Clare County Council

Tradaree Point Sludge Disposal Facility

Annual Environmental Report 2009

Waste Licence Reg. No. W0037-01

WYG Environmental & Planning (Ireland) Ltd.

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1.0 INTRODUCTION

WYG Environmental & Planning (Ireland) Ltd. was commissioned by Clare County Council to compile an Annual Environmental Report (AER) required under Condition 11 of Waste Licence Reg. No. W0037-01 for a Sludge Disposal Facility situated at Tradaree Point, Shannon (Clonmoney South), Co. Clare for the period January 2009 to December 2009.

1.1 BACKGROUND

The Environmental Protection Agency (EPA) issued Shannon Free Airport Development Company Limited with a Waste Licence on 1st May 2003. The ownership of the facility was subsequently passed onto Clare County Council under the same Waste Licence.

Under Condition 11.6, Section 11 of the W0037-01, an Annual Environmental Report (AER) must be prepared and submitted to the EPA for approval. The AER for the facility includes the information specified in Schedule F of the Waste Licence, Content of the Environmental Report, and has been prepared in accordance with the EPA (1999) Waste Licensing – Draft Guidance Note on Environmental Management Systems and Reporting to the Agency, the EPA Guidance Note for the Annual Environmental Report and the EPA AER/PRTR Guidance Document.

1.2 REPORTING PERIOD

This AER details the activities carried out at the facility in the period from January 2009 to December 2009 in accordance with W0037-01.

1.3 SITE DESCRIPTION

The site is situated approximately 4.5km south east of Shannon Town to the south-west of Bunratty (OS National Grid Reference 143,600E, 160,100N). The site is located on a peninsula, which extends into Shannon Estuary. A grassland constructed clay embankment, average height 5.0 mOD, lies to the south of the site between Shannon Estuary and the site.

The site location is shown in Figure 1.

1.4 FACILITY LAYOUT

The landfill (sludge disposal facility) is divided into two sections - the capped historic sludge disposal area and the four newly constructed lined cells. The area where the new cells have been constructed has an average elevation of 1.5mOD. The cells are bounded to the south-east and north-east by an open land drain. The average drain bed level is 0.6mOD. This discharges to Shannon Estuary via an outlet pipe under the clay embankment which is controlled by a sluice valve. A 10m wide buffer zone exists along the southern perimeter of the site between the edge of the catchment drain and the capped sludge cells. No sludge or restoration material is stored within this zone.

The layout of the facility is illustrated in Figure 2.

Tradaree Point Wastewater Treatment Plant (WWTP) provides treatment of both domestic and industrial effluent from Shannon Town and Shannon Industrial Estate. The sludge facility only accepts waste sludge from the Tradaree Point sludge treatment facility. Sludge has been disposed on the site since approximately 1981.

2.0 FACILITY INFRASTRUCTURE AND OPERATION

2.1 WASTE ACTIVITIES CARRIED OUT AT THE FACILITY

The facility is licensed to handle a maximum of 2,500 tonnes of waste per annum. This comprises 750 tpa (tonnes per annum) treated dewatered non-hazardous domestic sludge (EWC code 19 08 05) and 1,750 tpa of industrial sludge (EWC code 19 08 12, 19 08 14) in engineered cells within the facility boundary. Waste activities licensed at the facility under the Third and Fourth Schedules of the Waste Management Act 1996, are detailed below.

Table 2.1 Licensed Waste Disposal Activities in Accordance with the Third Schedule of the Waste Management Act

Class 1	Deposit on, in or under land (including landfill)* This activity is limited to the disposal of treated dewatered non-hazardous domestic and industrial sludge in the existing active cells within the facility.
Class 4	Surface impoundment, including placement of liquid or sludge discards into pits, pond or lagoons
Class 5	Specially engineered landfill, including placement into lined discreet cells which are capped and isolated from one another and the environment.
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 5 or paragraphs 8 to 10 of this Schedule (including evaporation, drying and calcination).
Class 13	Storage prior to submission to any activity referred to in a preceding paragraph of this Schedule, other than temporary storage, pending collection, on the premises where the waste concerned is produced.

2.2 METHODS OF DEPOSITION OF SLUDGE

Two different waste effluent streams undergo separate treatment at Tradaree Point WWTP. Industrial wastewater is treated in the Industrial Treatment Plant and domestic wastewater is treated in the Domestic Treatment Plant.

The only waste disposed of at the sludge disposal facility is treated dewatered sludge from the WWTP. No other waste is accepted for disposal at the facility. In the unlikely event of a different waste type being presented for disposal at the facility, a separate storage area is provided to contain the materials separately until such time as it can be removed off site to a suitable facility.

Sludge generated in the WWTP is sent to a dewatering building to the east of the plant. Both domestic and industrial sludge are dewatered using two belt presses after which the sludge is conveyed into an open trailer. The dewatered sludge is then transported to the landfill area and unloaded using a dumper.

The sludge is further dried naturally in the open air. Older dried sludges are excavated from their initial deposition area and heaped into mounds where they are permitted to re-vegetate by natural succession. The new cells are being filled sequentially in a similar manner. Cell 1 is currently the active cell and sludge is transported for landfilling on a daily basis between Monday and Friday by a dumper. Transportation to the landfill is facilitated by the provision of a causeway at the cell entrance which provides a dry area for the unloading of the sludge.

2.3 QUANTITY AND COMPOSITION OF SLUDGE DISPOSED

2.3.1 Sludge Disposed - 2009

The facility is licensed to handle up to 2,500 tonnes of waste sludge per annum. The quantities of mixed industrial and domestic sludge disposed at the facility between January and December 2009 are presented in Table 2.2 overleaf.

As specified in Condition 1.1 of the Waste Licence, only those categories and quantities listed in Part 1 (Activities Licenced) [See also Schedule A] can be accepted at the facility. During 2009, approximately 732 tonnes of mixed industrial and domestic sludge were accepted at the facility. This quantity is below the maximum 2,500 tonnes of waste per annum permitted.

Table 2.2: Quantities of Sludge Disposed in 2009

Month	Quantity (Kg)
January	85,300
February	35,220
March	33,500
April	83,960
May	38,610
June	83,590
July	47,190
August	70,930
September	66,860
October	82,130
November	60,150
December	44,510
TOTAL (kg)	731,950
TOTAL (tonnes)	**731.95**

2.3.2 Sludge Disposed 2004-2009

Table 2.3 overleaf details the quantities of sludge disposed at the facility between 2004 and 2009.

Table 2.3: Quantity of Sludge Disposed 2004-2009

Year	Quantity (Tonnes) Sludge Disposed/Annum
2004	1,022
2005	954
2006	408
2007	755.5
2008	548
2009	732

2.4 CALCULATED REMAINING CAPACITY OF THE FACILITY

In 2006, the quantity of sludge accepted (408 tonnes) was low compared to previous years due to the machinery breakdowns experienced in the WWTP. This increased to 755.5 tonnes in 2007. The volume of sludge disposed during 2008 was 548 tonnes, which was lower than in 2007 – this was due to reduced throughput and belt press breakdowns. The quantity of sludge accepted increased to 732 tonnes in 2009 and the annual figure is expected to remain in the region of 750 tonnes per annum (tpa).

The total capacity of the four lined cells is 12,029m^3. Landfilling in the lined cells commenced in Cell 1 in 2005. In 2009, approximately 732 tonnes of sludge (including both industrial and domestic) was disposed of at the facility.

The density of dewatered sludge varies depending on the dry matter concentration. In 2009, the average cake % dry matter reached in the sludge was 18.86%. At this rate, the bulk density is typically calculated at rate of 1.27 t/m^3 (assuming that the ratio of volatile and fixed sludge is 65%:35%). Therefore, at this density, the volume of waste sludge disposed of at the facility during 2009 was 576.4m^3. Based on the above it is estimated that, at the end of 2009, the remaining capacity at the facility is approximately 9,280m^3.

Based on the 2009 figure, it is expected that the landfill should reach its full capacity by 2025. However, if yearly tonnages remain low this figure could be extended.

2.5 RESTORATION OF FORMER SLUDGE DISPOSAL AREAS & COMPLETED CELLS/PHASES

A restoration and aftercare management plan for the facility was prepared in consultation with the EPA Restoration and Aftercare Manual and was previously submitted to the Agency in January 2004. The Agency confirmed in a letter (Ref. 37-1/GEN03bd) that the plan was to their satisfaction.

All unlined sludge mounds have been capped along with all unlined cells after EPA approval. Waste sludge continues to be disposed of into the first of the newly lined active cells – Cell 1.

The total capped area occupied by waste in the facility is 15,742m^2. Since 2005, a total of 3,397.5 tonnes of waste has been deposited into Cell 1.

2.6 TOPOGRAPHICAL SURVEY

A topographical survey was undertaken during September 2003 as part of Licence Condition 8.10.1. The results of the survey were submitted to the Agency in the 6-month report on Drawing No.1, submitted in October 2003. No additional topographical surveys have taken place at the facility since 2003.

2.7 LEACHATE MANAGEMENT

2.7.1 Leachate Pumping Records

A total of 28,465 m^3 of leachate was pumped during the reporting period. Leachate is collected from the existing sludge disposal area (Cell 1), the inactive cells (Cells 2-4) and the capped unlined area via a network of drains which are connected to a leachate collection sump and from here it is pumped to Tradaree WWTP. The pump has a capacity to pump 75m^3 per hour. The monthly averages of leachate generated during 2009 are detailed in Table 2.4 below.

Table 2.4: Quantities of Sludge Disposed in 2009

Month	Quantity (Kg)
January	3,838
February	1,728
March	1,476
April	2,721
May	705
June	2,616
July	94
August	5,636
September	4,686
October	3,774
November	749
December	441
TOTAL (kg)	28,465
TOTAL (tonnes)	**731.95**

2.8 ESTIMATED ANNUAL AND CUMULATIVE QUANTITIES OF LANDFILL GAS EMITTED

Landfill gas production is a function of the biodegradable portion of the wastes and other factors including the waste density and moisture content. According to the UK EA, total gas generation depends on the waste type being deposited on site and also the degradable carbon content. However the rate of decomposition depends on the site-specific factors. The time taken to decompose will directly influence the period over which landfill gas is generated.

Emissions through the in situ clay base and side walls of the landfill facility are expected to be small. The capped sludge disposal area does not have an engineered base lining. Site investigation results indicate that in situ clay has a hydraulic conductivity of less than 1 x 10^{-9}m/s. Gas levels are being measured in monitoring boreholes installed in the ground along the perimeter of the landfill to check if there are any emissions.

The UK Environment Agency's Guidance on the Management of Landfill Gas (November 2002) suggests that biodegradable wastes may be considered to have an approximate gas yield of between 5 - 10 m^3/t/yr over the first ten years of a sites life. In this instance, the waste sludge was dried to an average of 18.9% dry matter in 2009. Assuming that the dry matter content would equate to the biodegradable component of the sludge and based on a total input in 2009 of 138 tonnes of biodegradable waste (18.9% of 732 total tonnes), this would indicate that the following upper and lower quantities of landfill gas might be generated:

- At 5 m^3/t/yr an approximate production rate of 690m^3 per annum
- At 10 m^3/t/yr an approximate production rate of 1,380m^3 per annum

There are a number of significant controlling factors relating to landfill gas generation/extraction rates from biodegradable wastes including placement density, moisture content, quality of containment systems, climatic conditions and quantity of degradable cellulose available.

It must also be stressed that the above figure is based upon an estimation of the amount of available degradable waste deposited within the landfill body and therefore must only be considered to be an approximation.

A landfill gas assessment was undertaken by Tobin Consulting Engineers in April 2008. The purpose of the assessment was to determine the total quantity of landfill gas produced at the facility in order to determine

the viability of constructing a landfill gas flare on-site. The assessment was undertaken using a landfill gas generation model GasSim 2.0. Data from previous assessments undertaken in 2004 and 2007 were used in the assessment. The results show a peak in landfill gas production in 2003 (12.5 m^3/hr), with decreasing figures since that time. A total of 9.88 m^3/hr was predicted for 2007. The report concluded that owing to this low volume of gas being produced from the facility, it would not be considered a viable option to install a gas collection system and flaring unit. A gas collection system to operate successfully requires a volume of gas in the order of 75 m^3/hr.

A copy of the assessment report was included in the AER for the 2008 reporting period.

2.9 ESTIMATED ANNUAL AND CUMULATIVE QUANTITY OF INDIRECT EMISSIONS TO GROUNDWATER

Potential sources of indirect emissions into groundwater are:

Landfill Base

The naturally occurring low permeability clay underlying the site provides a natural liner for the capped area of the landfill. Previous site investigation results indicate that in situ clay has a hydraulic conductivity of less than 1 X $10m^{-9}$m/s. The new area of the landfill (Cells 1-4) is lined with a geotextile membrane as stipulated in the current waste licence consisting of a composite liner consisting of a 1m layer of compacted soil with a hydraulic conductivity of less than or equal to $1x10^{-9}$m/s. This is overlain by a geocomposite layer which in turn is overlain by a 2mm thick high density polyethylene (HDPE) layer.

Landfill Capping

The old sludge disposal areas were capped in 2004/2005. A five layer composite permanent capping was placed over all the old sludge cells as per the requirements of Condition 4.4 of the current licence. The five layers are comprised of the following;

(a) Geocomposite gas collection layer
(b) Barrier/Protection layer
(c) Geotextile protection layer
(d) Surface water drainage layer
(e) Subsoil layer
(f) Topsoil Layer

The capped layer is approximately 1 metre in thickness. The geosynthetic barrier has a minimum permeability of 1 x 10^{-9}m/s. This layer prevents surface water seeping into the sludge body and also facilitates the collection of gas. The surface water drainage layer collects surface water and extends to the system of open surface water drains at the base of the slopes from where it discharges to the existing catchment drains.

Surface Water Collection and Treatment System

Clean surface water from the uncapped existing sludge cells, is collected via a network of gravel drains which is then discharged to the perimeter drain. Visual inspection of the surface water locations and drains is conducted weekly.

Leachate Collection

Leachate is collected in the leachate pumping chamber from a series of collection drains at the site. The leachate is pumped via a 100mm diameter pipe to the effluent treatment plant for treatment.

In summary, as the landfill is contained by the provision of the features outlined above, the risk of indirect emissions to groundwater is greatly minimised.

3.0 MONITORING RESULTS

3.1 SUMMARY REPORT

This summary report has been compiled in accordance with the emission limit values (ELVs) for the following parameters as specified in Condition 6 and Schedule C of W0037-01:

- Dust
- Noise
- Landfill Gas

3.1.1 Dust Deposition

Dust deposition emission limit values as specified in W0037-01 are detailed in Table 3.1 below.

Table 3.1 Dust Deposition ELV

ELV ($mg/m^2/day$) Note 1
350

Note 1: 30 day composite sample

Annual dust monitoring was conducted by TE Laboratories Ltd. (TelLab) at four locations in October 2009. Dust monitoring locations are illustrated in Figure 2. 30-day composite samples were collected in accordance with licence requirements and forwarded to the TelLab accredited laboratory for analysis. The monitoring results are summarised in Table 3.2 below. Copies of the dust monitoring results are included in Appendix B.

Table 3.2 Dust Monitoring Results 2009

Location	N1	N3	N5	SS2
	$mg/m^2/day$			
October 2009	35	46	166	28

Measured dust levels at all of the monitoring locations were below the ELV of 350 $mg/m^3/day$.

3.1.2 Noise Emissions

Noise emission limit values as specified in W0037-01 are detailed in Table 3.3 below. Day-time and night-time noise monitoring was conducted by Cronin Environmental at four boundary locations (N1, N2, N3, N5) in October and November 2009. The noise survey report is attached in Appendix B. The monitoring results are summarised in Table 3.4 and 3.5 below.

Table 3.3: Noise ELV's

Day dB(A)L_{Aeq}(30 minutes)	Night dB(A)L_{Aeq}(30 minutes)
55	45

Table 3.4: Day-time Noise Measurements 2009

Location	Date	Sampling Interval	$L_{Aeq\ 30min}$ dB(A)	$L_{A90\ 30min}$ dB(A)	$L_{A10\ 30min}$ dB(A)
N1	13/10/09	30 minutes	42.1	33.4	39.7
N2	13/10/09	30 minutes	39.2	28.9	40.1
N3	13/10/09	30 minutes	43.6	40.5	45.8
N5	13/10/09	30 minutes	44.2	32.2	36.3

Table 3.5: Night-time Noise Measurements 2009

Location	Date	Sampling Interval	$L_{Aeq\ 30min}$ dB(A)	$L_{A90\ 30min}$ dB(A)	$L_{A10\ 30min}$ dB(A)
N1	10/11/09	30 minutes	50.4	46.1	52.1
N2	10/11/09	30 minutes	45.0	40.6	46.5
N3	10/11/09	30 minutes	44.7	40.3	46.2
N5	10/11/09	30 minutes	48.2	43.1	51.9

Day-time noise levels at all boundary locations did not exceed the daytime emission limit L_{Aeq} of 55dB.

Night-time noise levels at N1 and N5 on the 10th November (06.00 to 08.00 hours) were 50.4dB and 48.2dB respectively, which exceeded the night time emission limit L_{Aeq} of 45dB. It is noted that the predominant source of night-time noise at both locations was the nearby Roadstone Quarry. Road traffic was also audible at both locations. There was no noise audible from the sludge facility at either locations. The L_{Aeq} result for both locations exceeds the specified limit of 45dB(A), however this is due to the noise being generated on the nearby Roadstone facility. The L_{A90} results are in compliance with the limit.

3.1.3 Landfill Gas Emissions

The trigger levels for landfill gas emissions from the facility measured in any service duct or manhole on, at, or immediately adjacent to, the facility and/or at any other point located outside the body of the waste stipulated in Condition 6.3.1 of W0037-01 are detailed in Table 3.6 below:

Table 3.6 Landfill Gas Concentration

Methane	Carbon Dioxide (CO_2)
1% v/v (20% LEL)	1.5% v/v

During 2009, landfill gas concentrations were measured at the following locations: RD1, RD2, RD3, RD4, RD5, RD6, RD7, RD8, L6, L8, L10 and L12.

3.1.3.1 Methane

During 2009, monthly methane concentrations measured at gas monitoring location RD1 were below the threshold level of 1% v/v.

Methane levels in RD2 exceeded the threshold level of 1% v/v in eight of the monthly monitoring rounds, most notably in January, February, March, April and December, when the methane levels were 32.1%, 31.2%, 10.1%, 14.7% and 37.7% v/v respectively.

Methane levels measured at RD3 exceeded the threshold level of 1% v/v in eleven of the monthly monitoring rounds, most notably in January, February, November and December when the methane levels were 8.3%, 5.3%, 10.2% and 11.6% v/v respectively.

Methane levels measured at RD4 slightly exceeded the threshold level of 1% v/v in four of the twelve monthly monitoring rounds; RD4 levels were below the threshold level of 1% v/v throughout the remainder of the monitoring period.

Methane levels measured at RD5 exceeded the threshold level of 1% v/v in four of the 12 monthly monitoring rounds – January (7.9%), February (3.3%), March (2%) and May (3.8%). Methane levels measured at RD6 exceeded the threshold level of 1% v/v in all of the 12 monthly monitoring rounds – January (4.9%), February (7.4%), March (4.6%), April (8.8%), May (5.3%), June (10.9%), July (12.2%), August (7.9%), September (9.7%), October (10.7%), November (5.9%), December (2.7%).

In RD8, methane concentrations were slightly above the threshold level of 1% v/v in three of the monthly monitoring rounds, most notably in January (1.5%), February (2.7%) and May (3%).

Monthly recorded methane levels in the remaining monitoring boreholes (RD7, L6, L8, L10 and L12) were below 1% v/v.

3.1.3.2 Carbon Dioxide

Carbon dioxide concentrations were below the limit of 1.5% v/v at RD1 in five of the 12 monthly monitoring rounds but were elevated in seven of the rounds – February (3.5%), March (1.8%), May (2.9%), September (2.2%), October (7.3%), November (5.4%) and December (6.9%).

At RD2, carbon dioxide levels exceeded the threshold level of 1.5% v/v in nine of the twelve monthly monitoring rounds but concentrations were recorded at less than 10% during each of the rounds.

In RD3, carbon dioxide concentrations were above the threshold level of 1.5% v/v in all of the monthly monitoring rounds (January 14.8%, February 8.1%, March 7.7%, April 11.7% May 10.9%, June 7.4%, July 1.7%, August 8.3%, September 6.4%, October 11.8%, November 14.7%, December 13.2%).

In RD4, elevated levels of carbon dioxide were detected during nine of the monthly monitoring rounds, however concentrations were less than 5% during each of the rounds.

In RD5, carbon dioxide levels exceeded the threshold level of 1.5% in all of the monthly monitoring rounds (January 18.4%, February 18.5%, March 10.7%%, April 4.7% May 17.7%, June 7.3%, July 2.7%, August 5.6%, September 7%, October 8.2%, November 8.1%, December 9.4%).

In RD6, carbon dioxide levels exceeded the threshold level of 1.5% v/v in all of the monthly monitoring rounds but concentrations were recorded at less than 10% during each of the rounds. In RD8, carbon dioxide levels exceeded the threshold level of 1.5% v/v in four of the monthly monitoring rounds but concentrations were recorded at less than 10% during each of the rounds.

Monthly recorded carbon dioxide levels in the remaining monitoring boreholes (RD7, L6, L8, L10 and L12) were below 1.5% v/v.

Landfill gas monitoring results are attached in Appendix C.

3.2 MONITORING RESULTS AND INTERPRETATION

3.2.1 Introduction

Environmental monitoring was conducted at the facility during 2009 in accordance with Schedule D of Waste Licence W0037-01. Details of monitoring and reporting frequencies are presented in Table 3.7 below.

The locations of all environmental monitoring points are illustrated on Figure 2. Monitoring results are presented in Appendices A to H. Copies of the laboratory certificates are included in Appendix G.

Table 3.7 Environmental Monitoring and Reporting Frequency

Environmental Monitoring Requirement	Monitoring Frequency	Reporting Frequency
Groundwater Quality	Biannually/Annually	Biannually
Groundwater Levels	Biannually	Biannually
Surface Water Quality	Biannually	Biannually
Surface Water Visual Inspection	Weekly	Biannually
Leachate Quality	Biannually	Biannually
Leachate Levels	Quarterly	Biannually
Landfill Gas	Monthly	Biannually
Dust Deposition	Annually	Annually
Noise Emissions	Annually	Annually
Meteorological Monitoring	Daily	Annually
Ecological Monitoring	Biennial after Yr 1	Biennially

In 2009, dust analysis and reporting was carried out by TE Laboratories Ltd. (TelLab), Tullow, Co. Carlow. Noise monitoring and reporting was undertaken by Cronin Environmental, Cork. Groundwater and leachate level monitoring, groundwater, leachate, surface water and landfill gas analysis and reporting was carried out by Q Lab Ltd., Wexford.

Meteorological monitoring and surface water visual inspection is undertaken by facility management personnel at the facility.

3.2.2 Dust Monitoring

3.2.2.1 Dust Monitoring Locations

Dust monitoring was conducted at four monitoring locations in 2009 in accordance with Tables D.4.1 and D.3.1 of W0037-01.

Table 3.8 Dust Monitoring Locations

Location	Easting	Northing
N1	144,001	159,988
N3	143,727	159,831
N5	143,937	160,076
SS2	143,879	159,874

3.2.2.2 Dust Monitoring Methods

Details of the dust monitoring methods used are outlined in the dust monitoring results attached in Appendix A.

3.2.2.3 Dust Monitoring Results

The results of dust monitoring conducted at the facility during 2009 are presented in Table 3.9 overleaf. Dust concentrations and emission limit values as detailed in Schedule C.3 of W0037-01 were discussed in Section 3.1.1.

Table 3.9 Dust Monitoring Results 2009

Location	N1	N3	N5	SS2
	mg/m^2/day			
October 2009	35	46	166	28

All monitoring results were below the ELV for dust of 350 mg/m^2/day.

3.2.3 Groundwater Monitoring

3.2.3.1 Groundwater Monitoring Locations

Groundwater monitoring was conducted at five locations during 2009 in accordance with Schedule D.1.1 and D.6.1 of the current licence. Co-ordinates for all monitoring locations are detailed in Table 3.10 and locations are also illustrated on Figure 2. Monitoring results are attached in Appendix D.

Monitoring location RD2 is located at the southern boundary of the site and RD3 is located at the southwestern boundary of the site adjacent to the capped sludge cells. BH3 is located at the north eastern boundary of the site. BH4 and BH5 are both located in the buffer zone adjacent to the southern boundary of the facility and close to Shannon Estuary.

Table 3.10 Groundwater Monitoring Locations

Location	Easting	Northing
RD2	143,866	159,855
RD3	143,799	159,855
BH3	143,952	160,085
BH4	143,935	159,930
BH5	143,984	159,959

3.2.3.2 Groundwater Levels

Groundwater levels were monitored on a biannual basis in accordance with Schedule D.6.1 of W0037-01 and are included in Appendix D with the groundwater monitoring results.

Groundwater levels recorded during 2009 varied between 0m below top of casing (BTOC) (in BH4 November 2009) and 1.2m BTOC (in BH3 March 2009).

3.2.3.3 Groundwater Analytical Results

Groundwater monitoring was conducted on a biannual and annual basis in accordance with Schedule D.6.1 of the licence. Monitoring was undertaken in March and November 2009.

Groundwater analytical results are attached in Appendix D.

There are no emission limits stipulated in Waste Licence W0037-01, therefore the groundwater analytical results have been compared to the Interim Guideline Values (IGVs) specified in the EPA document: 'EPA Interim Report - Towards Setting Guideline Values for the Protection of Groundwater in Ireland' (2003).

The pH in all of the groundwater samples analysed during both monitoring rounds ranged from 7.18 to 7.33, which is within the IGV range of 6.5-9.5.

Electrical conductivity measurements ranged from 2,250 µS/cm in RD3 (November) to 14,660 µS/cm in BH4 (November), which are similar to 2008 results. The IGV of 1,000 µS/cm was exceeded in all of the samples analysed.

Ammonia concentrations in the nine samples analysed for this parameter were below the method detection limit of 0.02 and therefore below the IGV of 0.15 mg/l. Total phosphorus/orthophosphate concentrations in BH3 (November), BH4 (November), BH5 (November) and RD2 (November) were detected at 0.82 mg/l, 1.47 mg/l, 1.31 mg/l and 1.31 mg/l l respectively, which exceeded the IGV for orthophosphate of 0.03 mg/l. Total Oxidised Nitrogen concentrations in all of the samples analysed for this parameter were below the laboratory detection limit of 0.5 mg/l.

Following an observation made by the EPA during a site inspection in September 2009, salinity was analysed during the November monitoring round. Concentrations ranged from 0.9 parts per thousand (ppt) in RD3 to 16 ppt in BH4.

During the March and November monitoring rounds, the highest concentration of total organic carbon was detected at BH4 (120 mg/l – March; 280 mg/l - November).

There were exceedances above their respective IGVs of inorganic parameters chloride, sodium and potassium at some monitoring locations. Chloride concentrations ranged from 350 mg/l in RD3 (November) to 5,391 mg/l in BH4 (November). Chloride concentrations in all of the samples analysed exceeded the IGV of 30 mg/l. Sodium concentrations in three of the five samples analysed exceeded the IGV of 150 mg/l – BH3 (November 1,421 mg/l), BH4 (November 1,520 mg/l) and BH5 (November 1,095 mg/l). Potassium concentrations in four of the five samples analysed exceeded the IGV of 5 mg/l. Concentrations ranged from 6 mg/l in RD2 (November) to 63 mg/l in BH4 (November).

Exceedances of iron above the IGV of 0.2 mg/l were detected in BH3 (November), BH4 (November), BH5 (November) and RD2 (November). Concentrations of 1.21 mg/l, 1.08 mg/l, 1.02 mg/l and 0.8 mg/l were detected respectively. Magnesium concentrations in BH3 (November), BH4 (November) and BH5 (November) were 161 mg/l, 200 mg/l and 131 mg/l respectively, which exceed the IGV of 50 mg/l. The boron concentrations in BH4 (November) and BH5 (November) were 1.3 mg/l and 1.1 mg/l, which slightly exceed the IGV of 1 mg/l. The copper concentration in RD2 (November) was 0.04 mg/l which slightly exceeded the IGV of 0.03 mg/l.

Total phenol concentrations were below the laboratory detection limit of 0.1 mg/l in all of the samples analysed during both monitoring rounds.

Concentrations of arsenic, cadmium, calcium, chromium, cyanide, fluoride, lead, mercury, nickel, sulphate, tin and zinc were below their respective IGVs and/or laboratory detection limits in all of the samples analysed.

The concentrations of volatile organic compounds (VOC), semi-volatile organic compounds (SVOC), organochlorine pesticide and herbicide compounds were below laboratory detection limits at all of the monitoring locations.

3.2.3.4 Conclusions

Overall, there has been an improvement in groundwater quality at the facility since the last monitoring round in December 2008. Concentrations of calcium were below the IGV of 200 mg/l and historically this parameter was elevated at most or all monitoring locations.

Certain parameters such as electrical conductivity, chloride, iron, magnesium, potassium, sodium and total phosphorus concentrations remain elevated at most or all monitoring locations. It is noted that chloride concentrations were broadly similar to 2008 results. However potassium, sodium and magnesium concentrations were significantly lower than those recorded in previous years.

Consistently high conductivity, chloride, calcium, magnesium, potassium and sodium concentrations across most or all monitoring locations suggests there is a saline influence on the groundwater in the area due to the estuarine location of the site. Salinity concentrations measured in November 2009 would appear to confirm that there is saline intrusion into groundwater monitoring wells most notably at location BH4.

Measured concentrations ranged from 0.9 ppt in RD3 to 16 ppt in BH4 indicating brackish water (i.e. a mixture of freshwater and seawater with a salinity range of 0.5-30 ppt typical of an estuarine location).

TOC concentrations are broadly similar to those recorded in previous years.

3.2.4 Landfill Gas Monitoring

Measurements of landfill gas were carried out at all gas monitoring boreholes (RD1 to RD8) on a monthly basis in accordance with Table D.2.1 of the Waste Licence. Combined gas and leachate monitoring boreholes (L6, L8, L10, L12) were also monitored on a monthly basis for gas. All monitoring locations were sampled for methane, carbon dioxide, oxygen, temperature and pressure.

Results are compared against the EPA Guideline Emission Limits for methane (CH_4) and carbon dioxide (CO_2) at landfills, which are 1% v/v and 1.5% v/v, respectively (EPA Landfill Manuals: Landfill Monitoring, 2nd Edition, 2003). These are also the ELVs specified in Schedule C.2 of Waste Licence W0037-01.

3.2.4.1 Gas Monitoring Locations

Gas monitoring locations are detailed in Table 3.11 below and illustrated in Figure 2. Gas monitoring results are presented in Appendix C below.

Table 3.11 Gas Monitoring Locations

Location	Easting	Northing
RD1	143,761	159,997
RD2	143,876	159,883
RD3	143,801	159,851
RD4	143,760	160,092
RD5	143,906	159,999
RD6	143,928	160,071
RD7	144,000	159,979
RD8	143,939	159,938
L6	143,867	159,959
L8	143,924	159,995
L10	143,944	160,015
L12	143,940	160,064

3.2.4.2 Gas Monitoring Boreholes

Landfill gas measurements were undertaken using an Infrared Gas Analyser. The gas emitted is analysed for its content by % volume of the following constituents:

- Methane (CH_4)
- Carbon dioxide (CO_2)
- Oxygen (O_2)
- Atmospheric Pressure (mBar)

The LEL (lower explosive limit) for methane, atmospheric pressure (millibars) and temperature (^oC) were also recorded by the gas analyzer and relative pressure was calculated.

3.2.4.3 Gas Monitoring Results

Gas monitoring results are discussed below and are also included in Appendix C.

Borehole RD1

Borehole RD1 is located near the entrance to the facility just west of the capped sludge cells. Methane levels were below the ELV of 1% v/v throughout the monitoring period. However, elevated levels of carbon dioxide were recorded in February (3.5%), March (1.8%), May (2.9%), September (2.2%), October (7.3%), November (5.4%) and December (6.9%).

Borehole RD2

Borehole RD2 is located at the southern boundary of the site. Elevated levels of methane were recorded in January (32.2%), February (31.2%), March (10.1%), April (14.7%), May (3.1%), June (4.8%), November (7.9%) and December (37.7%). Elevated levels of carbon dioxide were recorded in January (4.9%), February (5.3%), April (5.1%), May (6.1%), June (3.1%), July (1.7%), October (2.6%), November (5.7%) and December (8.6%).

Borehole RD3

RD3 is located on the southwestern boundary of the site. Elevated levels of methane were recorded in January (8.3%), February (5.3%), March (2.4%), April (2.7%), May (2.3%), June (3%), July (1.1%), August (2.2%), October (3.4%), November (10.2%) and December (11.6%). Elevated levels of carbon dioxide were recorded in January (14.8%), February (8.1%), March (7.7%), April (11.7%), May (10.9%),

June (7.4%), July (1.71%), August (8.3%), September (6.4%), October (11.8%), November (14.7%) and December (13.2%).

Borehole RD4

RD4 was installed in June 2006 and monitoring at this location commenced in July 2006. RD4 is located just outside the perimeter of the facility in the northwest corner of the site. Elevated levels of methane were recorded in January (3.9%), February (2.6%), April (1.4%) and May (2.4%). Elevated levels of carbon dioxide were recorded in January (4%), February (4.1%), March (6.1%), April (4.4%), May (3.7%), June (3.7%), July (3.8%), August (3.2%) and September (4.2%).

Borehole RD5

RD5 was installed in June 2006 and monitoring at this location commenced in July 2006. RD5 is located in the centre of the site along the northern boundary of Cell No. 2. Elevated levels of methane were recorded in January (7.9%), February (3.3%), March (2%) and May (3.8%). Elevated levels of carbon dioxide were recorded in January (18.4%), February (18.5%), March (10.7%), April (4.7%), May (17.7%), June (7.3%), July (2.7%), August (5.6%), September (7%), October (8.2%), November (8.1%) and December (9.4%).

Borehole RD6

Located in the north corner of the site, RD6 was installed in May 2007 and monitoring at this location commenced in May 2007. Elevated levels of methane were recorded in January (4.9%), February (7.4%), March (4.6%), April (8.8%), May (5.3%), June (10.9%), July (12.2%), August (7.9%), September (9.7%), October (10.7%), November (5.9%) and December (2.7%). Elevated levels of carbon dioxide were recorded in January (5%), February (6.5%), March (6%), April (6.3%), May (4.6%), June (8.1%), July (10%), August (5.6%), September (9.6%), October (10.4%), November (6.2%) and December (8.9%).

Borehole RD7

Located in the southeast corner of the site, RD7 was installed in June 2006 and monitoring at this location commenced in July 2006. Recorded methane and carbon dioxide gas levels were below their respective landfill gas guideline limits as specified in W0037-01.

Borehole RD8

RD8 was installed in June 2006 and monitoring at this location commenced in July 2006. It is located at the southern end of Cell 2 in the middle of the site. Elevated levels of methane were recorded in January (1.5%), February (2.7%) and May (3%). Elevated levels of carbon dioxide were recorded in March (2.3%), April (1.6%), May (2.1%) and October (1.6%).

Combined Gas/Leachate Monitoring Boreholes

The combined gas and leachate monitoring boreholes are located along the northern boundaries of the four cells and are shown on Figure 2. Methane and carbon dioxide gas levels recorded in all four boreholes (L6, L8, L10 and L12) were below their respective landfill gas guideline limits as specified in W0037-01.

3.2.5 Leachate Monitoring

3.2.5.1 Leachate Monitoring Locations

In accordance with Schedule D.1 of the licence, leachate composition and level monitoring was conducted at locations detailed in Table 3.12.

Table 3.12 Leachate Monitoring Locations

Parameter	Location	Easting	Northing
Leachate Level	L1	143,795	159,990
	L2	143,796	159,926
	L3	143,843	159,890
	L4	143,797	160,016
	L5	143,821	159,997
	L7	143,895	159,928
	L9	143,939	159,958
	L11	143,991	160,000
	L13	143,976	160,052
Leachate Composition	SS3	143,806	159,951

3.2.5.2 Leachate Composition Results

There are no emission limits stipulated in Waste Licence W0037-01, therefore the leachate analytical results have been compared to the Interim Guideline Values (IGVs) listed in the EPA document: 'EPA Interim Report - Towards Setting Guideline Values for the Protection of Groundwater in Ireland' (2003).

Appendix E contains monthly leachate composition results, annual and biannual leachate analytical results. Leachate monitoring at SS3 was undertaken in March and November 2009 as per Schedule D of the licence.

The electrical conductivity in SS3 was measured at 1,581 µS/cm in March 2009 and 1,252 µS/cm in November 2009, which exceeds the IGV of 1000 µS/cm. This represents an increase from 827 µS/cm in September 2008.

The chloride concentration in SS3 was detected at 102 mg/l, which exceeds the IGV of 30 mg/l; however chloride concentrations have been consistently elevated since 2004.

Nickel and potassium concentrations were 0.07 mg/l and 8 mg/l respectively, which slightly exceed their respective IGVs of 0.02 mg/l and 5 mg/l.

Comparison of results with the results from previous years, indicate that a number of parameters (conductivity, chloride, nickel and potassium) remain consistently elevated above their respective IGVs. The chloride concentration increased from 29 mg/l in December 2008 to 102 mg/l in March 2009 but decreased to 29 mg/l in November 2009.

3.2.6 Noise Monitoring

3.2.6.1 Noise Monitoring Locations

Day-time and night-time annual noise monitoring was conducted at four boundary locations at the facility (N1, N2, N3, N5) on the 13th October (day-time) and the 10th November 2009 (night-time) as stipulated in Table D.4.1 of the licence. Noise monitoring locations are illustrated on Figure 2 and detailed in Table 3.13 below.

Table 3.13 Noise Monitoring Locations

Location	Easting	Northing
N1	144,001	159,988
N2	143,879	159,874
N3	143,727	159,831
N5	143,937	160,076

The noise survey report (including details of the methodology) is attached in Appendix B.

3.2.6.2 Noise Monitoring Results

The noise monitoring results are summarised in Table 3.14 and 3.15.

Table 3.14: Day-time Noise Measurements 2009

Location	Date	Sampling Interval	$L_{Aeq\ 30min}$ dB(A)	$L_{A90\ 30min}$ dB(A)	$L_{A10\ 30min}$ dB(A)
N1	13/10/09	30 minutes	42.1	33.4	39.7
N2	13/10/09	30 minutes	39.2	28.9	40.1
N3	13/10/09	30 minutes	43.6	40.5	45.8
N5	13/10/09	30 minutes	44.2	32.2	36.3

Table 3.15: Night-time Noise Measurements 2009

Location	Date	Sampling Interval	$L_{Aeq\ 30min}$ dB(A)	$L_{A90\ 30min}$ dB(A)	$L_{A10\ 30min}$ dB(A)
N1	10/11/09	30 minutes	50.4	46.1	52.1
N2	10/11/09	30 minutes	45.0	40.6	46.5
N3	10/11/09	30 minutes	44.7	40.3	46.2
N5	10/11/09	30 minutes	48.2	43.1	51.9

Day-time noise levels at all boundary locations did not exceed the daytime emission limit L_{Aeq} of 55dB.

Night-time noise levels at N1 and N5 on the 10th November (06.00 to 08.00 hours) were 50.4dB and 48.2dB respectively, which exceeded the night time emission limit L_{Aeq} of 45dB. It is noted that the predominant source of night-time noise at both locations was the nearby Roadstone Quarry. Road traffic was also audible at both locations. There was no noise audible from the sludge facility at either locations. The L_{Aeq} result for both locations exceeds the specified limit of 45dB(A), however this is due to the noise being generated on the nearby Roadstone facility. The L_{A90} results are in compliance with the limit.

3.2.7 Surface Water Monitoring

3.2.7.1 Surface Water Monitoring Locations

In total, five surface water locations were monitored in 2009 with differing biannual and annual parameter requirements as outlined in Table D.6.1 of the waste licence (SS1, SS2, SS4, SS6 and SS7). The surface water monitoring locations are located in the catchment drains along the perimeter of the facility. These drains collect surface water run-off from the site and ultimately discharge to the Shannon Estuary via a sluice gate.

Monitoring location SS1 is located in the catchment drain along the eastern boundary of the facility adjacent to Cell No. 3. Monitoring locations SS2 and SS4 are located in a drain at the southern tip of the landfill. SS6 and SS7 are both estuarine locations. Monitoring location SS7 was dry in March 2009 therefore no sample could be collected on the sampling date.

Monitoring locations are listed in Table 3.16 below and are illustrated on Figure 2.

Table 3.16: Surface Water Monitoring Locations

Location	Easting	Northing
SS1	144,000	160,040
SS2	143,879	159,874
SS4	143,936	160,003
SS6	143,907	159,862
SS7	143,927	159,873

3.2.7.2 Surface Water Monitoring

Surface water monitoring was conducted on a biannual basis at the five locations detailed in Table 3.16.

Sampling involved the submergence of the designated sample container into the surface water body. During submergence, every effort was made to keep the container steady so as to prevent sediment disturbance. Samples were collected and submitted to an accredited laboratory for analysis in March and November 2009 for the range of parameters outlined in Table D.6.1 of W0037-01.

Surface water analytical results are attached in Appendix F.

There are no surface water emission limits stipulated in waste licence W0037-01. Therefore, all surface water monitoring results have been compared to the Thresholds, AA-EQS's (Annual Average Environmental Quality Standard) and MAC-EQS's (Maximum Admissible Concentration Environmental Quality Standard Thresholds) specified in the Surface Water Quality Regulations SI 272 of 2009 applicable to transitional waters (Shannon Estuary at Shannon).

Copper concentrations at SS1, SS2, SS6 and SS7 exceeded the AA-EQS of 0.005 mg/l in November 2009. However further data for each location would be necessary to determine whether the AA-EQS is exceeded over a 12-month period.

There were no other exceedances of the relevant thresholds or EQS's for any of the remaining parameters analysed.

The analytical results indicate that surface water quality is generally good at and beyond the facility boundary.

3.2.7.3 Surface Water Visual Inspections

Visual inspections of surface water drains are carried out on a weekly basis and the visual inspection logs are available for inspection at the facility.

3.2.8 Meteorological Monitoring

Details of meteorological monitoring conducted at the facility in 2008 are attached in Appendix H.

Met Eireann publish meteorological data, which is obtained from their weather station at Shannon Airport. Meteorological data obtained from the Met Eireann weather station at Shannon Airport is summarised in the first three columns of Table 3.17 overleaf. Full details are included in Appendix H.

Table 3.17 Summary Rainfall Data

Month	Rainfall (mm) Shannon Airport	Evapotranspiration (mm) Shannon Airport	Evaporation (mm) Shannon Airport	Estimated Effective Rainfall - Capped Area (mm)	Estimated Effective Rainfall - Active Cell (mm)
JAN	120.4	13.1	17.6	107.3	102.8
FEB	15.7	16.6	23	-0.9	-7.3
MAR	64	38.4	56.6	25.6	7.4
APR	86.5	52.6	77.1	0*	0*
MAY	103.2	78	116.4	0*	0*
JUN	58.5	105.7	146.3	-47.2	0*
JUL	115.3	86.7	125.6	0*	0*
AUG	120.9	64.9	93.2	56	27.7
SEP	58.3	49.4	68.6	8.9	-10.3
OCT	87	28.1	38	58.9	49
NOV	263.2	16.1	21.4	247.1	241.8
DEC	72.7	9.1	12.1	63.6	60.6
TOTAL	**1165.7**	**558.7**	**795.9**	**607**	**369.8**

***Denotes months where evaporation and/or evapotranspiration exceeded total rainfall**

Rainfall data obtained from the Met Eireann weather station at Shannon Airport estimated that the site received approximately 1,165.7 mm of rainfall from January 2009 to December 2009. The total mean monthly rainfall was approximately 926.7 mm. Actual evapotranspiration and evaporation data obtained for Shannon Airport estimate the actual annual evapotranspiration was approximately 558.7 mm and actual annual evaporation was approximately 795.9 mm.

Effective rainfall for capped and non-capped/active cells was calculated as follows:

Effective Rainfall (mm) = Net Precipitation (mm) – Loss by Evapotranspiration (mm) (for capped cells)

Effective Rainfall (mm) = Net Precipitation (mm) – Loss by Evaporation (mm) (for active cells)

3.2.9 Annual Water Balance Calculation and Interpretation for Cells

The water balance was calculated using the average monthly figure of sludge disposed in 2009, which was 61 tonnes. A water balance is used to calculate the difference between rainfall on landfilled areas and the various losses prior to leachate generation.

Water balance calculations are attached in Appendix I.

The method used is based on equation developed by Ehring (Quality and Quantity Sanitary Landfill Leachate, 1983). This method is based on the use of a mathematical equation, which provides a conservative estimate, which caters for the worst-case scenarios.

The equation is as follows: $L_0 = [(ER.a) + LW + IR] – [aW]$

Where:

- L_0 : Free Leachate Produced
- ER: Effective Rainfall (net precipitation after loss by evaporation)
- A: Area of Cell(s)
- LW: Liquid waste
- IR: Infiltration from restored areas
- aW: Absorptive capacity of waste
- a_A: Active area
- aR: Restored area
- AL: Lagoon area
- WA: Waste in active area
- WR: Waste in restored area

Based on the calculations it is estimated that approximately 2,990 m^3 (upper bound) and 2,282 m^3 (lower bound) of leachate was produced on site in 2009. As the majority of the landfill is capped the potential for leachate generation is reduced.

3.2.10 Resource and Energy Consumption Summary

The only consumer of electricity at the facility is the leachate pump, which pumps the leachate from the leachate collection sump to the WWTP. The contribution of this sump to the overall electrical output of the entire WWTP is minor. The leachate pump is in operation for approximately 4 hrs per day.

Diesel is used to fuel the vehicles used on site namely the sludge dumper trucks and the tractor. Diesel is stored in a 5,000 litre capacity bunded tank located on site. Approximately 1,500 litres of diesel were used in 2009.

Mains water is provided via the public mains supply, however water usage at the facility is not metered.

3.2.11 Tank, Pipeline and Bund Integrity Testing and Inspection

The facility contains one bunded diesel tank as outlined in Section 3.2.10. The bund was installed in 2006 and the integrity assessment report was forwarded to the Agency as part of the 2006 AER. The bund is regularly inspected and tested by site personnel to verify integrity.

3.2.12 Review of Nuisance Controls

The assistant landfill supervisor conducts daily inspections of the landfill and the facility and records any incidents in daily duty sheets which are stored at the facility. The inspections are undertaken to identify any environmental nuisances caused by vermin, birds, flies, mud, dust, litter, and odours.

No complaints or incidents were received by the facility in 2009.

Rentokil carry out pest control in the treatment plant but no incidences of vermin have been reported on the landfill site. Birds and flies do not pose a problem at the site as there is no domestic refuse being deposited in the landfill; therefore there are no nuisance controls in place for birds or flies.

According to facility management:

- No complaints regarding odours were received in 2009.
- There is no problem with litter at the facility and no complaints were received in 2009 in this regard.

- There are no noise sensitive locations in the immediate vicinity of the facility and no complaints regarding noise from the facility were received in 2009.

There is a Roadstone Quarry near the site which influenced the night-time noise levels recorded during the annual noise survey undertaken in October 2009.

The only vehicles that use the site roads are a tractor owned by Clare County Council and a 5-tonne sludge dumper truck which is on hire. These are used to deposit the sludge to the landfill from the WWTP. The vehicles travel on a private road between the two sites and do not travel outside the boundary of the two sites.

In general, dust is not a problem encountered at the facility and thus no dust suppression measures are considered necessary. Dust monitoring is currently undertaken as per Table D.3.1 of the licence and no exceedances were detected in 2009.

4.0 MANAGEMENT OF THE FACILITY

4.1 Management and Staffing Structure

Clare County Council has been responsible for the facility since November 2004. The facility was previously managed by Shannon Development. The facility is under the operational control of the landfill manager – Edel Brennan. The assistant landfill managers are Ailish Johnston, Joan McCarthy and Joe Ryan. In addition, there is one weighbridge operator, Michael Lynch. The current management structure is outlined in Table 4.1 below.

Table 4.1: Management and Staffing Structure

Name	Position	Responsibilities	Replacement
Edel Brennan	Landfill Manager	Landfill management	Ailish Johnston
Ailish Johnston	Assistant Landfill Manager	Landfill management, monthly reporting, environmental monitoring, nuisance control	Joan McCarthy
Joan McCarthy	Assistant Landfill Manager	Landfill management, monthly reporting, environmental monitoring, nuisance control	Joe Ryan
Joe Ryan	Assistant Landfill Manager	Landfill management, monthly reporting, environmental monitoring, nuisance control	Michael Lynch
Michael Lynch	Weighbridge Operator	Weighing sludge	Joe Ryan

4.2 Environmental Management Programme/Environmental Objectives and Targets

The 2008 AER did not specify any environmental objectives and targets for 2009.

4.3 Schedule of Environmental Objectives and Targets for 2010

The licensee conducted a review of the EMS in 2009 and found that no changes to the EMS were required and therefore there are no amendments to the environmental objectives and targets required for the year 2010.

4.4 Facility Procedures

No new procedures were developed or implemented at the site between January 2009 and December 2009.

4.5 Financial Provision

In accordance with Condition 12 of the licence, Charges and Financial Provisions, Clare County Council has the ability to meet any financial commitments or liabilities incurred by the undertaking of the activities relating to the facility. Clare County Council annually in the preparation of the "Book of Estimates" and the passing of these estimates shall make provisions for any capital works and maintenance works required to fulfill the conditions of the waste licence for the facility.

Clare County Council also carries adequate insurance to deal with their liabilities. The type and level of insurance is constantly monitored and updated as required.

4.6 Staff Training

An Environmental Awareness Programme has been developed and implemented at the facility. A copy of the Programme was included in the 2006 AER. The Programme sets out environmental issues relevant to all site staff, contractors and visitors to the facility. Training for all staff involved in the operation of the facility is recorded in the training and awareness programme which includes a sign out section for staff members to record their attendance to courses.

Spill kit and chemical handling training was undertaken for staff employed at the facility in October 2007 and copies of training records were included in the 2007 AER.

As there have been no changes to the facility staff structure since 2007, no additional environmental training was undertaken in 2009.

4.7 Programme For Public Information

All information and correspondence supplied to the EPA (other than commercially sensitive information) and received from the EPA, is available to the public to view at Tradaree Point WWTP, Shannon (Clonmoney

South), Co. Clare. This includes a copy of the waste licence, all reports, monitoring results and interpretations required by the licence and other correspondence between the EPA and the facility. Any member of the public may view the information between the hours of 10.00 and 16.00 and by appointment only, at the below address.

All requests concerning the environmental performance of the facility should be forwarded to:

Ms. Edel Brennan,

Facility Manager,

Tradaree Point Sludge Disposal Facility,

Shannon (Clonmoney South),

Co. Clare

Tel: 061 364477

4.8 Facility Notice Board

In compliance with Condition 3.3 of Waste Licence W0037-01, a facility notice is in place at the entrance to the landfill site adjacent to the main gate, and contains all the details outlined in Section 3.3.3 of the licence.

5.0 REPORTED INCIDENTS AND COMPLAINTS SUMMARY

During the reporting period January 2009 to December 2009, no incidents occurred which would require reporting to the relevant authorities. No complaints or incidents were reported to the facility between January and December 2009.

5.1 Incidents

None during the reporting period.

5.2 Non-compliances

In September 2009, the EPA conducted a site inspection (ref: (W0037-01)09SI01MOR). No non-compliances were recorded. A number of observations were recorded and corrective actions specified. The licensee has since implemented the specified corrective actions and has forwarded relevant details to the Agency where required.

5.3 Complaints

None received during the reporting period.

5.4 Waste Records

Records of the amount and type of sludge (either industrial or domestic) disposed at the facility are kept on file at the facility. Receipts of incoming sludge are recorded at the weighbridge and filed. The weekly records from the weighbridge are then filed and stored in the administration building of the facility. The total quantity of the waste sludge is recorded on a weekly basis and is logged in a waste register that is kept on site at all times. Quantities of waste sludge disposed of to landfill are recorded in the monthly reports for the WWTP and also the AER.

The following information is recorded in the waste register;

- Name of the person transporting the load
- Date of transportation

- Sludge quantity
- Sludge type
- The name of the machine operator
- The cell in which the sludge is to be disposed

The site caretaker signs the logbook to confirm the sludge has been inspected prior to acceptance to the landfill. The records are then transferred to the site office where they are logged on a computer database.

The weighbridge was last calibrated in February 2009. A weighbridge calibration certificate was included with the 2008 AER.

Section 2 contains further information regarding sludge management.

6.0 FACILITY DEVELOPMENT

6.1 Developments during 2009

There were no other development works of note undertaken at the facility between January and December 2009.

6.2 Proposed Development of the Facility and Associated Timescales

At present, there are no facility development works planned for 2010.

Cell 1 is currently active and on reaching its full capacity it will be capped and landfilling of Cell 2 will commence. It is expected that this will occur towards the end of 2010.

FIGURE 1 – SITE LOCATION MAP

Tradaree Point Sludge Disposal Facility

Site Location Map

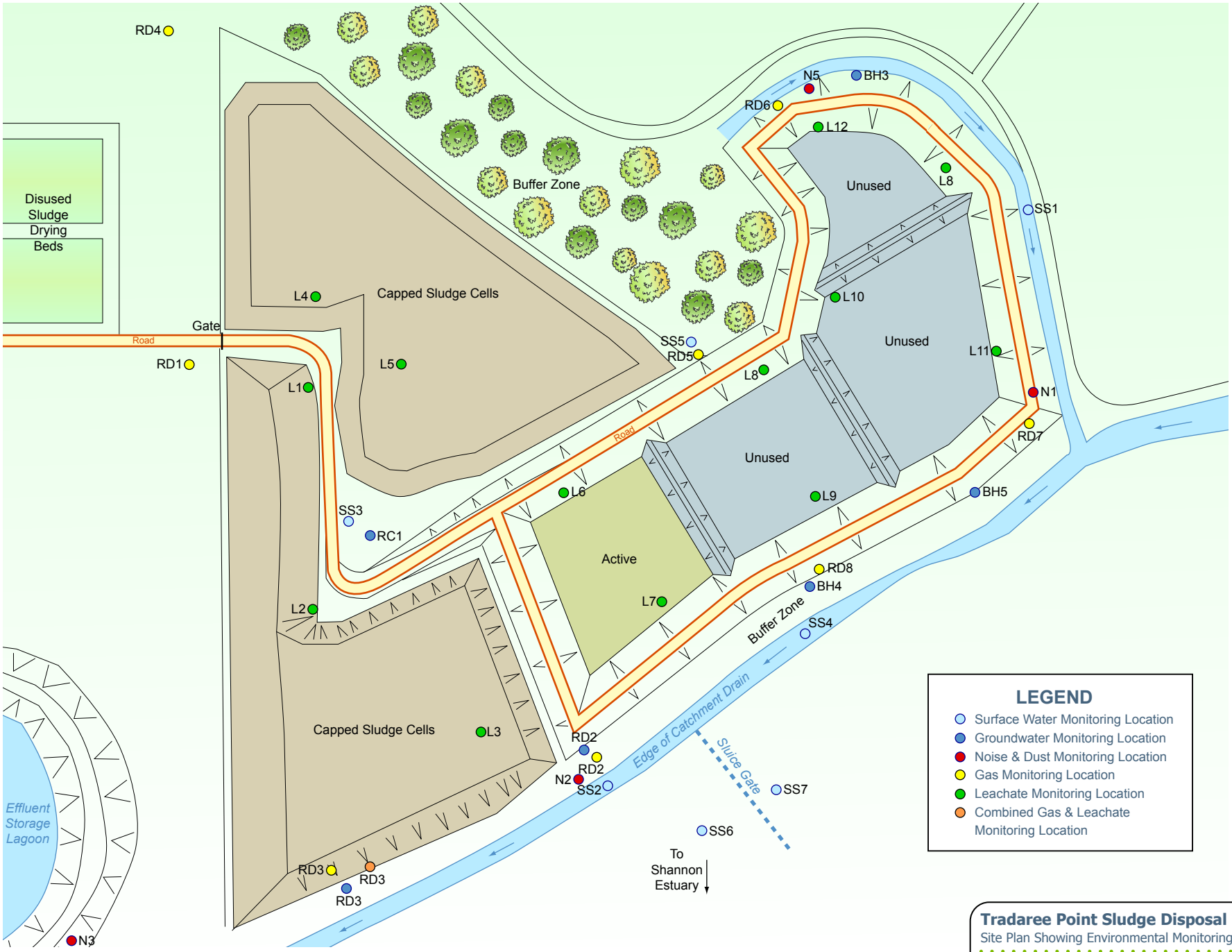
Figure No. 1

Job No. CE08106	**Date.** Mar. 2010
Finalised By - SR	**Office** - 1504
Drawn By: J Farrar - CS2,Illustrator	

WYG Ireland

NOTE: Drawing is for diagrammatic purposes only. No measurements to be taken.

FIGURE 2 – SITE PLAN SHOWING ENVIRONMENTAL MONITORING LOCATIONS



Tradaree Point Sludge Disposal Facility

Site Plan Showing Environmental Monitoring Locations

Figure No. 2

Job No. CE08106	**Date.** Mar. 2010
Finalised By - SR	**Office** - 1504
Drawn By: J Farrar - CS2,Illustrator	

WYG Ireland

NOTE: Drawing is for diagrammatic purposes only. No measurements to be taken.

APPENDICES

APPENDIX A – DUST MONITORING RESULTS

T.E. LABORATORIES LIMITED
Trading as
TelLab

Tullow Industrial Estate, Tullow, Co. Carlow
Phone: 059-9152881 Fax: 059-9152886

CERTIFICATE OF ANALYSIS

Project Description:	Analysis of Aqueous Samples		
Attention:	Ms. Ailish Johnston	**Lab ID:**	84578-84581
Company:	Response Engineering		
Address:	Railway Road, Charleville, Co. Cork	**Date Sampled:**	Unknown
Certificate No:	L/08/2416	**Date Rec'd:**	30.10.2009
Issue Date:	06.11.2009	**Our Ref:**	WS-25741

Project Summary: Four samples were analysed for a range of determinands. Please see page 2 for results. Terms & Conditions and methods used are outlined in the attached appendix.

No. of Pages: Results page 2 plus 4 page appendix

Mr. Mark Bowkett
Chief Executive

Breda Moore.

Ms Breda Moore
Technical Manager

TelLab

ANALYSIS OF DUST DEPOSITION GAUGES

Date Sampled: Unknown
Date Received: 30.10.2009
Date Analysis Commenced:30.10.2009
Our Ref.: WS-25741
Your Ref: Shannon Landfill
Certificate No. L/08/2416

Sample ID	Lab ID	Dustfall (mg/m^2d)* (n/a)	Dustfall (g/m^2d)* (n/a)
N1*	**84578**	35	0.035
N3	**84579**	46	0.046
N5##	**84580**	166	0.166
SS2#	**84581**	28	0.028

*Note: d = sampling period in days (31)
m = collecting surface area (metre)
g = mass of dustfall (gram)
mg = mass of dustfall (milligram)

** = 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.

Notes:
* Small leaves removed.
# Feathers found and removed.
Leaves and small insect found and removed.

``

APPENDIX B – NOISE SURVEY REPORT

ENVIRONMENTAL NOISE SURVEY

Confidential Report

Date: 13th October & 11th November, 2009

Company: Response Engineering Ltd.

Report Number: 103027/ck

CONFIDENTIAL REPORT

CLIENT: Response Engineering Ltd.
Tradaree WWTP,
Tradaree,
Shannon,
Co. Clare.

ORDER NO. PO R015800	**DATE:** 13th October & 11th November, 2009

REPORT NO. 103027/ck	**REPORT TITLE:** Environmental Noise Survey

REPORTED BY:

_____
Emma Lynch.

CONDITIONS:

1. *Reports shall not be reproduced except in full, without prior approval of Cronin Environmental.*
2. *Results contained in this report relate only to the item(s) tested.*
3. *All comments relating to this report should be forwarded to the above named person.*

ENVIRONMENTAL NOISE SURVEY

Company:	Response Engineering Ltd.
Date of Survey:	13th October & 11th November, 2009
Make & Model of instruments used:	Quest 2900 Integrating Data Logging Sound Level Meter & Pulsar Model 63 Precision Data Logging Sound Level Meter
Serial Number:	CD9060024 - Quest 2900 B17260F - Pulsar Model 63
Date of last factory calibration:	October 2008 - Quest 2900 September 2008 - Pulsar Model 63
Date of last site calibration:	13/10/2008 & 11/11/2009
Frequency Weighting :	"A"
Time Weighting:	"F"
Areas Measured:	N1 N2 N3 N5
Technician:	Emma Lynch.
Weather Conditions:	Day - Dry with a light easterly wind Night - Dry with no wind

Background

Cronin Environmental were contracted by Response Engineering Ltd. to carry out an environmental noise survey at their Waste Water Treatment facility in Tradaree, Shannon, Co. Clare.

Introduction

The instrument used to monitor the noise levels at Response Engineering Ltd. were a Quest 2900 Integrating/Datalogging Sound Level Meter & a Pulsar Model 63 Precision Data Logging Sound Level Meter. The Noise levels were measured in accordance with International Standard ISO 1996-1: 2003, ISO 1996-2:2007 & ISO 1996-3:1987 - Acoustics - Description, Measurement and Assessment of Environmental Noise and the "Guidance Note For Noise In Relation To Scheduled Activities - 2nd Edition" issued by the EPA.

The instruments are capable of performing a wide range of measurements simultaneously, including SPL, SEL, Leq, Lavg, TWA, Lmax, Lmin, LDN and Exceedance Levels, and has a measurement range of 20 - 140 decibels.

The instruments were set up on their tripods at four locations. The noise levels were monitored for a period of 30 minutes at each location during the day and night.

Noise Sources

Main On-Site Noise Sources:

1. Pumps
2. Flow of water

External Noise Sources:

1. Road traffic
2. Roadstone Quarry

Weather Conditions

Weather conditions were dry for noise level monitoring with a light south westerly breeze present during the day time survey and weather conditions were damp with no wind present during the night time survey.

Procedure

The instruments were connected to their microphones and were calibrated. Using the function key, the Sound Level Meters were set to read Leq, time weighting of "A", response time as "Fast" and the range as appropriate.

The Sound Level Meters were then placed on their tripods approximately 1.2-1.5 metres above ground level and at least 3.5 metres away from sound reflecting surfaces.

The measurements were then taken for a period of 30 minutes and logged in the internal memory.

When the measurements were completed the instruments were again checked using the sound level calibrators to ensure that no change had taken place with the calibration.

DAY-TIME MEASUREMENTS

LOCATION REFERENCE No.: N1

MEASURING PARAMETERS:

Range	30-90
Weighting	A
Time Constant	Fast
S.I Corr.	Frontal
Time Interval	30 Minutes

Date	13-10-2009
Session Started	13:35:20
Session Stopped	14:05:20

$L_Aeq_{(30)}$	SEL	L_{min}	L_{max}	L_5	L_{10}	L_{50}	L_{90}	L_{peak}
42.1dB	76.8dB	31.5dB	67.6dB	45.0dB	39.7dB	35.3dB	33.4dB	91.1dB

COMMENTS ON RESULTS AT THIS LOCATION

The predominant sources of noise at this measurement location were:

- Distant road traffic.
- Birds chirping.
- Cows.

There was no noise audible from Response Engineering Ltd.

The $L_A$eq result is in compliance with the specified limit of 55dB(A).

LOCATION REFERENCE No.: N2

MEASURING PARAMETERS:

Range	20-80
Weighting	A
Time Constant	Fast
S.I Corr.	Frontal
Time Interval	30 Minutes

Date	13-10-2009
Session Started	14:10:22
Session Stopped	14:40:22

$L_Aeq_{(30)}$	SEL	L_{min}	L_{max}	L_5	L_{10}	L_{50}	L_{90}	L_{peak}
39.2dB	73.7dB	25.1dB	62.1dB	44.9dB	40.1dB	31.7dB	28.9dB	75.9dB

COMMENTS ON RESULTS AT THIS LOCATION

The predominant sources of noise at this measurement location were:

- Distant road traffic.
- Birds chirping.
- Flow of water.

The L_Aeq result is in compliance with the specified limit of 55dB(A).

LOCATION REFERENCE No.: N3

MEASURING PARAMETERS:

Range	30-90
Weighting	A
Time Constant	Fast
S.I Corr.	Frontal
Time Interval	30 Minutes

Date	13-10-2009
Session Started	14:52:11
Session Stopped	15:22:11

$L_Aeq_{(30)}$	SEL	L_{min}	L_{max}	L_5	L_{10}	L_{50}	L_{90}	L_{peak}
43.6dB	78.7dB	35.1dB	71.9dB	47.2dB	45.8dB	42.0dB	40.5dB	96.6dB

COMMENTS ON RESULTS AT THIS LOCATION

The predominant sources of noise at this measurement location were:

- Distant road traffic.
- Birds chirping.
- Flow of water.

The $L_A$eq result is in compliance with the specified limit of 55dB(A).

LOCATION REFERENCE No.: N5

MEASURING PARAMETERS:

Range	30-90
Weighting	A
Time Constant	Fast
S.I Corr.	Frontal
Time Interval	30 Minutes

Date	13-10-2009
Session Started	13:25:15
Session Stopped	13:55:15

$L_Aeq_{(30)}$	SEL	L_{min}	L_{max}	L_5	L_{10}	L_{50}	L_{90}	L_{peak}
44.2dB	77.0dB	31.1dB	69.6dB	45.1dB	36.3dB	33.6dB	32.2dB	81.2dB

COMMENTS ON RESULTS AT THIS LOCATION

The predominant sources of noise at this measurement location were:

- Distant road traffic.
- Birds chirping.

There was no noise audible from Response Engineering Ltd.

The $L_A$eq result is in compliance with the specified limit of 55dB(A).

NIGHT-TIME MEASUREMENTS

LOCATION REFERENCE No.: N1

MEASURING PARAMETERS:

Range	30-90
Weighting	A
Time Constant	Fast
S.I Corr.	Frontal
Time Interval	30 Minutes

Date	10-11-2009
Session Started	07:03:11
Session Stopped	07:33:11

$L_Aeq_{(30)}$	SEL	L_{min}	L_{max}	L_5	L_{10}	L_{50}	L_{90}	L_{peak}
50.4dB	79.6dB	43.4dB	68.9dB	58.1dB	52.1dB	48.3dB	46.1dB	81.8dB

COMMENTS ON RESULTS AT THIS LOCATION

The predominant source of noise at this location was the nearby Roadstone Quarry. Road traffic was also audible at this location. There was no noise audible from Response Engineering Ltd.

The L_Aeq result exceeds the specified limit of 45dB(A), however this is due to the noise being generated on the nearby Roadstone facility. The L90 result is in compliance with the limit.

LOCATION REFERENCE No.: N2

MEASURING PARAMETERS:

Range	30-90
Weighting	A
Time Constant	Fast
S.I Corr.	Frontal
Time Interval	30 Minutes

Date	10-11-2009
Session Started	07:37:15
Session Stopped	08:07:15

$L_Aeq_{(30)}$	SEL	L_{min}	L_{max}	L_5	L_{10}	L_{50}	L_{90}	L_{peak}
45.0dB	74.1dB	36.9dB	80.7dB	48.3dB	46.5dB	42.8dB	40.6dB	95.0dB

COMMENTS ON RESULTS AT THIS LOCATION

The predominant sources of noise at this location were:

- The nearby Roadstone Quarry.
- Distant road traffic.
- Flow of water.

The L_Aeq result is in compliance with the specified limit of 45dB(A).

LOCATION REFERENCE No.: N3

MEASURING PARAMETERS:

Range	30-90
Weighting	A
Time Constant	Fast
S.I Corr.	Frontal
Time Interval	30 Minutes

Date	10-11-2009
Session Started	06:23:00
Session Stopped	06:53:00

$L_Aeq_{(30)}$	SEL	L_{min}	L_{max}	L_5	L_{10}	L_{50}	L_{90}	L_{peak}
44.7dB	78.9dB	37.2dB	73.6dB	49.9dB	46.2dB	42.1dB	40.3dB	91.6dB

COMMENTS ON RESULTS AT THIS LOCATION

The predominant sources of noise at this measurement location were:

- The nearby Roadstone Quarry.
- Distant road traffic.
- On site pumps - (vaguely audible).
- Flow of water.

The $L_A$eq result is in compliance with the specified limit of 45dB(A).

LOCATION REFERENCE No.: N5

MEASURING PARAMETERS:

Range	30-90
Weighting	A
Time Constant	Fast
S.I Corr.	Frontal
Time Interval	30 Minutes

Date	10-11-2009
Session Started	06:58:19
Session Stopped	07:28:19

$L_Aeq_{(30)}$	SEL	L_{min}	L_{max}	L_5	L_{10}	L_{50}	L_{90}	L_{peak}
48.2dB	82.1dB	40.2dB	70.7dB	53.4dB	51.9dB	50.3dB	43.1dB	93.0dB

COMMENTS ON RESULTS AT THIS LOCATION

The predominant source of noise at this location was the nearby Roadstone Quarry. Road traffic was also audible at this location. There was no noise audible from Response Engineering Ltd.

The L_Aeq result exceeds the specified limit of 45dB(A), however this is due to the noise being generated on the nearby Roadstone facility. The L90 result is in compliance with the limit.

Definitions

Noise: Any sound, that has the potential to cause disturbance, discomfort or psychological stress to a subject exposed to it, or any sound, that could cause actual physiological harm to a subject exposed to it, or physical damage to any structure exposed to it, is known as noise.

$L_{eq,T}$: This is the average sound pressure level during the measurement period T. During that period, the real noise level fluctuated, and therefore its acoustic energy varied. At the end of the period, it had a total acoustic energy. The $L_{eq,T}$ has that same total acoustic energy, but represents what the acoustic energy would have been had the real noise level remained constant during the measurement period.

SEL: Sound Exposure Level is defined as the constant level acting for 1 second which has the same acoustic energy as the original sound.

Lmax: The maximum Sound Pressure Level obtained.

Lmin: The minimum Sound Pressure Level obtained.

Lpeak: The peak level.

Ln: The SPL exceeded for N% of the time during a study. Four user selectable values are calculated. The default values are L5, L10, L50 and L90.

L10:is the sound pressure level that is exceeded for 10% of the time for which the given sound is measured. L10 is used to measure the louder intermittent noise peaks such as traffic, airplanes etc.

L90: is the sound pressure level that is exceeded for 90% of the time for which the given sound is measured L90 is used to cut out the louder incidental noise peaks such as traffic air planes etc. and measure the steady background noise.

L99: is the sound pressure levels that is exceeded for 99% of the time for which the given sound is measured. L99 is similar to L90 as it is used to record the lowest sound levels measured.

Definitions (contd.)

L_r: The A-weighted equivalent continuous noise level (Laeq,T) during a specified time period with specified adjustments for tonal, impulsive or intermittent noise. In general, the rating level is given by:

$$L_{Ar,Tr} = L_{Aeq,T} + K_I + K_T + K_R + K_S$$

K_I is a penalty for impulses (+5dB)
K_T is a penalty for tones (+5dB)
K_R is a penalty for time of day
K_S is a penalty for certain sources and situations

The Environmental Protection Agency's preferred rating methodology is broadly in line with the BS 4142 (1997) assessment procedure in which a noise containing both impulsive and tonal characteristics is penalised by 5dB. A 5dB penalty should also be applied in situations where the noise is either tonal or impulsive.

Noise Limits

The Department of Environment, Heritage and Local Government

Noise-sensitive uses in the vicinity of a quarry, such as dwellings, schools, hospitals, places of worship or areas of high amenity, require that the amount of noise be minimised. The sensitivity to noise is usually greater at night-time (20.00 to 08.00) than during the day, by about 10 dB (A). Many quarries are situated in areas of low background noise and it is appropriate to consider this when setting noise limits. In general, it can be expected that complaints will result where the noise from quarrying and associated activities are between 5 to 10 dB above the background noise levels. In areas of higher background noise levels, the EPA recommends that ideally, if the total noise level from all sources is taken into account, the noise level at sensitive locations should not exceed a LAeq (1 hour) of 55 dB(A) by daytime and a LAeq (15 minutes) of 45 dB(A) by nightime. Audible tonal or impulsive components in noise emissions (e.g. the reversing siren on a lorry, required for safety reasons) can be particularly intrusive, and such components should be minimised at any noise-sensitive location.

Environmental Protection Agency

There are no statutory limits for noise emissions, or for ambient noise levels in Ireland. In practice, noise limits for industrial activities are often specified having regard to the principles contained in the "Guidance Note For Noise In Relation To Scheduled Activities - 2nd Edition" issued by the EPA, the International Standard ISO 1996 Parts 1:2003, 2:2007, & 3:1987 – Acoustics - Description, measurement & assessment of environmental noise, ISO 9612 (1997) and BS4142 : 1997 – Rating industrial noise affecting mixed residential and industrial areas. The usual range of values allowed for industrial activities is 40-45 dB(A) at night, and 50-55 dB(A) during the day, at the nearest residence or at the boundary of the premises, but further controls may be specified if there are prominent discrete tones or impulses. Much depends on the existing noise levels, the character of the area and the nature of the development.

Statement of Compliance and Calibration

Cronin Environmental verify that the Quest 2900 was laboratory calibrated in October 2008 & the Pulsar Model 63 was laboratory calibrated in September 2008. The Sound Level Meters were calibrated against the laboratory standards held by Quest Technologies and Cirrus Research plc. which are traceable to the appropriate International Standards.

Cronin Environmental certify and state that the calibration of the instruments was verified prior to beginning the series of measurements and was again re-checked after the measurements were complete.

Techniques for controlling noise

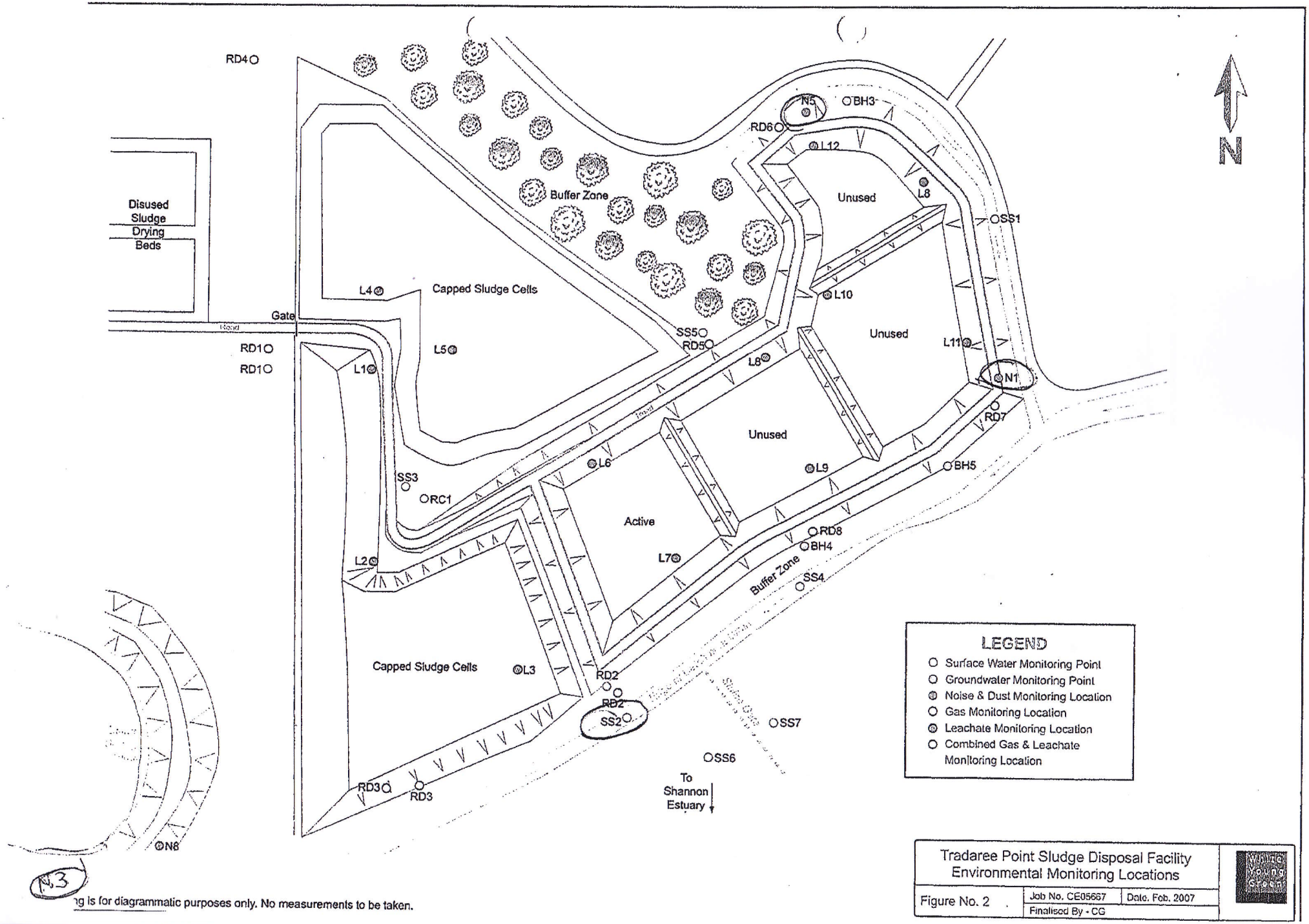
No priority ranking is intended, and the appropriate selection in a particular case will depend on the specifics of the activity and on site constraints.

- Barriers
- Enclosures (partial and Complete)
- Lagging of pipes and components
- Attenuators

Conclusion

All results obtained from the measurements taken at the four locations by day are in compliance with the daytime limit of 55dBA. The results recorded at N2 & N3 during the night-time survey are in compliance with the night-time limit of 45dBA. The results recorded at N1 & N5 during the night-time survey exceed the limit of 45dBA however this is due to the noise being generated on the nearby Roadstone facility. The L90 result is in compliance with the limit and is representative of the noise on the Response Engineering site.

MAP OF MONITORING LOCATIONS



ng is for diagrammatic purposes only. No measurements to be taken.

Tradaree Point Sludge Disposal Facility Environmental Monitoring Locations		
Figure No. 2	Job No. CE05667	Date. Feb. 2007
	Finalised By - CG	

APPENDIX C – LANDFILL GAS MONITORING RESULTS

Landfill Gas Analysis

Month January-2009

Date	Location	CO2	Methane	O2	Relative Pressure	Temp
		%	%	%	mBar	oC
22-Jan	RD1	0	0.1	19.1	0	10
	RD2	4.9	32.1	14	1.5	11
	RD3	14.8	8.3	10	6	11
	RD4	4.0	3.9	16.2	0.8	10
	RD5	18.4	7.9	14	6.1	12
	RD6	5.0	4.9	15.6	0	11
	RD7	0.1	0.3	20.8	4.5	11
	RD8	0.3	1.5	20.1	3.9	10
	L6	0	0.1	21	4.4	11
	L8	0	0.1	20.9	0.2	11
	L10	0	0.4	20.4	2	11
	L12	0	0.3	19.1	0	11
Trigger Level (% v/v)		1.5	1			

Shading indicates trigger level exceeded

Landfill Gas Analysis

Month February-2009

Date	Location	CO2	Methane	O2	Relative Pressure	Temp
		%	%	%	mBar	oC
24-Feb	RD1	3.5	0.0	16.8	0.1	6
	RD2	5.3	31.2	10.5	0.7	7
	RD3	8.1	5.3	6.4	3.4	7
	RD4	4.1	2.6	11.7	1.2	6
	RD5	18.5	3.3	3.0	-0.4	7
	RD6	6.5	7.4	10.2	0.0	8
	RD7	0.1	0.4	20.7	0.0	7
	RD8	0.8	2.7	20.2	3.1	6
	L6	0.0	0.0	21.0	1.5	7
	L8	0.0	0.2	20.6	0.0	7
	L10	0.1	0.0	20.9	0.0	7
	L12	0.1	0.0	20.8	0.0	7
Trigger Level (% v/v)		1.5	1			

Shading indicates trigger level exceeded

Landfill Gas Analysis

Month March-2009

Date	Location	CO2	Methane	O2	Relative Pressure	Temp
		%	%	%	mBar	oC
23-Mar	RD1	1.8	0.1	18.2	0.1	
	RD2	0.8	10.1	16.9	0.0	
	RD3	7.7	2.4	15.7	0.1	
	RD4	6.1	0.1	7.7	1.9	
	RD5	10.7	2.0	10.8	0.1	
	RD6	6.0	4.6	12.8	0.0	
	RD7	0.2	0.1	20.9	0.0	
	RD8	2.3	0.1	18.9	3.2	
	L6	0.0	0.0	20.8	0.0	
	L8	0.0	0.1	20.8	0.0	
	L10	0.0	0.1	20.9	0.0	
	L12	0.0	0.1	20.8	0.0	
Trigger Level (% v/v)		1.5	1			

Shading indicates trigger level exceeded

Landfill Gas Analysis

Month April-2009

Date	Location	CO2	Methane	O2	Atm Pressure	Temp
		%	%	%	mBar	oC
16-Apr	RD1	0.4	0.0	20.2	1005	12
	RD2	5.1	14.7	12.9	1003	13
	RD3	11.7	2.7	6.7	1003	11
	RD4	4.4	1.4	13.8	1003	12
	RD5	4.7	0.2	18.2	1004	11
	RD6	6.3	8.8	13.2	1004	11
	RD7	0.0	0.0	20.2	1003	10
	RD8	1.6	0.3	19.7	1003	11
	L6	0.0	0.0	20.2	1003	12
	L8	0.0	0.0	20.2	1003	10
	L10	0.0	0.0	20.2	1003	11
	L12	0.0	0.0	20.2	1003	11
Trigger Level (% v/v)		1.5	1			

Shading indicates trigger level exceeded

Landfill Gas Analysis

Month May-2009

Date	Location	CO2	Methane	O2	Pressure	Temp
		%	%	%	mBar	oC
27-May	RD1	2.9	0.0	13.6	0.1	14
	RD2	6.1	3.1	10.1	0.4	13
	RD3	10.9	2.3	6.1	2.5	14
	RD4	3.7	2.4	10.8	0.9	14
	RD5	17.7	3.8	2.6	-0.1	14
	RD6	4.6	5.3	9.1	0.0	16
	RD7	0.2	0.3	20.8	-0.1	14
	RD8	2.1	3.0	19.3	-0.1	14
	L6	0.0	0.1	20.8	0.0	14
	L8	0.0	0.2	20.9	0.0	14
	L10	0.1	0.0	20.8	-0.1	14
	L12	0.1	0.0	20.9	0.0	14
Trigger Level (% v/v)		1.5	1			

Shading indicates trigger level exceeded

Landfill Gas Analysis

Month June-2008

Date	Location	CO2	Methane	O2	Pressure	Temp
		%	%	%	mBar	oC
29-Jun	RD1	0.7	0.1	20.4	1013	25
	RD2	3.1	4.8	15.0	1010	25
	RD3	7.4	3.0	12.3	1011	25
	RD4	3.7	0.3	13.0	1009	25
	RD5	7.3	0.2	6.1	1011	26
	RD6	8.1	10.9	11.6	1010	26
	RD7	0.1	0.2	20.5	1010	25
	RD8	0.3	0.2	20.1	1010	25
	L6	0.6	0.2	19.5	1011	25
	L8	0.1	0.2	20.5	1011	25
	L10	0.0	0.2	20.5	1011	25
	L12	0.1	0.2	20.3	1011.0	25
Trigger Level (% v/v)		1.5	1			

Shading indicates trigger level exceeded

Landfill Gas Analysis

Month July-2008

Date	Location	CO2	Methane	O2	Relative Pressure	Temp
		%	%	%	mBar	oC
22-Jul	RD1	0.2	0.0	20.6	-0.1	15
	RD2	1.7	0.0	18.4	0.0	14
	RD3	1.7	1.1	19.2	0.0	15
	RD4	3.8	0.0	15.5	-1.4	15
	RD5	2.7	0.0	18.1	0.0	15
	RD6	10.0	12.2	10.7	0.0	16
	RD7	0.3	0.1	20.1	0.0	16
	RD8	0.7	0.4	19.9	0.0	15
	L6	0.1	0.0	20.5	0.0	16
	L8	0.0	0.0	20.5	0.0	16
	L10	0.0	0.0	20.5	0.0	16
	L12	0.1	0.0	20.4	0.0	16
Trigger Level (% v/v)		1.5	1			

Shading indicates trigger level exceeded

Landfill Gas Analysis

Month August-2008

Date	Location	CO2	Methane	O2	Relative Pressure	Temp
		%	%	%	mBar	oC
26-Aug	RD1	0.4	0.1	20.1	4.7	18
	RD2	1.0	0.0	19.8	0	18
	RD3	8.3	2.2	13.6	0	19
	RD4	3.2	0.0	17.8	0.2	17
	RD5	5.6	0.0	15.8	3.6	18
	RD6	5.6	7.9	14.8	-0.1	18
	RD7	0.1	0.0	20.6	0	18
	RD8	0.9	0.1	19.9	1.5	19
	L6	0.0	0.0	20.6	1.2	17
	L8	0.1	0.2	20.5	1.3	17
	L10	0.1	0.0	20.6	0.2	17
	L12	0.1	0.3	20.6	1.2	17
Trigger Level (% v/v)		1.5	1			

Shading indicates trigger level exceeded

Landfill Gas Analysis

Month September-2009

Date	Location	CO2	Methane	O2	Relative Pressure	Temp
		%	%	%	mBar	oC
28-Sep	RD1	2.2	0	18.7	0	17
	RD2	0.7	0.0	20	0.1	18
	RD3	6.4	0.1	13.4	0	17
	RD4	4.2	0.1	15.4	12.2	17
	RD5	7.0	0	13.2	15.4	17
	RD6	9.6	9.7	10.8	0	18
	RD7	0.1	0.0	20.5	0	17
	RD8	1.3	0.1	19.2	0	17
	L6	0.1	0.0	20.5	0.1	17
	L8	0.0	0.0	20.5	0	18
	L10	0.0	0.0	20.5	0	17
	L12	0.0	0.0	20.5	0	17
Trigger Level (% v/v)		1.5	1			

Shading indicates trigger level exceeded

Landfill Gas Analysis

Month October-2009

Date	Location	CO2	Methane	O2	Atm Pressure	Temp
		%	%	%	mBar	oC
28-Oct	RD1	7.3	0.3	14.8	1011	17
	RD2	2.6	0.5	18.4	1012	17
	RD3	11.8	3.4	6.4	1011	17
	RD4	0.6	0.1	20.3	1011	17
	RD5	8.2	0.6	11.5	1012	17
	RD6	10.4	10.7	8.7	1012	16
	RD7	0.1	0.0	20.5	1011	17
	RD8	1.6	0.0	18.6	1011	17
	L6	0.5	0.0	20.1	1011	17
	L8	0.1	0.0	20.4	1011	17
	L10	0.1	0.0	20.5	1012	17
	L12	0.0	0.0	20.4	1012	17
Trigger Level (% v/v)		1.5	1			

Shading indicates trigger level exceeded

Landfill Gas Analysis

Month November-2009

Date	Location	CO2	Methane	O2	Relative Pressure	Temp
		%	%	%	mBar	oC
26-Nov	RD1	5.4	0.8	11.2	0.4	7
	RD2	5.7	7.9	12.4	1.8	7
	RD3	14.7	10.2	3.2	3.1	6
	RD4	0.0	0.0	0	0	0
	RD5	8.1	0.1	10.0	20.5	6
	RD6	6.2	5.9	12.5	0	6
	RD7	0.1	0.0	20.3	0	7
	RD8	0.0	0.0	0	0	0
	L6	0.2	0.0	20.3	0.1	8
	L8	0.0	0.0	20.4	0	7
	L10	0.0	0.0	20.3	0	7
	L12	0.0	0.1	20.2	0	8
Trigger Level (% v/v)		1.5	1			

Shading indicates trigger level exceeded

Landfill Gas Analysis

Month December-2009

Date	Location	CO2	Methane	O2	Atm Pressure	Temp
		%	%	%	mBar	oC
21-Dec	RD1	6.9	0.8	10.3	988	4
	RD2	8.6	37.7	7.4	987	3
	RD3	13.2	11.6	4.5	987	3
	RD4	0.0	0.0	0	0	0
	RD5	9.4	0.5	8.9	986	4
	RD6	8.9	2.7	9.5	986	3
	RD7	0.2	0.0	20.2	986	4
	RD8	0.0	0.0	0	0	0
	L6	0.2	0.0	20.1	987	4
	L8	0.0	0.0	20.2	986	4
	L10	0.1	0.0	20.2	986	4
	L12	0.3	0.0	19.6	986	4
Trigger Level (% v/v)		1.5	1			

Shading indicates trigger level exceeded

APPENDIX D – GROUNDWATER MONITORING RESULTS

Table D.1 Biannual/Annual Groundwater Monitoring Results 2009 - Field Parameters, Inorganics, Metals

PARAMETER	UNIT	EPA IGV	BH3		BH4		BH5		RD2		RD3*	
			Mar-09	Nov-09	Mar-09	Nov-09	Mar-09	Nov-09	Mar-09	Nov-09	Mar-09	Nov-09
pH	units	≥6.5-≤9.5	7.18	7.22	7.24	7.21	7.25	7.25	7.33	7.29	n/r	7.3
Temperature	°C	25	12.5	10.5	11.7	11.2	12.5	11.9	10.9	11.3	n/r	11.6
Conductivity	µS/cm	1000	12810	13090	14160	14660	10250	10330	4040	3860	n/r	2250
Colour	-	-	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
Odour	-	-	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
Water Level	m	-	1.2	0.5	0.56	0	n/r	0.8	1.08	1	n/r	0.5
Ammonia	NH3-N	0.2	0.02	<0.02	<0.02	<0.02	0.02	<0.02	<0.02	<0.02	n/a	<0.02
BOD	mg/l	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Chloride	Cl mg/l	30	4650	4857	5148	5391	3564	3885	1044	932	n/a	350
Salinity	ppt	-	n/a	14	n/a	16	n/a	10.5	n/a	2.7	n/a	0.9
COD	mg/l	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Dissolved Oxygen	O_2 mg/l	NAC	n/a	7.81	n/a	6.11	n/a	5.89	n/a	7.1	n/a	8.1
Arsenic	As mg/l	0.01	n/a	<0.02	n/a	<0.02	n/a	<0.02	n/a	<0.02	n/a	<0.02
Barium	Ba mg/l	0.1	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boron	B mg/l	1	n/a	0.97	n/a	1.3	n/a	1.1	n/a	0.74	n/a	0.16
Cadmium	Cd mg/l	0.005	n/a	<0.01	n/a	<0.01	n/a	<0.01	n/a	<0.01	n/a	<0.01
Calcium	Ca mg/l	200	n/a	55	n/a	61	n/a	42	n/a	41	n/a	28
Chromium	Cr mg/l	0.03	n/a	<0.01	n/a	<0.01	n/a	<0.01	n/a	<0.01	n/a	<0.01
Copper	Cu mg/l	0.03	n/a	0.01	n/a	0.01	n/a	0.01	n/a	0.04	n/a	0.01
Cyanide	Cn mg/l	0.01	n/a	<0.05	n/a	<0.05	n/a	<0.05	n/a	<0.05	n/a	<0.05
Fluoride	F mg/l	1	n/a	<2.5	n/a	<2.5	n/a	<2.5	n/a	<0.5	n/a	<0.5
Iron	Fe mg/l	0.2	n/a	1.21	n/a	1.08	n/a	1.02	n/a	0.8	n/a	0.1
Lead	Pb mg/l	0.01	n/a	<0.03	n/a	<0.03	n/a	<0.03	n/a	<0.03	n/a	<0.03
Magnesium	Mg mg/l	50	n/a	161	n/a	200	n/a	131	n/a	28	n/a	15
Manganese	Mn mg/l	0.05	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Mercury	Hg mg/l	0.001	n/a	<0.01	n/a	<0.01	n/a	<0.01	n/a	<0.01	n/a	<0.01
Nickel	Ni mg/l	0.02	n/a	0.01	n/a	0.01	n/a	0.01	n/a	0.02	n/a	0.01
Potassium	K mg/l	5	n/a	54	n/a	63	n/a	40	n/a	6	n/a	4
Selenium	Se mg/l	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Sodium	Na mg/l	150	n/a	1421	n/a	1520	n/a	1095	n/a	31	n/a	21
Sulphate	SO_4 mg/l	200	n/a	<2	n/a	<2	n/a	<2	n/a	<2	n/a	60
Tin	Sn mg/l	-	n/a	<0.01	n/a	<0.01	n/a	<0.01	n/a	<0.01	n/a	<0.01
Total Phosphorous/Orthophosphate	P/PO_4 mg/l	0.03	n/a	0.82	n/a	1.47	n/a	1.31	n/a	1.31	n/a	0.026
Total Organic Carbon	C mg/l	NAC	38	230	120	280	20	190	21	170	n/a	170
Total Oxidised Nitrogen (water)	N mg/l	NAC	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	n/a	<0.5
Total Phenols	mg/l	0.0005	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	n/a	<0.1
Zinc	Zn mg/l	0.1	n/a	0.02	n/a	0.02	n/a	0.02	n/a	0.04	n/a	0.01
Detergents	mg/l	-	n/a	<0.002	n/a	<0.002	n/a	<0.002	n/a	<0.002	n/a	<0.002
Residue on evaporation	mg/l	-	n/a	7800	n/a	8500	n/a	7100	n/a	360	n/a	280

IGV = Interim Guideline Value - from the EPA document "Towards Setting Guideline Values for the Protection of Groundwater in Ireland"
Results are shaded where they exceed the EPA IGV
NAC = No abnormal change
n/a = not analysed
n/r = not recorded
Analysis conducted by Q Lab Ltd. on 26th March and 17th November 2009
*Location RD3 contained insufficient water to obtain a sample

Table D.2 Biannual/Annual Groundwater Monitoring Results 2009 - VOC

PARAMETER	UNIT	EPA IGV	Limit of Detection	List I/ List II	BH3	BH4	BH5	RD2	RD3
					Nov-09	Nov-09	Nov-09	Nov-09	Nov-09
1,1,1,2-Tetrachloroethane	µg/l	-		-	n/d	n/d	n/d	n/d	n/d
1,1,1-Trichloroethane	µg/l	500	0.5	I	n/d	n/d	n/d	n/d	n/d
1,1,2,2-Tetrachloroethane	µg/l	-	0.5	-	n/d	n/d	n/d	n/d	n/d
1,1,2-Trichloroethane	µg/l	-	0.5	-	n/d	n/d	n/d	n/d	n/d
1,1-Dichloroethane	µg/l	-		-	n/d	n/d	n/d	n/d	n/d
1,1-Dichloroethene	µg/l	-	0.5	-	n/d	n/d	n/d	n/d	n/d
1,1-Dichloropropene	µg/l	-		-	n/d	n/d	n/d	n/d	n/d
1,2,3-Trichlorobenzene	µg/l	0.4	0.5	I	n/d	n/d	n/d	n/d	n/d
1,2,3-Trichloropropane	µg/l	-	2.0	-	n/d	n/d	n/d	n/d	n/d
1,2,4-Trichlorobenzene	µg/l	0.4	0.5	I	n/d	n/d	n/d	n/d	n/d
1,2,4-Trimethylbenzene	µg/l	-	0.5	-	n/d	n/d	n/d	n/d	n/d
1,2-Dibromo-3-chloropropane	µg/l	-	2.0	-	n/d	n/d	n/d	n/d	n/d
1,2-Dibromoethane	µg/l	-	0.5	-	n/d	n/d	n/d	n/d	n/d
1,2-Dichlorobenzene	µg/l	10	1	I	n/d	n/d	n/d	n/d	n/d
1,2-Dichloroethane	µg/l	3		I	n/d	n/d	n/d	n/d	n/d
1,2-Dichloropropane	µg/l	-	0.1	-	n/d	n/d	n/d	n/d	n/d
1,3,5-Trimethylbenzene	µg/l	-		-	n/d	n/d	n/d	n/d	n/d
1,3-Dichlorobenzene	µg/l	0.01/50*	0.5	I	n/d	n/d	n/d	n/d	n/d
1,3-Dichloropropane	µg/l	-	0.5	-	n/d	n/d	n/d	n/d	n/d
1,4-Dichlorobenzene	µg/l	0.01/50*		I	n/d	n/d	n/d	n/d	n/d
2,2-Dichloropropane	µg/l	-	0.5	-	n/d	n/d	n/d	n/d	n/d
2-Chlorotoluene	µg/l	-	0.5	-	n/d	n/d	n/d	n/d	n/d
4-Chlorotoluene	µg/l	-	0.5	-	n/d	n/d	n/d	n/d	n/d
4-Isopropyltoluene	µg/l	-	0.5	-	n/d	n/d	n/d	n/d	n/d
Acetone	µg/l	-	2.0	-	n/d	n/d	n/d	n/d	n/d
Benzene	µg/l	1	0.1	I	n/d	n/d	n/d	n/d	n/d
Bromobenzene	µg/l	-	0.5	-	n/d	n/d	n/d	n/d	n/d
Bromochloromethane	µg/l	-	0.5	-	n/d	n/d	n/d	n/d	n/d
Bromodichloromethane	µg/l	-	2.0	-	n/d	n/d	n/d	n/d	n/d
Bromomethane	µg/l	-	0.5	-	n/d	n/d	n/d	n/d	n/d
Carbontetrachloride	µg/l	-	1	-	n/d	n/d	n/d	n/d	n/d
Chlorobenzene	µg/l	1	0.5	I	n/d	n/d	n/d	n/d	n/d
Chloroethane	µg/l	-	0.5	-	n/d	n/d	n/d	n/d	n/d
Trichloromethane/Chloroform	µg/l	12	1	I	n/d	n/d	n/d	n/d	n/d
Chloromethane	µg/l	-		-	n/d	n/d	n/d	n/d	n/d
cis-1,2-Dichloroethene	µg/l	30	0.5	II	n/d	n/d	n/d	n/d	n/d
cis-1,3-Dichloropropene	µg/l	-		-	n/d	n/d	n/d	n/d	n/d
Dibromochloromethane	µg/l	-	1	-	n/d	n/d	n/d	n/d	n/d
Dibromomethane	µg/l	-	0.1	-	n/d	n/d	n/d	n/d	n/d
Dichloromethane	µg/l	10	5	II	n/d	n/d	n/d	n/d	n/d
Dichlorofluoromethane	µg/l	-	10	II	n/d	n/d	n/d	n/d	n/d
Dichlorodifluoromethane	µg/l	-		-	n/d	n/d	n/d	n/d	n/d
Ethylbenzene	µg/l	10	0.5	II	n/d	n/d	n/d	n/d	n/d
Ethyl ether	µg/l	-	0.5	-	n/d	n/d	n/d	n/d	n/d
Hexachlorobutadiene	µg/l	0.1	0.5	I	n/d	n/d	n/d	n/d	n/d
Isopropylbenzene	µg/l	-	0.6	-	n/d	n/d	n/d	n/d	n/d
Methyl tert-butyl ether (MTBE)	µg/l	-	0.5	-	n/d	n/d	n/d	n/d	n/d
Naphthalene	µg/l	1	2	II	n/d	n/d	n/d	n/d	n/d
n-Butylbenzene	µg/l	-	0.5	-	n/d	n/d	n/d	n/d	n/d
Nitrobenzene	µg/l	-	0.5		n/d	n/d	n/d	n/d	n/d
o-Xylene	µg/l	-	0.5		n/d	n/d	n/d	n/d	n/d
m/p-Xylene	µg/l	10	0.5	II	n/d	n/d	n/d	n/d	n/d
Propylbenzene	µg/l	-	0.5	-	n/d	n/d	n/d	n/d	n/d
sec-Butylbenzene	µg/l	-	0.5	-	n/d	n/d	n/d	n/d	n/d
Styrene	µg/l	0.5/300*	2.0	-	n/d	n/d	n/d	n/d	n/d
tert-Butylbenzene	µg/l	-	0.5	-	n/d	n/d	n/d	n/d	n/d
Tetrachloroethene	µg/l	40	0.1	I	n/d	n/d	n/d	n/d	n/d
Tetrahydrofuran	µg/l	-	5.0	-	n/d	n/d	n/d	n/d	n/d
Toluene	µg/l	10		I	n/d	n/d	n/d	n/d	n/d
trans-1,2-Dichloroethene	µg/l	30		II	n/d	n/d	n/d	n/d	n/d
trans-1,3-Dichloropropene	µg/l	30	2	II	n/d	n/d	n/d	n/d	n/d
Trichloroethene	µg/l	70		II	n/d	n/d	n/d	n/d	n/d
Trichlorofluoromethane	µg/l	-		-	n/d	n/d	n/d	n/d	n/d
Trichloroethylene	µg/l	10		I	n/d	n/d	n/d	n/d	n/d
Vinyl Chloride/Chloroethene	µg/l	0.7*	0.5	-	n/d	n/d	n/d	n/d	n/d

IGV = Interim Guideline Value - from the EPA document "Towards Setting Guideline Values for the Protection of Groundwater in Ireland"
Results are shaded where they exceed the EPA IGV
NAC = No abnormal change
n/d = not detected
Analysis conducted by Q Lab Ltd. on 17th November 2009

Table D.3 Biannual/Annual Groundwater Monitoring Results 2009 - SVOC

PARAMETER	UNIT	EPA IGV	Limit of Detection	List I/ List II	BH3 Nov-09	BH4 Nov-09	BH5 Nov-09	RD2 Nov-09	RD3 Nov-09
1,3-Dichlorobenzene	µg/l	-	0.5	-	n/d	n/d	n/d	n/d	n/d
1,4-Dichlorobenzene	µg/l	-	0.5	I	n/d	n/d	n/d	n/d	n/d
1,2-Dichlorobenzene	µg/l	10	0.5	I	n/d	n/d	n/d	n/d	n/d
1,2,4-Trichlorobenzene	µg/l	-	0.5	-	n/d	n/d	n/d	n/d	n/d
Acenaphthylene	µg/l	-	0.01	-	n/d	n/d	n/d	n/d	n/d
Acenaphthene	µg/l	-	0.01	-	n/d	n/d	n/d	n/d	n/d
Anthracene	µg/l	10000	0.01	II	n/d	n/d	n/d	n/d	n/d
Benzo(b)fluoranthene	µg/l	0.5	0.01	II	n/d	n/d	n/d	n/d	n/d
Benzo(k)fluoranthene	µg/l	0.1	0.01	II	n/d	n/d	n/d	n/d	n/d
Benzo(a)pyrene	µg/l	0.0	0.01	II	n/d	n/d	n/d	n/d	n/d
Benzo(ghi)perylene	µg/l	0.1	0.01	II	n/d	n/d	n/d	n/d	n/d
Chrysene	µg/l	-	0.01	-	n/d	n/d	n/d	n/d	n/d
Dibenzo(ah)anthracene	µg/l	-	0.01	-	n/d	n/d	n/d	n/d	n/d
Fluorene	µg/l	-	0.01	-	n/d	n/d	n/d	n/d	n/d
Fluoranthene	µg/l	1	0.01	II	n/d	n/d	n/d	n/d	n/d
Hexachloroethane	µg/l	-	5	-	n/d	n/d	n/d	n/d	n/d
Hexachlorobutadiene	µg/l	-	0.5	-	n/d	n/d	n/d	n/d	n/d
Indeno(123-cd)pyrene	µg/l	0.1	0.01	II	n/d	n/d	n/d	n/d	n/d
Nitrobenzene	µg/l	10	0.5	II	n/d	n/d	n/d	n/d	n/d
Naphthalene	µg/l	-	0.01	II	n/d	n/d	n/d	n/d	n/d
Phenanthrene	µg/l	-	0.01	-	n/d	n/d	n/d	n/d	n/d
Pyrene	µg/l	-	0.01	-	n/d	n/d	n/d	n/d	n/d

IGV = Interim Guideline Value - from the EPA document "Towards Setting Guideline Values for the Protection of Groundwater in Ireland"
Results are shaded where they exceed the EPA IGV
NAC = No abnormal change
n/a = not analysed
n/d = not detected
Analysis conducted by Q Lab Ltd. on 17th November 2009

Table D.4 Biannual/Annual Groundwater Monitoring Results 2009 - Pesticides Herbicides

PARAMETER	UNIT	EPA IGV	Limit of Detection	BH3	BH4	BH5	RD2	RD3
				Nov-09	Nov-09	Nov-09	Nov-09	Nov-09
Organochlorine Pesticides								
Aldrin	µg/l	20	0.01	n/d	n/d	n/d	n/d	n/d
Dieldrin	µg/l	0.01	0.01	n/d	n/d	n/d	n/d	n/d
Heptachlor	µg/l	-	0.01	n/d	n/d	n/d	n/d	n/d
Heptachlor Epoxide	µg/l	-	0.01	n/d	n/d	n/d	n/d	n/d
Chlorinated Pesticides								
alpha-BHC	µg/l	0.1	0.01	n/d	n/d	n/d	n/d	n/d
beta-BHC	µg/l	0.1	0.01	n/d	n/d	n/d	n/d	n/d
gamma-BHC (Lindane)	µg/l	0.1	0.01	n/d	n/d	n/d	n/d	n/d
delta-BHC	µg/l	0.1	0.01	n/d	n/d	n/d	n/d	n/d
Endosulphan A	µg/l	0.001	0.01	n/d	n/d	n/d	n/d	n/d
Endosulphan B	µg/l	-	0.01	n/d	n/d	n/d	n/d	n/d
Endrin	µg/l	-	0.01	n/d	n/d	n/d	n/d	n/d
HCB	µg/l	-	0.01	n/d	n/d	n/d	n/d	n/d
HCBD	µg/l	-	0.01	n/d	n/d	n/d	n/d	n/d
Isodrin	µg/l	-	0.01	n/d	n/d	n/d	n/d	n/d
o,p-DDE	µg/l	-	0.01	n/d	n/d	n/d	n/d	n/d
p,p-DDE	µg/l	-	0.01	n/d	n/d	n/d	n/d	n/d
o,p-DDT	µg/l	-	0.01	n/d	n/d	n/d	n/d	n/d
p,p-DDT	µg/l	-	0.01	n/d	n/d	n/d	n/d	n/d
Organophosphorus Pesticides								
Thioazin	µg/l	-	0.01	n/d	n/d	n/d	n/d	n/d
Dimethoate	µg/l	-	0.01	n/d	n/d	n/d	n/d	n/d
Parathion	µg/l	-	0.01	n/d	n/d	n/d	n/d	n/d
Triethyl phosphorothioate	µg/l	-	0.01	n/d	n/d	n/d	n/d	n/d
Methyl Parathion	µg/l	-	0.01	n/d	n/d	n/d	n/d	n/d
Famphur	µg/l	-	0.01	n/d	n/d	n/d	n/d	n/d
Triazines (Herbicides)								
Atrazine	µg/l	1	0.01	n/d	n/d	n/d	n/d	n/d
Simazine	µg/l	1	0.01	n/d	n/d	n/d	n/d	n/d
Acid Herbicides								
2,4-D	µg/l	-	0.01	n/d	n/d	n/d	n/d	n/d
Dalapon	µg/l	-	0.01	n/d	n/d	n/d	n/d	n/d
2,4-DB	µg/l	-	0.01	n/d	n/d	n/d	n/d	n/d
Dichloroprop	µg/l	-	0.01	n/d	n/d	n/d	n/d	n/d
Dinoseb	µg/l	-	0.01	n/d	n/d	n/d	n/d	n/d
Pentachlorophenol	µg/l	-	0.01	n/d	n/d	n/d	n/d	n/d
2,4,5-T	µg/l	-	0.01	n/d	n/d	n/d	n/d	n/d

IGV = Interim Guideline Value - from the EPA document "Towards Setting Guideline Values for the Protection of Groundwater in Ireland"
Results are shaded where they exceed the EPA IGV
n/d = not detected
Analysis conducted by Q Lab Ltd. on 17th November 2009

APPENDIX E – LEACHATE MONITORING RESULTS AND PUMPING DATA

Table E.1 Biannual/Annual Leachate Monitoring Results 2009

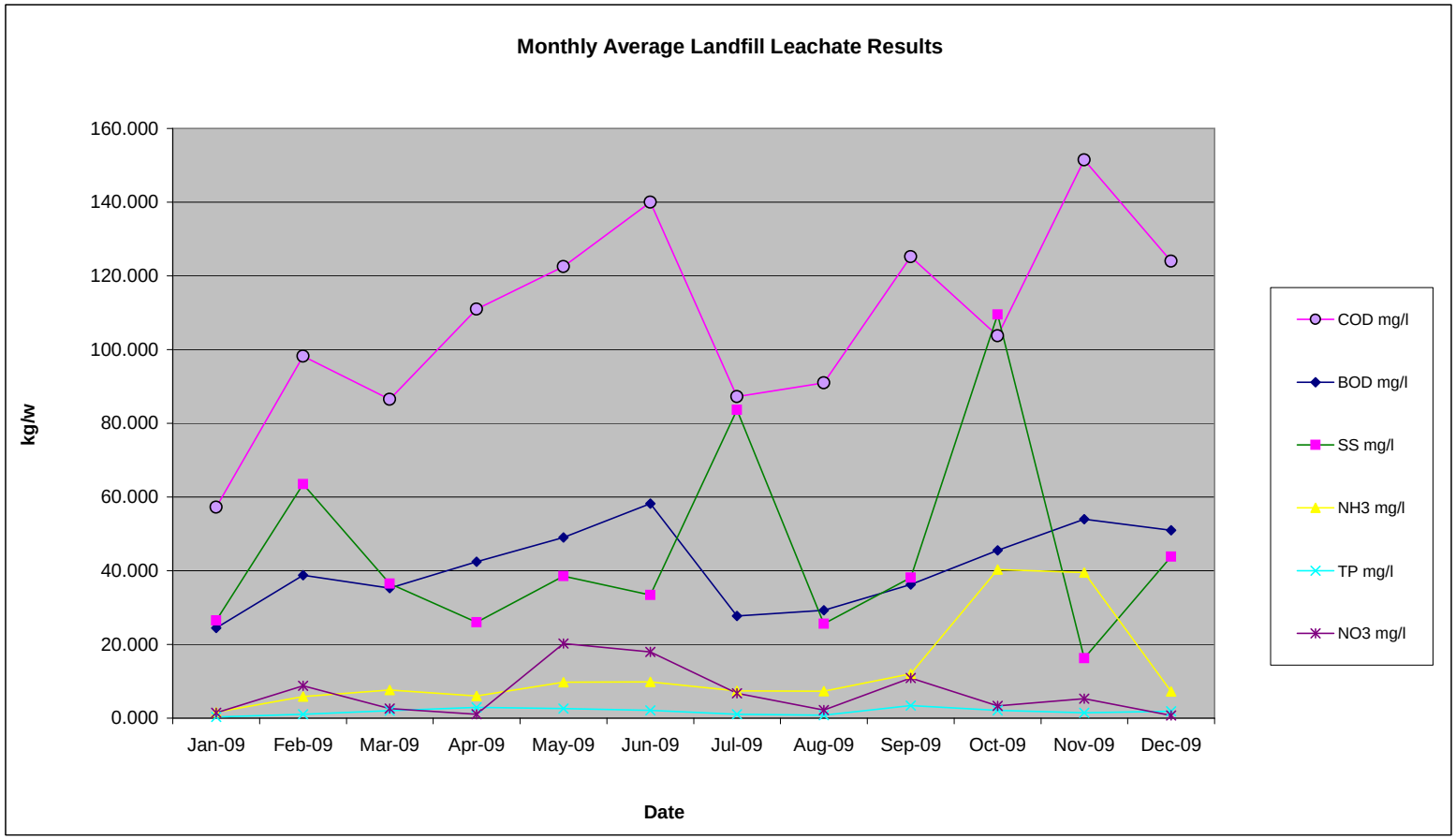
PARAMETER	UNIT	EPA IGV	SS3 2009		SS3 2008		SS3 2007		SS3 2006		SS3 2005		SS3 2004	
			Mar-09	Nov-09	Sep-08	Dec-08	Jun-07	Nov-07	Aug-06	Dec-06	Aug-05	Dec-05	Mar-04	Dec-04
pH	units	≥6.5-≤9.5	6.79	7.03	7.4	7	n/r	6.7	6.9	7.16	6.98	6.89	6.53	6.79
Temperature	°C	25	11	12.7	13	7	n/r	n/r	18	12.9	11.8	11	10	11.2
Ammonia (as NH4)	NH_3-N mg/l	0.15	0.06	8	<0.1	1.2	n/a	9.5	5.5	3.5	7	9	1.7	<0.01
Odour	-	-	n/r	n/r	None	None	None	None	None	None	None	None	Slight odour	n/r
Colour	-	NAC	n/r	n/r	Slightly Yellow	Yellow	Cloudy	Cloudy	Slightly Yellow	Yellow	Clear/Straw	Clear/Straw	Turbid/ Brown	n/r
COD	mg/l	-	130	75	44	37	93	187	79	215	90	130	54	85
BOD	mg/l	-	5.4	7.5	<2	11	4	6	7.25	26.75	5	40	20	<1
Detergents (as MBAS)	mg/l	-	n/a	<0.001	n/a	n/a	0.21	n/a	n/a	0.011	0.012	n/a	0.036	n/a
Electrical Conductivity	µS/cm	1000	1581	1252	827	n/a	n/a	1822	1269	870	2030	1413	1277	2030
Suspended Solids	mg/l	-	n/a	n/a	41	22	n/a	80	n/a	n/a	n/a	n/a	n/a	n/a
Sulphate	SO_4 mg/l	200	n/a	94	n/a	n/a	220	n/a	n/a	225	65.52	n/a	534.8	n/a
Total Phosphorous	P mg/l	-	n/a	0.88	3.2	n/a	n/a	n/a	n/a	0.5	0.06	n/a	0.25	n/a
Total Oxidised Nitrogen	N mg/l	NAC	9.9	32.1	<0.46	0.6	<0.2	<0.17	59	2.37	2	3.1	10.16	n/a
Chloride	Cl mg/l	30	102	29	24	29	95	170	326	326	n/a	n/a	107.34	95
Total Organic Carbon	C mg/l	NAC	n/a	n/a	n/a	n/a	n/a	n/a	99	99	n/a	n/a	n/a	n/a
Arsenic	As mg/l	0.01	n/a	<0.02	n/a	n/a	0.001	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boron	B mg/l	1	n/a	0.04	n/a	n/a	0.1	n/a	n/a	1.59	0.196	n/a	0.274	n/a
Cadmium	Cd mg/l	0.005	n/a	<0.01	n/a	n/a	<0.03	n/a	n/a	<0.0035	<0.0035	n/a	<0.0035	n/a
Calcium	Ca mg/l	200	n/a	120	n/a	n/a	235	n/a	n/a	193.1	260	n/a	209.85	n/a
Chromium	Cr mg/l	0.03	n/a	<0.01	n/a	n/a	<0.05	n/a	n/a	0.02	<0.01	n/a	0.012	n/a
Copper	Cu mg/l	0.03	n/a	0.02	n/a	n/a	<0.05	n/a	n/a	0.026	<0.015	n/a	<0.015	n/a
Cyanide	Cn mg/l	0.01	n/a	<0.05	n/a	n/a	<0.01	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Iron	Fe mg/l	0.2	n/a	3.2	n/a	n/a	1.57	n/a	n/a	4.718	33.53	n/a	0.013	n/a
Lead	Pb mg/l	0.01	n/a	<0.03	n/a	n/a	<0.2	n/a	n/a	0.006	<0.049	n/a	<0.002	n/a
Magnesium	Mg mg/l	50	n/a	20	n/a	n/a	36	n/a	n/a	26.44	51.79	n/a	43.6	n/a
Mercury	Hg mg/l	0.001	n/a	<0.01	n/a	n/a	<0.02	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Nickel	Ni mg/l	0.02	n/a	0.07	n/a	n/a	0.12	n/a	n/a	0.126	0.117	n/a	0.288	n/a
Potassium	K mg/l	5	n/a	8	n/a	n/a	7	n/a	n/a	8.6	9.93	n/a	9.47	n/a
Sodium	Na mg/l	150	n/a	31	n/a	n/a	56	n/a	n/a	60.37	123.3	n/a	72.42	n/a
Zinc	Zn mg/l	0.1	n/a	0.1	n/a	n/a	0.04	n/a	n/a	0.176	0.04	n/a	0.078	n/a
Diesel Range Organics (DRO)	mg/l	0.01	n/a	n/a	n/a	n/a	n/a	<0.01	n/a	n/a	n/a	n/a	n/a	n/a
List I organics	mg/l	0.01	n/a	n/a	n/a	n/a	<0.01	n/a	n/a	<0.001	n/a	n/a	<0.01	n/a
List II organics	mg/l	0.01	n/a	n/a	n/a	n/a	<0.01	n/a	n/a	<0.001	n/a	n/a	<0.01	n/a

IGV = Interim Guidleine Value - from the EPA document "*Towards Setting Guideline Values for the Protection of Groundwater in Ireland*"
Results are shaded where they exceed the EPA IGV
NAC = No abnormal change
n/a = not analysed
n/r = not recorded
Analysis conducted by Q Lab Ltd. on 26th March & 17th November 2009

Leachate Results

Monthly Average Landfill Leachate Results

Date	Flow	COD	BOD	SS	NH3	TP	NO3	COD	BOD	SS	NH3	TP	NO3
	m3/week	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	kg/Week	kg/Week	kg/Week	kg/Week	kg/Week	kg/Week
Jan-09	3838.124	57.250	24.500	26.500	1.638	0.343	1.450	204.176	87.726	94.097	6.716	1.213	6.464
Feb-09	1728.000	98.250	38.750	63.500	5.875	1.050	8.775	102.457	29.916	166.377	6.515	0.348	26.778
Mar-09	1476.250	86.500	35.250	36.500	7.625	2.018	2.625	111.775	44.199	64.507	10.446	2.449	4.674
Apr-09	2721.151	111.000	42.400	26.000	6.000	2.900	1.040	369.621	144.561	83.882	23.803	5.546	3.258
May-09	705.250	122.500	49.000	38.500	9.750	2.575	20.275	80.892	33.061	25.493	6.590	1.311	12.269
Jun-09	2616.250	140.000	58.250	33.375	9.813	2.125	17.950	371.178	144.405	136.198	36.253	5.477	76.921
Jul-09	94.026	87.250	27.750	83.625	7.375	1.018	6.775	7.095	2.286	6.182	0.578	0.071	0.465
Aug-09	5636.189	91.000	29.250	25.625	7.313	0.825	2.175	441.330	141.126	119.327	23.909	2.575	7.270
Sep-09	4686.364	125.200	36.250	38.100	12.000	3.420	10.880	549.440	149.458	192.585	49.558	14.418	57.678
Oct-09	3774.000	103.750	45.500	109.500	40.313	2.075	3.350	319.325	138.225	298.498	32.677	5.552	9.789
Nov-09	748.500	151.500	54.000	16.250	39.500	1.500	5.250	119.500	41.108	21.510	38.001	1.530	5.640
Dec-09	441.000	124.000	51.000	43.833	7.250	1.900	0.733	57.177	23.740	18.847	3.298	0.823	0.324
Average	**2,372.1**	**108.2**	**41.0**	**45.1**	**12.9**	**1.8**	**6.8**	**227.8**	**81.7**	**102.3**	**19.9**	**3.4**	**17.6**
TOTAL	**28,465.1**	**1,298.2**	**491.9**	**541.3**	**154.5**	**21.7**	**81.3**	**2,734.0**	**979.8**	**1,227.5**	**238.3**	**41.3**	**211.5**


Monthly Average Landfill Leachate Results
160.000
140.000
120.000
100.000
80.000
60.000
40.000
20.000
0.000
kg/w
Jan-09
Feb-09
Mar-09
Apr-09
May-09
Jun-09
Jul-09
Aug-09
Sep-09
Oct-09
Nov-09
Dec-09
Date
COD mg/l
BOD mg/l
SS mg/l
NH3 mg/l
TP mg/l
NO3 mg/l

APPENDIX F – SURFACE WATER MONITORING RESULTS

Table F.1 Biannual/Annual Surface Water Monitoring Results 2009

PARAMETER	UNIT	Threshold/AA-EQS/MAC-EQS	SS1		SS2		SS4		SS6		SS7*	
			Mar-09	Nov-09	Mar-09	Nov-09	Mar-09	Nov-09	Mar-09	Nov-09	Mar-09	Nov-09
pH	units	Hard water 6-9	8.13	7.45	8.15	7.56	8.17	7.33	8.18	7.61	n/r	n/r
Temperature	°C	<1.5°rise	9	9.9	9.7	10.7	9.2	11.9	9.5	10.3	n/r	n/r
Conductivity	µS/cm	1000	n/r	500	n/r	250	n/r	528	n/r	540	n/r	563
Suspended Solids	mg/l	-	6	2	2	16	2	4	120	36	n/a	n/a
Colour	-	NAC	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	n/r	n/r
Odour	-	NAC	None	None	None	None	None	None	None	None	n/r	n/r
Ammonia	NH3-N	-	<0.02	<0.02	0.03	<0.02	0.02	<0.02	<0.02	<0.02	n/r	n/a
Total Phosphorous	P mg/l	0.06 (molybdate reactive phosphorus)**	n/a	0.02	n/a	<0.02	n/a	<0.02	n/a	0.03	n/a	0.03
Total Organic Carbon	C mg/l	NAC	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Total Oxidised Nitrogen	N mg/l	NAC	n/a	1.1	n/a	1	n/a	0.7	n/a	<0.5	n/a	1.1
Total Phenols	mg/l	AA-EQS 0.008 MAC-EQS 0.046	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
BOD	mg/l	≤4 (95%ile)	1	2.5	0.8	<0.5	0.9	1.8	1.5	<0.5	n/a	n/a
COD	mg/l	-	<3	16	3	58	5	21	41	33	n/a	n/a
Oxygen Saturation	O_2 %	70-120% (95%ile) (summer)	82	21	78	27	80	68	76	22	n/a	n/a
Sodium	Na mg/l	-	n/a	15	n/a	17	n/a	20	n/a	16	n/a	21
Calcium	Ca mg/l	-	n/a	77	n/a	35	n/a	75	n/a	39	n/a	72
Chromium	Cr mg/l	CrVI: AA-EQS 0.0006 MAC-EQS 0.032	n/a	<0.01	n/a	<0.01	n/a	<0.01	n/a	<0.01	n/a	<0.01
Copper	Cu mg/l	AA-EQS 0.005	n/a	0.02	n/a	0.02	n/a	<0.01	n/a	0.03	n/a	0.03
Fluoride	F mg/l	AA-EQS 1.5	n/a	0.1	n/a	0.1	n/a	0.12	n/a	0.1	n/a	0.11
Iron	Fe mg/l	-	n/a	<0.02	n/a	<0.02	n/a	0.03	n/a	0.02	n/a	0.03
Lead	Pb mg/l	AA-EQS 0.0072 MAC-EQS n/a	n/a	<0.03	n/a	<0.03	n/a	<0.03	n/a	<0.03	n/a	<0.03
Magnesium	Mg mg/l	-	n/a	10	n/a	5	n/a	14	n/a	7	n/a	16
Manganese	Mn mg/l	-	n/a	0.012	n/a	0.011	n/a	0.018	n/a	0.019	n/a	0.007
Cadmium	Cd mg/l	-	n/a	<0.01	n/a	<0.01	n/a	<0.01	n/a	<0.01	n/a	<0.01
Potassium	K mg/l	-	n/a	4	n/a	4	n/a	5	n/a	4	n/a	5
Sulphates	SO4 mg/l	-	n/a	52	n/a	18	n/a	98	n/a	78	n/a	60
Zinc	Zn mg/l	AA-EQS 0.04	n/a	0.03	n/a	0.02	n/a	0.02	n/a	0.02	n/a	0.03
Cyanide	Cn mg/l	AA-EQS 0.01	n/a	<0.05	n/a	<0.05	n/a	<0.05	n/a	<0.05	n/a	<0.05
Arsenic	As mg/l	AA-EQS 0.02	n/a	<0.02	n/a	<0.02	n/a	<0.02	n/a	<0.02	n/a	<0.02
Boron	B mg/l	-	n/a	0.04	n/a	0.01	n/a	0.05	n/a	0.04	n/a	0.04
Mercury	Hg mg/l	-	n/a	<0.01	n/a	<0.01	n/a	<0.01	n/a	<0.01	n/a	<0.01
Tin	Sn mg/l	-	n/a	<0.01	n/a	<0.01	n/a	<0.01	n/a	<0.01	n/a	<0.01
Nickel	Ni mg/l	AA-EQS 0.02	n/a	<0.01	n/a	0.02	n/a	0.01	n/a	<0.01	n/a	<0.01

AA-EQS: Annual Average Environmental Quality Standard
MAC-EQS: Maximum Admissible Concentration Environmental Quality Standard
Thresholds, AA-EQS's & MAC-EQS's taken from the Surface Water Quality Regulations SI 272 of 2009 for transitional waters
Results are shaded where they exceed the relevant Threshold/AA-EQS/MAC-EQS
NAC = No abnormal change
n/a = not analysed
n/r = not recorded
Analysis conducted by Q Lab Ltd. on 26th March & 17th November 2009
*Location SS7 was dry at the time of sampling in March 2009
** value is for molybdate reactive phosphorus and used as guidance, values for total phosphorus have not yet been derived.

APPENDIX G – COPIES OF LABORATORY REPORTS

Q LAB LTD
Quality Systems and Laboratory Services

P.O. Box 27,
Strandfield Business Park,
Rosslare Road,
Wexford.
Tel: 053 914 5600
Fax: 053 918 4575
E.mail: info@qlab.ie

Test Report

Customer: Response Group
Railway Road
Charleville
Co. Cork

Account.: 9778

Report No.: 44225
Report Date: 14/04/2009
Received Date: 27/03/2009
Analysis Date: 26/03/2009
Order No.:
Page: 1 of 1
RevisionDate:

Sample ID: 67440

Description: Groundwater BH3, at Tradaree Sludge Facility taken 26.03.09

	ID	Test	SOP	Results
☐	67440	Phenols, ug/l	Subcontracted	<0.1
☐	67440	Total Organic Carbon mg/l	Subcontracted	38
☐	67440	Total Oxidised Nitrogen, mg/l	STM-C-30.1.0	<0.5
☐	67440	Temperature, °C	STM-C-41.1.0	12.5
☑	67440	pH value	STM-C-3.1.00	7.18
☑	67440	Conductivity, uS/cm @ 20°C	STM-C-4.1.00	12810
☑	67440	Chloride as Cl, mg/L	STM-C-5.1.00	4650
☐	67440	Ammonia as NH3-N, mg/l	STM-C-7.2.04	0.02
☐	67440	Groundwater level m	Subcontracted	1.2m

Comments:

Report Authorised By: Peter O'Byrne Peter O'Byrne Chem. Lab. Manager

Results relate only to Items Tested. Report must not be reproduced except in full without prior consultation.

☑ ***Indicates Accredited Test. Opinions and Comments are not included in the scope of Accreditation***

ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.0891

Q LAB LTD
Quality Systems and Laboratory Services

P.O. Box 27,
Strandfield Business Park,
Rosslare Road,
Wexford.
Tel: 053 914 5600
Fax: 053 918 4575
E.mail: info@qlab.ie

Test Report

Customer: Response Group
Railway Road
Charleville
Co. Cork

Account.: 9778

Report No.: 44226
Report Date: 14/04/2009
Received Date: 27/03/2009
Analysis Date: 26/03/2009
Order No.:
Page: 1 of 1
RevisionDate:

Sample ID: 67441

Description: Groundwater BH4, at Tradaree Sludge Facility taken 26.03.09

	ID	*Test*	*SOP*	*Results*
☐	67441	Phenols, ug/l	Subcontracted	<0.1
☐	67441	Total Organic Carbon mg/l	Subcontracted	120
☐	67441	Total Oxidised Nitrogen, mg/l	STM-C-30.1.0	<0.5
☐	67441	Temperature, °C	STM-C-41.1.0	11.7
☑	67441	pH value	STM-C-3.1.00	7.24
☑	67441	Conductivity, uS/cm @ 20°C	STM-C-4.1.00	14160
☑	67441	Chloride as Cl, mg/L	STM-C-5.1.00	5148
☐	67441	Ammonia as NH3-N, mg/l	STM-C-7.2.04	<0.02
☐	67441	Groundwater level m	Subcontracted	0.56m

Comments:

Report Authorised By: Peter O'Byrne Peter O'Byrne Chem. Lab. Manager

☑ ***Indicates Accredited Test. Opinions and Comments are not included in the scope of Accreditation***

ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.0897

QLAB LTD
Quality Systems and Laboratory Services

P.O. Box 27,
Strandfield Business Park,
Rosslare Road,
Wexford.
Tel: 053 914 5600
Fax: 053 918 4575
E.mail: info@qlab.ie

Test Report

Customer: Response Group
Railway Road
Charleville
Co. Cork

Account.: 9778

Report No.: 44227
Report Date: 14/04/2009
Received Date: 27/03/2009
Analysis Date: 26/03/2009
Order No.:
Page: 1 of 1
RevisionDate:

Sample ID: 67442

Description: Groundwater BH5, at Tradaree Sludge Facility taken 26.03.09

	ID	*Test*	*SOP*	*Results*
☐	67442	Phenols, ug/l	Subcontracted	<0.1
☐	67442	Total Organic Carbon mg/l	Subcontracted	20
☐	67442	Total Oxidised Nitrogen, mg/l	STM-C-30.1.0	<0.5
☐	67442	Temperature, °C	STM-C-41.1.0	12.5
☑	67442	pH value	STM-C-3.1.00	7.25
☑	67442	Conductivity, uS/cm @ 20°C	STM-C-4.1.00	10250
☑	67442	Chloride as Cl, mg/L	STM-C-5.1.00	3564
☐	67442	Ammonia as NH3-N, mg/l	STM-C-7.2.04	0.02
☐	67442	Groundwater level m	Subcontracted	0.8m

Comments:

Report Authorised By: Peter O'Byrne Peter O'Byrne Chem. Lab. Manager

Results relate only to Items Tested. Report must not be reproduced except in full without prior consultation.

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Quality Systems and Laboratory Services

P.O. Box 27,
Strandfield Business Park,
Rosslare Road,
Wexford.
Tel: 053 914 5600
Fax: 053 918 4575
E.mail: info@qlab.ie

Test Report

Customer: Response Group
Railway Road
Charleville
Co. Cork

Account.: 9778

Report No.: 44224
Report Date: 14/04/2009
Received Date: 27/03/2009
Analysis Date: 26/03/2009
Order No.:
Page: 1 of 1
RevisionDate:

Sample ID: 67439

Description: Groundwater RD2, at Tradaree Sludge Facility taken 26.03.09

	ID	*Test*	*SOP*	*Results*
☐	67439	Phenols, ug/l	Subcontracted	<0.1
☐	67439	Total Organic Carbon mg/l	Subcontracted	21
☐	67439	Total Oxidised Nitrogen, mg/l	STM-C-30.1.0	<0.5
☐	67439	Temperature, °C	STM-C-41.1.0	10.9
☑	67439	pH value	STM-C-3.1.00	7.33
☑	67439	Conductivity, uS/cm @ 20°C	STM-C-4.1.00	4040
☑	67439	Chloride as Cl, mg/L	STM-C-5.1.00	1044
☐	67439	Ammonia as NH3-N, mg/l	STM-C-7.2.04	<0.02
☐	67439	Groundwater level m	Subcontracted	1.08m

Comments:

Report Authorised By: Peter O'Byrne Peter O'Byrne Chem. Lab. Manager

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Report No.: 52003
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Sample ID: 77707

Description: Borehole Water (BH3) taken 16.11.09 at Shannon Landfill

Ref No:

	ID	Test	SOP	Results
☐	77707	Phenols, ug/l	Subcontracted	<0.1
☐	77707	Total Organic Carbon mg/l	Subcontracted	230
☐	77707	Total Oxidised Nitrogen, mg/l	STM-C-30.1.0	<0.5
☐	77707	Temperature, °C	STM-C-41.1.0	10.5
☑	77707	pH value	STM-C-3.1.00	7.22
☑	77707	Conductivity, uS/cm @ 20°C	STM-C-4.1.00	13090
☑	77707	Chloride as Cl, mg/L	STM-C-5.2.07	4857
☐	77707	Ammonia as NH3-N, mg/l	STM-C-7.2.04	<0.02
☐	77707	Groundwater level m	Subcontracted	0.5

Comments:

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RevisionDate:

Sample ID: 77712

Description: Borehole Water (BH3) taken 16.11.09 at Shannon Landfill

Ref No:

	ID	*Test*	*SOP*	*Results*
☐	77712	Zinc as Zn mg/l	Subcontracted	0.02
☐	77712	Calcium as Ca, mg/l	STM-C-22.1.0	55
☐	77712	Chromium as Cr mg/l	Subcontracted	<0.01
☐	77712	Copper as Cu mg/l	Subcontracted	0.01
☐	77712	Fluoride as F, mg/l	Subcontracted	<2.5
☑	77712	Iron as Fe, mg/l	STM-C-34.2.0	1.21
☐	77712	Lead as Pb, mg/l	Subcontracted	<0.03
☐	77712	Magnesium as Mg, mg/l	STM-C-23.1.0	161
☐	77712	Nickel as Ni mg/l	Subcontracted	0.01
☐	77712	Potassium as K, mg/l	STM-C-32.1.0	54
☐	77712	Cadmium as Cd mg/l	Subcontracted	<0.01
☐	77712	Sulphates as SO4, mg/l	STM-C-18.2.0	<2
☐	77712	List 1/11 Organic Substances ug/l	Subcontracted	Not Detected
☐	77712	Cyanide mg/l	Subcontracted	<0.05
☐	77712	Residue on Evaporation mg/l	STM-C-47.1.0	7800
☐	77712	Arsenic as As mg/l	Subcontracted	<0.02
☐	77712	Boron as B mg/l	Subcontracted	0.97
☐	77712	Mercury as Hg mg/l	Subcontracted	<0.01
☐	77712	Tin mg/l	Subcontracted	<0.01
☐	77712	Dissolved oxygen, mg/l	STM-C-10.3.0	7.81
☐	77712	Detergents as MBAS mg/l	Subcontracted	<0.002
☐	77712	Total Phosphorous as P, mg/l	STM-C-19.2.0	0.82

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☐	77712	Salinity		14.0
☐	77712	Sodium as Na, mg/l	STM-C-33.1.0	1421

Comments:

Report Authorised By:

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Report No.: 52004
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Sample ID: 77708

Description: Borehole Water (BH4) taken 16.11.09 at Shannon Landfill

Ref No:

	ID	Test	SOP	Results
☐	77708	Phenols, ug/l	Subcontracted	<0.1
☐	77708	Total Organic Carbon mg/l	Subcontracted	280
☐	77708	Total Oxidised Nitrogen, mg/l	STM-C-30.1.0	<0.5
☐	77708	Temperature, °C	STM-C-41.1.0	11.2
☑	77708	pH value	STM-C-3.1.00	7.21
☑	77708	Conductivity, uS/cm @ 20°C	STM-C-4.1.00	14660
☑	77708	Chloride as Cl, mg/L	STM-C-5.2.07	5391
☐	77708	Ammonia as NH3-N, mg/l	STM-C-7.2.04	<0.02
☐	77708	Groundwater level m	Subcontracted	0.0

Comments:

Report Authorised By: Peter O'Byrne Peter O'Byrne Chem. Lab. Manager

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Order No.:
Page: 1 of 2
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Sample ID: 77713

Description: Borehole Water (BH4) taken 16.11.09 at Shannon Landfill

Ref No:

	ID	Test	SOP	Results
☐	77713	Mercury as Hg mg/l	Subcontracted	<0.01
☐	77713	Lead as Pb, mg/l	Subcontracted	<0.03
☐	77713	Magnesium as Mg, mg/l	STM-C-23.1.0	200
☐	77713	Nickel as Ni mg/l	Subcontracted	0.01
☐	77713	Potassium as K, mg/l	STM-C-32.1.0	63
☐	77713	Sodium as Na, mg/l	STM-C-33.1.0	1520
☐	77713	Sulphates as SO4, mg/l	STM-C-18.2.0	<2
☐	77713	Zinc as Zn mg/l	Subcontracted	0.02
☐	77713	Cyanide mg/l	Subcontracted	<0.05
☐	77713	Residue on Evaporation mg/l	STM-C-47.1.0	8500
☑	77713	Iron as Fe, mg/l	STM-C-34.2.0	1.08
☐	77713	Boron as B mg/l	Subcontracted	1.3
☐	77713	Fluoride as F, mg/l	Subcontracted	<2.5
☐	77713	Tin mg/l	Subcontracted	<0.01
☐	77713	Dissolved oxygen, mg/l	STM-C-10.3.0	6.11
☐	77713	Detergents as MBAS mg/l	Subcontracted	<0.002
☐	77713	Total Phosphorous as P, mg/l	STM-C-19.2.0	1.47
☐	77713	Salinity		16.0
☐	77713	List 1/11 Organic Substances ug/l	Subcontracted	Not Detected
☐	77713	Cadmium as Cd mg/l	Subcontracted	<0.01
☐	77713	Calcium as Ca, mg/l	STM-C-22.1.0	61
☐	77713	Chromium as Cr mg/l	Subcontracted	<0.01

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☐	77713	Copper as Cu mg/l	Subcontracted	0.01
☐	77713	Arsenic as As mg/l	Subcontracted	<0.02

Comments:

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Report No.: 52005
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Sample ID: 77709

Description: Borehole Water (BH5) taken 16.11.09 at Shannon Landfill

Ref No:

	ID	Test	SOP	Results
☐	77709	Phenols, ug/l	Subcontracted	<0.1
☐	77709	Total Organic Carbon mg/l	Subcontracted	190
☐	77709	Total Oxidised Nitrogen, mg/l	STM-C-30.1.0	<0.5
☐	77709	Temperature, °C	STM-C-41.1.0	11.9
☑	77709	pH value	STM-C-3.1.00	7.25
☑	77709	Conductivity, uS/cm @ 20°C	STM-C-4.1.00	10330
☑	77709	Chloride as Cl, mg/L	STM-C-5.2.07	3885
☐	77709	Ammonia as NH3-N, mg/l	STM-C-7.2.04	<0.02
☐	77709	Groundwater level m	Subcontracted	0.8

Comments:

Report Authorised By: Peter O'Byrne Peter O'Byrne Chem. Lab. Manager

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Report No.: 52010
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RevisionDate:

Sample ID: 77714

Description: Borehole Water (BH5) taken 16.11.09 at Shannon Landfill

Ref No:

	ID	*Test*	*SOP*	*Results*
☐	77714	Arsenic as As mg/l	Subcontracted	<0.02
☐	77714	Mercury as Hg mg/l	Subcontracted	<0.01
☐	77714	Tin mg/l	Subcontracted	<0.01
☐	77714	Dissolved oxygen, mg/l	STM-C-10.3.0	5.89
☐	77714	Detergents as MBAS mg/l	Subcontracted	<0.002
☐	77714	Total Phosphorous as P, mg/l	STM-C-19.2.0	1.31
☐	77714	Salinity		10.5
☐	77714	List 1/11 Organic Substances ug/l	Subcontracted	Not Detected
☐	77714	Sulphates as SO4, mg/l	STM-C-18.2.0	<2
☐	77714	Zinc as Zn mg/l	Subcontracted	0.02
☐	77714	Sodium as Na, mg/l	STM-C-33.1.0	1095
☐	77714	Residue on Evaporation mg/l	STM-C-47.1.0	7100
☐	77714	Potassium as K, mg/l	STM-C-32.1.0	40
☐	77714	Boron as B mg/l	Subcontracted	1.1
☐	77714	Cadmium as Cd mg/l	Subcontracted	<0.01
☐	77714	Calcium as Ca, mg/l	STM-C-22.1.0	42
☐	77714	Chromium as Cr mg/l	Subcontracted	<0.01
☐	77714	Copper as Cu mg/l	Subcontracted	0.01
☐	77714	Fluoride as F, mg/l	Subcontracted	<2.5
☑	77714	Iron as Fe, mg/l	STM-C-34.2.0	1.02
☐	77714	Lead as Pb, mg/l	Subcontracted	<0.03
☐	77714	Magnesium as Mg, mg/l	STM-C-23.1.0	131

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☐	77714	Nickel as Ni mg/l	Subcontracted	0.01
☐	77714	Cyanide mg/l	Subcontracted	<0.05

Comments:

Report Authorised By:

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Report No.: 52001
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Sample ID: 77705

Description: Borehole Water (RD2) taken 16.11.09 at Shannon Landfill

Ref No:

	ID	Test	SOP	Results
☐	77705	Phenols, ug/l	Subcontracted	<0.1
☐	77705	Total Organic Carbon mg/l	Subcontracted	170
☐	77705	Total Oxidised Nitrogen, mg/l	STM-C-30.1.0	<0.5
☐	77705	Temperature, °C	STM-C-41.1.0	11.3
☑	77705	pH value	STM-C-3.1.00	7.29
☑	77705	Conductivity, uS/cm @ 20°C	STM-C-4.1.00	3860
☑	77705	Chloride as Cl, mg/L	STM-C-5.2.07	932
☐	77705	Ammonia as NH3-N, mg/l	STM-C-7.2.04	<0.02
☐	77705	Groundwater level m	Subcontracted	1.0

Comments:

Report Authorised By: Peter O'Byrne Peter O'Byrne Chem. Lab. Manager

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Sample ID: 77710

Description: Borehole Water (RD2) taken 16.11.09 at Shannon Landfill

Ref No:

	ID	Test	SOP	Results
☐	77710	Lead as Pb, mg/l	Subcontracted	<0.03
☐	77710	Dissolved oxygen, mg/l	STM-C-10.3.0	7.10
☐	77710	Detergents as MBAS mg/l	Subcontracted	<0.002
☐	77710	Total Phosphorous as P, mg/l	STM-C-19.2.0	0.18
☐	77710	Salinity		2.7
☐	77710	List I/11 Organic Substances ug/l	Subcontracted	Not Detected
☐	77710	Cadmium as Cd mg/l	Subcontracted	<0.01
☐	77710	Calcium as Ca, mg/l	STM-C-22.1.0	41
☐	77710	Chromium as Cr mg/l	Subcontracted	<0.01
☐	77710	Copper as Cu mg/l	Subcontracted	0.04
☐	77710	Residue on Evaporation mg/l	STM-C-47.1.0	360
☑	77710	Iron as Fe, mg/l	STM-C-34.2.0	0.80
☐	77710	Tin mg/l	Subcontracted	<0.01
☐	77710	Magnesium as Mg, mg/l	STM-C-23.1.0	28
☐	77710	Nickel as Ni mg/l	Subcontracted	0.02
☐	77710	Potassium as K, mg/l	STM-C-32.1.0	6
☐	77710	Sodium as Na, mg/l	STM-C-33.1.0	31
☐	77710	Sulphates as SO4, mg/l	STM-C-18.2.0	<2
☐	77710	Zinc as Zn mg/l	Subcontracted	0.04
☐	77710	Cyanide mg/l	Subcontracted	<0.05
☐	77710	Arsenic as As mg/l	Subcontracted	<0.02
☐	77710	Boron as B mg/l	Subcontracted	0.74

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☐	77710	Mercury as Hg mg/l	Subcontracted	<0.01
☐	77710	Fluoride as F, mg/l	Subcontracted	<0.50

Comments:

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Report No.: 52002
Report Date: 09/12/2009
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RevisionDate:

Sample ID: 77706

Description: Borehole Water (RD3) taken 16.11.09 at Shannon Landfill

Ref No:

	ID	Test	SOP	Results
☐	77706	Phenols, ug/l	Subcontracted	<0.1
☐	77706	Total Organic Carbon mg/l	Subcontracted	150
☐	77706	Total Oxidised Nitrogen, mg/l	STM-C-30.1.0	<0.5
☐	77706	Temperature, °C	STM-C-41.1.0	11.6
☑	77706	pH value	STM-C-3.1.00	7.30
☑	77706	Conductivity, uS/cm @ 20°C	STM-C-4.1.00	2250
☑	77706	Chloride as Cl, mg/L	STM-C-5.2.07	350
☐	77706	Ammonia as NH3-N, mg/l	STM-C-7.2.04	<0.02
☐	77706	Groundwater level m	Subcontracted	0.5

Comments:

Report Authorised By: Peter O'Byrne Peter O'Byrne Chem. Lab. Manager

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Sample ID: 77711

Description: Borehole Water (RD3) taken 16.11.09 at Shannon Landfill

Ref No:

	ID	Test	SOP	Results
☐	77711	Zinc as Zn mg/l	Subcontracted	0.01
☐	77711	Calcium as Ca, mg/l	STM-C-22.1.0	28
☐	77711	Chromium as Cr mg/l	Subcontracted	<0.01
☐	77711	Copper as Cu mg/l	Subcontracted	0.01
☐	77711	Fluoride as F, mg/l	Subcontracted	<0.50
☑	77711	Iron as Fe, mg/l	STM-C-34.2.0	0.10
☐	77711	Lead as Pb, mg/l	Subcontracted	<0.03
☐	77711	Magnesium as Mg, mg/l	STM-C-23.1.0	15
☐	77711	Nickel as Ni mg/l	Subcontracted	0.01
☐	77711	Potassium as K, mg/l	STM-C-32.1.0	4
☐	77711	Cadmium as Cd mg/l	Subcontracted	<0.01
☐	77711	Sulphates as SO4, mg/l	STM-C-18.2.0	60
☐	77711	List 1/11 Organic Substances ug/l	Subcontracted	Not Detected
☐	77711	Cyanide mg/l	Subcontracted	<0.05
☐	77711	Residue on Evaporation mg/l	STM-C-47.1.0	280
☐	77711	Arsenic as As mg/l	Subcontracted	<0.02
☐	77711	Boron as B mg/l	Subcontracted	0.16
☐	77711	Mercury as Hg mg/l	Subcontracted	<0.01
☐	77711	Tin mg/l	Subcontracted	<0.01
☐	77711	Dissolved oxygen, mg/l	STM-C-10.3.0	8.10
☐	77711	Detergents as MBAS mg/l	Subcontracted	<0.002
☐	77711	Total Phosphorous as P, mg/l	STM-C-19.2.0	0.026

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Rosslare Road,
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Email: info@qlab.ie

Test Report

Copy

Customer: Response Engineering Tra
Response Engineering
Tradaree WWTP
Shannon
Co. Clare
Account.: 10038

Report No.: 52007
Report Date: 09/12/2009
Received Date: 17/11/2009
Analysis Date: 17/11/2009
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Page: 2 of 2
RevisionDate:

☐	77711	Salinity		0.9
☐	77711	Sodium as Na, mg/l	STM-C-33.1.0	21

Comments:

Report Authorised By:

☑ *Indicates Accredited Test. Opinions and Comments are not included in the scope of Accreditation*

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.0831

FOR QUALITY AND EXCELLENCE IN LABORATORY ANALYSIS

PO Box 27,
Strandfield Business Park,
Drinagh
Wexford
Ireland

P/F : 00 353 (0)53 9145600/87545
Email: peter@qlab.ie

Chlorinated Pesticides, PCB	**(results in ug/l)**	**Limit of Detection LOD (ug/l)**
alpha-BHC	Not Detected	0.01
beta-BHC	Not Detected	0.01
delta-BHC	Not Detected	0.01
Endosulfan 1	Not Detected	0.01
Endosulphan 11	Not Detected	0.01
Endosulphan Sulfate	Not Detected	0.01
Endrin	Not Detected	0.01
Endrin Aldehyde	Not Detected	0.01
Gamma-BHC (Lindane)	Not Detected	0.01
4,4-DDD	Not Detected	0.01
4,4-DDE	Not Detected	0.01
4,4-DDT	Not Detected	0.01
Organophosphorous Pesticides		
Thioazin	Not Detected	<0.01
Dimethoate	Not Detected	<0.01
Parathion	Not Detected	<0.01
Triethyl phosphorothioate	Not Detected	<0.01
Methyl Parathion	Not Detected	<0.01
Famphur	Not Detected	<0.01

Acid Herbicides	**(results in ug/l)**	**Limit of Detection LOD (ug/l)**
2,4-D	Not Detected	<0.01
Dalapon	Not Detected	<0.01
2,4-DB	Not Detected	<0.01
Dichloroprop	Not Detected	<0.01
Dinoseb	Not Detected	<0.01
Pentachlorophenol	Not Detected	<0.01
Picloram	Not Detected	<0.01
2,4,5-T	Not Detected	<0.01
Triazines		
Atrazine	Not Detected	<0.01
Simazine	Not Detected	<0.01
PAH		
Benzo-a-pyrene	Not Detected	<0.01
Naphthalene	Not Detected	<0.01
Acenaphthylene	Not Detected	<0.01
Acenaphthene	Not Detected	<0.01
Fluorene	Not Detected	<0.01
Phenanthrene	Not Detected	<0.01
Anthracene	Not Detected	<0.01
Fluoranthene	Not Detected	<0.01
Pyrene	Not Detected	<0.01
Chrysene	Not Detected	<0.01
Dibenzo(a,h)anthracene	Not Detected	<0.01
Pesticides (OCP's)		
Aldrin	Not Detected	<0.01
Dieldrin	Not Detected	<0.01
Heptachlor	Not Detected	<0.01
Heptachlor Epoxide	Not Detected	<0.01
Pesticides- (Sum of all above)	<0.01	<0.01
Benzo(b)fluoranthene	Not Detected	<0.01
Benzo(k)fluoranthene	Not Detected	<0.01
Benzo(g,h,i)perylene	Not Detected	<0.01
Indeno(1,2,3-cd)pyrene	Not Detected	<0.01
PAH (Sum of 4 above)	<0.01	<0.01

VOCs	(results in ug/l)	Limit of Detection LOD (ug/l)
Dichlorofluoromethane	Not Detected	10
Chloromethane	Not Detected	0.5
Ethyl Chloride/Chloroethane	Not Detected	0.5
Vinyl Chloride/Chloroethane	Not Detected	0.5
Bromomethane	Not Detected	0.5
Trichloromonofluoromethane	Not Detected	0.5
Ethyl ether/Diethyl ether	Not Detected	0.5
11 Dichloroethene	Not Detected	0.5
Acetone	Not Detected	2.0
Iodomethane/methyl iodide	Not Detected	0.5
Carbon Disulphide	Not Detected	0.5
Allyl Chloride	Not Detected	0.5
Methylene Chloride/DCM	Not Detected	5.0
2-Propentrile/Acrylonitrile	Not Detected	2.0
Chloromethyl Cyanide/Chloroacetonitrile	Not Detected	0.5
Nitrobenzene	Not Detected	0.5
Propanenitrile	Not Detected	10.0
Hexachlorobutadiene	Not Detected	0.5
Trans-1,2 Dichloroethene	Not Detected	0.5
MtBE	Not Detected	0.5
11 Dichloroethene	Not Detected	0.5
22 Dichloropropane	Not Detected	0.5
Cis-1,2 Dichloroethene	Not Detected	0.5
2-Butanone	Not Detected	5.0
Methyl Acrylate	Not Detected	5.0
Bromochloromethane	Not Detected	0.5
Methacrylonitrile	Not Detected	5.0
Tetrahydrofuran	Not Detected	5.0
Trichloromethane/Chloroform	Not Detected	1.0
111 Trichloroethane	Not Detected	0.5
1-Chlorobutane	Not Detected	0.5
Carbon Tetrachloride	Not Detected	0.5
11 Dichloropropene	Not Detected	0.5
Benzene	Not Detected	0.1
12 Dichloropropane	Not Detected	0.1
Dibromomethane	Not Detected	0.1
Methyl Metacrylate	Not Detected	0.5
Bromodichloromethane	Not Detected	2.0
13 Dichloropropene, trans	Not Detected	2.0
Ethly Methacrylate	Not Detected	2.0
112 Trichloroethane	Not Detected	0.5
Tetrachloroethylene/tetrachloroethene	Not Detected	0.1

VOCs	(results in ug/l)	Limit of Detection LOD (ug/l)
13 Dichloropropane	Not Detected	0.5
2-Hexanone	Not Detected	1.0
Dibromochloromethane	Not Detected	1.0
12 Dibromomethane	Not Detected	0.5
Chlorobenzene	Not Detected	0.5
1112 Tetrachloroethane	Not Detected	2.0
Ethyl Benzene	Not Detected	0.5
M & p Xylene	Not Detected	0.5
O Xylene	Not Detected	0.5
Styrene	Not Detected	2.0
Bromoform	Not Detected	1.0
Isopropyl Benzene	Not Detected	0.6
Bromobenzene	Not Detected	0.5
1122 Tetrachloroethane	Not Detected	0.5
123 Trichloropropane	Not Detected	2.0
Trans 1,4 Dichloro 2 Butene, tran	Not Detected	2.0
Propyl Benzene	Not Detected	0.5
2-Chlorotoluene	Not Detected	0.5
4 Chlorotoluene	Not Detected	0.5
135 Trimethylbenzene	Not Detected	0.5
Tert vButyl Benzene	Not Detected	0.5
124 Trimethylbenzene	Not Detected	0.5
Sec Butyl Benzene	Not Detected	0.5
13 Dichlorobenzene	Not Detected	0.5
P Isopropyltoluene	Not Detected	0.5
14 Dichlorobenzene	Not Detected	0.5
12 Dichlorobenzene	Not Detected	0.5
N Butyl Benzene	Not Detected	0.5
Hexachloroethane	Not Detected	5.0
12 Dibromo 3 Chloropropane	Not Detected	2.0
124 Trichlorobenzene	Not Detected	0.5
Naphthalene	Not Detected	2.0
123 Trichlorobenzene	Not Detected	0.5

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Strandfield Business Park,
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Tel: 053 914 5600
Fax: 053 918 4575
E.mail: info@qlab.ie

Test Report

Customer: Response Group
Railway Road
Charleville
Co. Cork

Account.: 9778

Report No.: 44204
Report Date: 10/04/2009
Received Date: 27/03/2009
Analysis Date: 26/03/2009
Order No.:
Page: 1 of 1
RevisionDate:

Sample ID: 67419

Description: Leachate sample SS3, taken 26.03.09 from holding tank at Tradaree Sludge Facility

	ID	*Test*	*SOP*	*Results*
☐	67419	Total Oxidised Nitrogen, mg/l	STM-C-30.1.0	9.9
☑	67419	Conductivity, uS/cm @ 20°C	STM-C-4.1.00	1581
☑	67419	Chloride as Cl, mg/L	STM-C-5.1.00	102
☐	67419	Temperature, °C	STM-C-41.1.0	11.0
☑	67419	pH value	STM-C-3.1.00	6.79
☑	67419	COD mg/l	STM-C-11.2.0	130
☑	67419	BOD, mg/l	STM-C-10.2.0	5.4
☐	67419	Ammonia as NH3-N, mg/l	STM-C-7.2.04	0.06

Comments:

Report Authorised By: Peter O'Byrne Peter O'Byrne Chem. Lab. Manager

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Rosslare Road,
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Tel: 053 914 5600
Fax: 053 918 4575
E.mail: info@qlab.ie

Test Report

Customer: Response Engineering Tr
Response Engineering
Tradaree WWTP
Shannon
Co. Clare
Account.: 10038

Report No.: 52069
Report Date: 09/12/2009
Received Date: 19/11/2009
Analysis Date: 19/11/2009
Order No.:
Page: 1 of 1
RevisionDate:

Sample ID: 77775

Description: Leachate sample (SS3) taken 18.11.09 at Shannon Landfill

Ref No:

	ID	Test	SOP	Results
☐	77775	Total Oxidised Nitrogen, mg/l	STM-C-30.1.0	32.1
☑	77775	Conductivity, uS/cm @ 20°C	STM-C-4.1.00	1252
☑	77775	Chloride as Cl, mg/L	STM-C-5.2.07	29
☐	77775	Temperature, °C	STM-C-41.1.0	12.7
☑	77775	pH value	STM-C-3.1.00	7.03
☑	77775	COD mg/l	STM-C-11.2.0	75
☑	77775	BOD, mg/l	STM-C-10.2.0	7.5
☐	77775	Ammonia as NH3-N, mg/l	STM-C-7.2.04	8.0

Comments:

Report Authorised By: Peter O'Byrne Peter O'Byrne Chem. Lab. Manager

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Test Report

Customer: Response Engineering Tr
Response Engineering
Tradaree WWTP
Shannon
Co. Clare
Account.: 10038

Report No.: 51995
Report Date: 09/12/2009
Received Date: 17/11/2009
Analysis Date: 17/11/2009
Order No.:
Page: 1 of 2
RevisionDate:

Sample ID: 77699

Description: Leachate sample taken 16.11.09 at Shannon Landfill

Ref No:

	ID	Test	SOP	Results
☐	77699	Potassium as K, mg/l	STM-C-32.1.0	8
☐	77699	Cadmium as Cd mg/l	Subcontracted	<0.01
☐	77699	Calcium as Ca, mg/l	STM-C-22.1.0	120
☐	77699	Chromium as Cr mg/l	Subcontracted	<0.01
☐	77699	Copper as Cu mg/l	Subcontracted	0.02
☐	77699	Fluoride as F, mg/l	Subcontracted	<0.50
☑	77699	Iron as Fe, mg/l	STM-C-34.2.0	3.19
☐	77699	Lead as Pb, mg/l	Subcontracted	<0.03
☐	77699	Detergents as MBAS mg/l	Subcontracted	<0.001
☐	77699	Nickel as Ni mg/l	Subcontracted	0.07
☐	77699	Total Phosphorous as P, mg/l	STM-C-19.2.0	0.88
☐	77699	Sodium as Na, mg/l	STM-C-33.1.0	31
☐	77699	Zinc as Zn, mg/l	STM-C-38.1.0	0.08
☐	77699	Cyanide mg/l	Subcontracted	<0.05
☐	77699	Arsenic as As mg/l	Subcontracted	<0.02
☐	77699	Boron as B mg/l	Subcontracted	0.04
☐	77699	Mercury as Hg mg/l	Subcontracted	<0.01
☐	77699	Tin mg/l	Subcontracted	<0.01
☐	77699	Sulphates as SO4, mg/l	STM-C-18.2.0	94
☐	77699	Magnesium as Mg, mg/l	STM-C-23.1.0	20

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Tel: 053 914 5600
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Test Report

Customer: Response Engineering Tr
Response Engineering
Tradaree WWTP
Shannon
Co. Clare
Account.: 10038

Report No.: 51995
Report Date: 09/12/2009
Received Date: 17/11/2009
Analysis Date: 17/11/2009
Order No.:
Page: 2 of 2
RevisionDate:

Comments:

Report Authorised By: Peter O'Byrne Peter O'Byrne Chem. Lab. Manager

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Fax: 053 918 4575
E.mail: info@qlab.ie

Test Report

Customer: Response Group
Railway Road
Charleville
Co. Cork

Account.: 9778

Report No.: 44205
Report Date: 10/04/2009
Received Date: 27/03/2009
Analysis Date: 26/03/2009
Order No.:
Page: 1 of 1
RevisionDate:

Sample ID: 67420

Description: Surface water SS1, at Tradaree Sludge Facility taken 26.03.09

	ID	Test	SOP	Results
☐	67420	Temperature, °C	STM-C-41.1.0	9.0
☑	67420	Suspended Solids, mg/l	STM-C-2.1.00	6
☑	67420	pH value	STM-C-3.1.00	8.13
☐	67420	Oxygen Saturation %	STM-C-10.3.0	82
☑	67420	COD mg/l	STM-C-11.2.0	<3
☑	67420	BOD, mg/l	STM-C-10.2.0	1.0
☐	67420	Ammonia as NH3-N, mg/l	STM-C-7.2.04	<0.02

Comments:

Report Authorised By: Peter O'Byrne Peter O'Byrne Chem. Lab. Manager

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Strandfield Business Park,
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Fax: 053 918 4575
E.mail: info@qlab.ie

Test Report

Customer: Response Group
Railway Road
Charleville
Co. Cork

Account.: 9778

Report No.: 44206
Report Date: 10/04/2009
Received Date: 27/03/2009
Analysis Date: 26/03/2009
Order No.:
Page: 1 of 1
RevisionDate:

Sample ID: 67421

Description: Surface water SS2, at Tradaree Sludge Facility taken 26.03.09

	ID	*Test*	*SOP*	*Results*
☐	67421	Temperature, °C	STM-C-41.1.0	9.7
☑	67421	Suspended Solids, mg/l	STM-C-2.1.00	2
☑	67421	pH value	STM-C-3.1.00	8.15
☐	67421	Oxygen Saturation %	STM-C-10.3.0	78
☑	67421	COD mg/l	STM-C-11.2.0	3
☑	67421	BOD, mg/l	STM-C-10.2.0	0.8
☐	67421	Ammonia as NH3-N, mg/l	STM-C-7.2.04	0.03

Comments:

Report Authorised By: Peter O'Byrne Peter O'Byrne Chem. Lab. Manager

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Fax: 053 918 4575
E.mail: info@qlab.ie

Test Report

Customer: Response Group
Railway Road
Charleville
Co. Cork

Account.: 9778

Report No.: 44207
Report Date: 10/04/2009
Received Date: 27/03/2009
Analysis Date: 26/03/2009
Order No.:
Page: 1 of 1
RevisionDate:

Sample ID: 67422

Description: Surface water SS4, at Tradaree Sludge Facility taken 26.03.09

	ID	*Test*	*SOP*	*Results*
☐	67422	Temperature, °C	STM-C-41.1.0	9.2
☑	67422	Suspended Solids, mg/l	STM-C-2.1.00	2
☑	67422	pH value	STM-C-3.1.00	8.17
☐	67422	Oxygen Saturation %	STM-C-10.3.0	80
☑	67422	COD mg/l	STM-C-11.2.0	5
☑	67422	BOD, mg/l	STM-C-10.2.0	0.9
☐	67422	Ammonia as NH3-N, mg/l	STM-C-7.2.04	0.02

Comments:

Report Authorised By: Peter O'Byrne Peter O'Byrne Chem. Lab. Manager

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Fax: 053 918 4575
E.mail: info@qlab.ie

Test Report

Customer: Response Group
Railway Road
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Account.: 9778

Report No.: 44208
Report Date: 10/04/2009
Received Date: 27/03/2009
Analysis Date: 26/03/2009
Order No.:
Page: 1 of 1
RevisionDate:

Sample ID: 67423

Description: Surface water SS6, at Tradaree Sludge Facility taken 26.03.09

	ID	*Test*	*SOP*	*Results*
☐	67423	Temperature, °C	STM-C-41.1.0	9.5
☑	67423	Suspended Solids, mg/l	STM-C-2.1.00	120
☑	67423	pH value	STM-C-3.1.00	8.18
☐	67423	Oxygen Saturation %	STM-C-10.3.0	76
☑	67423	COD mg/l	STM-C-11.2.0	41
☑	67423	BOD, mg/l	STM-C-10.2.0	1.5
☐	67423	Ammonia as NH3-N, mg/l	STM-C-7.2.04	<0.02

Comments:

Report Authorised By: Peter O'Byrne Peter O'Byrne Chem. Lab. Manager

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ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.089T

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Tel: 053 914 5600
Fax: 053 918 4575
E.mail: info@qlab.ie

Test Report

Customer: Response Engineering Tr
Response Engineering
Tradaree WWTP
Shannon
Co. Clare
Account.: 10038

Report No.: 51992
Report Date: 08/12/2009
Received Date: 17/11/2009
Analysis Date: 17/11/2009
Order No.:
Page: 1 of 1
RevisionDate:

Sample ID: 77696

Description: Surface water (SS1) taken 16.11.09 at Shannon Landfill

Ref No:

	ID	*Test*	*SOP*	*Results*
☐	77696	Temperature, °C	STM-C-41.1.0	9.9
☑	77696	Suspended Solids, mg/l	STM-C-2.1.00	2
☑	77696	pH value	STM-C-3.1.00	7.45
☐	77696	Oxygen Saturation %	STM-C-10.3.0	21
☑	77696	COD mg/l	STM-C-11.2.0	16
☑	77696	BOD, mg/l	STM-C-10.2.0	2.5
☐	77696	Ammonia as NH3-N, mg/l	STM-C-7.2.04	<0.02

Comments:

Report Authorised By: Peter O'Byrne Peter O'Byrne Chem. Lab. Manager

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Rosslare Road,
Wexford.
Tel: 053 914 5600
Fax: 053 918 4575
E.mail: info@qlab.ie

Test Report

Customer: Response Engineering Tr
Response Engineering
Tradaree WWTP
Shannon
Co. Clare
Account.: 10038

Report No.: 51996
Report Date: 09/12/2009
Received Date: 17/11/2009
Analysis Date: 17/11/2009
Order No.:
Page: 1 of 2
RevisionDate:

Sample ID: 77700

Description: Surface water (SS1) taken 16.11.09 at Shannon Landfill

Ref No:

	ID	*Test*	*SOP*	*Results*
☐	77700	Sodium as Na, mg/l	STM-C-33.1.0	15
☐	77700	Calcium as Ca, mg/l	STM-C-22.1.0	77
☐	77700	Chromium as Cr mg/l	Subcontracted	<0.01
☐	77700	Copper as Cu mg/l	Subcontracted	0.02
☐	77700	Fluoride as F, mg/l	Subcontracted	0.10
☑	77700	Iron as Fe, mg/l	STM-C-34.2.0	<0.02
☐	77700	Lead as Pb, mg/l	Subcontracted	<0.03
☐	77700	Magnesium as Mg, mg/l	STM-C-23.1.0	10
☑	77700	Manganese as Mn, mg/l	STM-C-35.2.0	0.012
☐	77700	Cadmium as Cd mg/l	Subcontracted	<0.01
☐	77700	Potassium as K, mg/l	STM-C-32.1.0	4
☐	77700	Total Phosphorous as P, mg/l	STM-C-19.2.0	0.02
☐	77700	Sulphates as SO4, mg/l	STM-C-18.2.0	52
☐	77700	Total Oxidised Nitrogen, mg/l	STM-C-30.1.0	1.1
☐	77700	Zinc as Zn mg/l	Subcontracted	0.03
☐	77700	Cyanide mg/l	Subcontracted	<0.05
☐	77700	Arsenic as As mg/l	Subcontracted	<0.02
☐	77700	Boron as B mg/l	Subcontracted	0.04
☐	77700	Mercury as Hg mg/l	Subcontracted	<0.01
☐	77700	Tin mg/l	Subcontracted	<0.01
☑	77700	Conductivity, uS/cm @ 20°C	STM-C-4.1.00	500
☐	77700	Nickel as Ni mg/l	Subcontracted	<0.01

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Wexford.
Tel: 053 914 5600
Fax: 053 918 4575
E.mail: info@qlab.ie

Test Report

Customer: Response Engineering Tr
Response Engineering
Tradaree WWTP
Shannon
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Account.: 10038

Report No.: 51996
Report Date: 09/12/2009
Received Date: 17/11/2009
Analysis Date: 17/11/2009
Order No.:
Page: 2 of 2
RevisionDate:

Comments:

Report Authorised By: Peter O'Byrne Peter O'Byrne Chem. Lab. Manager

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ISO 7025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.0891T

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Tel: 053 914 5600
Fax: 053 918 4575
E.mail: info@qlab.ie

Test Report

Customer: Response Engineering Tr
Response Engineering
Tradaree WWTP
Shannon
Co. Clare
Account.: 10038

Report No.: 52067
Report Date: 08/12/2009
Received Date: 19/11/2009
Analysis Date: 19/11/2009
Order No.:
Page: 1 of 1
RevisionDate:

Sample ID: 77773

Description: Surface water (SS2) taken 18.11.09 at Shannon Landfill

Ref No:

	ID	*Test*	*SOP*	*Results*
☐	77773	Temperature, °C	STM-C-41.1.0	10.7
☑	77773	Suspended Solids, mg/l	STM-C-2.1.00	16
☑	77773	pH value	STM-C-3.1.00	7.56
☐	77773	Oxygen Saturation %	STM-C-10.3.0	27
☑	77773	COD mg/l	STM-C-11.2.0	58
☑	77773	BOD, mg/l	STM-C-10.2.0	<0.5
☐	77773	Ammonia as NH3-N, mg/l	STM-C-7.2.04	<0.02

Comments:

Report Authorised By: Peter O'Byrne Peter O'Byrne Chem. Lab. Manager

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Fax: 053 918 4575
E.mail: info@qlab.ie

Test Report

Customer: Response Engineering Tr
Response Engineering
Tradaree WWTP
Shannon
Co. Clare
Account.: 10038

Report No.: 51997
Report Date: 09/12/2009
Received Date: 17/11/2009
Analysis Date: 17/11/2009
Order No.:
Page: 1 of 2
RevisionDate:

Sample ID: 77701

Description: Surface water (SS2) taken 16.11.09 at Shannon Landfill

Ref No:

	ID	Test	SOP	Results
☐	77701	Sodium as Na, mg/l	STM-C-33.1.0	17
☐	77701	Calcium as Ca, mg/l	STM-C-22.1.0	35
☐	77701	Chromium as Cr mg/l	Subcontracted	<0.01
☐	77701	Copper as Cu mg/l	Subcontracted	0.02
☐	77701	Fluoride as F, mg/l	Subcontracted	0.10
☑	77701	Iron as Fe, mg/l	STM-C-34.2.0	<0.02
☐	77701	Lead as Pb, mg/l	Subcontracted	<0.03
☐	77701	Magnesium as Mg, mg/l	STM-C-23.1.0	5
☑	77701	Manganese as Mn, mg/l	STM-C-35.2.0	0.011
☐	77701	Cadmium as Cd mg/l	Subcontracted	<0.01
☐	77701	Potassium as K, mg/l	STM-C-32.1.0	4
☐	77701	Total Phosphorous as P, mg/l	STM-C-19.2.0	<0.02
☐	77701	Sulphates as SO4, mg/l	STM-C-18.2.0	18
☐	77701	Total Oxidised Nitrogen, mg/l	STM-C-30.1.0	1.0
☐	77701	Zinc as Zn mg/l	Subcontracted	0.02
☐	77701	Cyanide mg/l	Subcontracted	<0.05
☐	77701	Arsenic as As mg/l	Subcontracted	<0.02
☐	77701	Boron as B mg/l	Subcontracted	0.01
☐	77701	Mercury as Hg mg/l	Subcontracted	<0.01
☐	77701	Tin mg/l	Subcontracted	<0.01
☑	77701	Conductivity, uS/cm @ 20°C	STM-C-4.1.00	250
☐	77701	Nickel as Ni mg/l	Subcontracted	0.02

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Account.: 10038

Report No.: 51997
Report Date: 09/12/2009
Received Date: 17/11/2009
Analysis Date: 17/11/2009
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Report Authorised By: Peter O'Byrne Peter O'Byrne Chem. Lab. Manager

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Fax: 053 918 4575
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Report No.: 51993
Report Date: 08/12/2009
Received Date: 17/11/2009
Analysis Date: 17/11/2009
Order No.:
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RevisionDate:

Sample ID: 77697

Description: Surface water (SS4) taken 16.11.09 at Shannon Landfill

Ref No:

	ID	Test	SOP	Results
☐	77697	Temperature, °C	STM-C-41.1.0	11.9
☑	77697	Suspended Solids, mg/l	STM-C-2.1.00	4
☑	77697	pH value	STM-C-3.1.00	7.33
☐	77697	Oxygen Saturation %	STM-C-10.3.0	68
☑	77697	COD mg/l	STM-C-11.2.0	21
☑	77697	BOD, mg/l	STM-C-10.2.0	1.8
☐	77697	Ammonia as NH3-N, mg/l	STM-C-7.2.04	<0.02

Comments:

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Rosslare Road,
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Tel: 053 914 5600
Fax: 053 918 4575
E.mail: info@qlab.ie

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Tradaree WWTP
Shannon
Co. Clare
Account.: 10038

Report No.: 51998
Report Date: 09/12/2009
Received Date: 17/11/2009
Analysis Date: 17/11/2009
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Sample ID: 77702

Description: Surface water (SS4) taken 16.11.09 at Shannon Landfill

Ref No:

	ID	Test	SOP	Results
☐	77702	Sodium as Na, mg/l	STM-C-33.1.0	20
☐	77702	Calcium as Ca, mg/l	STM-C-22.1.0	75
☐	77702	Chromium as Cr mg/l	Subcontracted	<0.01
☐	77702	Copper as Cu mg/l	Subcontracted	<0.01
☐	77702	Fluoride as F, mg/l	Subcontracted	0.12
☑	77702	Iron as Fe, mg/l	STM-C-34.2.0	0.03
☐	77702	Lead as Pb, mg/l	Subcontracted	<0.03
☐	77702	Magnesium as Mg, mg/l	STM-C-23.1.0	14
☑	77702	Manganese as Mn, mg/l	STM-C-35.2.0	0.018
☐	77702	Cadmium as Cd mg/l	Subcontracted	<0.01
☐	77702	Potassium as K, mg/l	STM-C-32.1.0	5
☐	77702	Total Phosphorous as P, mg/l	STM-C-19.2.0	<0.02
☐	77702	Sulphates as SO4, mg/l	STM-C-18.2.0	98
☐	77702	Total Oxidised Nitrogen, mg/l	STM-C-30.1.0	0.7
☐	77702	Zinc as Zn mg/l	Subcontracted	0.02
☐	77702	Cyanide mg/l	Subcontracted	<0.05
☐	77702	Arsenic as As mg/l	Subcontracted	<0.02
☐	77702	Boron as B mg/l	Subcontracted	0.05
☐	77702	Mercury as Hg mg/l	Subcontracted	<0.01
☐	77702	Tin mg/l	Subcontracted	<0.01
☑	77702	Conductivity, uS/cm @ 20°C	STM-C-4.1.00	528
☐	77702	Nickel as Ni mg/l	Subcontracted	0.01

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P.O. Box 27,
Strandfield Business Park,
Rosslare Road,
Wexford.
Tel: 053 914 5600
Fax: 053 918 4575
E.mail: info@qlab.ie

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Tradaree WWTP
Shannon
Co. Clare
Account.: 10038

Report No.: 51998
Report Date: 09/12/2009
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Comments:

Report Authorised By: Peter O'Byrne Peter O'Byrne Chem. Lab. Manager

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E.mail: info@qlab.ie

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Shannon
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Report No.: 52068
Report Date: 08/12/2009
Received Date: 19/11/2009
Analysis Date: 19/11/2009
Order No.:
Page: 1 of 1
RevisionDate:

Sample ID: 77774

Description: Surface water (SS6) taken 18.11.09 at Shannon Landfill

Ref No:

	ID	*Test*	*SOP*	*Results*
☐	77774	Temperature, °C	STM-C-41.1.0	10.3
☑	77774	Suspended Solids, mg/l	STM-C-2.1.00	36
☑	77774	pH value	STM-C-3.1.00	7.61
☐	77774	Oxygen Saturation %	STM-C-10.3.0	22
☑	77774	COD mg/l	STM-C-11.2.0	33
☑	77774	BOD, mg/l	STM-C-10.2.0	<0.5
☐	77774	Ammonia as NH3-N, mg/l	STM-C-7.2.04	<0.02

Comments:

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Fax: 053 918 4575
E.mail: info@qlab.ie

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Response Engineering
Tradaree WWTP
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Co. Clare
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Report No.: 51999
Report Date: 09/12/2009
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Order No.:
Page: 1 of 2
RevisionDate:

Sample ID: 77703

Description: Surface water (SS6) taken 16.11.09 at Shannon Landfill

Ref No:

	ID	*Test*	*SOP*	*Results*
☐	77703	Sodium as Na, mg/l	STM-C-33.1.0	16
☐	77703	Calcium as Ca, mg/l	STM-C-22.1.0	39
☐	77703	Chromium as Cr mg/l	Subcontracted	<0.01
☐	77703	Copper as Cu mg/l	Subcontracted	0.03
☐	77703	Fluoride as F, mg/l	Subcontracted	0.10
☑	77703	Iron as Fe, mg/l	STM-C-34.2.0	0.02
☐	77703	Lead as Pb, mg/l	Subcontracted	<0.03
☐	77703	Magnesium as Mg, mg/l	STM-C-23.1.0	7
☑	77703	Manganese as Mn, mg/l	STM-C-35.2.0	0.019
☐	77703	Cadmium as Cd mg/l	Subcontracted	<0.01
☐	77703	Potassium as K, mg/l	STM-C-32.1.0	4
☐	77703	Total Phosphorous as P, mg/l	STM-C-19.2.0	0.03
☐	77703	Sulphates as SO4, mg/l	STM-C-18.2.0	78
☐	77703	Total Oxidised Nitrogen, mg/l	STM-C-30.1.0	<0.5
☐	77703	Zinc as Zn mg/l	Subcontracted	0.02
☐	77703	Cyanide mg/l	Subcontracted	<0.05
☐	77703	Arsenic as As mg/l	Subcontracted	<0.02
☐	77703	Boron as B mg/l	Subcontracted	0.04
☐	77703	Mercury as Hg mg/l	Subcontracted	<0.01
☐	77703	Tin mg/l	Subcontracted	<0.01
☑	77703	Conductivity, uS/cm @ 20°C	STM-C-4.1.00	540
☐	77703	Nickel as Ni mg/l	Subcontracted	<0.01

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Tel: 053 914 5600
Fax: 053 918 4575
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Tradaree WWTP
Shannon
Co. Clare
Account.: 10038

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Report Authorised By: Peter O'Byrne Peter O'Byrne Chem. Lab. Manager

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Report No.: 52000
Report Date: 09/12/2009
Received Date: 17/11/2009
Analysis Date: 17/11/2009
Order No.:
Page: 1 of 2
RevisionDate:

Sample ID: 77704

Description: Surface water (SS7) taken 16.11.09 at Shannon Landfill

Ref No:

	ID	Test	SOP	Results
☐	77704	Sodium as Na, mg/l	STM-C-33.1.0	21
☐	77704	Calcium as Ca, mg/l	STM-C-22.1.0	72
☐	77704	Chromium as Cr mg/l	Subcontracted	<0.01
☐	77704	Copper as Cu mg/l	Subcontracted	0.03
☐	77704	Fluoride as F, mg/l	Subcontracted	0.11
☑	77704	Iron as Fe, mg/l	STM-C-34.2.0	0.03
☐	77704	Lead as Pb, mg/l	Subcontracted	<0.03
☐	77704	Magnesium as Mg, mg/l	STM-C-23.1.0	16
☑	77704	Manganese as Mn, mg/l	STM-C-35.2.0	0.007
☐	77704	Cadmium as Cd mg/l	Subcontracted	<0.01
☐	77704	Potassium as K, mg/l	STM-C-32.1.0	5
☐	77704	Total Phosphorous as P, mg/l	STM-C-19.2.0	0.03
☐	77704	Sulphates as SO4, mg/l	STM-C-18.2.0	60
☐	77704	Total Oxidised Nitrogen, mg/l	STM-C-30.1.0	1.1
☐	77704	Zinc as Zn mg/l	Subcontracted	0.03
☐	77704	Cyanide mg/l	Subcontracted	<0.05
☐	77704	Arsenic as As mg/l	Subcontracted	<0.02
☐	77704	Boron as B mg/l	Subcontracted	0.04
☐	77704	Mercury as Hg mg/l	Subcontracted	<0.01
☐	77704	Tin mg/l	Subcontracted	<0.01
☑	77704	Conductivity, uS/cm @ 20°C	STM-C-4.1.00	563
☐	77704	Nickel as Ni mg/l	Subcontracted	<0.01

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Account.: 10038

Report No.: 52000
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Received Date: 17/11/2009
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Page: 1 of 2
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Sample ID: 77704

Description: Surface water (SS7) taken 16.11.09 at Shannon Landfill

Ref No:

	ID	Test	SOP	Results
☐	77704	Chromium as Cr mg/l	Subcontracted	<0.01
☐	77704	Zinc as Zn mg/l	Subcontracted	0.03
☐	77704	Cyanide mg/l	Subcontracted	<0.05
☐	77704	Arsenic as As mg/l	Subcontracted	<0.02
☐	77704	Boron as B mg/l	Subcontracted	0.04
☐	77704	Mercury as Hg mg/l	Subcontracted	<0.01
☐	77704	Tin mg/l	Subcontracted	<0.01
☑	77704	Conductivity, uS/cm @ 20°C	STM-C-4.1.00	563
☐	77704	Total Phosphorous as P, mg/l	STM-C-19.2.0	0.03
☐	77704	Total Oxidised Nitrogen, mg/l	STM-C-30.1.0	1.1
☐	77704	Calcium as Ca, mg/l	STM-C-22.1.0	72
☐	77704	Sulphates as SO4, mg/l	STM-C-18.2.0	60
☐	77704	Copper as Cu mg/l	Subcontracted	0.03
☐	77704	Fluoride as F, mg/l	Subcontracted	0.11
☑	77704	Iron as Fe, mg/l	STM-C-34.2.0	0.03
☐	77704	Lead as Pb, mg/l	Subcontracted	<0.03
☐	77704	Magnesium as Mg, mg/l	STM-C-23.1.0	16
☑	77704	Manganese as Mn, mg/l	STM-C-35.2.0	0.007
☐	77704	Nickel as Ni mg/l	Subcontracted	<0.01
☐	77704	Potassium as K, mg/l	STM-C-32.1.0	5
☐	77704	Sodium as Na, mg/l	STM-C-33.1.0	21
☐	77704	Cadmium as Cd mg/l	Subcontracted	<0.01

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APPENDIX H – METEOROLOGICAL DATA

Shannon Airport Weather Records 2009

Year	Month	Day	Mean Relative Humidity (%)	Mean MSL Pressure (hpa)	Mean wind Speed (kts)	Predominant Wind Direction (degrees)	Evaporation (mm)	Potential Evapotranspiration (mm)
2009	1	1	80	1027	9	90	0.683	0.563
2009	1	2	79	1029	9	90	0.7	0.573
2009	1	3	74	1029	7	95	0.897	0.722
2009	1	4	85	1024	5	100	0.337	0.246
2009	1	5	90	1024	5	85	0	0
2009	1	6	80	1029	5	105	0.156	0.091
2009	1	7	90	1028	3	115	0.071	0.013
2009	1	8	87	1027	7	120	0.258	0.223
2009	1	9	80	1024	9	140	0.501	0.443
2009	1	10	77	1015	15	180	1.254	0.954
2009	1	11	90	1005	16	190	0.85	0.62
2009	1	12	91	1003	8	200	0.272	0.186
2009	1	13	92	1009	6	205	0.383	0.283
2009	1	14	91	1000	16	150	0.751	0.503
2009	1	15	85	997	11	160	0.581	0.455
2009	1	16	85	1000	11	165	0.724	0.585
2009	1	17	85	991	18	215	1.037	0.711
2009	1	18	82	988	15	230	0.951	0.702
2009	1	19	89	977	12	225	0.451	0.327
2009	1	20	82	988	11	235	0.841	0.634
2009	1	21	93	989	10	145	0.545	0.388
2009	1	22	85	979	11	230	0.573	0.43
2009	1	23	88	981	7	260	0.533	0.409
2009	1	24	91	983	9	140	0.452	0.32
2009	1	25	89	974	8	360	0.402	0.277
2009	1	26	84	1000	8	270	0.596	0.463
2009	1	27	97	1007	4	135	0.311	0.21
2009	1	28	93	1011	8	115	0.425	0.299
2009	1	29	91	1001	16	120	0.823	0.576
2009	1	30	92	999	9	145	0.704	0.532
2009	1	31	95	1002	4	105	0.543	0.403
JAN			**2692.0**	**31140.0**	**292.0**	**5120**	**17.6**	**13.1**

Shannon Airport Weather Records 2009

Year	Month	Day	Mean Relative Humidity (%)	Mean MSL Pressure (hpa)	Mean wind Speed (kts)	Predominant Wind Direction (degrees)	Evaporation (mm)	Potential Evapotranspiration (mm)
2009	2	1	78	1009	10	75	0.871	0.665
2009	2	2	76	1008	9	355	0.901	0.687
2009	2	3	92	990	9	335	0.672	0.482
2009	2	4	91	990	8	30	0.562	0.387
2009	2	5	82	996	11	345	0.657	0.446
2009	2	6	83	1001	6	325	0.703	0.499
2009	2	7	78	1006	6	310	0.812	0.586
2009	2	8	88	999	8	230	0.905	0.673
2009	2	9	91	996	5	350	0.527	0.349
2009	2	10	90	1009	6	260	0.808	0.591
2009	2	11	92	1020	2	105	0.592	0.406
2009	2	12	94	1026	6	115	0.705	0.506
2009	2	13	91	1026	3	110	0.661	0.487
2009	2	14	85	1026	5	115	0.848	0.64
2009	2	15	89	1028	5	120	0.762	0.54
2009	2	16	89	1029	6	115	0.746	0.548
2009	2	17	84	1030	3	140	0.8	0.575
2009	2	18	84	1027	7	150	0.966	0.747
2009	2	19	89	1030	4	320	0.773	0.559
2009	2	20	89	1033	3	235	0.817	0.553
2009	2	21	89	1035	6	150	1.005	0.678
2009	2	22	90	1033	9	255	0.917	0.622
2009	2	23	91	1030	5	275	0.869	0.66
2009	2	24	83	1029	3	170	1.004	0.743
2009	2	25	86	1029	6	235	0.93	0.673
2009	2	26	89	1025	8	230	0.963	0.66
2009	2	27	85	1019	8	200	1.199	0.914
2009	2	28	89	1009	8	160	1.032	0.745
FEB			**2437.0**	**28488.0**	**175.0**	**5815.0**	**23.0**	**16.6**

Shannon Airport Weather Records 2009

Year	Month	Day	Mean Relative Humidity (%)	Mean MSL Pressure (hpa)	Mean wind Speed (kts)	Predominant Wind Direction (degrees)	Evaporation (mm)	Potential Evapotranspiration (mm)
2009	3	1	83	1010	9	255	1.606	1.132
2009	3	2	88	1015	11	240	1.124	0.804
2009	3	3	88	995	11	215	0.832	0.524
2009	3	4	91	982	8	245	0.976	0.627
2009	3	5	84	999	6	275	1.449	1.007
2009	3	6	88	1005	9	260	1.28	0.853
2009	3	7	92	1005	14	240	1.11	0.735
2009	3	8	82	1003	16	255	2.051	1.295
2009	3	9	84	1010	13	255	1.37	0.858
2009	3	10	85	1012	11	260	1.484	1.061
2009	3	11	88	1019	9	220	1.7	1.213
2009	3	12	86	1020	8	240	1.783	1.268
2009	3	13	85	1011	13	155	1.674	1.265
2009	3	14	75	1020	13	260	1.925	1.349
2009	3	15	78	1030	6	155	1.711	1.24
2009	3	16	77	1031	7	170	1.622	1.193
2009	3	17	76	1032	9	110	2.681	1.869
2009	3	18	80	1029	8	120	2.566	1.796
2009	3	19	78	1026	9	125	2.699	1.943
2009	3	20	76	1027	10	125	2.717	1.892
2009	3	21	83	1035	5	335	1.514	1.116
2009	3	22	85	1037	8	265	1.942	1.326
2009	3	23	82	1027	14	270	1.721	1.075
2009	3	24	86	1021	11	255	1.632	1.105
2009	3	25	78	1013	17	285	2.522	1.625
2009	3	26	80	1005	19	280	2.131	1.056
2009	3	27	82	1001	12	305	2.306	1.369
2009	3	28	65	1012	13	325	3.11	2.045
2009	3	29	86	1011	8	170	1.335	0.885
2009	3	30	92	1018	6	250	1.735	1.223
2009	3	31	85	1022	5	135	2.251	1.626
MAR			**2568.0**	**31483.0**	**318.0**	**7055.0**	**56.6**	**38.4**

Shannon Airport Weather Records 2009

Year	Month	Day	Mean Relative Humidity (%)	Mean MSL Pressure (hpa)	Mean wind Speed (kts)	Predominant Wind Direction (degrees)	Evaporation (mm)	Potential Evapotranspiration (mm)
2009	4	1	74	1023	8	150	2.318	1.734
2009	4	2	73	1020	7	140	3.35	2.303
2009	4	3	91	1013	10	135	1.676	1.165
2009	4	4	76	1019	9	260	2.801	1.847
2009	4	5	77	1017	10	150	2.523	1.727
2009	4	6	77	1001	13	215	2.823	1.8
2009	4	7	84	996	15	190	1.643	0.969
2009	4	8	73	1001	11	245	3.355	2.203
2009	4	9	92	993	11	150	1.329	0.854
2009	4	10	78	1000	8	240	3.383	2.203
2009	4	11	84	1008	6	145	1.607	1.151
2009	4	12	82	1012	8	140	3.09	2.055
2009	4	13	80	1003	10	125	3.059	2.162
2009	4	14	80	1004	12	110	3.054	2.067
2009	4	15	91	1008	8	25	1.034	0.732
2009	4	16	86	1007	11	35	2.074	1.431
2009	4	17	87	1012	8	45	1.335	0.958
2009	4	18	69	1019	7	90	4.485	3.247
2009	4	19	79	1024	7	130	2.756	1.96
2009	4	20	78	1027	6	120	3.768	2.67
2009	4	21	79	1027	6	245	3.172	2.171
2009	4	22	86	1021	11	155	2.061	1.384
2009	4	23	87	1016	5	160	2.306	1.708
2009	4	24	86	1010	7	285	2.538	1.774
2009	4	25	89	1005	14	330	1.884	1.232
2009	4	26	89	1005	9	265	1.686	1.083
2009	4	27	82	996	11	250	2.966	1.897
2009	4	28	88	1004	7	300	2.492	1.715
2009	4	29	92	1003	8	130	2.152	1.44
2009	4	30	75	1012	6	255	4.332	2.953
APR			**2464.0**	**30306.0**	**269.0**	**5215.0**	**77.1**	**52.6**

Shannon Airport Weather Records 2009

Year	Month	Day	Mean Relative Humidity (%)	Mean MSL Pressure (hpa)	Mean wind Speed (kts)	Predominant Wind Direction (degrees)	Evaporation (mm)	Potential Evapotranspiration (mm)
2009	5	1	76	1019	14	230	4.041	2.511
2009	5	2	76	1027	8	235	3.744	2.601
2009	5	3	76	1031	9	260	3.874	2.446
2009	5	4	92	1026	16	245	1.469	0.907
2009	5	5	85	1022	20	240	3.604	2.152
2009	5	6	87	1014	16	235	2.622	1.747
2009	5	7	74	1006	17	205	3.708	2.416
2009	5	8	75	1007	18	240	4.354	2.474
2009	5	9	75	1012	10	240	3.483	2.341
2009	5	10	67	1019	6	20	4.542	3.228
2009	5	11	61	1022	10	60	5.602	3.931
2009	5	12	56	1021	10	90	6.186	4.362
2009	5	13	77	1013	8	85	2.052	1.453
2009	5	14	92	1008	6	100	2.141	1.523
2009	5	15	83	1001	11	255	3.206	2.077
2009	5	16	85	990	13	185	2.752	1.763
2009	5	17	87	994	8	125	2.432	1.652
2009	5	18	90	1002	11	220	2.573	1.606
2009	5	19	86	1009	6	185	3.573	2.524
2009	5	20	79	1014	6	260	4.471	3.143
2009	5	21	80	1015	10	245	3.532	2.323
2009	5	22	89	1012	8	225	3.564	2.438
2009	5	23	77	1015	10	255	4.136	2.71
2009	5	24	77	1019	8	170	4.233	2.889
2009	5	25	82	1016	8	245	2.562	1.751
2009	5	26	77	1019	13	245	4.488	2.65
2009	5	27	95	1018	15	245	2.035	1.156
2009	5	28	82	1029	7	235	5.134	3.596
2009	5	29	78	1026	14	125	4.562	3.051
2009	5	30	72	1023	9	125	5.612	4.019
2009	5	31	62	1026	5	110	6.115	4.597
MAY			**2450.0**	**31475.0**	**330.0**	**5940.0**	**116.4**	**78.0**

Shannon Airport Weather Records 2009

Year	Month	Day	Mean Relative Humidity (%)	Mean MSL Pressure (hpa)	Mean wind Speed (kts)	Predominant Wind Direction (degrees)	Evaporation (mm)	Potential Evapotranspiration (mm)
2009	6	1	65	1027	4	110	6.053	4.592
2009	6	2	62	1027	3	120	6.265	4.79
2009	6	3	66	1023	6	15	6.219	4.7
2009	6	4	64	1018	5	45	6.085	4.521
2009	6	5	67	1011	9	20	5.58	3.816
2009	6	6	76	1007	12	360	3.729	2.532
2009	6	7	67	1006	9	15	4.733	3.392
2009	6	8	73	1007	9	25	3.936	2.682
2009	6	9	78	1010	7	50	3.038	2.223
2009	6	10	74	1012	5	285	4.475	3.254
2009	6	11	64	1019	6	330	5.383	3.886
2009	6	12	77	1016	8	100	5.723	4.003
2009	6	13	74	1015	9	145	5.398	3.774
2009	6	14	78	1016	6	140	3.913	2.912
2009	6	15	78	1016	6	55	5.151	3.754
2009	6	16	82	1019	8	170	4.635	3.323
2009	6	17	80	1012	13	250	4.209	2.657
2009	6	18	78	1017	15	250	3.954	2.553
2009	6	19	76	1025	13	260	3.69	2.594
2009	6	20	78	1028	12	265	5.051	3.332
2009	6	21	89	1028	8	255	3.599	2.573
2009	6	22	79	1029	3	255	5.233	4.018
2009	6	23	73	1026	6	110	6.4	4.807
2009	6	24	62	1020	8	110	6.629	4.926
2009	6	25	67	1013	8	100	6.327	4.595
2009	6	26	78	1011	7	105	4.716	3.533
2009	6	27	76	1014	9	110	4.394	3.272
2009	6	28	82	1012	12	100	3.005	2.236
2009	6	29	72	1015	7	110	5.963	4.358
2009	6	30	86	1017	10	115	2.838	2.09
JUN			**2221.0**	**30516.0**	**243.0**	**4380.0**	**146.3**	**105.7**

Shannon Airport Weather Records 2009

Year	Month	Day	Mean Relative Humidity (%)	Mean MSL Pressure (hpa)	Mean wind Speed (kts)	Predominant Wind Direction (degrees)	Evaporation (mm)	Potential Evapotranspiration (mm)
2009	7	1	87	1019	4	120	2.722	2.106
2009	7	2	88	1015	9	120	2.844	2.094
2009	7	3	75	1009	10	165	4.896	3.472
2009	7	4	76	1006	11	145	5.089	3.602
2009	7	5	85	1002	9	145	3.876	2.711
2009	7	6	84	1004	12	280	4.56	2.863
2009	7	7	78	1011	12	285	6.021	3.976
2009	7	8	72	1018	9	290	5.573	3.946
2009	7	9	72	1020	5	280	4.846	3.545
2009	7	10	90	1015	7	110	2.527	1.807
2009	7	11	91	1003	12	130	2.426	1.721
2009	7	12	77	1002	14	215	4.961	3.325
2009	7	13	83	1000	10	130	3.28	2.352
2009	7	14	85	1001	7	90	3.413	2.451
2009	7	15	82	1010	8	260	4.778	3.261
2009	7	16	77	1016	7	215	3.778	2.763
2009	7	17	77	1017	13	285	5.17	3.284
2009	7	18	87	1012	7	245	2.862	2.041
2009	7	19	79	1010	10	265	5.096	3.401
2009	7	20	76	1011	9	210	4.218	3.051
2009	7	21	84	995	10	85	3.729	2.68
2009	7	22	85	994	10	235	4.145	2.79
2009	7	23	86	999	9	205	3.237	2.28
2009	7	24	82	1010	8	255	4.759	3.263
2009	7	25	80	1017	9	145	3.97	2.825
2009	7	26	82	1006	15	195	3.924	2.539
2009	7	27	78	1009	13	225	6.085	3.761
2009	7	28	84	1006	11	165	2.586	1.753
2009	7	29	80	1009	9	245	3.367	2.387
2009	7	30	75	1018	10	225	4.673	3.191
2009	7	31	88	1009	15	145	2.213	1.503
JUL			**2525.0**	**31273.0**	**304.0**	**6110.0**	**125.6**	**86.7**

Shannon Airport Weather Records 2009

Year	Month	Day	Mean Relative Humidity (%)	Mean MSL Pressure (hpa)	Mean wind Speed (kts)	Predominant Wind Direction (degrees)	Evaporation (mm)	Potential Evapotranspiration (mm)
2009	8	1	80	1008	14	255	4.262	2.767
2009	8	2	86	1008	11	145	2.954	1.956
2009	8	3	87	1003	12	145	2.679	1.879
2009	8	4	76	1005	11	160	4.174	2.954
2009	8	5	74	1012	12	170	4.307	3.023
2009	8	6	77	1018	7	170	3.506	2.581
2009	8	7	75	1021	7	170	3.389	2.494
2009	8	8	86	1019	7	255	3.752	2.673
2009	8	9	85	1017	6	190	2.662	1.989
2009	8	10	89	1014	9	260	2.451	1.721
2009	8	11	90	1023	10	245	2.391	1.669
2009	8	12	92	1021	9	245	2.483	1.784
2009	8	13	74	1020	4	125	3.855	2.9
2009	8	14	87	1011	10	165	2.328	1.723
2009	8	15	86	1010	12	240	3.171	2.061
2009	8	16	83	1014	13	235	2.491	1.803
2009	8	17	80	1014	9	215	3.557	2.573
2009	8	18	85	1010	11	145	2.782	2.02
2009	8	19	93	1006	9	160	1.623	1.129
2009	8	20	87	1006	13	230	3.176	2.034
2009	8	21	77	1017	12	190	4.284	2.901
2009	8	22	81	1017	10	135	3.54	2.302
2009	8	23	88	1005	11	140	2.126	1.413
2009	8	24	79	1002	11	185	3.447	2.392
2009	8	25	81	1003	9	200	2.874	1.996
2009	8	26	88	1000	13	255	2.03	1.284
2009	8	27	85	1007	14	220	2.427	1.581
2009	8	28	83	1014	15	260	3.657	2.39
2009	8	29	79	1020	9	235	3.061	2.2
2009	8	30	93	1010	8	140	1.653	1.2
2009	8	31	86	1000	10	155	2.091	1.477
AUG			**2592.0**	**31355.0**	**318.0**	**6040.0**	**93.2**	**64.9**

Shannon Airport Weather Records 2009

Year	Month	Day	Mean Relative Humidity (%)	Mean MSL Pressure (hpa)	Mean wind Speed (kts)	Predominant Wind Direction (degrees)	Evaporation (mm)	Potential Evapotranspiration (mm)
2009	9	1	86	1001	11	200	2.887	1.962
2009	9	2	92	1000	9	105	1.356	0.934
2009	9	3	82	1003	11	260	2.971	1.946
2009	9	4	80	1014	13	260	3.279	2.211
2009	9	5	79	1021	11	235	2.501	1.804
2009	9	6	88	1013	12	145	1.86	1.425
2009	9	7	86	1012	11	145	2.216	1.477
2009	9	8	87	1012	12	245	1.798	1.29
2009	9	9	82	1032	4	280	2.816	2.024
2009	9	10	83	1039	3	355	3.091	2.237
2009	9	11	79	1038	4	110	3.177	2.308
2009	9	12	83	1033	2	30	2.832	2.07
2009	9	13	81	1031	3	20	3.081	2.252
2009	9	14	82	1030	4	25	3.053	2.171
2009	9	15	82	1030	6	330	1.768	1.296
2009	9	16	76	1029	7	15	2.542	1.908
2009	9	17	78	1024	4	115	1.433	1.138
2009	9	18	73	1018	6	145	2.126	1.613
2009	9	19	79	1018	8	290	2.139	1.484
2009	9	20	81	1024	7	205	2.298	1.645
2009	9	21	79	1021	12	195	2.56	1.898
2009	9	22	81	1022	13	225	2.429	1.626
2009	9	23	84	1026	9	225	2.312	1.653
2009	9	24	80	1028	7	210	2.14	1.605
2009	9	25	82	1028	10	230	2.41	1.777
2009	9	26	88	1029	5	235	1.592	1.177
2009	9	27	90	1030	7	240	1.393	1.026
2009	9	28	90	1030	8	250	1.396	1.054
2009	9	29	85	1026	6	255	1.587	1.197
2009	9	30	87	1023	5	270	1.528	1.143
SEP			**2485.0**	**30685.0**	**230.0**	**5850.0**	**68.6**	**49.4**

Shannon Airport Weather Records 2009

Year	Month	Day	Mean Relative Humidity (%)	Mean MSL Pressure (hpa)	Mean wind Speed (kts)	Predominant Wind Direction (degrees)	Evaporation (mm)	Potential Evapotranspiration (mm)
2009	10	1	79	1024	6	335	1.381	1.012
2009	10	2	89	1021	11	240	1.619	1.208
2009	10	3	83	1010	16	245	1.718	1.208
2009	10	4	79	1012	5	240	1.601	1.211
2009	10	5	85	1008	7	105	1.488	1.11
2009	10	6	90	1003	7	330	0.766	0.551
2009	10	7	82	1014	3	310	1.327	0.935
2009	10	8	78	1019	4	135	1.606	1.155
2009	10	9	86	1009	11	125	1.589	1.312
2009	10	10	88	1016	7	230	1.522	1.101
2009	10	11	89	1019	8	270	1.201	0.781
2009	10	12	87	1029	3	110	1.108	0.79
2009	10	13	90	1030	5	110	1.126	0.851
2009	10	14	85	1030	6	115	1.436	1.096
2009	10	15	92	1034	3	350	1.043	0.755
2009	10	16	86	1036	4	25	0.911	0.664
2009	10	17	89	1031	5	115	1.087	0.764
2009	10	18	89	1020	6	170	1.125	0.867
2009	10	19	87	1001	14	140	1.359	1.02
2009	10	20	83	985	11	130	1.398	1.074
2009	10	21	88	982	13	95	1.404	1.07
2009	10	22	89	990	7	95	1.158	0.832
2009	10	23	93	1001	7	95	0.796	0.581
2009	10	24	89	996	18	225	1.19	0.829
2009	10	25	86	1009	14	240	1.318	0.992
2009	10	26	93	1014	8	100	0.729	0.511
2009	10	27	91	1007	14	145	0.973	0.719
2009	10	28	87	1012	10	135	1.146	0.915
2009	10	29	91	1012	14	135	1.055	0.825
2009	10	30	91	1009	14	145	0.842	0.605
2009	10	31	89	1014	8	145	0.998	0.791
OCT			**2703.0**	**31397.0**	**269.0**	**5385.0**	**38.0**	**28.1**

Shannon Airport Weather Records 2009

Year	Month	Day	Mean Relative Humidity (%)	Mean MSL Pressure (hpa)	Mean wind Speed (kts)	Predominant Wind Direction (degrees)	Evaporation (mm)	Potential Evapotranspiration (mm)
2009	11	1	89	999	10	265	0.729	0.509
2009	11	2	89	998	11	250	0.952	0.729
2009	11	3	84	986	15	240	0.924	0.657
2009	11	4	84	987	15	275	1.184	0.892
2009	11	5	77	1001	13	280	1.201	0.956
2009	11	6	86	998	13	245	0.75	0.534
2009	11	7	85	993	14	265	0.964	0.709
2009	11	8	86	1013	7	285	0.686	0.518
2009	11	9	96	1016	8	125	0.466	0.311
2009	11	10	90	1013	4	355	0.341	0.175
2009	11	11	95	999	7	90	0.542	0.394
2009	11	12	87	989	10	165	0.76	0.582
2009	11	13	87	988	11	130	0.691	0.526
2009	11	14	85	984	10	290	0.646	0.526
2009	11	15	88	995	10	155	0.717	0.577
2009	11	16	89	992	14	220	0.646	0.512
2009	11	17	87	1000	12	185	0.578	0.44
2009	11	18	90	997	18	185	0.921	0.699
2009	11	19	93	991	13	170	0.644	0.492
2009	11	20	85	1004	10	205	0.244	0.22
2009	11	21	84	994	19	155	0.606	0.493
2009	11	22	84	990	22	230	1.308	0.924
2009	11	23	87	998	15	245	0.564	0.475
2009	11	24	88	993	15	200	0.925	0.741
2009	11	25	82	991	17	205	1.203	0.959
2009	11	26	88	995	12	205	0.635	0.493
2009	11	27	94	996	7	215	0.423	0.311
2009	11	28	96	991	4	305	0.205	0.132
2009	11	29	89	995	13	330	0.72	0.502
2009	11	30	89	1011	6	310	0.207	0.145
NOV			**2633.0**	**29897.0**	**355.0**	**6780.0**	**21.4**	**16.1**

Shannon Airport Weather Records 2009

Year	Month	Day	Mean Relative Humidity (%)	Mean MSL Pressure (hpa)	Mean wind Speed (kts)	Predominant Wind Direction (degrees)	Evaporation (mm)	Potential Evapotranspiration (mm)
2009	12	1	91	1000	14	125	0.538	0.347
2009	12	2	91	991	8	115	0.517	0.429
2009	12	3	86	1004	8	275	0.516	0.418
2009	12	4	96	1000	8	115	0.574	0.446
2009	12	5	91	986	11	145	0.656	0.514
2009	12	6	80	986	15	195	1.075	0.862
2009	12	7	89	992	10	220	0.326	0.26
2009	12	8	85	1000	12	165	0.612	0.479
2009	12	9	84	1010	9	180	0.739	0.626
2009	12	10	91	1025	8	110	0.102	0.101
2009	12	11	87	1027	13	120	0.559	0.458
2009	12	12	91	1032	9	75	0.436	0.341
2009	12	13	94	1033	4	25	0	0
2009	12	14	98	1028	3	315	0.24	0.17
2009	12	15	92	1021	5	25	0.283	0.203
2009	12	16	97	1017	6	325	0.241	0.164
2009	12	17	92	1019	6	15	0	0
2009	12	18	90	1025	5	335	0.008	0
2009	12	19	89	1016	5	245	0.375	0.282
2009	12	20	94	1003	6	230	0.221	0.159
2009	12	21	94	989	6	215	0.237	0.167
2009	12	22	100	987	2	115	0.134	0.098
2009	12	23	98	987	3	325	0.214	0.154
2009	12	24	98	990	3	345	0.108	0.049
2009	12	25	98	994	5	110	0.158	0.101
2009	12	26	91	991	9	160	0.515	0.389
2009	12	27	88	1002	6	245	0.034	0.018
2009	12	28	93	1001	6	40	0.408	0.308
2009	12	29	89	992	16	35	0.914	0.611
2009	12	30	92	990	18	25	0.723	0.437
2009	12	31	81	1005	15	35	0.675	0.476
DEC			**2830.0**	**31143.0**	**254.0**	**5005.0**	**12.1**	**9.1**
TOTAL	**2009**						**795.9**	**558.8**

Rainfall Calculations

Month	Rainfall (mm) Shannon Airport	Evapotranspiration (mm) Shannon Airport	Evaporation (mm) Shannon Airport	Estimated Effective Rainfall - Capped Area (mm)	Estimated Effective Rainfall - Active Cell (mm)
JAN	120.4	13.1	17.6	107.3	102.8
FEB	15.7	16.6	23	-0.9	-7.3
MAR	64	38.4	56.6	25.6	7.4
APR	86.5	52.6	77.1	0*	0*
MAY	103.2	78	116.4	0*	0*
JUN	58.5	105.7	146.3	-47.2	0*
JUL	115.3	86.7	125.6	0*	0*
AUG	120.9	64.9	93.2	56	27.7
SEP	58.3	49.4	68.6	8.9	-10.3
OCT	87	28.1	38	58.9	49
NOV	263.2	16.1	21.4	247.1	241.8
DEC	72.7	9.1	12.1	63.6	60.6
TOTAL	**1165.7**	**558.7**	**795.9**	**607**	**369.8**

APPENDIX I – WATER BALANCE CALCULATIONS

Water Balance Calculations 2009

Upper Bound 10% infiltration of actual rainfall on the area covered with capping and Cell 1

Period (Jan 2009 - December 2009)	Active cell (m2)	Effective Rainfall (m) - Active Cell	Volume of waste (t)	Effective Rainfall x Active area	Absorptive Capacity (m3)	Volume of free leachate	Final Capped Area (m2)	Effective Rainfall (m) - Capped Area	Volume of Leachate capped (m3)	Total Leachate produced
January	4,370	0.1028	61	449.236	3.468	445.77	15742	0.1073	168.91	614.68
February	4,370	0	61	0	3.468	-3.47	15742	0	0.00	-3.47
March	4,370	0.0074	61	32.338	3.468	28.87	15742	0.0256	40.30	69.17
April	4,370	0	61	0	3.468	-3.47	15742	0	0	0
May	4,370	0	61	0	3.468	-3.47	15742	0	0	0
June	4,370	0	61	0	3.468	-3.47	15742	0	0.00	0
July	4,370	0	61	0	3.468	-3.47	15742	0	0	0
August	4,370	0.0277	61	121.049	3.468	117.58	15742	0.056	88.16	205.74
September	4,370	0	61	0	3.468	-3.47	15742	0.0089	14.01	10.54
October	4,370	0.049	61	214.13	3.468	210.66	15742	0.0589	92.72	303.38
November	4,370	0.2418	61	1056.666	3.468	1053.20	15742	0.2471	388.98	1442.18
December	4,370	0.0606	61	264.822	3.468	261.35	15742	0.0636	100.12	361.47
						2096.63			**893.20**	**2989.83**

Lower Bound 2% Infiltration of actual rainfall on the area covered with capping and Cell 1

Period (Jan 2009 - December 2009)	Active cell (m2)	Effective rainfall (m)	Volume of waste (t)	Effective Rainfall x Active area	Absorptive Capacity (m3)	Volume of free leachate	Final Capped Area (m2)	Effective Rainfall (m) - Capped Area	Volume of Leachate capped (m3)	Total Leachate produced
January	4,370	0.1028	61	449.236	3.468	445.77	15742	0.1073	33.78	479.55
February	4,370	0	61	0	3.468	-3.47	15742	0	0.00	-3.47
March	4,370	0.0074	61	32.338	3.468	28.87	15742	0.0256	8.06	36.93
April	4,370	0	61	0	3.468	-3.47	15742	0	0	0.00
May	4,370	0	61	0	3.468	-3.47	15742	0	0	0.00
June	4,370	0	61	0	3.468	-3.47	15742	0	0.00	-3.47
July	4,370	0	61	0	3.468	-3.47	15742	0	0.00	-3.47
August	4,370	0.0277	61	121.049	3.468	117.58	15742	0.056	17.63	135.21
September	4,370	0	61	0	3.468	-3.47	15742	0.0089	2.80	-0.67
October	4,370	0.049	61	214.13	3.468	210.66	15742	0.0589	18.54	229.21
November	4,370	0.2418	61	1056.666	3.468	1053.20	15742	0.2471	77.80	1130.99
December	4,370	0.0606	61	264.822	3.468	261.35	15742	0.0636	20.02	281.38
						2096.63			**178.64**	**2282.20**