Clare County Council

Tradaree Point Sludge Disposal Facility

Annual Environmental Report 2011

Waste Licence Reg. No. W0037-01

Response Group

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1.0 INTRODUCTION

Response Group 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 2011 to December 2011.

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Licence, Content of the Environmental Report, and has been prepared in accordance with the EPA (1999) Waste Licensing – Draft Guidance Note on Environmental Management Systems and Reporting to the Agency, the EPA Guidance Note for the Annual Environmental Report and the EPA AER/PRTR Guidance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 2011 to December 2011 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 accepts waste sludge from the Tradaree Point WWTP. 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 activity cells within the facility.
Class 4	Surface impoundment, including placement of liquid or sludge discards into pits, ponds 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 the Schedule which results in final compounds or mixtures which are disposed of by means of any activity referred to in paragraphs 1 to 5 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 sludge 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 2011

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 2011 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 2011, approximately 228 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 2011

Month	Quantity (Kg)
January	30,000
February	30,000
March	24,865
April	54,890
May	22,790
June	25,400
July	0
August	0
September	0
October	0
November	0
December	40000
Total (kg)	227945
TOTAL (tonnes)	228

2.3.2 Sludge Disposed 2004-2011

Table 2.3 below details the quantities of sludge disposed at the facility between 2004 and 2011.

Year	Quantity (Tonnes) Sludge Disposed/Annum
2004	1,022
2005	954
2006	408
2007	756
2008	548
2009	732
2010	489
2011	228

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 reduce through put and belt press breakdowns. The quantity of sludge accepted increased to 732 tonnes in 2009 but decreased in 2010 to 489 tonnes. The volume of sludge disposed in 2011 was 228 tonnes, No sludge passed through the facility between July and December 2011 due to machinery (belt press) breakdown.

The total capacity of the four lined cells is 12,029m3. Landfilling in the lined cells commenced in Cell 1 in 2005. In 2011, approximately 228 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 2011, the average cake % dry matter reached in the sludge was 19.65%. At this rate, the bulk density is typically calculated at rate of 1.41t/m3 (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 2011 was 162m3.

Based on the 2011 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 and 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 15,742m2. Since 2005, a total of 4,105 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 2,876 m3 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 75m3 per hour.

The monthly averages of leachate generated during 2011 are detailed in Table 2.4 below.

Table 2.4: the monthly averages of leachate generated in 2011

Month	Flow Rate (m^3/Month)
January	308
February	324
March	287
April	285
May	224
June	314
July	399
August	135
September	84
October	285
November	166
December	65
Total (M^3/Year)	2876

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 10-9m/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 m3/t/yr over the first ten years of a sites life. In this instance, the waste sludge was dried to an average of 19.65% dry matter in 2011. Assuming that the dry matter content would equate to the biodegradable component of the sludge and based on a total input in 2011 of 45 tonnes of biodegradable waste (19.65% of 228 total tonnes), this would indicate that the following upper and lower quantities of landfill gas might be generated:

- At 5 m3/t/yr an approximate production rate of 225m3 per annum
- At 10 m3/t/yr an approximate production rate of 450m3 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.

The most recent landfill gas assessment at Tradaree 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 m3/hr), with decreasing figures since that time. A total of 9.88 m3/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 m3/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-9m/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 1x10-9m/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 10-9m/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/m2/day) Note 1
350

Note 1: 30 day composite sample

Annual dust monitoring was conducted by TE Laboratories Ltd. (TelLab) at four locations between 29th July and 26th August 2011. 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 A.

Table 3.2 Dust Monitoring Results 2011

Location	N1	N3	N5	SS2
	mg/m2/day			
August 2011	23	18	52	16

Measured dust levels at all of the monitoring locations were below the ELV of 350 mg/m3/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 Response Group at four boundary locations (N1, N2, N3, N5) on the 12th December 2011. 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 2011

Location	Date	Sampling Interval	L_{Aeq} 30min Db(A)
N1	12/12/11	30 Minutes	41.7
N2	12/12/11	30 Minutes	39.5
N3	12/12/11	30 Minutes	38.9
N5	12/12/11	30 Minutes	41.5

Table 3.5 Night-time Noise Measurements 2011

Location	Date	Sampling Interval	L_{Aeq} 30min Db(A)
N1	12/12/11	30 Minutes	41.9
N2	12/12/11	30 Minutes	40.5
N3	12/12/11	30 Minutes	39.9
N5	12/12/11	30 Minutes	41.0

The average figures show that there are no noise issues on site. All results obtained from the measurements taken at the four locations by day and night are within the daytime and night-time limits of 55Dba and 45Dba. The noises that were most evident on site were the road traffic, on-site pumps and birds. It is clear from carrying out this report that the Waste Water Treatment Plant is having a minimal impact on the local environment in terms of Noise Pollution

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 Concentrations

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

During 2011, 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

Monthly methane concentrations measured at gas monitoring location RD1 were all below the threshold level of 1% v/v in 2011.

Methane levels in RD2 are below the threshold level in June and August but exceeded the threshold level of 1% v/v in all other monthly monitoring rounds. Methane levels above the threshold level ranged from 1.1% (November) to 31.3% (March).

Methane levels measured at RD3 exceeded the threshold level of 1% v/v in six of the monthly monitoring rounds. Methane levels above the threshold level ranged from 2.4% v/v (April) to 33.1% v/v (March).

Methane levels measured at RD4 exceeded the threshold level of 1% v/v in six of the twelve monthly monitoring rounds. Methane levels above the threshold level ranged from 1.1% (February) to 49.5% (October). All the other monthly monitoring rounds March to August were below the threshold level.

Methane levels measured at RD5 exceeded the threshold level of 1% v/v in seven of the 12 monthly monitoring rounds. Methane levels above the threshold level ranged from 2.2% (March) to 8.5% (November).

Methane levels measured at RD6 exceeded the threshold level of 1% v/v in all of the 12 monthly monitoring rounds. Methane levels ranged from 25.6% (January) to 84.2% (October).

Methane levels measured at RD8 exceeded the threshold level of 1% v/v in February with a level of 4.8%. The remaining months were all below the threshold level.

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 exceeded the limit of 1.5% v/v at RD1 in seven of the 12 monthly monitoring rounds – January (2.6%), February (1.6%), March (4.3%), April (1.5%), October (2.1%), November (3.5%) and December (3.5%).

At RD2, carbon dioxide levels exceeded the threshold level of 1.5% v/v in eight of the 12 monthly monitoring rounds – January (2.5%), February (2.8%), March (7.7%), April (2.2%), May (3.9%), July (2.1%), October (6.7%) and December (5.2%).

In RD3, carbon dioxide concentrations were above the threshold level of 1.5% v/v in nine of the 12 monthly monitoring rounds – January (17.8%), February (17.8%), March (20.3%), April (2.5%), May (13.3%), September (1.6%), October (5.5%), November (3.8%)and December (6.5%).

In RD4, carbon dioxide concentrations were above the threshold level of 1.5% v/v in all of the monthly in monitoring rounds – January (4.2%), February (5.5%), March (5.5%), April (5.4%), May (7.2%), June (6.3%), July (2.9%), August (6.3%), September (6.4%), October (11.5%), November (9.1%) and December (7.3%).

In RD5, carbon dioxide levels exceeded the threshold level of 1.5% in all of the monthly monitoring rounds – January (5.1%), February (4.4%), March (5.1%), April (2.0%), May (3.8%), June (5.4%), July (6.8%), August (5.4%), September (19.5%), October (17.7%), November (15.6%) and December (13.5%).

In RD6, carbon dioxide levels exceeded the threshold level of 1.5% v/v in all of the monthly monitoring rounds - January (11.4%), February (11.9%), March (14.1%), April (14.6%), May (14.4%), June (14.6%), July (17.7%), August (14.6%), September (18.7%), October (18.7%), November (16.9%) and December (16.0%).

In RD8, carbon dioxide levels exceeded the threshold level of 1.5% v/v in four of the monthly monitoring rounds – January (3.4%), February (1.6%), March (13.7%), April (1.2%).

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 2011 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 F. 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	Biannually

In 2011,
Dust analysis and reporting was carried out by TE Laboratories Ltd. (TelLab), Tullow, Co. Carlow.

Noise monitoring was carried out by Response Group.

Groundwater and leachate level monitoring, groundwater, leachate, surface water and landfill gas analysis and reporting was carried out by AMS (Advanced Micro Services & Environmental Laboratories Ltd) Clonmel, Co. Tipperary.

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 2011 in accordance with Tables D.4.1 and D.3.1 of W0037-01. Dust monitoring locations are outlined in Table 3.8 below.

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 results attached in Appendix A.

3.2.2.3 Dust Monitoring Results

The results of dust monitoring conducted at the facility during 2011 are presented in Table 3.9 below. 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 2011

Location	N1	N3	N5	SS2
	$mg/m^2/day$			
August 2011	23	18	52	16

All monitoring results were below the ELV for dust of 350 mg/m2/day.

3.2.3 Groundwater Monitoring

3.2.3.1 Groundwater Monitoring Locations

Groundwater monitoring was conducted at five locations during 2011 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 south-western 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.

Monitoring location BH3 was not sampled during the December monitoring round as the location was inaccessible at the time of sampling due to heavy bramble overgrowth. Monitoring location BH5 was not sampled during the December monitoring round as the borehole cover was unable to be removed due to frost.

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 E with the groundwater monitoring results. Groundwater levels recorded during 2011 varied between 0.0m below top of casing (BTOC) (in RD3 November 2011) and 3.8m BTOC (in BH4 November 2011).

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 April and November 2011.

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 7.11 to 7.90, which is within the IGV range of 6.5-9.5.

Electrical conductivity measurements ranged from 2080 PS/cm in RD3 (November) to 13,730 PS/cm in BH4 (November), which are similar to previous monitoring results. The IGV of 1,000 PS/cm was exceeded in all of the samples analysed.

Ammonia concentrations in BH3, BH4, BH5, RD2 and RD3 were detected at 24.8mg/l, 17.6mg/l, 14.1mg/l, 10.9mg/l and 0.19mg/l respectively, which were above the IGV of 0.15 mg/l.

Total phosphorus/orthophosphate concentrations in RD2 (0.11mg/l), BH3 (6.8mg/l), BH4 (1.65mg/l) and BH5 (8mg/l) exceeded the IGV for orthophosphate of 0.03 mg/l.

Total Oxidised Nitrogen concentrations in RD3 and BH5 (April 2011) was detected at 1.2 mg/l and 2.3mg/l respectively, all other samples analysed for this parameter were below the laboratory detection. This is similar to previous monitoring rounds.

Total organic carbon concentrations ranged from 1.5mg/l in RD3 (November 2011) to 24mg/l in BH3 and BH 4 (April 2011), TOC concentrations were similar to previous monitoring rounds.

Chloride concentrations ranged from 265 mg/l in RD3 (November 2011) to 5,350 mg/l in BH4 (April 2011). Chloride concentrations in all of the samples analysed exceeded the IGV of 30 mg/l.

Sodium concentration in RD2, RD3, BH3, BH4, and BH5 were detected at 650mg/l, 430mg/l, 2300mg/l, 2500mg/l and 1700mg/l (April 2011), which all exceeded the IGV of 150 mg/l.

Potassium concentrations in all five samples analysed during the April monitoring round exceeded the IGV of 5 mg/l. Concentrations ranged from 9.5mg/l in RD3 to 140mg/l in BH4.

Iron concentration in RD3 was detected at <0.01mg/l (April 2011). The Iron concentration in RD2 (1.5mg/l), BH3 (9.2mg/l), BH4 (14mg/l) and BH5 (0.74mg/l) all exceeded the IGV of 0.2 mg/l.

Magnesium was detected in RD3 (April 2011) at a concentration of 16mg/l. All other samples exceeded the IGV of 50 mg/l, ranging from 74mg/l in RD2 to 370mg/l in BH4.

The chromium concentrations in all samples were <0.01mg/l, which are below the IGV of 0.03 mg/l.

Total phenol concentrations were below the laboratory detection limit 0.0005mg/l in all the samples analysed during both monitoring rounds.

Calcium concentrations in BH3 (240mg/l), BH4 (260mg/l) and BH5 (220 mg/l) were above the IGV of 200mg/l. RD2 63mg/l and RD 3 37mg/l were below the IGV.

Concentrations of arsenic, boron, cadmium, copper, 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) and semi-volatile organic compounds (SVOC) were below laboratory detection limits at all of the monitoring locations.

3.2.3.4 Conclusions

Overall, the groundwater results are similar to the 2011 biannual and annual monitoring rounds. This represents an improvement in groundwater quality at the facility since previous monitoring rounds.

Certain parameters such as electrical conductivity, chloride, iron, magnesium, potassium, sodium and total phosphorus concentrations remain elevated at most or all monitoring locations compared to the IGV's.

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 December 2010 would appear to confirm that there is saline intrusion into groundwater monitoring wells most notably at location BH4. Measured concentrations ranged from 0.3 ppt in RD3 to 6 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 (CH4) and carbon dioxide(CO2) 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.

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.

3.2.5 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 April and November 2011 as per Schedule D of the licence.

The electrical conductivity in SS3 was measured at 1,530 PS/cm in April 2011 and 1,030 PS/cm in November 2011, which exceed the IGV of 1000 PS/cm. This is similar to previous monitoring rounds.

The chloride concentration in SS3 was detected at 111mg/l in April 2011 and 30.5mg/l in November 2011, which exceeds the IGV of 30 mg/l; however chloride concentrations have been consistently elevated since 2004.

The ammonia concentration in SS3 was detected at 10.6mg/l in April 2011 and 0.49mg/l in November 2011, which exceeds the IGV of 0.15 mg/l; however chloride concentrations have been consistently elevated since 2004.

Nickel and potassium concentrations were 0.11mg/l and 15mg/l respectively, which exceed their respective IGVs of 0.02 mg/l and 5 mg/l.

The iron concentration in SS3 was detected at 0.3mg/l in April 2011, which exceeded the IGV of 0.02 mg/l.

Comparison of results with the results from previous years, indicate that a number of parameters (Conductivity, ammonia, chloride, iron, nickel and potassium) remain consistently elevated above their respective IGVs.

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 14th December 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
N3	143.727	159.831
N5	143.937	160.076
SS2	143.879	159.874

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 2011

Location	Date	Sampling Interval	L_{Aeq} 30min dB(A)
N1	12/12/2011	30	41.7
N3	12/12/2011	30	38.9
N5	12/12/2011	30	41.5
SS2	12/12/2011	30	39.5

Table 3.15 Night-time Noise Measurements 2011

Location	Date	Sampling Interval	L_{Aeq} 30min dB(A)
N1	12/12/2011	30	41.9
N3	12/12/2011	30	39.9
N5	12/12/2011	30	41
SS2	12/12/2011	30	40.5

Day-time and night time noise levels at all boundary locations did not exceed the daytime emission limit LAeq of 55dB and 45 dB respectively.
It is noted that the predominant source on site were non site related traffic noise, on-site pumps and Birds.

3.2.7 Surface Water Monitoring

3.2.7.1 Surface Water Monitoring Locations

In total, five surface water locations were monitored in 2011 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 April 2011 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 April and November 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). Surface monitoring location SS7 was dry at the time of sampling.

There were no exceedances of the relevant thresholds or EQS's for any of the parameters analysed during both monitoring rounds undertaken in 2011.

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 I. 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 below.

Table 3.17 Summary Rainfall Data

Month	Rainfall (mm) Shannon Airport	Evapotranspiration (mm) Shannon Airport	Evaporation (mm)	Estimated Effective Rainfall – Capped Area (mm)	Estimated Effective Rainfall – Active Cell (mm)
JAN	74.1	8.1	11.5	66	62.6
FEB	149	16.3	23.5	132.7	125.5
MAR	34.3	37.4	54.2	0*	0*
APR	42.2	62.9	88.2	0*	0*
MAY	93.3	71.4	112	21.9	0*
JUN	112.5	79.6	116.6	32.9	0*
JUL	31.7	74.7	105.2	0*	0*
AUG	54.1	62.1	87.2	0*	0*
SEP	94.7	44	63.5	50.7	31.2
OCT	99.1	27.7	37.7	71.4	61.4
NOV	87.2	18.5	23.9	68.7	63.3
DEC	144.7	14.3	18.5	130.4	126.2
TOTAL	1016.9	517	742	574.7	470.2

***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 1016.9 mm of rainfall from January 2011 to December 2011.

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 2011, which was 19 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: $L0 = [(ER.a) + LW + IR] – [aW]$
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 2,918 m3 (upper bound) and 2,194 m3 (lower bound) of leachate was produced on site in 2011. 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 1,050 litres of diesel were used in 2011.

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 2011.

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 2011.
- There is no problem with litter at the facility and no complaints were received in 2011 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 2011.

The only vehicles that use the site roads are a tractor owned by Clare County Council and a 5-tonne sludge dumper truck. 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 exceedance was detected in 2011.

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, Paul O Keeffe and Michael Lynch. In addition, there is one weighbridge operator, John O Brien. 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	Land Fill Management	Ailish Johnson
Ailish Johnston	Landfill Assistant Manager	Landfill management, monthly reporting, environmental monitoring, nuisance control	Paul O Keeffe
Paul O'Keeffe	Landfill Assistant Manager	Landfill management, monthly reporting, environmental monitoring, nuisance control	Michael Lynch
Michael Lynch	Landfill Assistant Manager	Landfill management, monthly reporting, environmental monitoring, nuisance control	John O Brien
John O Brien	Weighbridge operator	Weighing sludge	Henry Greensmith

4.2 Environmental Management Programme/Environmental Objectives and Targets

The 2010 AER did not specify any environmental objectives and targets for 2011.

4.3 Schedule of Environmental Objectives and Targets for 2011

The licensee conducted a review of the EMS in 2010 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 2011.

4.4 Facility Procedures

No new procedures were developed or implemented at the site between January 2011 and December 2011.

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.

No additional environmental training was undertaken in 2011.

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 2011 to December 2011, no incidents occurred which would require reporting to the relevant authorities. No complaints or incidents were reported to the facility between January and December 2011.

5.1 Incidents

None recorded.

5.2 Non-compliances

No non-compliances were recorded.

5.3 Complaints

None Received.

5.4 Waste Record

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 December 2011.

Section 2 contains further information regarding sludge management.

6.0 FACILITY DEVELOPMENT

6.1 Developments during 2011

There were no other development works of note undertaken at the facility between January and December 2011.

6.2 Proposed Development of the Facility and Associated Timescales

At present, there are no facility development works planned for 2012.
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 in 2012.

FIGURE 1 – SITE LOCATION MAP

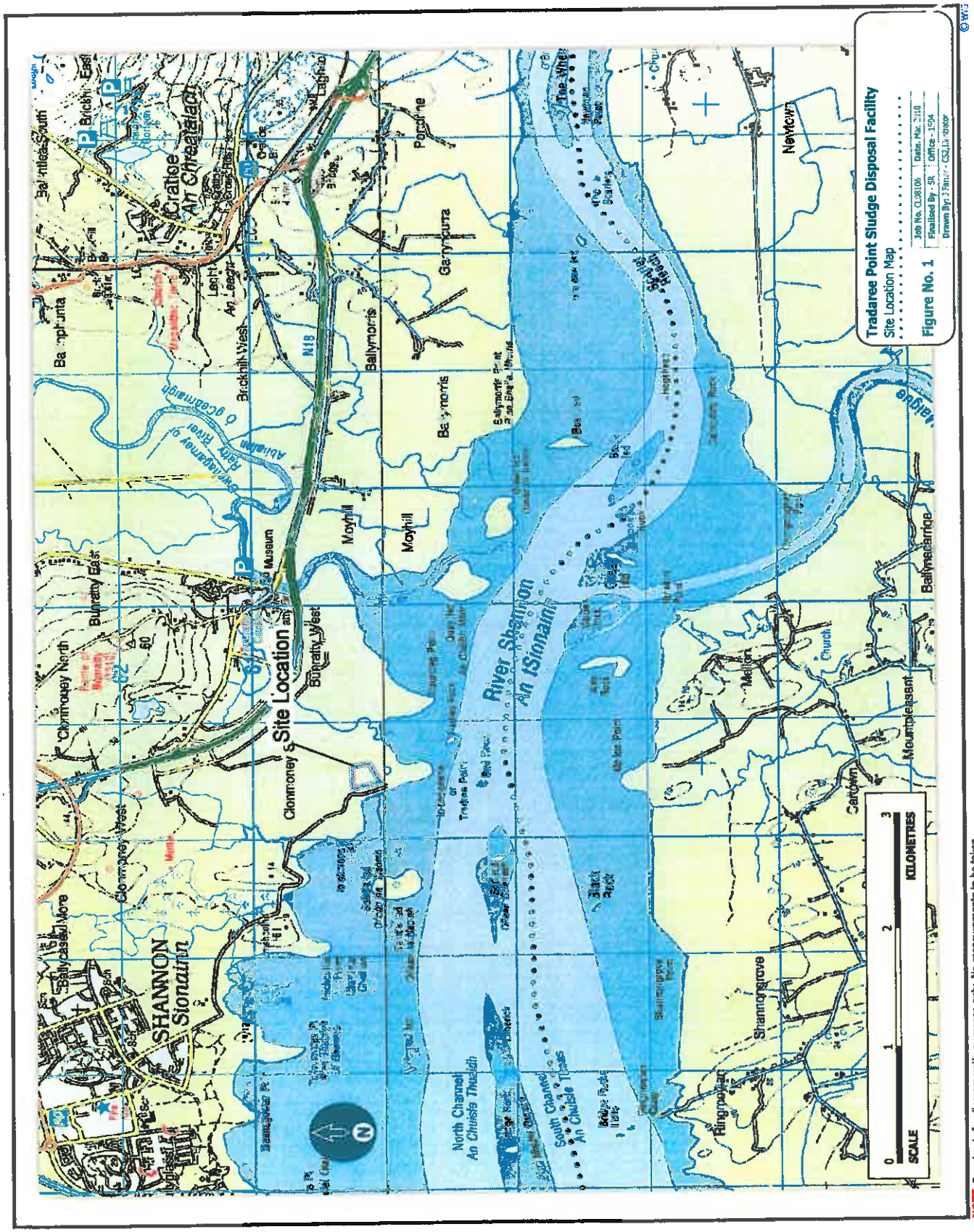
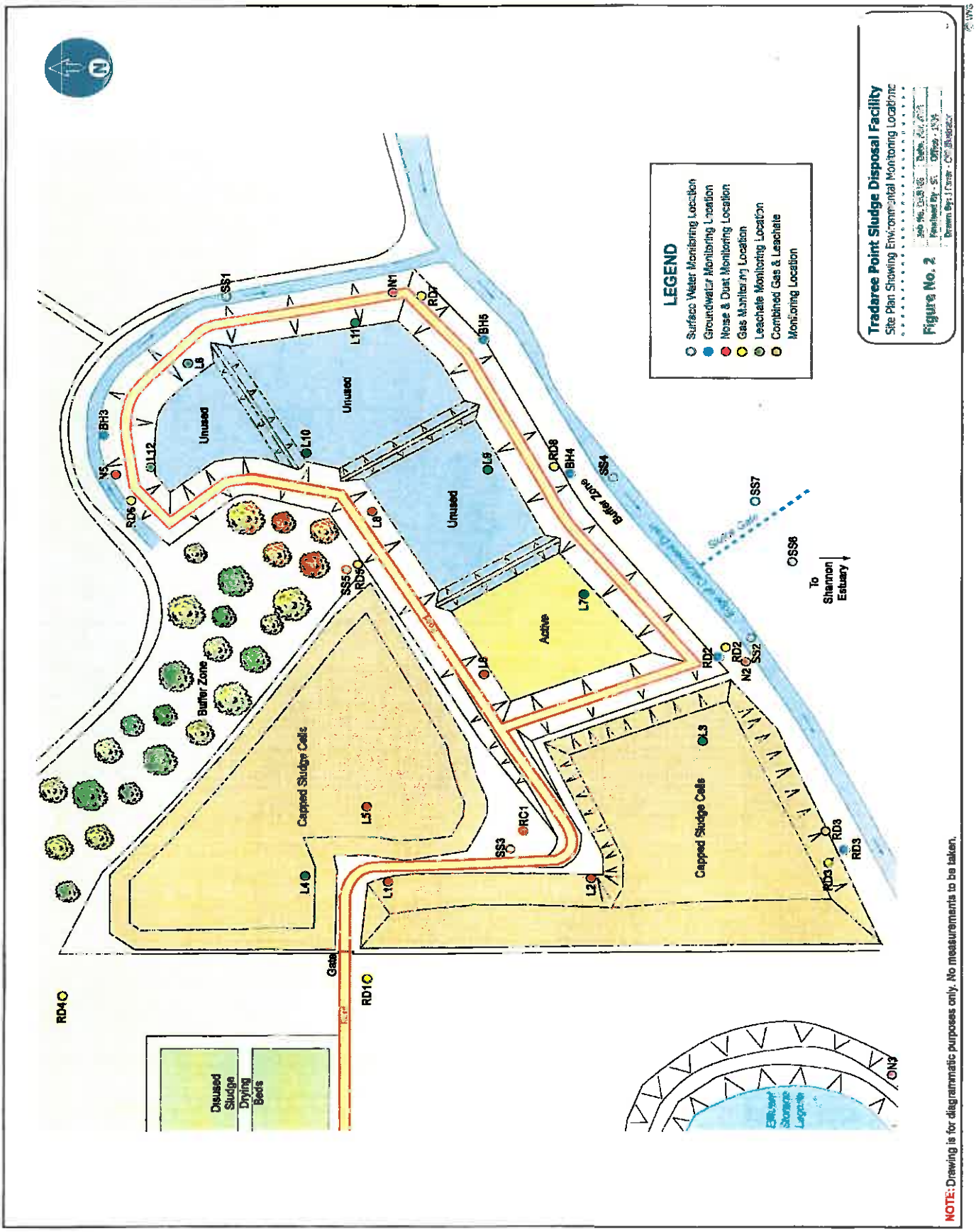

Tradaree Point Sludge Disposal Facility
Site Location Map
Figure No. 1
Site Location
River Shannon
An tSionainn
SHANNON
Sionainn
Clonmoney
Moyhill
Ballymorris
Garrykyura
Newtown
Mountpleasant
Shannongrove
Ringmoylan
North Channel
An Chuisle Thuaidh
South Channel
An Chuisle Theas
SCALE
KILOMETRES
NOTE: Drawing is for diagrammatic purposes only. No measurements to be taken.

FIGURE 2 – SITE PLAN SHOWING ENVIRONMENTAL MONITORING LOCATIONS


LEGEND
Surface Water Monitoring Location
Groundwater Monitoring Location
Noise & Dust Monitoring Location
Gas Monitoring Location
Leachate Monitoring Location
Combined Gas & Leachate Monitoring Location
Tradaree Point Sludge Disposal Facility
Site Plan Showing Environmental Monitoring Locations
Figure No. 2
Unused
Unused
Unused
Active
Capped Sludge Cells
Capped Sludge Cells
Buffer Zone
Buffer Zone
Gate
Disused Sludge Drying Beds
To Shannon Estuary
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
Loughmartin Business Park, Tullow, Co Carlow
Phone 059-9152881 Fax: 059-9152886

CERTIFICATE OF ANALYSIS

Page 1 of 2

Project Description:	Analysis of Dust Sample		
Attention:	Ms. Ailish Johnston	**Lab ID:**	97596
Company:	Response Engineering		
Address:	Railway Road, Charleville, Co. Cork	**Date Sampled:**	29.07.2011-26.08.2011
Certificate No:	L/11/1774	**Date Rec'd:**	29.08.2011
Issue Date:	12.09.2011	**Our Ref:**	WS-30393

Project Summary: One sample was 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:29.07.2011-26.08.2011
Date Received: 29.08.2011
Date Analysis Commenced:08.09.2011
Our Ref.: WS-30393
Your Ref: Shannon Landfill
Certificate No. L/11/1774

Sample ID	Lab ID	Dustfall (mg/m^2d)* (n/a)	Dustfall (g/m^2d)* (n/a)
N5	97596	52	0.052

*Note: d = sampling period in days (29)
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.

T.E Laboratories

TelLab

ANALYSIS OF DUST DEPOSITION GAUGES

Date Sampled: 30.06.2011 - 29.07.2011
Date Received: 02.08.2011
Date Analysis Commenced:05.08.2011
Our Ref.: WS-30241
Your Ref: Shannon Landfill
Certificate No. L/11/1581

Sample ID	Lab ID	Dustfall (mg/m^2d)* (n/a)	Dustfall (g/m^2d)* (n/a)
N1	97171	23	0.023
N3	97172	18	0.018
SS2	97173	16	0.016

*Note: d = sampling period in days (29)
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.

T.E Laboratories

APPENDIX B – NOISE SURVEY REPORT

Tradaree WWTP

Environmental Noise Monitoring 12th December 2011

Code	Location	Time	Range dB	Average dB	Maximum dB	Background Noise	Compliant
N1 Daytime	Boundary @ Landfill Cell 3	10.45 – 11.15	30-90	41.7	63.4	Road Traffic	Yes
N2 Daytime	Boundary @ Landfill Cell 1	11.21 - 11:51	30-90	39.5	69.5	Road Traffic, On-site pumps, Birds	Yes
N3 Daytime	Boundary @ Lagoon	11.55 - 12:25	30-90	38.9	71.7	Road Traffic, Flow of Water, Birds	Yes
N5 Daytime	Boundary @ Landfill Cell 1	12.30 - 13:00	30-90	41.5	56.7	Birds, Bees, Road Traffic	Yes
N1 Night-Time	Boundary @ Landfill Cell 3	23.30 - 00:00	30-90	41.9	59.9	Road Traffic	Yes
N2 Night-Time	Boundary @ Landfill Cell 1	00:10 - 00:40	30-90	40.5	71.3	Road Traffic, On-site pumps, Flow of Water	Yes
N3 Night-Time	Boundary @ Lagoon	00:50 - 01:20	30-90	39.9	73	Road Traffic, On-site pumps, Flow of Water	Yes
N5 Night-Time	Boundary @ Landfill Cell 1	01:30 - 02:00	30-90	41	59.5	Road Traffic	Yes

The weather was wet throughout the Daytime and Night-Time noise measurements.

The Noise meter was an INFOTECH – SLM – 1352A and was calibrated on the morning of the test.

Conclusion:

The average figures show that there are no noise issues on site. All results obtained from the measurements taken at the four locations by day and night are within the daytime and night-time limits of 55dBA and 45dBA. The noises that were most evident on site were the road traffic, on-site pumps and birds. It is clear from carrying out this report that the Waste Water Treatment Plant is having a minimal impact on the local environment in terms of Noise Pollution.

APPENDIX C – Landfill Gas Monitoring Results

Landfill Gas Analysis

Month January 2011

Date	Location	CO2	Methane	O2	Pressure	Relative Pressure	Temp
		%	%	%	mBar	mBar	OC
24-Jan-11	RD1	2.6	0.0	16.3	1039.0	0.0	8
	RD2	2.5	1.9	18.9	1039.0	0.0	8
	RD3	17.8	28.9	0.5	1039.0	17.9	7
	RD4	4.2	3.0	14.0	1039.0	-1.8	8
	RD5	5.1	6.9	10.0	1039.0	-22.0	7
	RD6	11.4	25.6	0.7	1038.0	0.0	7
	RD7	0.1	0.0	20.0	1038.0	0.0	7
	RD8	3.4	0.0	16.3	1038.0	0.0	8
	L6	0.1	0.0	19.8	1039.0	0.1	8
	L8	0.0	0.0	19.3	1038.0	-0.7	8
	L10	0.0	0.0	20.0	1038.0	0.0	8
	L12	0.0	0.0	19.7	1038.0	0.0	8
Trigger Level		1.5% v/v	1% v/v				

Shading indicates trigger level exceeded

Landfill Gas Analysis

Month February 2011

Date	Location	CO2	Methane	O2	Pressure	Atmosph	Temp
		%	%	%	mBar	Pressure	oC
24/02/11	RD1	1.6	0	19	0	1014	9
	RD2	2.8	1.2	19.5	0	1014	9
	RD3	17.8	30.8	0.6	32.6	1014	8
	RD4	5.5	1.1	8	-14.4	1014	9
	RD5	4.4	4.5	12.7	-2.2	1014	9
	RD6	11.9	35.3	0.3	-0.1	1014	9
	RD7	0.1	0	20.9	0	1014	10
	RD8	1.6	0	20.1	0.2	1014	9
	L6	0.1	0	20.7	0	1014	9
	L8	0.1	0	20.9	-0.6	1014	11
	L10	0.1	0	20.8	-1.8	1014	10
	L12	0.1	0	20.3	0.2	1014	10
Trigger Level		1.5% v/v	1% v/v				

Shading indicates trigger level exceeded

Landfill Gas Analysis							
Month	March 2011						
Date	Location	CO2	Methane	O2	Pressure	Atmosph	Temp
		%	%	%	mBar	Pressure	oC
28-Mar-11	RD1	4 3	0.1	15.6	0	1015	12
	RD2	7 7	31 2	12.4	0.1	1016	11
	RD3	20 3	33 1	0.7	27.2	1016	12
	RD4	5 5	0.6	10.5	-13.8	1016	11
	RD5	5 1	2 2	16.6	0.9	1020	11
	RD6	14 1	42 6	0.1	3.3	1019	11
	RD7	0.2	0.0	14.9	0	1018	11
	RD8	13 7	4.8	6.3	0.3	1017	13
	L6	0.1	0.0	20.8	0.4	1016	13
	L8	0.1	0.0	19.2	0.1	1016	13
	L10	0.1	0.0	20.4	-0.2	1018	11
	L12	0.1	0.1	19.0	-0.3	1019	11
Trigger Level		1.5% v/v	1% v/v				
Shading indicates trigger level exceeded							

Landfill Gas Analysis							
Month	April 2011						
Date	Location	CO2	Methane	O2	Pressure	Atmosph	Temp
		%	%	%	mBar	Pressure	oC
26-Apr-11	RD1	1 5	0.1	19.6	0	1025	13
	RD2	2 2	11 8	17.9	0	1025	13
	RD3	2 5	2 4	18.5	0	1025	14
	RD4	5 4	0.1	9.8	-14.1	1025	14
	RD5	2	0.2	19.3	-0.1	1027	13
	RD6	14 6	54.8	0.9	0	1026	14
	RD7	0.1	0.0	21	0	1026	14
	RD8	1 2	0.0	19.6	0	1025	14
	L6	0.1	0.0	20.8	0	1025	15
	L8	0.1	0.0	21	0	1025	15
	L10	0.1	0.0	21	0	1025	14
	L12	0.1	0.1	20.9	0	1026	14
Trigger Level		1.5% v/v	1% v/v				
Shading indicates trigger level exceeded							

Landfill Gas Analysis

Month May 2011

Date	Location	CO2	Methane	O2	Pressure	Atmosph	Temp
		%	%	%	mBar	Pressure	oC
23/5/11	RD1	0.6	0	20	0.1	1010	12
	RD2	3.9	21.5	14.6	0	1010	12
	RD3	13.3	2.7	6.4	-6.1	1010	11
	RD4	7.2	0	8.9	-0.2	1010	12
	RD5	3.8	0.0	18.5	0	1010	11
	RD6	14.4	67.1	.01	0.3	1009	11
	RD7	0.1	0	20.7	0	1010	10
	RD8	0.2	0	20.7	0	1010	10
	L6	0.1	0	20.7	0.5	1009	11
	L8	0.1	0	20.8	0.6	1009	12
	L10	0	0	20.7	0	1009	12
	L12	0.1	0	20.6	0.2	1009	12
Trigger Level		1.5% v/v	1% v/v				

Shading indicates trigger level exceeded

Landfill Gas Analysis

Month June 2011

Date	Location	CO2	Methane	O2	Pressure	Atmosph	Temp
		%	%	%	mBar	Pressure	oC
30-Jun-11	RD1	1.4	0.0	19.9	-0.1	14	1030
	RD2	0.8	0.4	20.1	-0.1	14	1030
	RD3	0.8	0	20.3	0	14	1030
	RD4	6.3	0.0	13.1	-6.1	14	1030
	RD5	5.4	0.0	17.6	0.3	14	1029
	RD6	14.6	64.4	4.5	0.2	15	1029
	RD7	0.1	0.0	20.7	0	14	1030
	RD8	0.2	0.0	20.6	0	14	1030
	L6	0.0	0.0	20.8	0.4	14	1029
	L8	0.1	0.0	20.8	0.2	14	1030
	L10	0.1	0.1	20.7	0.3	15	1029
	L12	0.2	0.6	20.5	-0.2	14	1029
Trigger Level		1.5% v/v	1% v/v				

Shading indicates trigger level exceeded

Landfill Gas Analysis

Month July 2011

Date	Location	CO2	Methane	O2	Pressure	Atmosph	Temp
		%	%	%	mBar	Pressure	oC
29-Jul-11	RD1	0.5	0.0	20	0	13	1021
	RD2	2.1	6.7	17.9	0	13	1022
	RD3	0.9	0.2	19.6	0.1	13	1021
	RD4	2.9	0.0	17.3	-11.7	13	1021
	RD5	6.8	0.0	16.7	-1.4	12	1025
	RD6	17.7	78.4	1.4	0	12	1024
	RD7	0.1	0.0	20.4	0	13	1022
	RD8	0	0	20.5	0	13	1022
	L6	0	0	20.5	0	13	1022
	L8	0	0	20.4	-0.8	13	1022
	L10	0	0	20.3	-0.1	13	1022
	L12	0	0	20.3	-0.2	13	1023
Trigger Level		1.5% v/v	1% v/v				

Shading indicates trigger level exceeded

Landfill Gas Analysis

Month August 2011

Date	Location	CO2	Methane	O2	Pressure	Atmosph	Temp
		%	%	%	mBar	Pressure	oC
30-Aug-11	RD1	1.4	0.0	19.9	-0.1	14	1030
	RD2	0.8	0.4	20.1	-0.1	14	1030
	RD3	0.8	0	20.3	0	14	1030
	RD4	6.3	0.0	13.1	-6.1	14	1030
	RD5	5.4	0.0	17.6	0.3	14	1029
	RD6	14.6	64.4	4.5	0.2	15	1029
	RD7	0.1	0.0	20.7	0	14	1030
	RD8	0.2	0.0	20.6	0	14	1030
	L6	0.0	0.0	20.8	0.4	14	1029
	L8	0.1	0.0	20.8	0.2	14	1030
	L10	0.1	0.1	20.7	0.3	15	1029
	L12	0.2	0.6	20.5	-0.2	14	1029
Trigger Level		1.5% v/v	1% v/v				

Shading indicates trigger level exceeded

Landfill Gas Analysis

Month September 2011

Date	Location	CO2	Methane	O2	Pressure	Atmosph	Temp
		%	%	%	mBar	Pressure	oC
29-Sep-11	RD1	0.7	0.1	19.6	0	1014	16
	RD2	1.5	1 9	18.7	0	1014	15
	RD3	1.6	0.5	19.1	0	1014	15
	RD4	6 4	16 3	10.8	-6.3	1014	16
	RD5	19 5	7 1	0.4	-0.2	1014	15
	RD6	18.7	83 3	0	-0.3	1014	15
	RD7	0.1	0.1	20.3	0	1014	16
	RD8	0.1	0.1	20.3	0	1014	16
	L6	0.0	0.1	20.3	0	1014	16
	L8	0.0	0.1	20.3	0	1014	16
	L10	0.1	0.0	20.3	0	1014	15
	L12	0.1	0.1	20.1	0	1014	15
Trigger Level		1.5% v/v	1% v/v				

Shading indicates trigger level exceeded

Landfill Gas Analysis

Month October 2011

Landfill Gas Analysis

Date	Location	CO2	Methane	O2	Pressure	Atmosph	Temp
		%	%	%	mBar	Pressure	oC
25-Oct-11	RD1	2 1	0.8	18.3	5.8	992	17
	RD2	6 7	25 0	12.7	1.1	990	16
	RD3	5 5	8.2	15.8	0.1	990	16
	RD4	11 5	49 5	2.3	-0.2	993	16
	RD5	17 7	7 2	0.7	13.6	992	16
	RD6	18 7	84 2	0	-1.3	991	16
	RD7	0.2	0.2	19.9	0	991	16
	RD8	0.1	0.1	19.9	0	991	16
	L6	0.1	0.1	19.9	0.2	991	16
	L8	0.1	0.1	19.9	-0.5	991	16
	L10	0.1	0.2	19.9	0.3	990	16
	L12	0.1	0.4	19.8	0.5	991	16
Trigger Level		1.5% v/v	1% v/v				

Shading indicates trigger level exceeded

Landfill Gas Analysis

Month November 2011

Date	Location	CO2	Methane	O2	Pressure	Atmosph	Temp
		%	%	%	mBar	Pressure	oC
28-Nov-11	RD1	3 5	0.2	16.8	5.4	1008	15
	RD2	1.2	1 1	18.5	0.1	1008	14
	RD3	3 8	1	18.4	0	1008	14
	RD4	9 1	18 2	1.8	-2.6	1008	15
	RD5	15 6	8 5	2.2	-9.2	1008	15
	RD6	16 9	75 6	0	0	1007	14
	RD7	0.1	0.2	20.1	0	1007	14
	RD8	0.2	0.2	20.1	0	1008	14
	L6	0.1	0.2	20.1	-0.1	1008	15
	L8	0.0	0.2	20.1	0	1007	15
	L10	0.0	0.2	20.1	0	1007	15
	L12	0.1	0.4	19.8	0	1007	14
Trigger Level		1.5% v/v	1% v/v				

Shading indicates trigger level exceeded

Landfill Gas Analysis

Month December 2011

Date	Location	CO2	Methane	O2	Pressure	Temp	Atmosph
		%	%	%	mBar	oC	Pressure
19-Dec-11	RD1	3 5	0.2	18.6	0	11	1015
	RD2	5 2	1 6	18.6	0	9	1013
	RD3	6 5	0.9	18	0.2	10	1013
	RD4	7 3	14.5	2.7	-4.3	10	1015
	RD5	13 5	7 7	0.9	1.5	10	1013
	RD6	16	64 1	0	-1	10	1012
	RD7	0.2	0.2	20.4	0	8	1012
	RD8	0.4	0.8	19.4	0	8	1012
	L6	0.1	0.1	20.3	0	11	1012
	L8	0.1	0.2	20.2	0	10	1012
	L10	0.1	0.2	20.3	0	11	1012
	L12	0.1	0.2	20.2	0	11	1012
Trigger Level		1.5% v/v	1% v/v				

Shading indicates trigger level exceeded

APPENDIX D – GROUNDWATER MONITORING RESULTS

Biannual/Annual Groundwater Monitoring Results 2011

PARAMETER	UNIT	EPA IGV	BH3		BH4		BH5		RD2		RD3	
			Apr	Nov	Apr	Nov	Apr	Nov	Apr	Nov	Apr	Nov
pH		≥6.5-≤9.5	6.6	7.1	6.7	7.1	6.8	7.4	7	7.4	7.3	7.6
Temperature	°C	25	9.1	10.4	8.9	10.3	9.4	10.7	9.1	9.6	9.3	10.3
Conductivity	µS/cm	1000	10340	13160	11510	13730	8490	10350	3120	4270	2350	2080
Water Level	m	-	1.05	0.6	0.3	3.8	1.1	0.4	0.84	0.77	0.86	0
Ammonia	NH3-N	0.2	24 8	22 6	17 6	17 1	14 1	16 2	10 9	12 9	0.19	0 39
Chloride	Cl mg/l	30	4825	4825	5350	4900	3650	3600	1020	1020	380	265
DO	%	NAC	1.6		4		0.75		9		0	
Arsenic	As mg/l	0.01	0 04		0 02		<0.02		0 02		<0.02	
Boron	B mg/l	1	1		1 3		1		0.078		0.17	
Cadmium	Cd mg/l	0.005	<0.01		<0.01		<0.01		<0.01		<0.01	
Calcium	Ca mg/l	200	240		260		220		63		37	
Chromium	Cr mg/l	0.03	<0.01		<0.01		<0.01		<0.01		<0.01	
Copper	Cu mg/l	0.03	<0.01		<0.01		<0.01		<0.01		<0.01	
Cyanide	Cn mg/l	0.01	<0.05		<0.05		<0.05		<0.05		<0.05	
Fluoride	F mg/l	1	0.82		0.64		0.81		0.99		0.95	
Iron	Fe mg/l	0.2	9 2		14		0 74		1 5		<0.01	
Lead	Pb mg/l	0.01	<0.03		<0.03		<0.03		<0.03		<0.03	
Magnesium	Mg mg/l	50	330		370		250		74		16	
Mercury	Hg mg/l	0.001	<0.01		<0.01		<0.01		<0.01		<0.01	
Nickel	Ni mg/l	0.02	<0.01		<0.01		<0.01		<0.01		<0.01	
Potassium	K mg/l	5	120		140		100		75		9 5	
Sodium	Na mg/l	150	2300		2500		1700		650		430	
Sulphate	SO_4 mg/l	200	100.4		6.1		55.6		<5		58.9	
Tin	Sn mg/l	-	<0.01		<.01		<0.01		<0.01		<0.01	
Total Phorphorus / Orthophosphate	P/PO_4 mg/l	0.03	6 8		1 65		8		0 11		<0.1	
Total Organic Carbon	C mg/l	NAC	24	16	24	15	20	10	18	13	3	1.5
Total Oxidised Nitrogen	N mg/l	NAC	<1.0	<2	<1.0	<2	2.3	<2	<1.0	<2	1.2	<2
Total Phenols	mg/l	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Zinc	Zn mg/l	0.1	<0.01		<0.01		0.02		<0.01		<0.01	
Solids Total	mg/l	-	12744		11548		16000		2720		1604	

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 AMS (Advanced Micro Services & Environmental Laboratories Ltd) on 27th April and 29th November 2011.

APPENDIX E – LEACHATE MONITORING RESULTS AND PUMPING DATA

Biannual / Annual Leachate Monitoring Results 2011

Parameter	Unit	EPA IGV	SS3	
			Apr-11	Nov-11
Ammonia	mg/l	0.15	10 6	0 49
Arsenic	mg/l	0.01	<0.02	
BOD Total 5 Day with ATU	mg/l	-	<2	3.1
Boron	mg/l	1	0.1	
Cadmium	mg/l	0.005	<0.01	
Calcium	mg/l	200	280	
Chloride	mg/l	30	111	30 5
Chromium	mg/l	0.03	<0.01	
COD Total	mg/l	-	113	53
Conductivity	uS/cm	1000	1530	1030
Copper	mg/l	0.03	<0.01	
Cyanide (Total)	mg/l	0.01	<0.05	
Dissolved Oxygen	%	NAC	0	
Flouride	mgF/l		0.75	
Groundwater Level	m	-		
Iron	mg/l	0.2	0.3	
Lead	mg/l	0.01	<0.03	
Magnesium	mg/l	50	44	
Mercury	mg/l	0.001	<0.01	
Mn (Dissolved				
Nickel	mg/l	0.02		
Nitrate	mg/l		<2.0	6.9
Nitrite	mg/l		0.05	0.33
pH Value	Units	6.5-9.5	6.5	7.5
Phenol	ug/l			
Potassium	mg/l	5	15	
Sodium	mg/l	150	83	
Solids Suspended		-		
Solids Total	mg/l			
Sulphate	mg/l	200	130.1	
Surfactant Anionic	ug/l		<200	
Temperature	°C	25	8.4	10.3
Tin	mg/l		<0.01	
Total Organic Carbon	mg/l	NAC		
Total Oxidised Nitrogen (TON)	mg/l	NAC	<1.0	<2
Total Phosphorus	mg/l	0.01	0.55	
Zinc	mg/l	0.1	0.02	

IGV = Interim Guideline Value - from the EPA Document "Towards Setting Guideline Values for the Protection of Groundwater in Ireland"

Results are shaded where they exceeded the EPA IGV

NAC = No abnormal Change

n/a = not analysed

n/r = not recorded

Analysis conducted by AMS (Advanced Micro Services & Environmental Laboratories Ltd) on 27th April and 29th November 2011.

APPENDIX F – SURFACE WATER MONITORING RESULTS

Biannual/Annual Surface Water Monitoring Results 2011

Parameter	Unit	EPA IGV	SS1 Apr-11	SS2 Apr-11	SS2 Nov-11	SS4 Apr-11	SS4 Nov-11	SS6 Apr-11	SS6 Nov-11	SS7 Apr-11	SS7 Nov-11	SW1 Apr-11	SW1 Nov-11
Ammonia	mg/l	0.02		<0.03	0 19	0.05	0 25	0.07	0.05		0.06	0 04	0.014
Arsenic	mg/l	0.02	<0.02	<0.02		<0.02		<0.02					
BOD Total 5 Day with ATU	mg/l	≤4		28.4	4 4	1.7	2.7	9	<2		<2	<1	3.5
Boron	mg/l	1	0.07	0.11		0.12		0.26					
Cadmium	mg/l	0.005	<0.01	<0.01		<0.01		<0.01					
Calcium	mg/l	200	150	180		170		170					
Chloride	mg/l	30											
Chromium	mg/l	0.03	<0.01	<0.01		<0.01		<0.01					
COD Total	mg/l	-		331	56	<10	48	98	30		30	11	51
Conductivity	uS/cm	1000		1024		916		1412				814	
Copper	mg/l	0.03	<0.01	<0.01		<0.01		<0.01					
Cyanide (Total)	mg/l	0.01	<0.05	<0.05		<0.05		<0.05					
Dissolved Oxygen	%	NAC	8.6	9.1	7.3	9.8	7.5	8.6	10.58		10.46		7.4
Flouride	mgF/l	5.0		0.35		0.51		0.79				0.07	
Groundwater Level	m	-											
Iron	mg/l	0.2	0.08	<0.01		<0.01		0.03					
Lead	mg/l	0.01	<0.03	<0.03		<0.03		<0.03					
Magnesium	mg/l	50	15	23		20		62					
Mercury	mg/l	0.001	<0.01	<0.01		<0.01		<0.01					
Mn (Dissolved	Ug/l		2	2600		1		2					
Nickel	mg/l	0.05	<0.01	0 09		<0.01		<0.01					
Nitrate	mg/l	-		3.1		4.9		5.3				8.9	
Nitrite	mg/l	-		<0.05		<0.05		<0.05				<0.05	
pH Value	Units	6.5-9.5		7.5	7.5	7.7	7.7	7.7	8.1		7.6	7.7	7.6
Phenol	ug/l												
Potassium	mg/l	5	9 1	8 3		11		40					
Sodium	mg/l	150	45	63		49		320					
Solids Suspended		50		850	<20	24	<20	318	27		30	<10	<20
Solids Total	mg/l												
Sulphate	mg/l	200		153.3		202		214 7				95.4	
Surfactant Anionic	ug/l												
Temperature	OC	25	7.2	7.7	9.7	8.6	9.7	8.1				7.2	9.7
Tin	mg/l	-	<0.01	<0.01		<0.01		<0.01					
Total Organic Carbon	mg/l	NAC											
Total Oxidised Ntirogen (TON)	mg/l	NAC		<1.0		1.1		1.2				2	
Total Phosphorus	mg/l	-		1.22		<0.1		0.33				0.46	
Zinc	mg/l	0.1	<0.01	<0.01		<0.01		<0.01					

IGV = Interim Guideline Value - from the EPA Document "Towards Setting Guideline Values for the Protection of Groundwater in Ireland"
Results are shaded where they exceeded the EPA IGV
NAC = No abnormal Change
n/a = not analysed
n/r = not recorded
Analysis conducted by AMS (Advanced Micro Services & Environmental Laboratories Ltd) on 27th April and 29th November 2011.

APPENDIX G – COPIES OF LABORATORY REPORTS

Advanced Micro Services & Environmental Laboratories Ltd
Carrigeen Business Park, Clonmel, Co. Tipperary
Tel: 052 6178100 • Fax: 052 6178133
www.amslabs.ie

ADVANCED MICRO SERVICES & ENVIRONMENTAL LABORATORIES LTD

TEST CERTIFICATE

Rev.No. 00

Confidential Report

Customer Contact: Ailish Johnson
Customer Name: Response Group
Traderee WWTP
Shannon
Co. Clare

Date of Receipt: 27/04/11
Date of Report: 28/05/11

Report Ref: WAT36607
Order No.: C110406

No. of Samples: 1
Sample Description: borehole water

Test Report

Sample Ref.	Lab No.	Test Description	Results / Units	Test Ref.	Flag
6. RD2 Annual Boreholes 27/04/11	WAT36607	Arsenic	0.02 mg/l	SUBCON	S*
		Boron	0.78 mg/l	SUBCON	S*
		Cadmium	<0.01 mg/l	SUBCON	S
		Calcium	63 mg/l	SUBCON	S*
		Chromium	<0.01 mg/l	SUBCON	S
		Copper	<0.01 mg/l	SUBCON	S
		Cyanide(Total)	<0.05 mg/l	SUBCON	S
		Iron	1.5 mg/l	SUBCON	S
		Lead	<0.03 mg/l	SUBCON	S
		Magnesium	74 mg/l	SUBCON	S*
		Mercury	<0.01 mg/l	SUBCON	S
		Nickel	<0.01 mg/l	SUBCON	S
		Potassium	75 mg/l	SUBCON	S*
		Sodium	650 mg/l	SUBCON	S*
		Tin	<0.01 mg/l	SUBCON	S*
		Zinc	<0.01 mg/l	SUBCON	S

Advanced Micro Services & Environmental Laboratories Ltd
Carrigeen Business Park, Clonmel, Co. Tipperary
Tel: 052 6178100 • Fax: 052 6178133
www.amslabs.ie

TEST CERTIFICATE

Test Report

Sample Ref.	Lab No.	Test Description	Results / Units	Test Ref.	Flag
6. RD2 Annual Boreholes 27/04/11	WAT36607	Temperature	9.1 Celcius	on site	S*
		Dissolved Oxygen	9 %	on site	S*
		List 1/11 Organic Substances ug/l	Not Detected#	SUBCON	S~

Results for all tests on list are below the Limit of Detection for this test.

S~ indicates a test that was subcontracted to another INAB accreditted laboratory on our approved list of subcontractors.
S indicates analysis that was subcontracted to another laboratory on our approved list of subcontractors who holds UKAS accreditation for this test.
S* indicates analysis that was subcontracted to another laboratory on our approved list of subcontractors who does not hold UKAS accreditation for this test.
This report relates only to samples tested.
This report shall not be reproduced except in full, without the approval of the Managing Director.

Approved By: Denis Kent
Technical Manager

Advanced Micro Services & Environmental Laboratories Ltd
Carrigeen Business Park, Clonmel, Co. Tipperary
Tel: 052 6178100 • Fax: 052 6178133
www.amslabs.ie

TEST CERTIFICATE

Ms Eilish Johnston
Response Engineering
Tradaree WWTP
Shannon, Clare
Ireland

Certificate Number: TWAT018736-2 Supplementary

Order Number:

Date Analysis Started: 28/04/2011

Date Reported: 30/05/2011

Lab Ref.	Sample Details	Method Number	Test	Result	Units	Flag
WAT36607	Desc: 6. RD2 Annual Boreholes 27/04/11 Date Received: 28/04/2011	NOT APPLICABLE	Transfer	See Attached Report	.	Ã
		P243	Sulphate	<5	mg / l SO4	
		P228	Fluoride	0.99	mg F / l	*
		P207	Total Phosphorus	0.11	mg / l P	
		P245	Surfactant Anionic	<200	µg / l LS	*
		P265	Solids Total	2720	mg / l	*

Note - On Site Sampling and analysis is carried out on behalf of AMS, by a subcontract company.

Denis M Kent
Technical Manager

Disclaimers:

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TEST CERTIFICATE

Rev.No. 00

Confidential Report

Customer Contact: Allish Johnson
Customer Name: Response Group
Traderee WWTP
Shannon
Co. Clare

Date of Receipt: 27/04/11
Date of Report: 28/05/11

Report Ref: WAT36612
Order No.: C110406

No. of Samples: 1
Sample Description: borehole water

Test Report

Sample Ref.	Lab No.	Test Description	Results / Units	Test Ref.	Flag
7. RD2 Bi-Annual Boreholes 27/04/11	WAT36612	Phenol	<0.5 ug/l	SUBCON	S
		Total Organic Carbon	18 mg/l	SUBCON	S
		Groundwater level	0.84 metres	on site	S*
		Temperature	9.1 Celcius	on site	S*
		Dissolved Oxygen	9 %	on site	S*

S indicates analysis that was subcontracted to another laboratory on our approved list of subcontractors who holds UKAS accreditation for this test.
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Technical Manager

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TEST CERTIFICATE

Ms Eilish Johnston
Response Engineering
Tradaree WWTP
Shannon, Clare
Ireland

Certificate Number: TWAT018741-1 Final

Order Number:

Date Analysis Started: 28/04/2011

Date Reported: 27/05/2011

Lab Ref.	Sample Details	Method Number	Test	Result	Units	Flag
WAT36612	Desc: 7. RD2 Bi- Annual Boreholes 27/04/11 Date Received: 28/04/2011	P235	Nitrate	<2.0	mg / l NO3	*
		NOT APPLICABLE	Transfer	See Attached Report	.	Ã
		P205	Chloride	1020	mg / l Cl	
		P236	Ammonia	10.90	mg / l N	
		P217	Nitrite	<0.05	mg / l NO2	*
		P268	Total Oxidised Nitrogen (TON)	<1.0	mg / l N	*
		UNKNOWN	Water Temperature	9.1	°C	*
		P227	Conductivity	3120	µS / cm	*
		P233	pH Value	7.0	Units	

Note - On Site Sampling and analysis is carried out on behalf of AMS, by a subcontract company.

Denis M Kent
Technical Manager

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response group

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Confidential Report

Customer Contact:	Eilish Johnson	Date of Receipt:	30/11/11
Customer Name:	Response Engineering Tradaree WWTP Shannon Co. Clare	Date of Report:	21/12/11

Report Ref:	WAT 23355-1	No. of Samples:	1
Order No.:	N/A	Sample Description:	Water

Test Report

Sample Ref.	Lab No.	Test Description	Results / Units	Test Ref.	Flag
RD2 taken 29/11/11 @ 9.30	WAT 42671	Total Organic Carbon (TOC)	13 mg/L	SUBCON	S
		Phenol	<0.0005 mg/L	SUBCON	S*
		Cresols	<0.0005 mg/L	SUBCON	S*
		Dimethylphenols	<0.0005 mg/L	SUBCON	S*
		Trimethylphenols	<0.0005 mg/L	SUBCON	S*

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Denis Kent
Technical Manager

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TEST CERTIFICATE

Ms Eilish Johnston
Response Engineering
Tradaree WWTP
Shannon, Clare
Ireland

Certificate Number: TWAT023355-1 Final

Order Number: POR 024780

Date Analysis Started: 30/11/2011

Date Reported: 21/12/2011

Lab Ref.	Sample Details	Method Number	Test	Result	Units	Flag
WAT42671	Desc: RD2 taken @ 09.30 Bi- Annual Boreholes 29/11/11 Order No: POR 024780 Date Received: 30/11/2011	P235	Nitrate	<5.0	mg / l NO3	*
		NOT APPLICABLE	Transfer	See Attached Report	.	Ã
		P205	Chloride	1020	mg / l Cl	
		P236	Ammonia	12.90	mg / l N	
		P217	Nitrite	<0.05	mg / l NO2	*
		P268	Total Oxdised Nitrogen (TON)	<2	mg / l N	*
		UNKNOWN	Water Temperature	9.6	°C	*
		P227	Conductivity	4270	µS / cm	*
		P233	pH Value	7.4	Units	

Note - Collection and onsite testing of samples was carried out by Advanced Micro Lab and environmental personnel.
Total Depth of Bore - 16.1m.
Water level below casing - 0.77m

Denis M Kent
Technical Manager

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TEST CERTIFICATE

Rev.No. 00

Confidential Report

Customer Contact: Ailish Johnson
Customer Name: Response Group
Tradaree WWTP
Shannon
Co. Clare

Date of Receipt: 27/04/11
Date of Report: 28/05/11

Report Ref: WAT36608
Order No.: C110406

No. of Samples: 1
Sample Description: borehole water

Test Report

Sample Ref.	Lab No.	Test Description	Results / Units	Test Ref.	Flag
8. RD3 Annual Boreholes 27/04/11	WAT36608	Arsenic	<0.02 mg/l	SUBCON	S*
		Boron	0.17 mg/l	SUBCON	S*
		Cadmium	<0.01 mg/l	SUBCON	S
		Calcium	37 mg/l	SUBCON	S*
		Chromium	<0.01 mg/l	SUBCON	S
		Copper	<0.01 mg/l	SUBCON	S
		Cyanide(Total)	<0.05 mg/l	SUBCON	S
		Iron	<0.01 mg/l	SUBCON	S
		Lead	<0.03 mg/l	SUBCON	S
		Magnesium	16 mg/l	SUBCON	S*
		Mercury	<0.01 mg/l	SUBCON	S
		Nickel	<0.01 mg/l	SUBCON	S
		Potassium	9.5 mg/l	SUBCON	S*
		Sodium	430 mg/l	SUBCON	S*
		Tin	<0.01 mg/l	SUBCON	S*
		Zinc	<0.01 mg/l	SUBCON	S

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Test Report

Sample Ref.	Lab No.	Test Description	Results / Units	Test Ref.	Flag
8. RD3 Annual Boreholes 27/04/11	WAT36608	Temperature	9.3 Celcius	on site	S*
		Dissolved Oxygen	0 %	on site	S*
		List 1/11 Organic Substances ug/l	Not Detected #	SUBCON	S~

Results for all tests on the list are below the limit of detection for the test.

S~ indicates a test that was subcontracted to abother iNAB accreditted laboratory on our approved list of subcontractors.
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Denis Kent
Technical Manager

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TEST CERTIFICATE

Ms Eilish Johnston
Response Engineering
Tradaree WWTP
Shannon, Clare
Ireland

Certificate Number: TWAT018737-2 Supplementary

Order Number:

Date Analysis Started: 28/04/2011

Date Reported: 30/05/2011

Lab Ref.	Sample Details	Method Number	Test	Result	Units	Flag
WAT36608	Desc: B. RD3 Annual Boreholes 27/04/11 Date Received: 28/04/2011	NOT APPLICABLE	Transfer	See Attached Report	.	Ã
		P243	Sulphate	58.9	mg / l SO4	
		P228	Fluoride	0.95	mg F / l	*
		P207	Total Phosphorus	<0.1	mg / l P	
		P245	Surfactant Anionic	<200	µg / l LS	*
		P265	Solids Total	1604	mg / l	*

Note - On Site Sampling and analysis is carried out on behalf of AMS, by a subcontract company.

Denis M Kent
Technical Manager

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TEST CERTIFICATE

Rev.No. 00

Confidential Report

Customer Contact: Ailish Johnson
Customer Name: Response Group
Traderee WWTP
Shannon
Co. Clare

Date of Receipt: 27/04/11
Date of Report: 28/05/11

Report Ref: WAT36613
Order No.: C110406

No. of Samples: 1
Sample Description: borehole water

Test Report

Sample Ref.	Lab No.	Test Description	Results / Units	Test Ref.	Flag
9. RD3 Bi-Annual Boreholes 27/04/11	WAT36613	Phenol	<0.5 ug/l	SUBCON	S
		Total Organic Carbon	3 mg/l	SUBCON	S
		Groundwater level	0.86 metres	on site	S*
		Temperature	9.3 Celcius	on site	S*
		Dissolved Oxygen	0 %	on site	S*

S indicates analysis that was subcontracted to another laboratory on our approved list of subcontractors who holds UKAS accreditation for this test.
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Technical Manager

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TEST CERTIFICATE

Ms Eilish Johnston
Response Engineering
Tradaree WWTP
Shannon, Clare
Ireland

Certificate Number: TWAT018742-1 Final

Order Number:

Date Analysis Started: 28/04/2011

Date Reported: 27/05/2011

Lab Ref.	Sample Details	Method Number	Test	Result	Units	Flag
WAT36613	Desc: 9. RD3 Bi- Annual Boreholes 27/04/11 Date Received: 28/04/2011	P235	Nitrate	5.3	mg / l NO3	*
		NOT APPLICABLE	Transfer	See Attached Report	.	Ã
		P205	Chloride	380	mg / l Cl	
		P236	Ammonia	0.19	mg / l N	
		P217	Nitrite	<0.05	mg / l NO2	*
		P268	Total Oxidised Nitrogen (TON)	1.2	mg / l N	*
		UNKNOWN	Water Temperature	9.3	°C	*
		P227	Conductivity	2350	µS / cm	*
		P233	pH Value	7.3	Units	

Note - On Site Sampling and analysis is carried out on behalf of AMS, by a subcontract company.

Denis M Kent
Technical Manager

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TEST CERTIFICATE

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Confidential Report

Customer Contact:	Eilish Johnson	Date of Receipt:	30/11/11
Customer Name:	Response Engineering Tradaree WWTP Shannon Co. Clare	Date of Report:	21/12/11

Report Ref:	WAT 23356-1	No. of Samples:	1
Order No.:	N/A	Sample Description:	Water

Test Report

Sample Ref.	Lab No.	Test Description	Results / Units	Test Ref.	Flag
RD3 taken 29/11/11 @ 10.15	WAT 42672	Total Organic Carbon (TOC)	1.5 mg/L	SUBCON	S
		Phenol	<0.0005 mg/L	SUBCON	S*
		Cresols	<0.0005 mg/L	SUBCON	S*
		Dimethylphenols	<0.0005 mg/L	SUBCON	S*
		Trimethylphenols	<0.0005 mg/L	SUBCON	S*

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Approved By: Denis Kent
Denis Kent
Technical Manager

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TEST CERTIFICATE

Ms Eilish Johnston
Response Engineering
Tradaree WWTP
Shannon, Clare
Ireland

Certificate Number: TWAT023356-1 Final

Order Number: POR 024780

Date Analysis Started: 30/11/2011

Date Reported: 21/12/2011

Lab Ref.	Sample Details	Method Number	Test	Result	Units	Flag
WAT42672	Desc: RD3 Bi- Annual Boreholes taken @ 10.15 on 29/11/11 Order No: POR 024780 Date Received: 30/11/2011	P235	Nitrate	<5.0	mg / l NO3	*
		NOT APPLICABLE	Transfer	See Attached Report	.	Ã
		P205	Chloride	265	mg / l Cl	
		P236	Ammonia	0.39	mg / l N	
		P217	Nitrite	<0.05	mg / l NO2	*
		P268	Total Oxidised Nitrogen (TON)	<2	mg / l N	*
		UNKNOWN	Water Temperature	10.3	°C	*
		P227	Conductivity	2080	µS / cm	*
		P233	pH Value	7.6	Units	

Note - Collection and onsite testing of samples was carried out by Advanced Micro Lab and environmental personnel.
Total Depth of Bore - 18.3m.
Water level below casing - 0.0m

Denis M Kent
Technical Manager

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TEST CERTIFICATE

Rev.No. 00

Confidential Report

Customer Contact: Ailish Johnson
Customer Name: Response Group
Traderee WWTP
Shannon
Co. Clare

Date of Receipt: 27/04/11
Date of Report: 28/05/11

Report Ref: WAT36609
Order No.: C110406

No. of Samples: 1
Sample Description: borehole water

Test Report

Sample Ref.	Lab No.	Test Description	Results / Units	Test Ref.	Flag
10. BH3 Annual Boreholes 27/04/11	WAT36609	Arsenic	0.04 mg/l	SUBCON	S*
		Boron	1 mg/l	SUBCON	S*
		Cadmium	<0.01 mg/l	SUBCON	S
		Calcium	240 mg/l	SUBCON	S*
		Chromium	<0.01 mg/l	SUBCON	S
		Copper	<0.01 mg/l	SUBCON	S
		Cyanide(Total)	<0.05 mg/l	SUBCON	S
		Iron	9.2 mg/l	SUBCON	S
		Lead	<0.03 mg/l	SUBCON	S
		Magnesium	330 mg/l	SUBCON	S*
		Mercury	<0.01 mg/l	SUBCON	S
		Nickel	<0.01 mg/l	SUBCON	S
		Potassium	120 mg/l	SUBCON	S*
		Sodium	2300 mg/l	SUBCON	S*
		Tin	<0.01 mg/l	SUBCON	S*
		Zinc	<0.01 mg/l	SUBCON	S

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Test Report

Sample Ref.	Lab No.	Test Description	Results / Units	Test Ref.	Flag
10. BH3 Annual Boreholes 27/04/11	WAT36609	Temperature	9.1 Celcius	on site	S*
		Dissolved Oxygen	1.6 %	on site	S*
		List 1/11 Organic Substances ug/l	Not Detected#	SUBCON	S~

Results for all tests on the list are below the limit of detection for this test.

S~ indicates a test that was subcontracted to another INAB accredited laboratory on our approved list of subcontractors.
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Denis Kent
Technical Manager

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TEST CERTIFICATE

Ms Eilish Johnston
Response Engineering
Tradaree WWTP
Shannon, Clare
Ireland

Certificate Number: TWAT018738-2 Supplementary

Order Number:

Date Analysis Started: 28/04/2011

Date Reported: 30/05/2011

Lab Ref.	Sample Details	Method Number	Test	Result	Units	Flag
WAT36609	Desc: 10. BH3 Annual Boreholes 27/04/11 Date Received: 28/04/2011	NOT APPLICABLE	Transfer	See Attached Report	.	A
		P243	Sulphate	100.4	mg / l SO4	
		P228	Fluoride	0.82	mg F / l	*
		P207	Total Phosphorus	6.8	mg / l P	
		P245	Surfactant Anionic	<200	µg / l LS	*
		P265	Solids Total	12744	mg / l	*

Note - On Site Sampling and analysis is carried out on behalf of AMS, by a subcontract company.

Denis M Kent
Technical Manager

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TEST CERTIFICATE

Rev.No. 00

Confidential Report

Customer Contact: Ailish Johnson
Customer Name: Response Group
Tradaree WWTP
Shannon
Co. Clare

Date of Receipt: 27/04/11
Date of Report: 28/05/11

Report Ref: WAT38614
Order No.: C110406

No. of Samples: 1
Sample Description: borehole water

Test Report

Sample Ref.	Lab No.	Test Description	Results / Units	Test Ref.	Flag
11. BH3 Bi-Annual Boreholes 27/04/11	WAT38614	Phenol	<0.5 ug/l	SUBCON	S
		Total Organic Carbon	24 mg/l	SUBCON	S
		Groundwater level	1.05 metres	on site	S*
		Temperature	9.1 Celcius	on site	S*
		Dissolved Oxygen	1.6 %	on site	S*

S Indicates analysis that was subcontracted to another laboratory on our approved list of subcontractors who holds UKAS accreditation for this test.
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Denis Kent
Technical Manager

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TEST CERTIFICATE

Ms Eilish Johnston
Response Engineering
Tradaree WWTP
Shannon, Clare
Ireland

Certificate Number: TWAT018743-1 Final

Order Number:

Date Analysis Started: 28/04/2011

Date Reported: 27/05/2011

Lab Ref.	Sample Details	Method Number	Test	Result	Units	Flag
WAT36614	Desc: 11. BH3 Bl- Annual Boreholes 27/04/11 Date Received: 28/04/2011	P235	Nitrate	<2.0	mg / l NO3	*
		NOT APPLICABLE	Transfer	See Attached Report	.	Ã
		P205	Chloride	4825	mg / l Cl	
		P236	Ammonia	24.80	mg / l N	
		P217	Nitrite	<0.05	mg / l NO2	*
		P268	Total Oxidised Nitrogen (TON)	<1.0	mg / l N	*
		UNKNOWN	Water Temperature	9.1	°C	*
		P227	Conductivity	10340	µS / cm	*
		P233	pH Value	6.6	Units	

Note - On Site Sampling and analysis is carried out on behalf of AMS, by a subcontract company.

Denis M Kent
Technical Manager

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Rev.No. 00

Confidential Report

Customer Contact: Eilish Johnson
Customer Name: Response Engineering
Tradaree WWTP
Shannon
Co. Clare

Date of Receipt: 30/11/11
Date of Report: 21/12/11

Report Ref: WAT 23357-1
Order No.: N/A

No. of Samples: 1
Sample Description: Water

Test Report

Sample Ref.	Lab No.	Test Description	Results / Units	Test Ref.	Flag
BH3 taken 29/11/11 @ 11.45	WAT 42673	Total Organic Carbon (TOC)	16 mg/L	SUBCON	S
		Phenol	<0.0005 mg/L	SUBCON	S*
		Cresols	<0.0005 mg/L	SUBCON	S*
		Dimethylphenols	<0.0005 mg/L	SUBCON	S*
		Trimethylphenols	<0.0005 mg/L	SUBCON	S*

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Technical Manager

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TEST CERTIFICATE

Ms Eilish Johnston
Response Engineering
Tradaree WWTP
Shannon, Clare
Ireland

Certificate Number: TWAT023357-1 Final

Order Number: POR 024780

Date Analysis Started: 30/11/2011

Date Reported: 21/12/2011

Lab Ref.	Sample Details	Method Number	Test	Result	Units	Flag
WAT42673	Desc: BH3 Bi- Annual Boreholes taken @ 11.45 on 29/11/11 Order No: POR 024780 Date Received: 30/11/2011	P235	Nitrate	<5.0	mg / l NO3	*
		NOT APPLICABLE	Transfer	See Attached Report	.	Ã
		P205	Chloride	4825	mg / l Cl	
		P236	Ammonia	22.60	mg / l N	
		P217	Nitrite	<0.05	mg / l NO2	*
		P268	Total Oxidised Nitrogen (TON)	<2	mg / l N	*
		UNKNOWN	Water Temperature	10.4	°C	*
		P227	Conductivity	13160	µS / cm	*
		P233	pH Value	7.1	Units	

Note - Collection and onsite testing of samples was carried out by Advanced Micro Lab and environmental personnel.
Total Depth of Bore - 5.3m.
Water level below casing - 0.6m

Denis M Kent
Technical Manager

Disclaimers:

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AMS ADVANCED MICRO SERVICES & ENVIRONMENTAL LABORATORIES LTD

TEST CERTIFICATE

Rev.No. 00

Confidential Report

Customer Contact: Ailish Johnson
Customer Name: Response Group
Traderee WWTP
Shannon
Co. Clare

Date of Receipt: 27/04/11
Date of Report: 28/05/11

Report Ref: WAT36610
Order No.: C110406

No. of Samples: 1
Sample Description: borehole water

Test Report

Sample Ref.	Lab No.	Test Description	Results / Units	Test Ref.	Flag
12. BH4 Annual Boreholes 27/04/11	WAT36610	Arsenic	0.02 mg/l	SUBCON	S*
		Boron	1.3 mg/l	SUBCON	S*
		Cadmium	<0.01 mg/l	SUBCON	S
		Calcium	260 mg/l	SUBCON	S*
		Chromium	<0.01 mg/l	SUBCON	S
		Copper	<0.01 mg/l	SUBCON	S
		Cyanide(Total)	<0.05 mg/l	SUBCON	S
		Iron	14 mg/l	SUBCON	S
		Lead	<0.03 mg/l	SUBCON	S
		Magnesium	370 mg/l	SUBCON	S*
		Mercury	<0.01 mg/l	SUBCON	S
		Nickel	<0.01 mg/l	SUBCON	S
		Potassium	140 mg/l	SUBCON	S*
		Sodium	2500 mg/l	SUBCON	S*
		Tin	<0.01 mg/l	SUBCON	S*
		Zinc	<0.01 mg/l	SUBCON	S

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Test Report

Sample Ref.	Lab No.	Test Description	Results / Units	Test Ref.	Flag
12. BH4 Annual Boreholes 27/04/11	WAT36610	Temperature	8.9 Celcius	on site	S*
		Dissolved Oxygen	4 %	on site	S*
		List 1/11 Organic Substances ug/l	Not Detected #	SUBCON	S~

Results for all tests on the list are below the limit of detection for this test.

S~ indicates a test which was subcontracted to abother INAB accredited laboratory on our approved list of subcontractors.
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Denis Kent
Technical Manager

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TEST CERTIFICATE

Ms Eilish Johnston
Response Engineering
Tradaree WWTP
Shannon, Clare
Ireland

Certificate Number: TWAT018739-2 Supplementary

Order Number:

Date Analysis Started: 28/04/2011

Date Reported: 30/05/2011

Lab Ref.	Sample Details	Method Number	Test	Result	Units	Flag
WAT36610	Desc: 12. BH4 Annual Boreholes 27/04/11 Date Received: 28/04/2011	NOT APPLICABLE	Transfer	See Attached Report	-	Ã
		P243	Sulphate	6.1	mg / l SO4	
		P228	Fluoride	0.64	mg F / l	*
		P207	Total Phosphorus	1.65	mg / l P	
		P245	Surfactant Anionic	<200	µg / l LS	*
		P265	Solids Total	11548	mg / l	*

Note - On Site Sampling and analysis is carried out on behalf of AMS, by a subcontract company.

Denis M Kent
Technical Manager

Disclaimers:

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TEST CERTIFICATE

Rev.No. 00

Confidential Report

Customer Contact: Ailish Johnson
Customer Name: Response Group
Traderee WWTP
Shannon
Co. Clare

Date of Receipt: 27/04/11
Date of Report: 28/05/11

Report Ref: WAT36815
Order No.: C110406

No. of Samples: 1
Sample Description: borehole water

Test Report

Sample Ref.	Lab No.	Test Description	Results / Units	Test Ref.	Flag
13. BH4 Bi-Annual Boreholes 27/04/11	WAT36815	Phenol	<0.5 ug/l	SUBCON	S
		Total Organic Carbon	24 mg/l	SUBCON	S
		Groundwater level	0.3 metres	on site	S*
		Temperature	8.9 Celcius	on site	S*
		Dissolved Oxygen	4 %	on site	S*

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This report relates only to samples tested.

Approved By: Denis Kent
Technical Manager

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TEST CERTIFICATE

Ms Ellish Johnston
Response Engineering
Tradaree WWTP
Shannon, Clare
Ireland

Certificate Number: TWAT018744-1 Final

Order Number:

Date Analysis Started: 28/04/2011

Date Reported: 27/05/2011

Lab Ref.	Sample Details	Method Number	Test	Result	Units	Flag
WAT36615	Desc: 13. BH4 Bi- Annual Boreholes 27/04/11 Date Received: 28/04/2011	P235	Nitrate	3.5	mg / l NO3	*
		NOT APPLICABLE	Transfer	See Attached Report	.	Ã
		P205	Chloride	5350	mg / l Cl	
		P236	Ammonia	17.60	mg / l N	
		P217	Nitrite	<0.05	mg / l NO2	*
		P268	Total Oxidised Nitrogen (TON)	<1.0	mg / l N	*
		UNKNOWN	Water Temperature	8.9	°C	*
		P227	Conductivity	11510	µS / cm	*
		P233	pH Value	6.7	Units	

Note - On Site Sampling and analysis is carried out on behalf of AMS, by a subcontract company.

Denis M Kent
Technical Manager

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response group

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TEST CERTIFICATE

Rev.No. 00

Confidential Report

Customer Contact:	Eilish Johnson	Date of Receipt:	30/11/11
Customer Name:	Response Engineering Tradaree WWTP Shannon Co. Clare	Date of Report:	21/12/11
Report Ref:	WAT 23358-1	No. of Samples:	1
Order No.:	N/A	Sample Description:	Water

Test Report

Sample Ref.	Lab No.	Test Description	Results / Units	Test Ref.	Flag
BH4 taken 29/11/11 @ 13.30	WAT 42674	Total Organic Carbon (TOC)	15 mg/L	SUBCON	S
		Phenol	<0.0005 mg/L	SUBCON	S*
		Cresols	<0.0005 mg/L	SUBCON	S*
		Dimethylphenols	<0.0005 mg/L	SUBCON	S*
		Trimethylphenols	<0.0005 mg/L	SUBCON	S*

S indicates analysis that was subcontracted to another laboratory on our approved list of subcontractors who holds UKAS accreditation for this test.
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Denis Kent
Technical Manager

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TEST CERTIFICATE

Ms Eilish Johnston
Response Engineering
Tradaree WWTP
Shannon, Clare
Ireland

Certificate Number: TWAT023358-1 Final

Order Number: POR 024780

Date Analysis Started: 30/11/2011

Date Reported: 21/12/2011

Lab Ref.	Sample Details	Method Number	Test	Result	Units	Flag
WAT42674	Desc: BH4 Bi- Annual Boreholes taken @ 13.30 on 29/11/11 Order No: POR 024780 Date Received: 30/11/2011	P235	Nitrate	<5.0	mg / l NO3	*
		NOT APPLICABLE	Transfer	See Attached Report	.	Ã
		P205	Chloride	4900	mg / l Cl	
		P236	Ammonia	17.10	mg / l N	
		P217	Nitrite	<0.05	mg / l NO2	*
		P268	Total Oxidised Nitrogen (TON)	<2	mg / l N	*
		UNKNOWN	Water Temperature	10.3	°C	*
		P227	Conductivity	13730	µS / cm	*
		P233	pH Value	7.1	Units	

Note - Collection and onsite testing of samples was carried out by Advanced Micro Lab and environmental personnel.
Total Depth of Bore - 6.4m.
Water level below casing - 3.8m

Denis M Kent
Technical Manager

Disclaimers:

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TEST CERTIFICATE

Rev.No. 00

Confidential Report

Customer Contact: Ailish Johnson
Customer Name: Response Group
Tradaree WWTP
Shannon
Co. Clare

Date of Receipt: 27/04/11
Date of Report: 28/05/11

Report Ref: WAT36611
Order No.: C110406

No. of Samples: 1
Sample Description: borehole water

Test Report

Sample Ref.	Lab No.	Test Description	Results / Units	Test Ref.	Flag
14. BH5 Annual Boreholes 27/04/11	WAT36611	Arsenic	<0.02 mg/l	SUBCON	S*
		Boron	1 mg/l	SUBCON	S*
		Cadmium	<0.01 mg/l	SUBCON	S
		Calcium	220 mg/l	SUBCON	S*
		Chromium	<0.01 mg/l	SUBCON	S
		Copper	<0.01 mg/l	SUBCON	S
		Cyanide(Total)	<0.05 mg/l	SUBCON	S
		Iron	0.74 mg/l	SUBCON	S
		Lead	<0.03 mg/l	SUBCON	S
		Magnesium	250 mg/l	SUBCON	S*
		Mercury	<0.01 mg/l	SUBCON	S
		Nickel	<0.01 mg/l	SUBCON	S
		Potassium	100 mg/l	SUBCON	S*
		Sodium	1700 mg/l	SUBCON	S*
		Tin	<0.01 mg/l	SUBCON	S*
		Zinc	0.02 mg/l	SUBCON	S

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Test Report

Sample Ref.	Lab No.	Test Description	Results / Units	Test Ref.	Flag
14. BH5 Annual Boreholes 27/04/11	WAT38611	Temperature	9.4 Celcius	on site	S*
		Dissolved Oxygen	0.75 %	on site	S*
		List 1/11 Organic Substances ug/l	Not Detected #	SUBCON	S~

Results for all tests on the list are below the limit of detection for the test.

S~ indicates a test which was subcontracted to abother INAB accredited laboratory on our approved list of subcontractors.
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Approved By: Denis Kent
Denis Kent
Technical Manager

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AMS ADVANCED MICRO SERVICES & ENVIRONMENTAL LABORATORIES LTD

TEST CERTIFICATE

Ms Eilish Johnston
Response Engineering
Tradaree WWTP
Shannon, Clare
Ireland

Certificate Number: TWAT018740-3 Supplementary

Order Number:

Date Analysis Started: 28/04/2011

Date Reported: 30/05/2011

Lab Ref.	Sample Details	Method Number	Test	Result	Units	Flag
WAT36611	Desc: 14. BH5 Annual Boreholes 27/04/11 Date Received: 28/04/2011	NOT APPLICABLE	Transfer	See Attached Report	.	Á
		P243	Sulphate	55.6	mg / l SO4	
		P228	Fluoride	0.81	mg F / l	*
		P207	Total Phosphorus	8	mg / l P	
		P245	Surfactant Anionic	<200	µg / l LS	*
		P265	Solids Total	16000	mg / l	*

Note - On Site Sampling and analysis is carried out on behalf of AMS, by a subcontract company.

Denis M Kent
Technical Manager

Disclaimers:

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TEST CERTIFICATE

Rev.No. 00

Confidential Report

Customer Contact: Ailish Johnson
Customer Name: Response Group
Tradaree WWTP
Shannon
Co. Clare

Date of Receipt: 27/04/11
Date of Report: 28/05/11

Report Ref: WAT36616
Order No.: C110406

No. of Samples: 1
Sample Description: borehole water

Test Report

Sample Ref.	Lab No.	Test Description	Results / Units	Test Ref.	Flag
15. BH5 Bi-Annual Boreholes 27/04/11	WAT36616	Phenol	<0.5 ug/l	SUBCON	S
		Total Organic Carbon	20 mg/l	SUBCON	S
		Groundwater level	1.1 metres	on site	S*
		Temperature	9.4 Celcius	on site	S*
		Dissolved Oxygen	0.75 %	on site	S*

S indicates analysis that was subcontracted to another laboratory on our approved list of subcontractors who holds UKAS accreditation for this test.
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Denis Kent
Technical Manager

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TEST CERTIFICATE

Ms Eilish Johnston
Response Engineering
Tradaree WWTP
Shannon, Clare
Ireland

Certificate Number: TWAT018745-1 Final

Order Number:

Date Analysis Started: 28/04/2011

Date Reported: 27/05/2011

Lab Ref.	Sample Details	Method Number	Test	Result	Units	Flag
WAT36616	Desc: 15. BH5 Bi- Annual Boreholes 27/04/11 Date Received: 28/04/2011	P235	Nitrate	10.2	mg / l NO3	*
		NOT APPLICABLE	Transfer	See Attached Report	.	Ã
		P205	Chloride	3650	mg / l Cl	
		P236	Ammonia	14.10	mg / l N	
		P217	Nitrite	<0.05	mg / l NO2	*
		P268	Total Oxidised Nitrogen (TON)	2.3	mg / l N	*
		UNKNOWN	Water Temperature	9.4	°C	*
		P227	Conductivity	8490	µS / cm	*
		P233	pH Value	6.8	Units	

Note - On Site Sampling and analysis is carried out on behalf of AMS, by a subcontract company.

Denis M Kent
Technical Manager

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TEST CERTIFICATE

Rev.No. 00

Confidential Report

Customer Contact: Eilish Johnson
Customer Name: Response Engineering
Tradaree WWTP
Shannon
Co. Clare

Date of Receipt: 30/11/11
Date of Report: 21/12/11

Report Ref: WAT 23359-1
Order No.: N/A

No. of Samples: 1
Sample Description: Water

Test Report

Sample Ref.	Lab No.	Test Description	Results / Units	Test Ref.	Flag
BH5 taken 29/11/11 @ 11.15	WAT 42675	Total Organic Carbon (TOC)	10 mg/L	SUBCON	S
		Phenol	<0.0005 mg/L	SUBCON	S*
		Cresols	<0.0005 mg/L	SUBCON	S*
		Dimethylphenols	<0.0005 mg/L	SUBCON	S*
		Trimethylphenols	<0.0005 mg/L	SUBCON	S*

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Technical Manager

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TEST CERTIFICATE

Ms Eilish Johnston
Response Engineering
Tradaree WWTP
Shannon, Clare
Ireland

Certificate Number: TWAT023359-1 Final

Order Number: POR 024780

Date Analysis Started: 30/11/2011

Date Reported: 21/12/2011

Lab Ref.	Sample Details	Method Number	Test	Result	Units	Flag
WAT42675	Desc: BH5 BI- Annual Boreholes taken @ 11.15 on 29/11/11 Order No: POR 024780 Date Received: 30/11/2011	P235	Nitrate	<5.0	mg / l NO3	*
		NOT APPLICABLE	Transfer	See Attached Report	-	Ã
		P205	Chloride	3600	mg / l Cl	
		P236	Ammonia	16.20	mg / l N	
		P217	Nitrite	<0.05	mg / l NO2	*
		P268	Total Oxidised Nitrogen (TON)	<2	mg / l N	*
		UNKNOWN	Water Temperature	10.7	°C	*
		P227	Conductivity	10350	µS / cm	*
		P233	pH Value	7.4	Units	

Note - Collection and onsite testing of samples was carried out by Advanced Micro Lab and environmental personnel.
Total Depth of Bore - 6.2m.
Water level below casing - 0.4m

Denis M Kent
Technical Manager

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TEST CERTIFICATE

Ms Ellish Johnston
Response Engineering
Tradaree WWTP
Shannon, Clare
Ireland

Certificate Number: TWAT018734-1 Final

Order Number:

Date Analysis Started: 28/04/2011

Date Reported: 27/05/2011

Lab Ref.	Sample Details	Method Number	Test	Result	Units	Flag
WAT36605	Desc: 4. Bi-Annual Lechate SS3 27/04/11 Date Received: 28/04/2011	P235	Nitrate	<2.0	mg / l NO3	*
		P280	BOD Total 5 Day with ATU	<2	mg / l	
		P210	COD Total	113	mg / l O2	
		P205	Chloride	111	mg / l Cl	
		P236	Ammonia	10.60	mg / l N	
		P217	Nitrite	0.05	mg / l NO2	*
		P268	Total Oxidised Nitrogen (TON)	<1.0	mg / l N	*
		UNKNOWN	Water Temperature	8.4	°C	*
		P227	Conductivity	1530	µS / cm	*
		P233	pH Value	6.5	Units	

Note - On Site Sampling and analysis is carried out on behalf of AMS, by a subcontract company.

Denis M Kent
Technical Manager

Disclaimers:

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TEST CERTIFICATE

Rev.No. 00

Confidential Report

Customer Contact: Ailish Johnson
Customer Name: Response Group
Traderee WWTP
Shannon
Co. Clare

Date of Receipt: 27/04/11
Date of Report: 28/05/11

Report Ref: WAT36606
Order No.: C110406

No. of Samples: 1
Sample Description: Leachate

Test Report

Sample Ref.	Lab No.	Test Description	Results / Units	Test Ref.	Flag
6. Annual Lechate SS3 27/04/11	WAT36606	Arsenic	<0.02 mg/l	SUBCON	S*
		Boron	0.1 mg/l	SUBCON	S*
		Cadmium	<0.01 mg/l	SUBCON	S
		Calcium	280 mg/l	SUBCON	S*
		Chromium	<0.01 mg/l	SUBCON	S
		Copper	<0.01 mg/l	SUBCON	S
		Cyanide(Total)	<0.05 mg/l	SUBCON	S
		Iron	0.3 mg/l	SUBCON	S
		Lead	<0.03 mg/l	SUBCON	S
		Magnesium	44 mg/l	SUBCON	S*
		Mercury	<0.01 mg/l	SUBCON	S
		Nickel	0.11 mg/l	SUBCON	S
		Potassium	15 mg/l	SUBCON	S*
		Sodium	83 mg/l	SUBCON	S*
		Tin	<0.01 mg/l	SUBCON	S*
		Zinc	0.02 mg/l	SUBCON	S

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TEST CERTIFICATE

Test Report

Sample Ref.	Lab No.	Test Description	Results / Units	Test Ref.	Flag
5. Annual Lechate SS3 27/04/11	WAT36606	Temperature	8.4 Celcius	on site	S*
		Dissolved Oxygen	0 %	on site	S*

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S* indicates analysis that was subcontracted to another laboratory on our approved list of subcontractors who does not hold UKAS accreditation for this test.
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Approved By: _____
Denis Kent
Technical Manager

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TEST CERTIFICATE

Ms Eilish Johnston
Response Engineering
Tradaree WWTP
Shannon, Clare
Ireland

Certificate Number: TWAT018735-1 Final

Order Number:

Date Analysis Started: 28/04/2011

Date Reported: 27/05/2011

Lab Ref.	Sample Details	Method Number	Test	Result	Units	Flag
WAT36606	Desc: 5. Annual Lechate SS3 27/04/11 Date Received: 28/04/2011	NOT APPLICABLE	Transfer	See Attached Report	.	Ā
		P243	Sulphate	130.1	mg / l SO4	
		P228	Fluoride	0.75	mg F / l	*
		P207	Total Phosphorus	0.55	mg / l P	
		P245	Surfactant Anionic	<200	µg / l LS	*

Note - On Site Sampling and analysis is carried out on behalf of AMS, by a subcontract company.

Denis M Kent
Technical Manager

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TEST CERTIFICATE

Ms Eilish Johnston
Response Engineering
Tradaree WWTP
Shannon, Clare
Ireland

Certificate Number: TWAT023354-1 Final

Order Number: POR 024780

Date Analysis Started: 30/11/2011

Date Reported: 21/12/2011

Lab Ref.	Sample Details	Method Number	Test	Result	Units	Flag
WAT42670	Desc: SS3 taken @ 12.00 on 29.11.11 Bi-Annual Lechate Order No: POR 024780 Date Received: 30/11/2011	P235	Nitrate	6.9	mg / l NO3	*
		P280	BOD Total 5 Day with ATU	3.1	mg / l	
		P210	COD Total	53	mg / l O2	
		P205	Chloride	30.5	mg / l Cl	
		P236	Ammonia	0.49	mg / l N	
		P217	Nitrite	0.33	mg / l NO2	*
		P268	Total Oxidised Nitrogen (TON)	<2	mg / l N	*
		UNKNOWN	Water Temperature	10.3	°C	*
		P227	Conductivity	1030	µS / cm	*
		P233	pH Value	7.5	Units	

Note - Collection and onsite testing of samples was carried out by Advanced Micro Lab and environmental personnel.

Denis M Kent
Technical Manager

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TEST CERTIFICATE

Rev.No. 00

Confidential Report

Customer Contact: Allish Johnson
Customer Name: Response Group
Traderee WWTP
Shannon
Co. Clare

Date of Receipt: 27/04/11
Date of Report: 28/05/11

Report Ref: WAT36617
Order No.: C110406

No. of Samples: 1
Sample Description: Surface water

Test Report

Sample Ref.	Lab No.	Test Description	Results / Units	Test Ref.	Flag
16. SS1 Annual Surface Water 27/04/11	WAT36617	Arsenic	<0.02 mg/l	SUBCON	S*
		Boron	0.07 mg/l	SUBCON	S*
		Cadmium	<0.01 mg/l	SUBCON	S
		Calcium	150 mg/l	SUBCON	S*
		Chromium	<0.01 mg/l	SUBCON	S
		Copper	<0.01 mg/l	SUBCON	S
		Cyanide(Total)	<0.05 mg/l	SUBCON	S
		Iron	0.08 mg/l	SUBCON	S
		Lead	<0.03 mg/l	SUBCON	S
		Magnesium	15 mg/l	SUBCON	S*
		Mn (Dissolved)	2 ug/l	SUBCON	S
		Mercury	<0.01 mg/l	SUBCON	S
		Nickel	<0.01 mg/l	SUBCON	S

response group

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Test Report

Sample Ref.	Lab No.	Test Description	Results / Units	Test Ref.	Flag
16. SS1 Annual Surface Water 27/04/11	WAT38617	Potassium	9.1 mg/l	SUBCON	S*
		Sodium	45 mg/l	SUBCON	S*
		Tin	<0.01 mg/l	SUBCON	S
		Zinc	<0.01 mg/l	SUBCON	S
		Temperature	7.2 Celcius	on site	S*
		Dissolved Oxygen	8.6 %	on site	S*

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Approved By: Denis Kent
Denis Kent
Technical Manager

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TEST CERTIFICATE

Ms Eilish Johnston
Response Engineering
Tradaree WWTP
Shannon, Clare
Ireland

Certificate Number: TWAT018746-1 Final

Order Number:

Date Analysis Started: 28/04/2011

Date Reported: 27/05/2011

Lab Ref.	Sample Details	Method Number	Test	Result	Units	Flag
WAT36617	Desc: 16. SW1 Annual Surface Water 27/04/11 Date Received: 28/04/2011	P235	Nitrate	8.9	mg / l NO3	*
		NOT APPLICABLE	Transfer	See Attached Report	.	Ã
		P243	Sulphate	95.4	mg / l SO4	
		P228	Fluoride	0.07	mg F / l	*
		P207	Total Phosphorus	0.46	mg / l P	
		P217	Nitrite	<0.05	mg / l NO2	*
		P268	Total Oxidised Nitrogen (TON)	2	mg / l N	*
		P227	Conductivity	814	µS / cm	*

Note - On Site Sampling and analysis is carried out on behalf of AMS, by a subcontract company.

Denis M Kent
Technical Manager

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TEST CERTIFICATE

Ms Eilish Johnston
Response Engineering
Tradaree WWTP
Shannon, Clare
Ireland

Certificate Number: TWAT018750-2 Supplementary

Date Analysis Started: 28/04/2011

Order Number:

Date Reported: 30/05/2011

Lab Ref.	Sample Details	Method Number	Test	Result	Units	Flag
WAT36621	Desc: 17. SW1 Bi-Annual Surface Water 27/04/11 Date Received: 28/04/2011	P280	BOD Total 5 Day with ATU	<1	mg/l	
		P210	COD Total	11	mg/l O2	
		P236	Ammonia	0.04	mg/l N	
		UNKNOWN	Water Temperature	7.2	°C	*
		P233	pH Value	7.7	Units	
		P202	Solids Suspended	<10	mg/l	

Note - On Site Sampling and analysis is carried out on behalf of AMS, by a subcontract company.

Denis M Kent
Technical Manager

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TEST CERTIFICATE

Ms Eilish Johnston
Response Engineering
Tradaree WWTP
Shannon, Clare
Ireland

Certificate Number: TWAT023360-1 Final

Order Number: POR 024780

Date Analysis Started: 30/11/2011

Date Reported: 21/12/2011

Lab Ref.	Sample Details	Method Number	Test	Result	Units	Flag
WAT42676	Desc: SW1 Bi-Annual Surface Water taken @ 12.00 on 29/11/11 Order No: POR 024780 Date Received: 30/11/2011	P280	BOD Total 5 Day with ATU	3.5	mg / l	
		P210	COD Total	51	mg / l O2	
		P204	Oxygen Dissolved	7.4	mg / l O2	
		P236	Ammonia	0.14	mg / l N	
		UNKNOWN	Water Temperature	9.7	°C	*
		P233	pH Value	7.6	Units	
		P202	Solids Suspended	<20	mg / l	

Note - Collection and onsite testing of samples was carried out by Advanced Micro Lab and environmental personnel.

Denis M Kent
Technical Manager

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response group

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TEST CERTIFICATE

Rev.No. 00

Confidential Report

Customer Contact: Allish Johnson
Customer Name: Response Group
Tradaree WWTP
Shannon
Co. Clare

Date of Receipt: 27/04/11
Date of Report: 28/05/11

Report Ref: WAT36618
Order No.: C110406

Test Report

No. of Samples: 1
Sample Description: Surface water

Sample Ref.	Lab No.	Test Description	Results / Units	Test Ref.	Flag
18. SS2 Annual Surface Water 27/04/11	WAT36618	Arsenic	<0.02 mg/l	SUBCON	S*
		Boron	0.11 mg/l	SUBCON	S*
		Cadmium	<0.01 mg/l	SUBCON	S
		Calcium	180 mg/l	SUBCON	S*
		Chromium	<0.01 mg/l	SUBCON	S
		Copper	<0.01 mg/l	SUBCON	S
		Cyanide(Total)	<0.05 mg/l	SUBCON	S
		Iron	<0.01 mg/l	SUBCON	S
		Lead	<0.03 mg/l	SUBCON	S
		Magnesium	23 mg/l	SUBCON	S*
		Mn (Dissolved)	2600 ug/l	SUBCON	S
		Mercury	<0.01 mg/l	SUBCON	S
		Nickel	0.09 mg/l	SUBCON	S

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Test Report

Sample Ref.	Lab No.	Test Description	Results / Units	Test Ref.	Flag
18. SS2 Annual Surface Water 27/04/11	WAT36618	Potassium	8.3 mg/l	SUBCON	S*
		Sodium	63 mg/l	SUBCON	S*
		Tin	<0.01 mg/l	SUBCON	S
		Zinc	<0.01 mg/l	SUBCON	S
		Temperature	7.7 Celcius	on site	S*
		Dissolved Oxygen	9.1 %	on site	S*

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Approved By: Denis Kent
Technical Manager

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TEST CERTIFICATE

Ms Eilish Johnston
Response Engineering
Tradaree WWTP
Shannon, Clare
Ireland

Certificate Number: TWAT018747-1 Final

Order Number:

Date Analysis Started: 28/04/2011

Date Reported: 27/05/2011

Lab Ref.	Sample Details	Method Number	Test	Result	Units	Flag
WAT36618	Desc: 18. SS2 Annual Surface Water 27/04/11 Date Received: 28/04/2011	P235	Nitrate	3.1	mg / l NO3	*
		NOT APPLICABLE	Transfer	See Attached Report	.	Ã
		P243	Sulphate	153.3	mg / l SO4	
		P228	Fluoride	0.35	mg F / l	*
		P207	Total Phosphorus	1.22	mg / l P	
		P217	Nitrite	<0.05	mg / l NO2	*
		P268	Total Oxidised Nitrogen (TON)	<1.0	mg / l N	*
		P227	Conductivity	1024	µS / cm	*

Note - On Site Sampling and analysis is carried out on behalf of AMS, by a subcontract company.

Denis M Kent
Technical Manager

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TEST CERTIFICATE

Ms Eilish Johnston
Response Engineering
Tradaree WWTP
Shannon, Clare
Ireland

Certificate Number: TWAT018751-2 Supplementary

Order Number:

Date Analysis Started: 28/04/2011

Date Reported: 30/05/2011

Lab Ref.	Sample Details	Method Number	Test	Result	Units	Flag
WAT36622	Desc: 19. SS2 Bi-Annual Surface Water 27/04/11 Date Received: 28/04/2011	P280	BOD Total 5 Day with ATU	28.4	mg / l	
		P210	COD Total	331	mg / l O2	
		P236	Ammonia	<0.03	mg / l N	
		UNKNOWN	Water Temperature	7.7	°C	*
		P233	pH Value	7.5	Units	
		P202	Solids Suspended	850	mg / l	

Note - On Site Sampling and analysis is carried out on behalf of AMS, by a subcontract company.

Denis M Kent
Technical Manager

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TEST CERTIFICATE

Ms Eilish Johnston
Response Engineering
Tradaree WWTP
Shannon, Clare
Ireland

Certificate Number: TWAT023361-1 Final

Order Number: POR 024780

Date Analysis Started: 30/11/2011

Date Reported: 21/12/2011

Lab Ref.	Sample Details	Method Number	Test	Result	Units	Flag
WAT42677	Desc: SS2 Bi-Annual Surface Water taken @ 10.00 on 29/11/11 Order No: POR 024780 Date Received: 30/11/2011	P280	BOD Total 5 Day with ATU	4.4	mg / l	
		P210	COD Total	56	mg / l O2	
		P204	Oxygen Dissolved	7.3	mg / l O2	
		P236	Ammonia	0.19	mg / l N	
		UNKNOWN	Water Temperature	9.7	°C	*
		P233	pH Value	7.5	Units	
		P202	Solids Suspended	<20	mg / l	

Note - Collection and onsite testing of samples was carried out by Advanced Micro Lab and environmental personnel.

Denis M Kent
Technical Manager

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TEST CERTIFICATE

Rev.No. 00

Confidential Report

Customer Contact: Ailish Johnson
Customer Name: Response Group
Traderee WWTP
Shannon
Co. Clare

Date of Receipt: 27/04/11
Date of Report: 28/05/11

Report Ref: WAT36619
Order No.: C110406

No. of Samples: 1
Sample Description: Surface water

Test Report

Sample Ref.	Lab No.	Test Description	Results / Units	Test Ref.	Flag
20. SS4 Annual Surface Water 27/04/11	WAT36619	Arsenic	<0.02 mg/l	SUBCON	S*
		Boron	0.12 mg/l	SUBCON	S*
		Cadmium	<0.01 mg/l	SUBCON	S
		Calcium	170 mg/l	SUBCON	S*
		Chromium	<0.01 mg/l	SUBCON	S
		Copper	<0.01 mg/l	SUBCON	S
		Cyanide(Total)	<0.05 mg/l	SUBCON	S
		Iron	<0.01 mg/l	SUBCON	S
		Lead	<0.03 mg/l	SUBCON	S
		Magnesium	20 mg/l	SUBCON	S*
		Mn (Dissolved)	1 ug/l	SUBCON	S
		Mercury	<0.01 mg/l	SUBCON	S
		Nickel	<0.01 mg/l	SUBCON	S

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Test Report

Sample Ref.	Lab No.	Test Description	Results / Units	Test Ref.	Flag
20. SS4 Annual Surface Water 27/04/11	WAT36619	Potassium	11 mg/l	SUBCON	S*
		Sodium	49 mg/l	SUBCON	S*
		Tin	<0.01 mg/l	SUBCON	S
		Zinc	<0.01 mg/l	SUBCON	S
		Temperature	8.6 Celcius	on site	S*
		Dissolved Oxygen	9.8 %	on site	S*

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Technical Manager

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TEST CERTIFICATE

Ms Eilish Johnston
Response Engineering
Tradaree WWTP
Shannon, Clare
Ireland

Certificate Number: TWAT018748-1 Final

Date Analysis Started: 28/04/2011

Order Number:

Date Reported: 27/05/2011

Lab Ref.	Sample Details	Method Number	Test	Result	Units	Flag
WAT36619	Desc: 20.SS4 Annual Surface Water 27/04/11 Date Received: 28/04/2011	P235	Nitrate	4.9	mg / l NO3	*
		NOT APPLICABLE	Transfer	See Attached Report	-	Ã
		P243	Sulphate	202	mg / l SO4	
		P228	Fluoride	0.51	mg F / l	*
		P207	Total Phosphorus	<0.1	mg / l P	
		P217	Nitrite	<0.05	mg / l NO2	*
		P268	Total Oxidised Nitrogen (TON)	1.1	mg / l N	*
		P227	Conductivity	916	µS / cm	*

Note - On Site Sampling and analysis is carried out on behalf of AMS, by a subcontract company.

Denis M Kent
Technical Manager

Disclaimers:

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TEST CERTIFICATE

Ms Eilish Johnston
Response Engineering
Tradaree WWTP
Shannon, Clare
Ireland

Certificate Number: TWAT018752-2 Supplementary

Order Number:

Date Analysis Started: 28/04/2011

Date Reported: 30/05/2011

Lab Ref.	Sample Details	Method Number	Test	Result	Units	Flag
WAT36623	Desc: 21.SS4 Bi-Annual Surface Water 27/04/11 Date Received: 28/04/2011	P280	BOD Total 5 Day with ATU	1.7	mg / l	
		P210	COD Total	<10	mg / l O2	
		P236	Ammonia	0.05	mg / l N	
		UNKNOWN	Water Temperature	8.6	°C	*
		P233	pH Value	7.7	Units	
		P202	Solids Suspended	24	mg / l	

Note - On Site Sampling and analysis is carried out on behalf of AMS, by a subcontract company.

Denis M Kent
Technical Manager

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TEST CERTIFICATE

Ms Elfish Johnston
Response Engineering
Tradaree WWTP
Shannon, Clare
Ireland

Certificate Number: TWAT023362-1 Final

Order Number: POR 024780

Date Analysis Started: 30/11/2011

Date Reported: 21/12/2011

Lab Ref.	Sample Details	Method Number	Test	Result	Units	Flag
WAT42678	Desc: SS4 Bi-Annual Surface Water taken @ 11.30 on 29/11/11 Order No: POR 024780 Date Received: 30/11/2011	P280	BOD Total 5 Day with ATU	2.7	mg / l	
		P210	COD Total	48	mg / l O2	
		P204	Oxygen Dissolved	7.5	mg / l O2	
		P236	Ammonia	0.25	mg / l N	
		UNKNOWN	Water Temperature	9.7	°C	*
		P233	pH Value	7.7	Units	
		P202	Solids Suspended	<20	mg / l	

Note - Collection and onsite testing of samples was carried out by Advanced Micro Lab and environmental personnel.

Denis M Kent
Technical Manager

Disclaimers:

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TEST CERTIFICATE

Rev.No. 00

Confidential Report

Customer Contact: Ailish Johnson
Customer Name: Response Group
Traderee WWTP
Shannon
Co. Clare

Date of Receipt: 27/04/11
Date of Report: 28/05/11

Report Ref: WAT36620
Order No.: C110406

No. of Samples: 1
Sample Description: Surface water

Test Report

Sample Ref.	Lab No.	Test Description	Results / Units	Test Ref.	Flag
22. SS6 Annual Surface Water 27/04/11	WAT36620	Arsenic	<0.02 mg/l	SUBCON	S*
		Boron	0.26 mg/l	SUBCON	S*
		Cadmium	<0.01 mg/l	SUBCON	S
		Calcium	170 mg/l	SUBCON	S*
		Chromium	<0.01 mg/l	SUBCON	S
		Copper	<0.01 mg/l	SUBCON	S
		Cyanide(Total)	<0.05 mg/l	SUBCON	S
		Iron	0.03 mg/l	SUBCON	S
		Lead	<0.03 mg/l	SUBCON	S
		Magnesium	62 mg/l	SUBCON	S*
		Mn (Dissolved)	2 ug/l	SUBCON	S
		Mercury	<0.01 mg/l	SUBCON	S
		Nickel	<0.01 mg/l	SUBCON	S

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TEST CERTIFICATE

Test Report

Sample Ref.	Leb No.	Test Description	Results / Units	Test Ref.	Flag
22. SS6 Annual Surface Water 27/04/11	WAT36620	Potassium	40 mg/l	SUBCON	S*
		Sodium	320 mg/l	SUBCON	S*
		Tin	<0.01 mg/l	SUBCON	S
		Zinc	<0.01 mg/l	SUBCON	S
		Temperature	8.1 Celcius	on site	S*
		Dissolved Oxygen	8.6 %	on site	S*

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Approved By:_____
Denis Kent
Technical Manager

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TEST CERTIFICATE

Ms Eilish Johnston
Response Engineering
Tradaree WWTP
Shannon, Clare
Ireland

Certificate Number: TWAT018749-1 Final

Order Number:

Date Analysis Started: 28/04/2011

Date Reported: 27/05/2011

Lab Ref.	Sample Details	Method Number	Test	Result	Units	Flag
WAT36620	Desc: 22. SS6 Annual Surface Water 27/04/11 Date Received: 28/04/2011	P235	Nitrate	5.3	mg / l NO3	*
		NOT APPLICABLE	Transfer	See Attached Report	.	Ã
		P243	Sulphate	214.7	mg / l SO4	
		P228	Fluoride	0.79	mg F / l	*
		P207	Total Phosphorus	0.33	mg / l P	
		P217	Nitrite	<0.05	mg / l NO2	*
		P268	Total Oxidised Nitrogen (TON)	1.2	mg / l N	*
		P227	Conductivity	1412	µS / cm	*

Note - On Site Sampling and analysis is carried out on behalf of AMS, by a subcontract company.

Denis M Kent
Technical Manager

Disclaimers:

Results reported in this Test Certificate relate only to the samples tested on an as received basis.
Opinions and interpretations expressed herein are outside the scope of INAB accreditation.
'*' Indicates a test which is not included in the INAB accreditation schedule of this laboratory.
' Ã ' Indicates a test which is subcontracted to another laboratory on our approved list of subcontractors.

Advanced Micro Services & Environmental Laboratories Ltd
Corrigeen Business Park, Clonmel, Co. Tipperary
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TEST CERTIFICATE

Ms Eilish Johnston
Response Engineering
Tradaree WWTP
Shannon, Clare
Ireland

Certificate Number: TWAT018753-2 Supplementary

Order Number:

Date Analysis Started: 28/04/2011

Date Reported: 30/05/2011

Lab Ref.	Sample Details	Method Number	Test	Result	Units	Flag
WAT36624	Desc: 23. SS6 Bi-Annual Surface Water 27/04/11 Date Received: 28/04/2011	P280	BOD Total 5 Day with ATU	9	mg / l	
		P210	COD Total	98	mg / l O2	
		P236	Ammonia	0.07	mg / l N	
		UNKNOWN	Water Temperature	8.1	°C	*
		P233	pH Value	7.7	Units	
		P202	Solids Suspended	318	mg / l	

Note - On Site Sampling and analysis is carried out on behalf of AMS, by a subcontract company.

Denis M Kent
Technical Manager

Disclaimers:

Results reported in this Test Certificate relate only to the samples tested on an as received basis.
Opinions and interpretations expressed herein are outside the scope of INAB accreditation.
'*' Indicates a test which is not included in the INAB accreditation schedule of this laboratory.

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TEST CERTIFICATE

Ms Eilish Johnston
Response Engineering
Tradaree WWTP
Shannon, Clare
Ireland

Certificate Number: TWAT022916-2 Supplementary

Order Number: POR 024780

Date Analysis Started: 02/12/2011

Date Reported: 21/12/2011

Lab Ref.	Sample Details	Method Number	Test	Result	Units	Flag
WAT42764	Desc: SS6 Bi-annual Surface Water 01/12/11. Taken by: A. Johnston Order No: POR 024780 Date Received: 02/12/2011	P280	BOD Total 5 Day with ATU	<2	mg / l	
		P210	COD Total	30	mg / l O2	
		P204	Oxygen Dissolved	10.58	mg / l O2	
		P236	Ammonia	0.05	mg / l N	
		P233	pH Value	8.1	Units	
		P202	Solids Suspended	27	mg / l	
WAT42765	Desc: SS7 Bi-annual Surface Water 01/12/11. Taken by: A. Johnston Order No: POR 024780 Date Received: 02/12/2011	P280	BOD Total 5 Day with ATU	<2	mg / l	
		P210	COD Total	30	mg / l O2	
		P204	Oxygen Dissolved	10.46	mg / l O2	
		P236	Ammonia	0.06	mg / l N	
		P233	pH Value	7.6	Units	
		P202	Solids Suspended	30	mg / l	

Note - Response carried out sampling and no temperature readings were recorded.

Denis M Kent
Technical Manager

Disclaimers:

Results reported in this Test Certificate relate only to the samples tested on an as received basis.
Opinions and interpretations expressed herein are outside the scope of INAB accreditation.

Appendix H – Meteorological Data

Shannon Airport Weather Records 2011

Year	Month	Day	Mean Relative Humidity (%)	Mean MSL pressure (hpa)	Mean Wind speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2011	1	1	90.6	1029.2	2.8	285.0	0.2	0.3
2011	1	2	85.9	1030.5	6.5	30.0	0.4	0.6
2011	1	3	85.3	1024.3	2.2	95.0	0.3	0.4
2011	1	4	87.7	1009.2	8.1	215.0	0.3	0.4
2011	1	5	90.9	995.6	5.9	220.0	0.2	0.2
2011	1	6	93.2	998.1	4.0	25.0	0.3	0.5
2011	1	7	86.7	995.4	7.9	25.0	0.3	0.4
2011	1	8	87.2	998.2	8.2	245.0	0.1	0.0
2011	1	9	86.1	1009.9	6.6	200.0	0.4	0.4
2011	1	10	96.0	997.8	8.4	110.0	0.3	0.4
2011	1	11	93.1	1007.8	7.6	90.0	0.2	0.3
2011	1	12	99.0	1004.2	6.6	180.0	0.2	0.3
2011	1	13	95.8	1003.7	6.9	140.0	0.3	0.4
2011	1	14	85.4	1002.5	11.1	195.0	0.3	0.4
2011	1	15	92.6	998.6	17.3	190.0	0.5	0.7
2011	1	16	82.8	1006.8	12.1	205.0	0.3	0.4
2011	1	17	92.5	1019.6	2.3	125.0	0.0	0.1
2011	1	18	93.7	1031.6	2.2	130.0	0.0	0.2
2011	1	19	93.2	1035.7	5.0	115.0	0.1	0.2
2011	1	20	98.2	1038.4	2.6	105.0	0.2	0.2
2011	1	21	99.3	1042.1	2.0	355.0	0.0	0.1
2011	1	22	100.0	1042.9	1.7	15.0	0.2	0.2
2011	1	23	99.8	1041.9	3.2	320.0	0.2	0.2
2011	1	24	97.7	1038.2	3.3	245.0	0.2	0.3
2011	1	25	95.2	1024.7	7.8	285.0	0.4	0.5
2011	1	26	84.3	1017.7	8.4	360.0	0.4	0.5
2011	1	27	80.8	1023.4	7.0	45.0	0.6	0.8
2011	1	28	73.7	1025.7	4.3	20.0	0.5	0.7
2011	1	29	82.4	1025.6	3.4	25.0	0.2	0.4
2011	1	30	85.0	1025.3	3.5	125.0	0.3	0.4
2011	1	31	90.1	1022.0	8.4	115.0	0.3	0.5
JAN							**8.1**	**11.5**

Shannon Airport Weather Records 2011

Year	Month	Day	Mean Relative Humidity (%)	Mean MSL pressure (hpa)	Mean Wind speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2011	2	1	91.6	1022.4	8.2	220.0	0.3	0.5
2011	2	2	83.1	1016.2	15.9	220.0	0.6	0.9
2011	2	3	87.1	1014.4	17.2	220.0	0.6	0.9
2011	2	4	87.4	1006.0	28.0	230.0	0.6	1.1
2011	2	5	99.3	1008.6	6.6	190.0	0.3	0.5
2011	2	6	95.4	1008.3	7.7	135.0	0.5	0.6
2011	2	7	85.8	1008.0	13.0	260.0	0.4	0.7
2011	2	8	89.6	1013.5	9.5	105.0	0.4	0.6
2011	2	9	93.8	1007.8	6.0	140.0	0.3	0.5
2011	2	10	95.5	1009.5	4.9	105.0	0.4	0.6
2011	2	11	88.9	1005.2	7.5	215.0	0.6	0.7
2011	2	12	87.0	1004.2	9.9	145.0	0.4	0.6
2011	2	13	93.7	993.2	4.1	215.0	0.4	0.6
2011	2	14	82.3	994.4	8.6	215.0	0.8	1.1
2011	2	15	89.5	980.2	11.0	80.0	0.6	0.8
2011	2	16	86.7	987.9	6.6	60.0	0.6	0.9
2011	2	17	95.4	1002.8	3.6	20.0	0.4	0.6
2011	2	18	94.0	1001.4	9.5	125.0	0.4	0.6
2011	2	19	91.5	1005.0	7.0	115.0	0.7	1.0
2011	2	20	90.2	1005.1	11.2	125.0	0.7	1.0
2011	2	21	90.8	1008.0	4.5	115.0	0.7	1.0
2011	2	22	98.6	1010.8	6.5	120.0	0.5	0.7
2011	2	23	90.2	1010.9	9.2	140.0	0.9	1.2
2011	2	24	85.6	1015.9	8.8	155.0	0.9	1.2
2011	2	25	83.8	1015.8	10.3	180.0	0.8	1.1
2011	2	26	85.5	1019.5	8.8	245.0	0.8	1.3
2011	2	27	81.9	1027.6	8.6	300.0	0.9	1.3
2011	2	28	82.6	1035.1	2.1	325.0	0.6	0.9
FEB							**16.3**	**23.5**

Shannon Airport Weather Records 2011

Year	Month	Day	Mean Relative Humidity (%)	Mean MSL pressure (hpa)	Mean Wind speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2011	3	1	77.0	1039.2	4.9	120.0	1.1	1.5
2011	3	2	79.9	1037.9	3.7	110.0	0.8	1.1
2011	3	3	81.9	1037.6	2.6	50.0	0.8	1.2
2011	3	4	90.9	1033.7	2.0	30.0	0.6	0.8
2011	3	5	86.8	1031.7	2.3	100.0	0.7	0.9
2011	3	6	77.1	1030.1	5.0	115.0	0.8	1.1
2011	3	7	79.0	1028.4	4.0	115.0	1.1	1.6
2011	3	8	86.9	1018.8	9.3	230.0	0.8	1.2
2011	3	9	81.7	1015.8	15.0	255.0	1.1	1.8
2011	3	10	77.3	1012.0	15.4	255.0	1.1	1.6
2011	3	11	88.3	1007.4	7.8	215.0	0.7	1.0
2011	3	12	89.5	998.3	7.8	320.0	0.8	1.2
2011	3	13	84.3	1003.7	7.8	320.0	1.1	1.7
2011	3	14	81.3	1013.8	4.7	345.0	1.0	1.4
2011	3	15	81.0	1016.7	3.1	320.0	1.2	1.7
2011	3	16	82.4	1015.7	4.3	175.0	1.2	1.8
2011	3	17	70.5	1018.0	5.8	290.0	1.1	1.6
2011	3	18	77.8	1024.4	5.4	225.0	1.2	1.7
2011	3	19	89.5	1029.4	8.9	145.0	0.7	1.2
2011	3	20	89.8	1027.7	8.1	235.0	1.3	1.9
2011	3	21	88.9	1032.8	4.7	135.0	1.1	1.5
2011	3	22	80.5	1038.5	2.7	120.0	2.0	2.9
2011	3	23	77.0	1039.1	3.4	105.0	1.7	2.4
2011	3	24	77.1	1033.3	3.4	75.0	1.8	2.5
2011	3	25	79.3	1021.6	4.5	25.0	1.8	2.5
2011	3	26	76.0	1016.1	5.6	20.0	1.7	2.5
2011	3	27	79.8	1015.7	4.9	20.0	1.5	2.1
2011	3	28	79.5	1014.6	5.3	105.0	1.7	2.5
2011	3	29	83.4	1008.8	6.9	120.0	1.6	2.1
2011	3	30	82.3	1003.8	11.0	145.0	1.6	2.5
2011	3	31	79.5	1003.8	16.8	230.0	1.8	2.7
MAR							**37.4**	**54.2**

Shannon Airport Weather Records 2011

Year	Month	Day	Mean Relative Humidity (%)	Mean MSL pressure (hpa)	Mean Wind speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2011	4	1	84.5	1002.1	17.3	170.0	1.0	1.5
2011	4	2	85.9	1005.0	8.8	200.0	1.6	2.2
2011	4	3	76.1	1012.2	8.3	235.0	2.0	2.9
2011	4	4	84.7	1010.8	14.7	170.0	1.5	2.3
2011	4	5	89.3	1011.8	12.6	205.0	1.4	2.0
2011	4	6	78.0	1019.4	10.3	160.0	2.5	3.5
2011	4	7	91.3	1029.5	6.6	230.0	1.5	2.1
2011	4	8	90.3	1027.1	5.3	105.0	1.7	2.3
2011	4	9	75.5	1020.6	8.6	120.0	1.5	1.9
2011	4	10	88.1	1023.8	4.5	210.0	1.4	1.9
2011	4	11	74.5	1027.0	12.9	255.0	1.9	3.2
2011	4	12	73.5	1030.4	9.7	225.0	2.0	3.1
2011	4	13	89.6	1014.0	11.7	155.0	1.3	2.1
2011	4	14	80.9	1016.9	5.8	285.0	1.3	1.7
2011	4	15	79.0	1019.4	5.1	220.0	2.0	2.8
2011	4	16	76.7	1023.7	5.0	300.0	1.8	2.5
2011	4	17	76.1	1024.1	4.0	110.0	2.3	3.1
2011	4	18	72.8	1015.5	7.0	120.0	2.9	4.0
2011	4	19	69.0	1013.9	3.5	25.0	2.4	3.3
2011	4	20	75.6	1015.6	3.8	350.0	1.8	2.3
2011	4	21	71.4	1011.0	5.4	120.0	3.4	4.6
2011	4	22	78.5	1004.3	9.5	125.0	1.9	2.6
2011	4	23	72.6	1016.3	6.0	280.0	2.8	4.0
2011	4	24	80.3	1022.4	5.8	255.0	1.9	2.6
2011	4	25	73.6	1029.0	6.8	30.0	1.7	2.3
2011	4	26	75.8	1028.1	4.1	360.0	2.8	3.9
2011	4	27	79.3	1026.5	3.5	325.0	2.5	3.4
2011	4	28	75.1	1021.8	3.7	125.0	3.1	4.2
2011	4	29	68.5	1015.4	5.6	50.0	3.5	4.8
2011	4	30	71.8	1010.8	8.7	20.0	3.5	4.8
APR							**62.9**	**88.2**

Shannon Airport Weather Records 2011

Year	Month	Day	Mean Relative Humidity (%)	Mean MSL pressure (hpa)	Mean Wind speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2011	5	1	70.1	1009.0	9.7	55.0	2.8	3.8
2011	5	2	70.9	1010.2	7.5	75.0	2.0	2.6
2011	5	3	70.6	1013.3	12.3	105.0	2.2	3.2
2011	5	4	78.8	1012.0	12.0	120.0	2.7	4.0
2011	5	5	82.4	1008.0	11.5	140.0	2.4	3.3
2011	5	6	83.4	1005.4	11.5	155.0	2.3	3.6
2011	5	7	85.5	1001.2	11.6	115.0	1.9	2.7
2011	5	8	79.9	999.7	17.1	150.0	2.6	4.4
2011	5	9	81.8	1007.2	15.5	160.0	2.1	3.3
2011	5	10	77.3	1016.6	13.7	210.0	2.7	4.0
2011	5	11	82.1	1020.8	13.3	240.0	2.3	3.6
2011	5	12	79.7	1021.6	13.1	255.0	2.2	3.4
2011	5	13	81.0	1019.5	10.5	240.0	2.5	3.9
2011	5	14	75.7	1025.9	11.5	280.0	2.4	3.8
2011	5	15	85.7	1028.2	13.3	260.0	1.7	2.7
2011	5	16	83.7	1024.7	14.8	250.0	1.8	2.9
2011	5	17	92.0	1018.4	11.6	250.0	1.7	2.7
2011	5	18	76.4	1015.2	14.1	260.0	1.9	3.3
2011	5	19	77.3	1017.9	9.0	225.0	1.9	2.8
2011	5	20	74.3	1016.2	11.6	245.0	2.8	4.5
2011	5	21	83.9	1008.5	14.0	175.0	1.5	2.6
2011	5	22	76.3	1011.8	17.0	250.0	2.7	4.7
2011	5	23	74.5	1012.4	22.1	255.0	2.3	4.8
2011	5	24	69.0	1025.3	11.5	250.0	3.2	4.9
2011	5	25	80.3	1010.9	17.0	180.0	1.9	2.9
2011	5	26	77.2	1015.6	18.4	300.0	2.7	4.6
2011	5	27	85.0	1020.6	11.8	240.0	1.5	2.6
2011	5	28	82.0	1011.8	13.0	250.0	2.4	3.8
2011	5	29	79.4	1008.7	13.7	255.0	2.1	3.3
2011	5	30	71.3	1012.1	10.3	245.0	3.4	5.4
2011	5	31	75.5	1022.0	11.0	250.0	2.8	4.1
MAY							**71.4**	**112.0**

Shannon Airport Weather Records 2011

Year	Month	Day	Mean Relative Humidity (%)	Mean MSL pressure (hpa)	Mean Wind speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2011	6	1	85.5	1028.1	12.1	250.0	2.2	3.3
2011	6	2	81.5	1035.4	3.5	235.0	3.3	4.4
2011	6	3	75.8	1033.5	5.6	315.0	4.5	6.1
2011	6	4	79.3	1027.9	8.9	340.0	3.2	4.4
2011	6	5	74.9	1017.1	9.9	305.0	2.2	3.0
2011	6	6	85.3	1007.0	7.7	215.0	1.5	2.1
2011	6	7	88.0	999.1	12.7	245.0	2.2	3.6
2011	6	8	79.3	1005.9	15.6	290.0	2.6	4.4
2011	6	9	70.9	1013.8	7.4	270.0	2.6	3.7
2011	6	10	72.8	1015.0	6.6	270.0	3.1	4.5
2011	6	11	69.9	1016.4	4.1	180.0	3.2	4.5
2011	6	12	90.2	1003.8	8.0	60.0	1.2	1.7
2011	6	13	75.0	1012.0	9.4	270.0	3.4	5.3
2011	6	14	78.5	1013.8	10.0	145.0	2.7	4.2
2011	6	15	74.3	1009.4	9.8	240.0	3.0	4.6
2011	6	16	76.0	1006.9	10.3	210.0	3.1	4.8
2011	6	17	84.2	997.7	10.4	245.0	2.1	3.0
2011	6	18	83.6	1002.4	14.5	270.0	2.6	4.4
2011	6	19	76.5	1011.9	6.0	250.0	2.8	3.8
2011	6	20	85.3	1007.8	6.3	100.0	1.9	2.6
2011	6	21	88.9	1003.1	6.0	250.0	2.6	3.7
2011	6	22	82.7	1009.4	11.1	280.0	3.5	5.6
2011	6	23	74.5	1018.8	9.0	270.0	3.0	4.4
2011	6	24	91.2	1016.7	9.3	140.0	0.8	1.1
2011	6	25	91.4	1015.9	12.0	220.0	1.6	2.4
2011	6	26	77.0	1015.7	10.3	155.0	2.7	3.7
2011	6	27	75.5	1017.0	6.5	320.0	2.8	3.9
2011	6	28	78.6	1020.8	6.8	260.0	3.1	4.5
2011	6	29	78.6	1024.7	9.3	260.0	2.9	4.3
2011	6	30	73.4	1028.8	7.3	270.0	3.3	4.6
JUN							**79.6**	**116.6**

Shannon Airport Weather Records 2011

Year	Month	Day	Mean Relative Humidity (%)	Mean MSL pressure (hpa)	Mean Wind speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2011	7	1	74.0	1027.1	3.5	195.0	2.5	3.3
2011	7	2	72.0	1019.5	6.2	145.0	3.3	4.5
2011	7	3	74.9	1017.0	4.3	155.0	3.5	4.8
2011	7	4	74.7	1011.7	9.8	135.0	2.6	3.5
2011	7	5	81.3	1003.5	11.5	185.0	2.7	4.3
2011	7	6	88.0	996.9	8.8	120.0	1.6	2.4
2011	7	7	89.7	994.6	11.3	210.0	1.7	2.6
2011	7	8	84.3	998.9	9.9	280.0	2.9	4.3
2011	7	9	79.0	1012.1	6.3	275.0	3.8	5.4
2011	7	10	80.5	1019.4	5.8	265.0	3.1	4.4
2011	7	11	78.6	1022.0	3.5	355.0	2.1	2.7
2011	7	12	74.1	1021.4	3.5	5.0	2.3	3.0
2011	7	13	76.1	1021.5	4.6	115.0	3.6	4.9
2011	7	14	81.5	1021.0	4.9	260.0	2.5	3.3
2011	7	15	84.8	1012.3	7.9	195.0	2.0	2.7
2011	7	16	89.3	998.9	16.5	260.0	2.1	3.8
2011	7	17	84.7	1000.1	19.2	295.0	1.8	2.9
2011	7	18	84.5	1001.9	14.7	290.0	2.0	3.1
2011	7	19	79.0	1009.5	10.7	285.0	2.7	4.0
2011	7	20	77.5	1011.8	6.3	340.0	2.9	4.0
2011	7	21	75.1	1018.9	6.3	335.0	1.5	2.0
2011	7	22	73.5	1021.3	6.5	315.0	3.0	4.3
2011	7	23	80.5	1017.4	3.2	220.0	1.6	2.1
2011	7	24	93.3	1013.3	5.6	240.0	1.9	2.6
2011	7	25	92.8	1013.1	7.6	255.0	2.0	2.8
2011	7	26	79.7	1018.6	5.0	320.0	3.7	5.1
2011	7	27	93.6	1022.2	3.3	110.0	1.5	2.0
2011	7	28	78.3	1027.2	8.8	360.0	1.9	2.7
2011	7	29	79.5	1025.6	4.6	25.0	1.7	2.3
2011	7	30	83.6	1018.3	7.1	145.0	2.2	3.1
2011	7	31	86.9	1010.8	7.8	245.0	1.7	2.4
JUL							74.7	105.2

Shannon Airport Weather Records 2011

Year	Month	Day	Mean Relative Humidity (%)	Mean MSL pressure (hpa)	Mean Wind speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2011	8	1	77.5	1011.4	4.0	290.0	2.5	3.3
2011	8	2	70.5	1014.3	4.1	265.0	2.5	3.3
2011	8	3	79.3	1010.8	8.1	115.0	2.1	2.8
2011	8	4	88.0	1009.0	10.3	275.0	1.0	1.4
2011	8	5	81.1	1012.6	4.8	250.0	1.1	1.4
2011	8	6	87.2	1003.4	6.1	135.0	2.0	2.8
2011	8	7	83.3	1000.5	6.2	170.0	2.6	3.7
2011	8	8	79.6	1013.9	11.4	280.0	2.9	4.3
2011	8	9	75.7	1026.4	5.9	265.0	2.1	2.8
2011	8	10	90.6	1016.5	12.4	220.0	1.5	2.2
2011	8	11	94.1	1009.4	11.3	250.0	1.8	2.7
2011	8	12	91.6	1006.4	8.9	235.0	1.8	2.5
2011	8	13	88.9	1003.5	11.5	240.0	1.7	2.5
2011	8	14	81.5	1008.5	10.2	245.0	2.7	4.0
2011	8	15	91.5	1012.1	7.6	175.0	1.2	1.7
2011	8	16	81.1	1014.4	10.6	285.0	2.2	3.4
2011	8	17	79.3	1018.8	3.8	5.0	2.0	2.7
2011	8	18	82.1	1018.1	5.0	330.0	2.2	3.0
2011	8	19	85.9	1014.5	10.1	135.0	1.5	2.2
2011	8	20	77.0	1012.1	6.7	170.0	2.8	3.8
2011	8	21	81.4	1014.0	7.8	250.0	2.2	3.0
2011	8	22	73.5	1020.0	2.8	340.0	1.8	2.3
2011	8	23	74.5	1013.1	5.6	160.0	2.5	3.4
2011	8	24	78.1	1007.9	8.4	205.0	2.5	3.7
2011	8	25	82.9	1001.8	8.7	115.0	1.8	2.6
2011	8	26	85.8	1009.0	7.5	305.0	1.8	2.6
2011	8	27	81.8	1016.3	10.8	280.0	2.1	3.1
2011	8	28	79.2	1019.6	7.5	275.0	2.0	2.8
2011	8	29	78.6	1022.2	4.6	310.0	1.9	2.7
2011	8	30	75.0	1018.7	3.4	90.0	1.6	2.1
2011	8	31	72.6	1015.5	4.5	100.0	1.9	2.5
AUG							**62.1**	**87.2**

Shannon Airport Weather Records 2011

Year	Month	Day	Mean Relative Humidity (%)	Mean MSL pressure (hpa)	Mean Wind speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2011	9	1	82.1	1010.5	8.0	120.0	1.7	2.2
2011	9	2	83.5	1006.6	8.0	215.0	1.8	2.5
2011	9	3	83.7	1003.8	9.1	240.0	1.6	2.4
2011	9	4	81.8	1000.6	12.6	205.0	1.9	2.8
2011	9	5	89.5	1005.7	13.3	250.0	1.1	1.7
2011	9	6	85.5	1002.0	19.5	250.0	1.1	2.0
2011	9	7	89.2	1010.2	13.2	250.0	1.0	1.3
2011	9	8	91.4	1005.3	9.1	240.0	1.4	2.1
2011	9	9	87.3	1001.7	10.6	145.0	1.9	2.6
2011	9	10	80.1	990.1	16.8	180.0	1.9	2.8
2011	9	11	82.9	993.4	16.5	220.0	1.4	2.1
2011	9	12	76.1	997.3	25.4	245.0	1.7	2.9
2011	9	13	79.8	1011.1	15.9	250.0	2.1	3.2
2011	9	14	85.0	1018.9	6.5	255.0	1.3	1.7
2011	9	15	83.6	1016.6	8.7	115.0	1.5	2.1
2011	9	16	89.9	1006.7	13.0	220.0	1.4	2.2
2011	9	17	87.8	1004.9	13.4	265.0	1.4	2.2
2011	9	18	84.8	1010.9	13.2	290.0	1.6	2.2
2011	9	19	95.5	1010.5	10.6	235.0	0.9	1.4
2011	9	20	81.9	1014.4	9.9	235.0	1.4	1.9
2011	9	21	83.1	1012.7	15.6	240.0	1.6	2.3
2011	9	22	83.5	1017.7	10.2	245.0	1.5	2.0
2011	9	23	82.0	1010.0	11.8	165.0	1.5	2.0
2011	9	24	79.2	1007.7	8.2	195.0	1.8	2.5
2011	9	25	83.1	1005.8	12.4	185.0	1.3	1.7
2011	9	26	82.0	1016.7	8.5	160.0	1.2	1.6
2011	9	27	84.2	1020.5	13.5	150.0	1.9	2.5
2011	9	28	86.5	1015.6	15.0	140.0	1.6	2.2
2011	9	29	87.8	1015.6	10.2	140.0	1.2	1.6
2011	9	30	93.3	1015.7	7.8	280.0	0.6	0.9
SEPT							**44.0**	**63.5**

Shannon Airport Weather Records 2011

Year	Month	Day	Mean Relative Humidity (%)	Mean MSL pressure (hpa)	Mean Wind speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2011	10	1	96.6	1022.2	5.0	25.0	0.5	0.7
2011	10	2	98.6	1020.4	3.6	265.0	0.6	0.8
2011	10	3	88.0	1015.4	9.3	240.0	1.2	1.7
2011	10	4	83.3	1017.6	9.7	220.0	1.1	1.5
2011	10	5	85.1	1010.1	17.4	230.0	1.3	1.9
2011	10	6	78.1	1014.6	17.6	265.0	1.6	2.4
2011	10	7	75.1	1026.0	11.5	285.0	1.7	2.2
2011	10	8	96.5	1024.9	10.5	245.0	0.7	1.1
2011	10	9	93.6	1017.5	16.3	235.0	0.9	1.3
2011	10	10	90.0	1015.0	20.6	240.0	1.1	1.5
2011	10	11	92.6	1018.3	14.5	245.0	0.7	1.1
2011	10	12	92.8	1021.6	6.7	265.0	0.8	1.1
2011	10	13	88.2	1026.0	6.0	130.0	0.8	1.1
2011	10	14	88.5	1023.3	10.0	155.0	0.9	1.2
2011	10	15	89.6	1020.0	6.5	165.0	0.6	0.8
2011	10	16	82.0	1020.1	9.9	210.0	1.1	1.5
2011	10	17	84.1	1009.9	14.3	200.0	1.0	1.4
2011	10	18	80.8	1013.2	11.2	260.0	1.2	1.6
2011	10	19	80.0	1024.3	7.3	285.0	1.0	1.4
2011	10	20	87.0	1025.6	7.6	185.0	0.7	0.9
2011	10	21	80.6	1014.6	11.9	165.0	1.2	1.5
2011	10	22	89.5	1002.0	10.2	165.0	0.7	1.0
2011	10	23	92.0	988.9	11.8	140.0	0.7	0.9
2011	10	24	95.3	984.4	7.6	280.0	0.5	0.7
2011	10	25	92.5	990.7	3.3	170.0	0.6	0.8
2011	10	26	86.0	996.1	9.8	165.0	0.9	1.2
2011	10	27	86.7	1007.7	6.5	245.0	0.7	0.9
2011	10	28	86.7	1016.1	11.7	165.0	0.6	0.9
2011	10	29	87.1	1008.1	14.0	215.0	0.9	1.2
2011	10	30	91.0	1008.9	9.0	140.0	0.7	0.9
2011	10	31	89.9	1001.1	11.3	165.0	0.6	0.8
OCT							27.7	37.7

Shannon Airport Weather Records 2011

Year	Month	Day	Mean Relative Humidity (%)	Mean MSL pressure (hpa)	Mean Wind speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2011	11	1	82.8	1001.7	10.9	155.0	0.7	1.0
2011	11	2	88.5	985.8	20.3	150.0	1.0	1.3
2011	11	3	86.2	980.8	10.5	155.0	0.7	0.9
2011	11	4	89.5	994.0	4.2	125.0	0.4	0.6
2011	11	5	89.0	1013.9	2.9	90.0	0.3	0.5
2011	11	6	88.6	1026.3	6.4	120.0	0.5	0.7
2011	11	7	86.3	1022.5	7.3	115.0	0.5	0.7
2011	11	8	88.8	1009.2	8.4	110.0	0.7	0.9
2011	11	9	85.2	1003.7	11.3	140.0	0.7	0.9
2011	11	10	85.9	1008.9	10.4	135.0	0.8	1.0
2011	11	11	80.6	1000.2	17.8	140.0	1.4	1.7
2011	11	12	82.8	1016.9	9.4	155.0	0.5	0.7
2011	11	13	84.8	1017.1	12.1	100.0	0.9	1.1
2011	11	14	91.1	1017.3	10.4	105.0	0.7	0.9
2011	11	15	86.3	1014.0	9.4	100.0	0.7	0.9
2011	11	16	92.0	1010.5	7.4	120.0	0.6	0.8
2011	11	17	91.6	1004.1	15.7	165.0	0.5	0.7
2011	11	18	89.7	1003.0	12.6	155.0	0.5	0.6
2011	11	19	93.0	1009.2	4.6	120.0	0.2	0.3
2011	11	20	95.8	1012.6	6.5	135.0	0.3	0.4
2011	11	21	95.6	1012.4	4.0	320.0	0.2	0.3
2011	11	22	89.3	1019.7	6.1	145.0	0.2	0.3
2011	11	23	87.6	1019.4	11.6	200.0	0.5	0.7
2011	11	24	85.8	1015.2	15.8	180.0	0.5	0.7
2011	11	25	83.0	1022.2	12.7	240.0	0.7	0.8
2011	11	26	84.6	1017.5	16.9	210.0	0.9	1.1
2011	11	27	75.0	1020.9	12.6	265.0	0.7	0.9
2011	11	28	83.6	1010.6	13.3	160.0	0.8	1.0
2011	11	29	86.3	999.5	14.2	250.0	0.6	0.8
2011	11	30	86.0	1005.9	14.3	180.0	0.6	0.8
NOV							**18.5**	**23.9**

Shannon Airport Weather Records 2011

Year	Month	Day	Mean Relative Humidity (%)	Mean MSL pressure (hpa)	Mean Wind speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2011	12	1	88.3	1005.6	5.7	220.0	0.3	0.4
2011	12	2	94.0	1009.2	10.8	225.0	0.3	0.5
2011	12	3	80.4	1005.2	10.7	260.0	0.5	0.7
2011	12	4	87.4	1004.1	9.4	260.0	0.5	0.6
2011	12	5	84.2	1008.6	10.9	255.0	0.6	0.8
2011	12	6	89.3	1007.2	10.6	245.0	0.5	0.6
2011	12	7	80.7	1012.2	13.8	270.0	0.7	0.9
2011	12	8	84.1	1005.6	19.8	260.0	0.8	1.1
2011	12	9	81.5	1012.8	8.6	270.0	0.1	0.1
2011	12	10	89.1	1013.0	7.5	190.0	0.2	0.3
2011	12	11	92.0	1002.5	8.7	220.0	0.3	0.5
2011	12	12	87.1	992.5	12.5	240.0	0.6	0.8
2011	12	13	71.5	982.7	21.9	240.0	1.1	1.5
2011	12	14	86.8	987.4	10.3	210.0	0.4	0.5
2011	12	15	84.1	995.7	8.7	245.0	0.3	0.3
2011	12	16	91.0	997.5	8.3	255.0	0.1	0.2
2011	12	17	82.2	1016.9	6.1	285.0	0.3	0.4
2011	12	18	91.2	1021.6	4.4	240.0	0.2	0.3
2011	12	19	93.5	1014.4	9.6	265.0	0.3	0.4
2011	12	20	92.9	1017.3	9.2	265.0	0.3	0.4
2011	12	21	94.5	1021.3	13.6	250.0	0.5	0.6
2011	12	22	85.2	1021.1	10.3	200.0	0.7	0.8
2011	12	23	86.3	1020.1	9.2	285.0	0.0	0.0
2011	12	24	88.7	1024.6	14.8	235.0	0.4	0.5
2011	12	25	89.3	1021.6	17.4	215.0	0.6	0.8
2011	12	26	82.5	1024.7	14.6	210.0	0.9	1.1
2011	12	27	87.0	1022.6	12.6	165.0	0.6	0.7
2011	12	28	79.1	1021.0	17.3	260.0	0.7	0.9
2011	12	29	87.3	1024.6	19.1	255.0	0.9	1.1
2011	12	30	98.0	1016.5	12.8	245.0	0.4	0.5
2011	12	31	95.6	1006.5	13.0	225.0	0.2	0.3
DEC							**14.3**	**18.5**

Appendix I – Water Balance Calculations

Water Balance Calculations 2011

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

Period (Jan 2011 - Dec 2011)	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	4370	0.0626	19	273.562	3.468	270.09	15742	0.066	103.90	373.99
February	4370	0.1255	19	548.435	3.468	544.97	15742	0.1327	208.90	753.86
March	4370	0	19	0	3.468	-3.47	15742	0	0	-3.47
April	4370	0	19	0	3.468	-3.47	15742	0	0	-3.47
May	4370	0	19	0	3.468	-3.47	15742	0.0219	34.47	31.01
June	4370	0	19	0	3.468	-3.47	15742	0.0329	51.79	48.32
July	4370	0	19	0	3.468	-3.47	15742	0	0	-3.47
August	4370	0	19	0	3.468	-3.47	15742	0	0	-3.47
September	4370	0.0312	19	136.344	3.468	132.88	15742	0.0507	79.81	212.69
October	4370	0.0614	19	268.318	3.468	264.85	15742	0.0714	112.40	377.25
November	4370	0.0633	19	276.621	3.468	273.15	15742	0.0687	108.15	381.30
December	4370	0.1262	19	551.494	3.468	548.03	15742	0.1304	205.28	753.30
TOTAL						**2013.16**			**904.69**	**2917.85**

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

Period (Jan 2011 - Dec 2011)	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	4370	0.063	19	273.562	3.468	270.09	15742	0.066	20.78	290.87
February	4370	0.126	19	548.435	3.468	544.97	15742	0.133	41.78	586.75
March	4370	0	19	0	3.468	-3.47	15742	0	0	-3.47
April	4370	0	19	0	3.468	-3.47	15742	0	0	-3.47
May	4370	0	19	0	3.468	-3.47	15742	0.022	6.89	3.43
June	4370	0	19	0	3.468	-3.47	15742	0.033	10.36	6.89
July	4370	0	19	0	3.468	-3.47	15742	0	0	-3.47
August	4370	0	19	0	3.468	-3.47	15742	0	0	-3.47
September	4370	0.031	19	136.344	3.468	132.88	15742	0.051	15.96	148.84
October	4370	0.061	19	268.318	3.468	264.85	15742	0.071	22.48	287.33
November	4370	0.063	19	276.621	3.468	273.15	15742	0.069	21.63	294.78
December	4370	0.126	19	551.494	3.468	548.03	15742	0.130	41.06	589.08
TOTAL						**2013.16**			**180.94**	**2194.10**