	1016.2	16.3	8.1
2009	7	31	6.4	16.3	95	1007.4	14.2	10.5
2009	8	1	2.6	14.4	88	1004.4	14.1	10.1
2009	8	2	6.3	8.5	91	1008.1	15.2	9.2
2009	8	3	8.2	13.2	95	1002.6	17	12.3
2009	8	4	2.0	13.1	83	1004.2	17.8	11.9
2009	8	5	1.3	15.4	83	1010.2	16.9	10.6
2009	8	6	0.8	8.9	84	1017.5	17.4	9.9
2009	8	7	0.3	8.5	81	1020.0	16.9	8.9
2009	8	8	1.7	7.1	89	1018.5	16.7	12.2
2009	8	9	2.0	7.7	90	1016.1	15.3	11.2
2009	8	10	2.5	9.3	92	1013.6	17.9	12.4
2009	8	11	4.3	8.2	96	1021.2	15.8	12.1
2009	8	12	2.1	7.9	91	1020.5	16.5	11.8
2009	8	13	0.2	3.7	81	1020.3	16.1	11.2
2009	8	14	11.0	13.3	98	1009.1	16.5	12.4
2009	8	15	6.8	12.5	87	1007.7	16.8	12
2009	8	16	3.7	12.3	93	1011.5	15.8	12
2009	8	17	0.7	8.1	87	1013.2	17	11.7
2009	8	18	4.6	11.8	97	1009.4	18.3	12.7

2009	8	19	14.5	10.7	96	1004.8	16.1	12.5
2009	8	20	16.9	9.6	92	1003.9	16.1	9.5
2009	8	21	3.4	10.0	85	1014.4	15.3	7.7
2009	8	22	14.7	9.6	90	1015.9	15.9	7.8
2009	8	23	16.1	10.8	94	1003.5	16.1	8
2009	8	24	3.5	12.1	89	1000.2	15.1	8.1
2009	8	25	2.2	9.3	84	1001.9	15.9	9.1
2009	8	26	14.5	11.7	94	999.3	15.2	9.6
2009	8	27	6.6	12.3	93	1005.1	14.7	8.9
2009	8	28	5.6	12.9	88	1011.8	13.8	8.2
2009	8	29	0.5	9.6	84	1018.9	14.8	8.6
2009	8	30	9.3	10.3	99	1008.6	16.5	8.8
2009	8	31	12.9	9.4	93	998.8	14.8	9.6
2009	9	1	5.9	9.8	94	998.9	14.3	8.3
2009	9	2	1.0	6.7	94	999.8	13.3	9.3
2009	9	3	1.2	12.4	83	1001.2	13.9	8.4
2009	9	4	0.2	13.1	82	1011.1	14.2	7.9
2009	9	5	0.3	11.6	80	1018.1	14.5	10.1
2009	9	6	8.1	12.5	97	1011.7	14.9	9.9
2009	9	7	3.7	10.5	90	1011.0	15.1	9.9
2009	9	8	11.5	14.7	90	1009.4	16.2	8.2
2009	9	9	0.2	6.4	80	1031.9	16.4	7.3
2009	9	10	0.0	3.8	82	1039.7	16.8	9
2009	9	11	0.0	4.5	75	1038.6	18.7	8.4
2009	9	12	0.0	3.4	75	1033.7	19.2	9.6
2009	9	13	0.0	3.8	70	1031.8	19.9	9.6
2009	9	14	0.0	4.8	83	1031.5	16.4	9.9
2009	9	15	2.8	7.0	93	1030.9	14	10.5
2009	9	16	0.0	7.1	75	1030.0	15.4	7.9
2009	9	17	0.0	4.1	81	1025.0	15.2	7.1
2009	9	18	0.0	7.0	80	1017.7	12.8	6.7
2009	9	19	0.8	8.4	78	1016.9	14.2	6.5
2009	9	20	0.2	9.2	87	1022.6	14.2	7.1
2009	9	21	2.8	17.6	94	1017.6	14.3	12.2
2009	9	22	1.6	12.6	89	1019.3	14.2	9.4
2009	9	23	0.3	9.0	85	1024.0	14.5	7.4
2009	9	24	0.0	9.3	84	1025.9	14.9	9.6
2009	9	25	0.0	10.0	83	1025.9	16.5	10.7
2009	9	26	0.5	6.5	95	1027.8	17.3	10.5
2009	9	27	1.0	9.1	96	1028.5	15	11.6
2009	9	28	0.7	11.3	94	1028.1	13.9	11.7
2009	9	29	0.4	9.3	97	1025.2	13.7	11.1
2009	9	30	3.2	8.4	98	1022.2	13.9	9
2009	10	1	0.1	6.3	86	1023.8	11.4	7.4
2009	10	2	1.9	11.6	96	1018.7	13.3	8.4
2009	10	3	4.3	16.1	84	1007.1	12	6
2009	10	4	0.2	4.9	86	1011.4	12	4.9

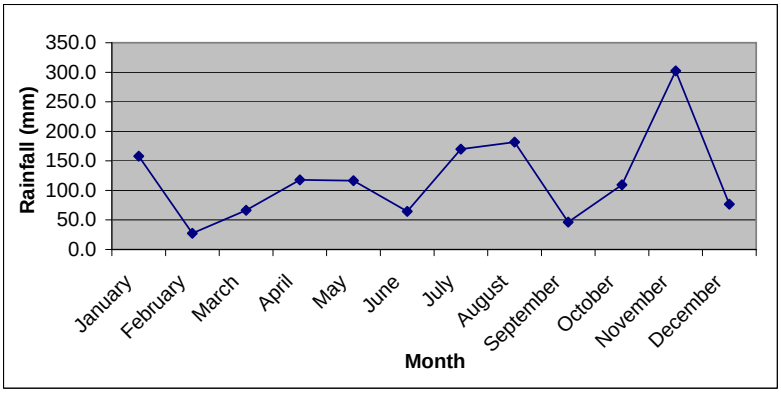
2009	10	5	0.1	6.7	88	1007.5	14	6.2
2009	10	6	0.1	8.5	80	1004.5	10.7	5.4
2009	10	7	0.0	5.2	78	1013.7	11.6	3.6
2009	10	8	0.0	4.6	78	1018.4	12.8	4.8
2009	10	9	6.0	10.1	92	1008.7	12.3	6.9
2009	10	10	0.4	6.3	90	1014.6	13.8	9
2009	10	11	2.3	8.6	88	1019.2	11.7	8.1
2009	10	12	0.0	4.0	88	1029.4	13	5.5
2009	10	13	0.9	4.5	99	1029.5	14.5	11
2009	10	14	0.4	4.3	96	1030.1	15.8	9.8
2009	10	15	0.0	2.8	92	1034.8	14	8.5
2009	10	16	0.0	3.7	87	1037.3	14.6	7.7
2009	10	17	0.3	5.2	92	1031.3	12	5.8
2009	10	18	9.1	5.8	100	1019.3	11.2	8.2
2009	10	19	5.3	12.8	96	1000.7	11.6	9.1
2009	10	20	12.5	11.0	95	985.6	12.8	6.3
2009	10	21	3.1	13.4	93	984.6	12.5	6.2
2009	10	22	0.2	6.8	94	990.6	13.8	8.2
2009	10	23	0.5	5.1	97	1001.4	12.4	6.1
2009	10	24	18.0	21.0	94	992.3	13.5	10.5
2009	10	25	4.8	15.3	93	1005.9	12.3	9
2009	10	26	7.4	7.2	96	1014.3	12.4	9
2009	10	27	5.2	14.5	97	1005.9	14.1	11.5
2009	10	28	5.6	9.8	97	1011.2	15.3	10.4
2009	10	29	0.4	12.7	98	1011.7	14.6	10.4
2009	10	30	17.3	13.8	98	1007.8	15	11.4
2009	10	31	3.0	10.8	95	1012.1	13.8	10.3
2009	11	1	19.7	10.7	91	998.2	10.9	6.2
2009	11	2	10.5	8.8	91	995.1	10	4.8
2009	11	3	12.9	11.6	93	982.8	9.9	5.1
2009	11	4	7.4	16.0	90	984.1	9.3	5.5
2009	11	5	2.9	16.0	92	998.2	9.1	5.4
2009	11	6	12.0	10.8	92	995.4	9.2	2.8
2009	11	7	12.4	10.6	93	990.5	8	3.8
2009	11	8	0.5	6.8	90	1012.3	10.8	5.7
2009	11	9	12.7	9.8	100	1015.2	8.5	4
2009	11	10	0.2	5.7	91	1012.9	9.9	3.8
2009	11	11	8.1	9.5	96	1000.4	7.5	1.8
2009	11	12	12.0	10.5	96	986.7	8	3.7
2009	11	13	1.7	8.8	93	988.8	8.4	3.2
2009	11	14	9.3	9.8	89	984.0	9.1	2.4
2009	11	15	4.5	10.8	93	993.6	10.4	3.1
2009	11	16	30.8	10.3	98	989.6	8.2	5.4
2009	11	17	20.5	7.4	96	997.7	8.4	3.4
2009	11	18	22.7	12.2	99	994.9	11.9	3.5
2009	11	19	14.5	15.8	97	988.9	11.9	9.9
2009	11	20	4.0	9.1	89	1002.6	10	3.8

2009	11	21	22.4	17.4	93	993.1	11.8	5
2009	11	22	14.6	20.8	92	984.0	8.9	4.1
2009	11	23	3.9	11.7	93	994.7	9.6	5.4
2009	11	24	18.1	15.3	94	989.4	11.1	3.9
2009	11	25	9.0	16.7	87	985.7	7.7	3.7
2009	11	26	7.4	8.6	94	992.2	5.4	2
2009	11	27	7.1	6.3	97	994.4	4.9	-0.7
2009	11	28	0.1	3.8	100	991.9	2.6	-2.6
2009	11	29	0.1	9.9	90	996.6	5.6	-1.8
2009	11	30	0.3	5.5	94	1011.3	4.8	-1
2009	12	1	6.6	13.1	98	998.6	6.8	-0.4
2009	12	2	0.3	7.8	97	991.1	7.6	3.6
2009	12	3	2.2	11.1	90	1002.6	4.6	0.6
2009	12	4	3.3	7.9	99	999.4	8.9	0.9
2009	12	5	7.4	10.2	98	984.8	9.9	4.8
2009	12	6	3.8	13.9	88	982.0	6.8	3.1
2009	12	7	5.6	9.5	96	989.8	6.7	1.7
2009	12	8	4.0	13.0	93	997.6	9.7	3.6
2009	12	9	2.0	8.6	94	1008.7	7.5	3.2
2009	12	10	0.0	6.8	97	1025.4	6.4	2.1
2009	12	11	0.8	13.6	96	1028.0	8.2	3.5
2009	12	12	0.0	10.5	94	1032.9	4.8	1.5
2009	12	13	0.0	4.8	92	1034.1	5.3	0.2
2009	12	14	0.6	5.6	93	1028.5	7.2	0.5
2009	12	15	0.6	7.3	93	1023.0	7.3	1.9
2009	12	16	2.0	5.9	96	1018.2	7	2.7
2009	12	17	0.0	6.6	89	1020.9	4.3	-0.2
2009	12	18	0.0	4.5	84	1026.2	0.3	-2.4
2009	12	19	2.3	7.9	94	1015.0	4.5	-2.1
2009	12	20	3.4	8.0	99	1001.0	0.1	-2.4
2009	12	21	3.3	5.6	96	988.2	0.9	-2.4
2009	12	22	3.5	6.6	97	986.3	1.3	-3
2009	12	23	0.0	3.5	98	987.2	0.2	-4.6
2009	12	24	0.0	2.5	93	990.1	1.5	-3.7
2009	12	25	4.4	6.5	99	993.7	1	-6.1
2009	12	26	6.2	7.3	99	989.8	1.8	-0.6
2009	12	27	2.1	9.3	92	1000.5	3.2	-1.3
2009	12	28	0.0	6.1	94	1003.0	1.5	-4
2009	12	29	1.8	13.6	92	997.2	2	0.1
2009	12	30	10.5	17.9	96	996.3	2.2	-0.1
2009	12	31	0.0	12.2	78	1009.2	1.5	-1.6

nock Airport

Year	Month	Day	Rainfall (mm)
2009	1	1	0.0
2009	1	2	0.0
2009	1	3	0.0
2009	1	4	0.4
2009	1	5	0.0
2009	1	6	0.0
2009	1	7	0.0
2009	1	8	0.0
2009	1	9	0.0
2009	1	10	2.5
2009	1	11	15.2
2009	1	12	1.9
2009	1	13	0.4
2009	1	14	11.6
2009	1	15	1.0
2009	1	16	3.1
2009	1	17	13.5
2009	1	18	11.6
2009	1	19	7.3
2009	1	20	9.0
2009	1	21	10.0
2009	1	22	4.6
2009	1	23	2.9
2009	1	24	5.6
2009	1	25	22.9
2009	1	26	4.5
2009	1	27	2.2
2009	1	28	0.0
2009	1	29	4.1
2009	1	30	10.4
2009	1	31	13.2
			157.9
2009	2	1	0.1
2009	2	2	0.0
2009	2	3	2.5
2009	2	4	0.8
2009	2	5	0.2
2009	2	6	1.0
2009	2	7	1.4
2009	2	8	2.6
2009	2	9	0.9
2009	2	10	0.9
2009	2	11	0.1
2009	2	12	0.5
2009	2	13	0.3
2009	2	14	0.3
2009	2	15	0.2
2009	2	16	0.1
2009	2	17	0.0
2009	2	18	0.4
2009	2	19	3.6
2009	2	20	0.0
2009	2	21	0.2
2009	2	22	1.0
2009	2	23	1.0
2009	2	24	0.1
2009	2	25	1.4
2009	2	26	1.3
2009	2	27	0.4
2009	2	28	6.0
			27.3
2009	3	1	1.9
2009	3	2	1.0
2009	3	3	6.8

Year	Month	Rainfall (mm)
2009	January	157.9
2009	February	27.3
2009	March	66.3
2009	April	117.8
2009	May	116.4
2009	June	64.4
2009	July	169.8
2009	August	181.8
2009	September	46.4
2009	October	109.4
2009	November	302.3
2009	December	76.7
		1436.5



2009	3	4	4.2
2009	3	5	2.9
2009	3	6	1.7
2009	3	7	5.2
2009	3	8	7.2
2009	3	9	8.1
2009	3	10	1.3
2009	3	11	4.9
2009	3	12	0.1
2009	3	13	2.0
2009	3	14	1.3
2009	3	15	0.0
2009	3	16	1.3
2009	3	17	0.1
2009	3	18	0.0
2009	3	19	0.0
2009	3	20	0.0
2009	3	21	0.0
2009	3	22	0.0
2009	3	23	0.9
2009	3	24	0.5
2009	3	25	1.3
2009	3	26	4.2
2009	3	27	6.9
2009	3	28	0.9
2009	3	29	1.3
2009	3	30	0.0
2009	3	31	0.3
			66.3
2009	4	1	0.0
2009	4	2	0.0
2009	4	3	8.3
2009	4	4	1.6
2009	4	5	0.4
2009	4	6	3.9
2009	4	7	16.3
2009	4	8	1.1
2009	4	9	18.9
2009	4	10	4.5
2009	4	11	1.6
2009	4	12	0.0
2009	4	13	17.1
2009	4	14	1.0
2009	4	15	1.7
2009	4	16	0.0
2009	4	17	0.0
2009	4	18	0.0
2009	4	19	0.0
2009	4	20	0.8
2009	4	21	1.2
2009	4	22	3.0
2009	4	23	6.8
2009	4	24	8.6
2009	4	25	0.8
2009	4	26	5.2
2009	4	27	3.6
2009	4	28	0.9
2009	4	29	8.8
2009	4	30	1.7
			117.8
2009	5	1	5.0
2009	5	2	3.3
2009	5	3	2.0
2009	5	4	1.6
2009	5	5	8.0
2009	5	6	8.6
2009	5	7	6.1

2009	5	8	4.2
2009	5	9	4.3
2009	5	10	0.0
2009	5	11	0.0
2009	5	12	0.0
2009	5	13	0.4
2009	5	14	5.7
2009	5	15	14.0
2009	5	16	13.2
2009	5	17	5.2
2009	5	18	2.5
2009	5	19	2.5
2009	5	20	2.7
2009	5	21	2.8
2009	5	22	4.1
2009	5	23	10.2
2009	5	24	0.1
2009	5	25	3.8
2009	5	26	0.9
2009	5	27	4.6
2009	5	28	0.1
2009	5	29	0.0
2009	5	30	0.5
2009	5	31	0.0
			116.4
2009	6	1	0.0
2009	6	2	0.0
2009	6	3	0.0
2009	6	4	0.0
2009	6	5	0.0
2009	6	6	0.5
2009	6	7	0.0
2009	6	8	0.2
2009	6	9	0.0
2009	6	10	0.0
2009	6	11	0.0
2009	6	12	11.8
2009	6	13	2.5
2009	6	14	2.0
2009	6	15	0.4
2009	6	16	6.0
2009	6	17	12.0
2009	6	18	4.6
2009	6	19	0.0
2009	6	20	0.8
2009	6	21	0.4
2009	6	22	0.0
2009	6	23	0.0
2009	6	24	2.3
2009	6	25	0.0
2009	6	26	6.4
2009	6	27	0.1
2009	6	28	4.5
2009	6	29	1.0
2009	6	30	8.9
			64.4
2009	7	1	3.0
2009	7	2	0.2
2009	7	3	5.3
2009	7	4	19.5
2009	7	5	7.1
2009	7	6	16.1
2009	7	7	0.2
2009	7	8	0.1
2009	7	9	0.0
2009	7	10	3.9
2009	7	11	8.6

2009	7	12	0.6
2009	7	13	15.2
2009	7	14	4.9
2009	7	15	7.2
2009	7	16	1.2
2009	7	17	0.0
2009	7	18	3.3
2009	7	19	6.8
2009	7	20	2.1
2009	7	21	9.2
2009	7	22	1.0
2009	7	23	12.6
2009	7	24	2.2
2009	7	25	3.1
2009	7	26	12.4
2009	7	27	3.4
2009	7	28	6.4
2009	7	29	1.7
2009	7	30	6.1
2009	7	31	6.4
			169.8
2009	8	1	2.6
2009	8	2	6.3
2009	8	3	8.2
2009	8	4	2.0
2009	8	5	1.3
2009	8	6	0.8
2009	8	7	0.3
2009	8	8	1.7
2009	8	9	2.0
2009	8	10	2.5
2009	8	11	4.3
2009	8	12	2.1
2009	8	13	0.2
2009	8	14	11.0
2009	8	15	6.8
2009	8	16	3.7
2009	8	17	0.7
2009	8	18	4.6
2009	8	19	14.5
2009	8	20	16.9
2009	8	21	3.4
2009	8	22	14.7
2009	8	23	16.1
2009	8	24	3.5
2009	8	25	2.2
2009	8	26	14.5
2009	8	27	6.6
2009	8	28	5.6
2009	8	29	0.5
2009	8	30	9.3
2009	8	31	12.9
			181.8
2009	9	1	5.9
2009	9	2	1.0
2009	9	3	1.2
2009	9	4	0.2
2009	9	5	0.3
2009	9	6	8.1
2009	9	7	3.7
2009	9	8	11.5
2009	9	9	0.2
2009	9	10	0.0
2009	9	11	0.0
2009	9	12	0.0
2009	9	13	0.0
2009	9	14	0.0

2009	9	15	2.8
2009	9	16	0.0
2009	9	17	0.0
2009	9	18	0.0
2009	9	19	0.8
2009	9	20	0.2
2009	9	21	2.8
2009	9	22	1.6
2009	9	23	0.3
2009	9	24	0.0
2009	9	25	0.0
2009	9	26	0.5
2009	9	27	1.0
2009	9	28	0.7
2009	9	29	0.4
2009	9	30	3.2
			46.4
2009	10	1	0.1
2009	10	2	1.9
2009	10	3	4.3
2009	10	4	0.2
2009	10	5	0.1
2009	10	6	0.1
2009	10	7	0.0
2009	10	8	0.0
2009	10	9	6.0
2009	10	10	0.4
2009	10	11	2.3
2009	10	12	0.0
2009	10	13	0.9
2009	10	14	0.4
2009	10	15	0.0
2009	10	16	0.0
2009	10	17	0.3
2009	10	18	9.1
2009	10	19	5.3
2009	10	20	12.5
2009	10	21	3.1
2009	10	22	0.2
2009	10	23	0.5
2009	10	24	18.0
2009	10	25	4.8
2009	10	26	7.4
2009	10	27	5.2
2009	10	28	5.6
2009	10	29	0.4
2009	10	30	17.3
2009	10	31	3.0
			109.4
2009	11	1	19.7
2009	11	2	10.5
2009	11	3	12.9
2009	11	4	7.4
2009	11	5	2.9
2009	11	6	12.0
2009	11	7	12.4
2009	11	8	0.5
2009	11	9	12.7
2009	11	10	0.2
2009	11	11	8.1
2009	11	12	12.0
2009	11	13	1.7
2009	11	14	9.3
2009	11	15	4.5
2009	11	16	30.8
2009	11	17	20.5
2009	11	18	22.7

2009	11	19	14.5
2009	11	20	4.0
2009	11	21	22.4
2009	11	22	14.6
2009	11	23	3.9
2009	11	24	18.1
2009	11	25	9.0
2009	11	26	7.4
2009	11	27	7.1
2009	11	28	0.1
2009	11	29	0.1
2009	11	30	0.3
			302.3
2009	12	1	6.6
2009	12	2	0.3
2009	12	3	2.2
2009	12	4	3.3
2009	12	5	7.4
2009	12	6	3.8
2009	12	7	5.6
2009	12	8	4.0
2009	12	9	2.0
2009	12	10	0.0
2009	12	11	0.8
2009	12	12	0.0
2009	12	13	0.0
2009	12	14	0.6
2009	12	15	0.6
2009	12	16	2.0
2009	12	17	0.0
2009	12	18	0.0
2009	12	19	2.3
2009	12	20	3.4
2009	12	21	3.3
2009	12	22	3.5
2009	12	23	0.0
2009	12	24	0.0
2009	12	25	4.4
2009	12	26	6.2
2009	12	27	2.1
2009	12	28	0.0
2009	12	29	1.8
2009	12	30	10.5
2009	12	31	0.0
			76.7