Connaught Regional Residual Landfill

EPA Waste Licence W0178-01

Annual Environmental Report

January 2008 - December 2008

TOBIN
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setting the standard

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1 INTRODUCTION

TOBIN Consulting Engineers have been commissioned by *greenstar* to carry out environmental monitoring and the Annual Environmental Report (AER) at the Connaught Regional Residual Landfill site, Co. Galway, in accordance with condition 8.0 and Schedule D of Waste Licence No. W0178-01 issued by the Environmental Protection Agency. The reporting period for the AER 2008 is from the 1st January 2008 to 31st December 2008.

2 WASTE ACTIVITIES CARRIED OUT AT THE FACILITY

The East Galway facility is a fully contained landfill site. It is designed to accept waste for final disposal into discrete lined cells in accordance with the EPA Landfill Design Manual. Waste activities are licensed at the facility under the Third and Fourth Schedule of the Waste Management Acts 1996 to 2003 (See Tables 2.1 and 2.2).

Table 2-1 Licensed Waste Disposal Activities (3rd Schedule of Waste Management Acts)

Class 1	Deposit on, in or under land (including landfill): Thus activity is limited to the disposal of non-hazardous waste into lined cells.
Class 4	Surface impoundment, including placement of liquid or sludge discards into pits, ponds or lagoons. This activity is limited to the management of leachate and surface water at the facility.
Class 5	Specifically engineered landfill, including placement into discrete lined cells which are capped and isolated from one another and the environment: This is the principal activity. This activity is limited to the disposal of non-hazardous waste into lined cells.
Class 6	Biological treatment not referred to elsewhere in this Schedule which results in final compounds or mixtures which are disposed of by means of any activity referred to in paragraphs 1 to 10 of this Schedule: This activity is limited to potential future treatment of leachate at the facility
Class 13	Storage prior to submission of 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: This activity is limited to the temporary storage of unacceptable wastes in the waste quarantine area prior to dispatch off-site to an alternative facility.

Table 2-2 Licensed Waste Disposal Activities (4th Schedule of Waste Management Acts)

Class 4	Recycling or reclamation of other inorganic materials: This activity is limited to the use of material reclaimed from construction and demolition waste for the purposes of fill, daily cover, road construction and other uses.
Class 11	Use of waste obtained from any activity referred to in a preceding paragraph of the Schedule: This activity is limited to the use of material reclaimed from construction and demolition waste for the purposes of fill, daily cover, road construction and other uses.
Class 13	Storage of waste intended for submission to any activity referred to in a preceding paragraph of this Schedule, other than temporary storage, pending collection, on the premises where such waste is produced: This activity is limited to the temporary storage prior to use of material reclaimed from construction and demolition waste for the purposes of fill, daily cover, road construction and other uses.

3 QUANTITY & COMPOSITION OF WASTE

Table 3-1 Connaught Regional Residual Landfill Waste Inputs 2008

Waste Type	Description	Total Accepted 2008 (tonnes)	Licence Limit (tonnes)
Household		66,578.41	45,000
Commercial		30,730.16	27,500
Industrial non-hazardous	Misc. Non-Haz Industrial solid wastes	999.52	27,500
Total Waste Intake		**98,308.09**	**100,000**
Inert wastes for recovery purposes			
Cover / Engineering Material	Shredded timber - reused on site	6,950.90	
Cover / Engineering Material	Recovered C&D rubble	255.01	
Cover / Engineering Material	Soil and fine material reused onsite for daily and intermediate cover and liner protection	6,711.11	
Total Waste Recovered		**13,917.02**	**27,320**

Total Site Intake		**112,225.11**	**127,320**

4 CALCULATED REMAINING CAPACITY OF THE FACILITY

The remaining capacity of the facility is a function of time and available space on the site. The facility EIS states that the initial total capacity of the facility has been estimated at 1,176,471 m^3. The new cell floor level in Phase 2 gives additional capacity of 137,843 m^3. Therefore the total capacity of the facility has been estimated at 1,314,314 m^3.

It is estimated that the facility accepted approximately 125,000 m^3 of waste in 2008. The remaining capacity of the facility has been calculated to be 929,314 m^3.

5 METHODS OF DEPOSITION OF WASTE

Waste is delivered to the facility in heavy goods vehicles (HGVs) with the appropriate covers to prevent any loss of load. Each HGV must pass through the weighbridge prior to proceeding to the active waste disposal area. The weighbridge operator and/or site manager may at their own discretion request the load be tipped in the Waste Inspection Area. Waste vehicles then proceed to the active waste disposal area where waste is deposited under the direction of a banks man.

Waste is deposited directly on a surface of waste close to and above the advancing tipping face. In accordance with Condition 5.3.1 of the Waste Licence, the active working face is confined to a height of 2.5 metres after compaction, a width of 25 metres and a slope no greater than 1 in 3. Deposited waste is spread in shallow layers on the inclined surface and compacted. The steel-wheeled compactor operates on the gradient of the more shallow face, pushing thin layers of wastes and applying compaction pressure to them. Light waste is mixed with heavier materials or covered with permeable soil drawn from stockpiles of heavy inert waste or fine sand stockpiles located on the site. Alternative fabric cover systems are also utilised as appropriate.

6 REPORT ON ENVIRONMENTAL EMISSIONS

This summary report has been compiled in accordance with emission limit values (ELVs) for the following media as detailed in Condition 6 and Schedule C of the current Licence.

- Dust
- Noise
- Landfill Gas
- Surface Water Discharge (Measured at SW6 & SW7)

6.1 DUST DEPOSITION LIMITS

Dust deposition emission limit values as stipulated in Licence 178-1 are detailed in Table 6.1.

Table 6-1 Dust Deposition ELVs

Level (mg/m2/day)
350

Note: 30 day composite sample with the results expressed as mg/m2/day

Dust monitoring was conducted at four locations on four occasions during the 2008 reporting period, as illustrated on Drawing 1322/01/101, Appendix A. Alcontrol Geochem Ireland conducted analysis of the dust deposition results from the facility. Dust reports were included in the 1st, 2nd, 3rd and 4th Quarterly monitoring reports.

Dust monitoring conformed to the ELV of 350mg/m2/day throughout the monitoring period at all five locations, with the exception of D4 during July, see section 7.5.2.

6.2 NOISE EMISSIONS

Noise emission limit values as stipulated in Licence 178-1 are detailed in Table 6.2 below.

Table 6-2 Noise Emission

Day Db(A) LAeq (15 minutes)	Night dB(A) LAeq (15 minutes)
55	45

Noise monitoring was conducted at five locations on a quarterly basis in 2008. The completed

monitoring reports were issued to the EPA as part of the 1st, 2nd, 3rd and 4th Quarterly monitoring reports.

The measured noise levels are all within the limit value of 55 dB (A) (daytime) set out in Schedule D of Waste Licence W0178-01, with the exception of N5 during all 4 monitoring periods. The dominant source of noise at N5 was road traffic, while landfilling activities were audible as background levels (L90) ranged from 34-48 dB (A).

6.3 LANDFILL GAS CONCENTRATIONS (IN ANY BUILDINGS ON/ADJACENT TO THE FACILITY)

Landfill gas emission limit values as stipulated in Licence 178-1 are detailed in Table 6.3 below.

Table 6-3 Landfill Gas Concentrations

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

6.3.1 LANDFILL GAS MONITORING WELLS

Measured methane concentrations exceeded the emission limit in LG9 and in LG5 during monitoring intervals in each quarter. Elevated carbon dioxide concentrations were also recorded in the monitoring events, and wells LG5, LG7, LG8, LG9, LG10, LG14, LG15, LG16, LG18 & LG20 showed incidents where the ELV was exceeded. The source of methane and/or carbon dioxide in perimeter gas monitoring wells is attributed to the continuous decay of organic peatr. All incidents were reported by the site to the Agency in a landfill gas incident report after each monitoring event.

6.4 SURFACE WATER DISCHARGE LIMITS (MEASURED AT SW6 & SW7)

Surface water discharge emission limit values at monitoring locations SW6 & SW7 as stipulated in Licence 178-1 are detailed in Table 6.4 below.

Table 6-4 Surface Water Discharge Limits

Level (Suspended Solids mg/l)
35 mg/l

Suspended solids concentrations at SW6 and SW7 complied with the 35 mg/L ELV throughout 2008.

7 SUMMARY ENVIRONMENTAL RESULTS

Monitoring was conducted at the CRRL facility in accordance with Schedule D of the Waste Licence 178-1. Details of monitoring and reporting frequencies of environmental data are presented the below. The locations of all environmental monitoring points are illustrated on Drawing 1322/01/01, Appendix A.

7.1 BIOLOGICAL ASSESSMENT

7.1.1 MACROINVERTABATES

Biological sampling was carried out at 4(no.) monitoring points, namely IN1 and IN4 on the Killaghmore Stream, which is contiguous with part of the western site boundary, and IN2 and IN3 on the Ballintober Stream, which is contiguous with part of the eastern site boundary.

7.1.2 METHODOLOGY

Samples were taken according to standard EPA methodology and the kick samples were taken in the most suitable gravel-stone substrate present using a net with a 1mm mesh for duration of 2 minutes. The samples were then preserved with 70 % alcohol and delivered to Openfield Consultancy for identification and analysis.

The results were then analysed and values assigned using the EPA scheme of Biotic Indices.

Table 7-1 The Biological River Quality Classification System (Q Value)

Q Value	Community diversity	Water quality	Condition
Q5	High	Good	Satisfactory
Q4	Reduced	Fair	Satisfactory
Q3	Much reduced	Doubtful	Unsatisfactory
Q2	Low	Poor	Unsatisfactory
Q1	Very low	Bad	Unsatisfactory

7.1.3 INVERTEBRATE SAMPLING RESULTS

The results of the invertebrate sampling are presented in Table 7.2. All 4 (no.) samples had a dominance of group ‘C’ taxa, a presence of Group ‘D’ taxa (exception of IN1), an absence of group ‘A’ taxa, an absence or low occurrence of group ‘B’ taxa, suggesting a Q-value of 3 which is indicative of moderate levels of pollution.

Table 7-2 Macroinvertebrate Taxa at Surface Water Points

	Group A Taxa		Group B Taxa		Group C Taxa		Group D Taxa		Group E Taxa		Q- Value Determination
	Total Numbers	Relative Abundance, %	Total Numbers	Relative Abundance, %	Total Numbers	Relative Abundance, %	Total Numbers	Relative Abundance, %	Total Numbers	Relative Abundance, %	
IN1	0	-	0	-	49	72	19	28	0	-	3
IN2	0	-	0	-	15	24	46	73	2	3	2-3
IN3	0	-	0	-	63	80	13	17	2	3	3
IN4	0	-	1	1	69	90	7	9	0	0	3

7.1.4 DISCUSSION OF RESULTS

Upstream locations are shaded in yellow and include locations IN1 and IN2. Upstream monitoring location IN1 on the Killaghmore Stream has a Q value of 3, 'Moderately polluted' and shows no change since 2007. Upstream location IN2 on the Ballintober stream has a Q value of 2-3, 'Moderately polluted' and shows a moderate improvement when compared with a Q value of 2 in 2007.

Downstream location IN3 on the Ballintober Stream has a Q value of 3, 'Moderately polluted' and shows no change since 2007, and similarly downstream location IN4 on the Killaghmore stream shows no change since 2007 with a Q value of 3. There is no deterioration in the quality status recorded in the downstream locations relative those upstream.

7.2 ELECTROFISHING SURVEY

An electro-fishing survey at 4(no.) locations was carried out by Stillwaters Consultancy as defined in Schedule D of Waste Licence 178-1.

In 2002 eight sites were electro-fished. The streams adjacent to the landfill site are not named on the

Ordnance Survey Discovery Series 1:50000 (Map 46). They are known locally as the Ballintober and Killaghmore Streams and combine to form the Raford River a tributary of the Dunkellin River. In 2005 and 2006 four of the sites A,B,C and D. were surveyed.

In 2007 in response to comments by the Western Regional Fisheries Board to sample salmonid stretches, sites E, F and G were examined and sites E and G were electro-fished.

In 2008 following a prolonged period of rain giving rise to unsuitable electric fishing survey conditions sites A, B, C, D, E and G were fished on 3 October. Site F remains totally overgrown with bank-side vegetation and was not possible to fish.

7.2.1 METHODOLOGY

Electric fishing was carried out at sites A, B, C, D, E and G. Site F was overgrown with bank-side vegetation and largely impossible to fish.

Sites A, B, C and D were fished using a Safari Surveyor, pulsed direct current electro-fisher. Sites E and G, which were wider and deeper, were fished using a Safari Research 550-E. At site F, the bank vegetation was such that electro-fishing was not practical. The stream where it could be seen was of reasonable salmonid quality with stone and cobble.

7.2.2 ELECTRO-FISHING SURVEY RESULTS

The survey was carried out on the 3 October 2008. Electro-fishing conditions were good.

Sites A. This was overgrown and difficult to fish. It was only possible to fish by pushing back weed growth and in small stretches where the weed coverage permitted. The 3-spined stickleback, *Gasterosteus aculeatus*, was present. The shrimp, *Gammurus duebeni* was observed.

Site B. This site was overgrown and difficult to fish. The 3-spined stickleback was recorded. The shrimp *Gammurus duebeni* was observed.

Site C There was more in-stream vegetation than normal at this site. The 3-spined stickleback was present and was common. The shrimp *Gammarus* shrimp was recorded.

Site D This site was heavily overgrown. It was not possible to fish the original site selected. In an area cleared of vegetation by cattle shoals of 3-spined stickle backs were observed. A site just

upstream of the original site was fished. The 3-spined stickle backs were recorded as common.

Site E. The 3-spined stickleback was present. Trout had been recorded at this site in 2007 but none were recorded in 2008. Current water quality does not appear to be the reason for the absence of trout as the site appears to have better water quality than in 2007 with abundant aquatic plants and less filamentous algae.

Table 7-3 Results of Electro-fishing Survey (October 2008)

Site	Site Description	Fishing Description	Species Recorded
Site A	Over grown bog drain.	Only where weed growth permitted	3-spined Sticklebacks common. The shrimp, *Gammurus duebeni* was observed
Site B	Bog drain ca. 2m deep, completely over grown	overgrown and difficult to fish	3-spined stickleback was recorded. The shrimp *Gammurus duebeni* was observed.
Site C	Large Weed growth .	There was more in-stream vegetation than normal at this site, difficult to fish	The 3-spined stickleback was present and was common. The shrimp *Gammarus* shrimp was recorded.
Site D	heavily overgrown	Only where weed growth permitted	shoals of 3-spined stickle backs were observed. The 3-spined stickle backs were recorded as common.
Site E	appears to have better water quality than in 2007 with abundant aquatic plants and less filamentous algae	40m stretch fished	Appendix G
Site F	Bank vegetation too dense to fish Visually stream was of reasonable salmonid quality with stone and cobble substrate	Fishing not possible	-
Site G	Heavy bankside vegetation and overhanging trees. Heavily shaded with gravel and cobble substrate	40m stretch fished	Stoneloach, *Barbatula barbatula*, were present as were 3-spined stickleback. White-clawed crayfish *Austropotamobius pallipes Lereboullet* were plentiful with some large specimens present.

Table 7-4 Trout Maturity and Measurements

Trout	Trout
0+	**1+ & >**
6.6	16.7
6.8	17.2
6.8	17.2
7.2	17.7
7.8	18.0
7.8	18.6
8.0	19.4
8.0	19.4
8.2	
8.2	
8.4	
8.5	
8.8	
8.8	
8.8	
9.0	
9.0	
9.6	

Site F. This site fished in 2002 has since become covered in by bank vegetation. The stream provides reasonable salmon habitat although little light penetrates because of the bank cover. It was not possible to fish this stretch.

Site G. This was a good quality salmonid stretch of channel with good flows and with good bank cover and moderate in-stream vegetation.

Trout were common both 0+ (trout in their 1st year but not yet 1 year old) and 1+ (trout 1 year and older), see Table 7.4 below. Measurements are given in centimetres (cm). Stoneloach, *Barbatula barbatula*, were present as were 3-spined stickleback. One specimen of Gudgeon, *Gobio gobio* (8.7cm) was found. White-clawed crayfish *Austropotamobius pallipes Lereboullet* were plentiful with some large specimens present.

7.3 SURFACE WATER MONITORING

Surface water monitoring was conducted at the facility at six locations, SW1 to SW7, with the exception of SW2, which was dry during all four quarterly monitoring visits this year. Water sampling was undertaken by TOBIN Consulting Engineers, using the "grab" sampling method. The laboratory-supplied containers were submerged beneath the surface of the water and squeezed gently when screwing on the cap to ensure an air tight seal. The filled sample containers were stored in a coolbox for transport to the laboratory. Quarterly surface water samples were analysed for parameters stipulated in D.5 of the Waste Licence. Details of all surface water sampling were forwarded to the EPA in reports Quarter 1 to Quarter 4 2008.

7.3.1 SURFACE WATER QUALITY RESULTS

The Emission limit value for Suspended Solids (35 mg/L) was not exceeded during the four quarterly events at SW6 or SW7 monitoring locations at which the ELV applies. The concentration at SW3 during the Q2 event was 171 mg/L, but was localised to this upstream area and was at normal concentrations (10 mg/L; 11 mg/L) at the other monitoring points.

pH and conductivity results were within normal ranges for surface water. Chloride concentrations ranged from 13 mg/L to 31 mg/l.

Ammoniacal Nitrogen peaked during Q3, which was attributable to heavy rainfall events throughout the monitoring quarter resulting in increased recharge of groundwater containing naturally elevated levels of ammoniacal nitrogen to surface water. Concentrations resumed the background trend in the following quarter in Q4.

Figure 7-1 SW pH results Connaught Landfill 2008

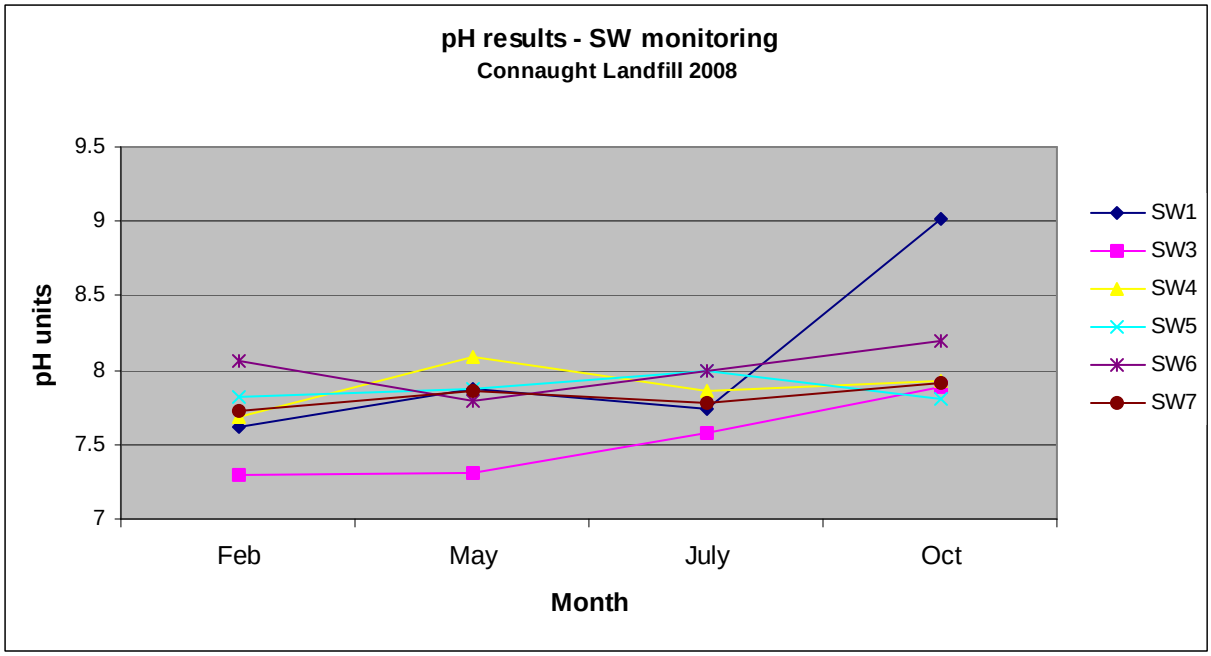

Table 7-5 SW pH results Connaught Landfill 2008

pH Units	Feb	May	July	Oct
SW1	7.62	7.88	7.74	9.02
SW3	7.29	7.31	7.58	7.89
SW4	7.69	8.09	7.86	7.93
SW5	7.82	7.88	7.99	7.81
SW6	8.06	7.79	7.99	8.19
SW7	7.73	7.86	7.78	7.91

Note SW2 Dry

Figure 7-2 SW Conductivity results Connaught Landfill 2008

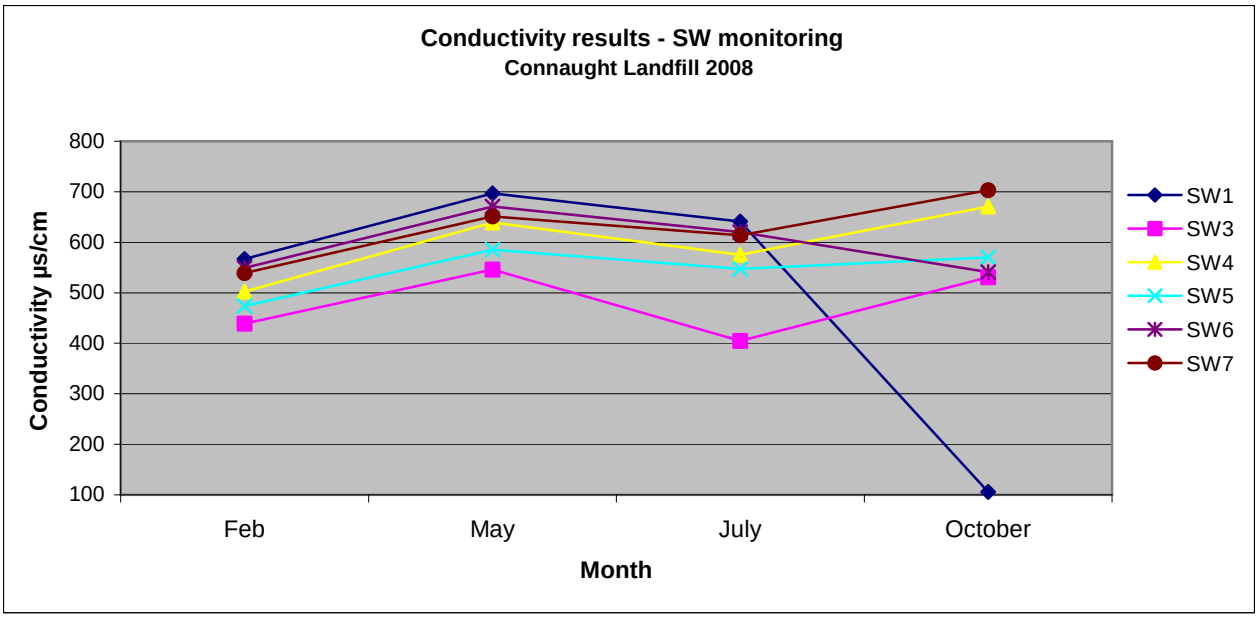

Table 7-6 SW Conductivity results Connaught Landfill 2008

Conductivity µs/cm	Feb	May	July	October
SW1	567	697	641	106
SW3	439	546	405	531
SW4	502	639	575	671
SW5	474	585	547	570
SW6	549	671	620	541
SW7	539	651	614	703

Note SW2 Dry

Figure 7-3 SW Chloride results Connaught Landfill 2008

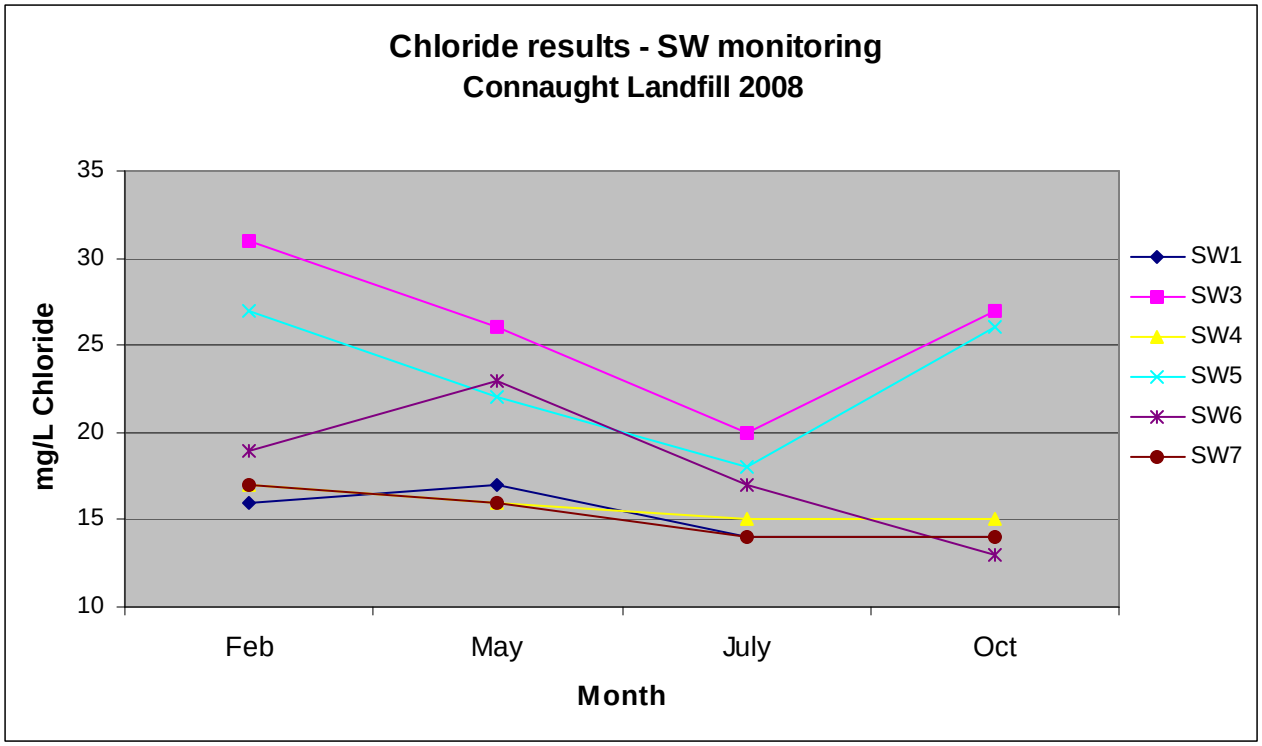

Table 7-7 SW Chloride results Connaught Landfill 2008

Chloride mg/L	Feb	May	July	Oct
SW1	16	17	14	14
SW3	31	26	20	27
SW4	17	16	15	15
SW5	27	22	18	26
SW6	19	23	17	13
SW7	17	16	14	14

Note SW2 Dry

Figure 7-4 SW Ammoniacal N Results Connaught Landfill 2008

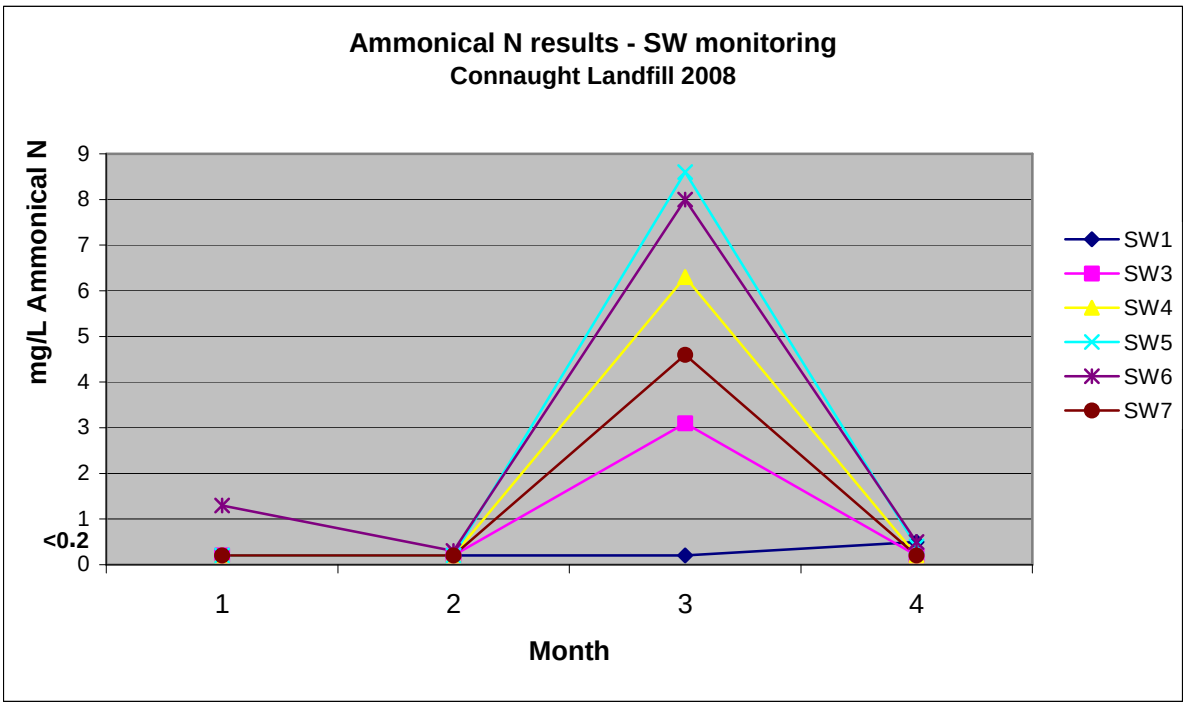

Table 7-8 SW Ammoniacal N Results Connaught Landfill 2008

Ammoniacal N (mg/L N)	Feb	May	July	Oct
SW1	<0.2	<0.2	<0.2	0.5
SW3	<0.2	<0.2	3.1	<0.2
SW4	<0.2	<0.2	6.3	0.2
SW5	<0.2	<0.2	8.6	0.4
SW6	1.3	0.3	8	0.5
SW7	<0.2	<0.2	4.6	<0.2

Figure 7-5 SW Suspended Solids results Connaught Landfill 2008

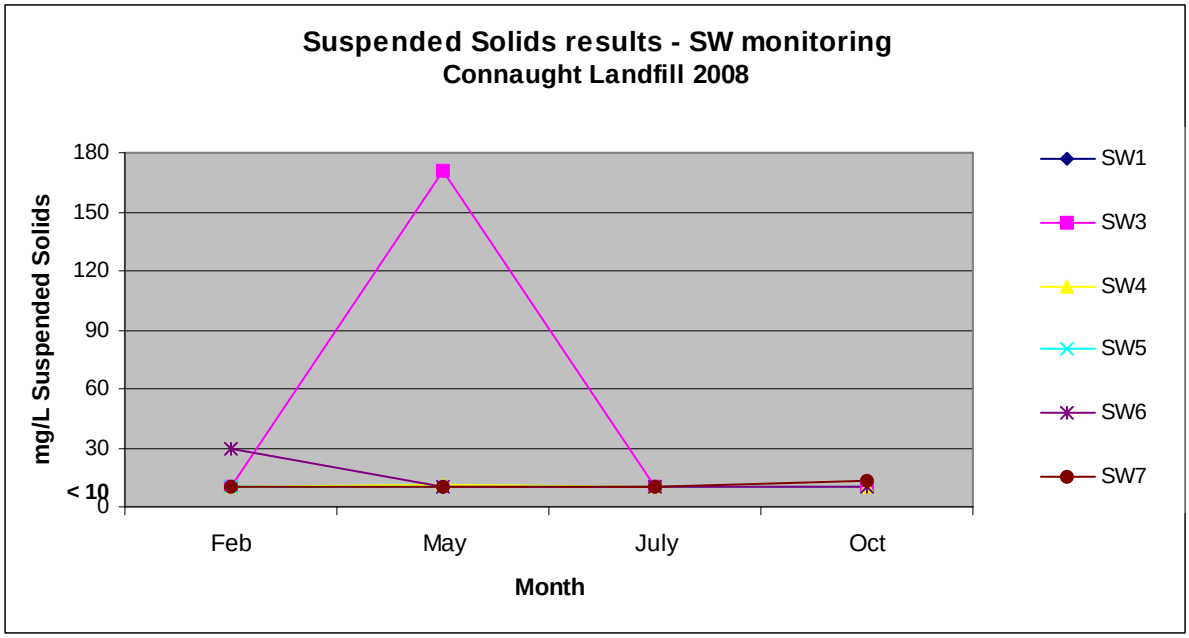

Table 7-9 SW Suspended Solids results Connaught Landfill 2008

Suspended Solids mg/L	Feb	May	July	Oct
SW1	<10	<10	<10	<10
SW3	<10	171	<10	<10
SW4	<10	11	<10	<10
SW5	<10	<10	<10	<10
SW6	*29*	<10	<10	<10
SW7	<10	<10	<10	13

7.4 GROUNDWATER MONITORING

Groundwater monitoring was conducted at eight locations during 2008 in accordance with Schedule D.1 and D.5 of the Licence.

A Waterra inertial lift pump and dedicated hosing was used to purge 3(no.) well volumes from the borehole prior to sampling. The laboratory supplied sample containers were filled directly from the dedicated hosing. The filled sample containers were stored in a coolbox for transport to the laboratory. Visual and olfactory properties of the groundwater were recorded as part of the sampling process. ALcontrol Geochem, who are an ISO 17025 and UKAS accredited laboratory, carried out analyses on the water samples.

Table 7-10 Groundwater Trigger Values from 2007 Analyses as Revised in 2007 AER

Parameter	*Units*	*GW1-A*	*GW2*	*GW3*	*GW4-A*	*GW5-A*	*GW6*	*GW7*	*GW8*
pH (upper limit)	pH Units	9.02	9.79	9.38	9.14	8.82	10.56	9.53	8.86
pH (lower limit)	pH Units	5.73	5.35	5.56	5.77	5.7	5.54	5.87	5.28
Chloride	mg/l	20.40	39.60	24.00	39.60	32.40	24.00	18.00	37.20
Ammoniacal Nitrogen (as N)	mg/l	0.48	6.36	5.40	3.60	6.96	7.44	1.08	3.72
Total Organic Carbon	mg/l	60.00	55.20	27.60	60.00	74.40	48.00	21.60	39.60

Table 7-11 Groundwater Trigger Values from 2008 Analyses as Revised in 2008 AER

Parameter	*Units*	*GW1-A*	*GW2*	*GW3*	*GW4-A*	*GW5-A*	*GW6*	*GW7*	*GW8*
Potassium	mg/l	1.92	2.88	1.44	1.08	21.00	4.20	3.00	0.96
Sodium	mg/l	14.40	20.40	16.32	17.22	20.40	50.40	37.20	20.40
pH (lower limit)	pH Units	5.73	5.35	5.56	5.77	5.70	5.54	5.87	5.28
pH	pH Units	9.02	9.79	9.38	9.14	9.22	10.56	9.53	9.61
Chloride	pH Units	20.40	46.80	24.00	39.60	32.40	24.00	18.00	37.20
Ammoniacal Nitrogen	mg/l	1.92	6.36	5.40	3.60	8.52	7.44	2.40	3.72
TOC	mg/l	60.00	55.20	27.60	60.00	74.40	48.00	21.60	39.60

Figure 7-6 Groundwater pH results - CRRL 2008

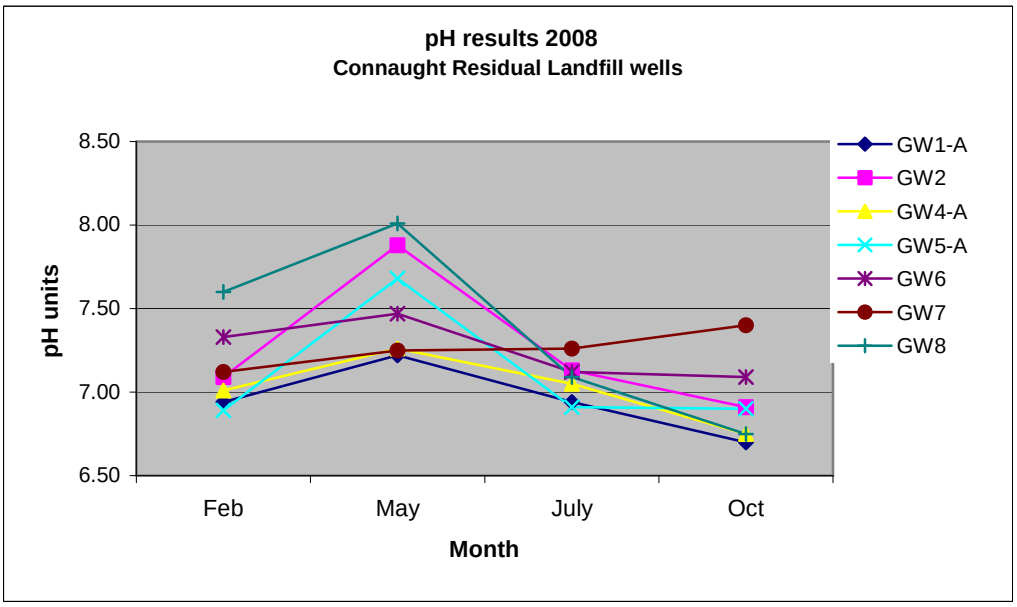

Figure 7-7 Groundwater pH results - CRRL GW3

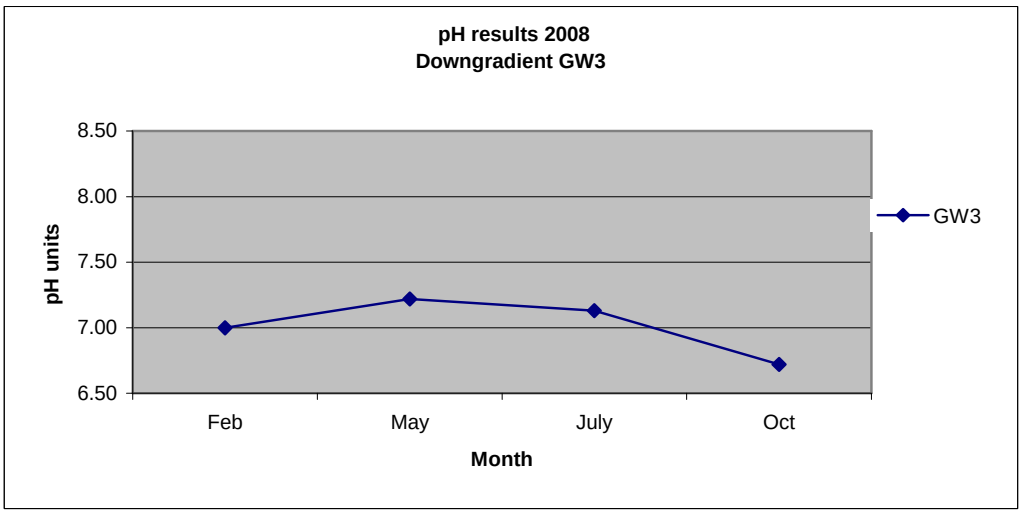

Table 7-12 Groundwater pH results - CRRL 2008

pH units	Feb	May	July	Oct
GW1-A	6.94	7.22	6.94	6.70
GW2	7.09	7.88	7.13	6.91
GW3	7.00	7.22	7.13	6.72
GW4-A	7.01	7.26	7.05	6.75
GW5-A	6.89	7.68	6.91	6.90
GW6	7.33	7.47	7.12	7.09
GW7	7.12	7.25	7.26	7.40
GW8	7.60	8.01	7.09	6.75

Figure 7-8 Groundwater Conductivity results – CRRL 2008

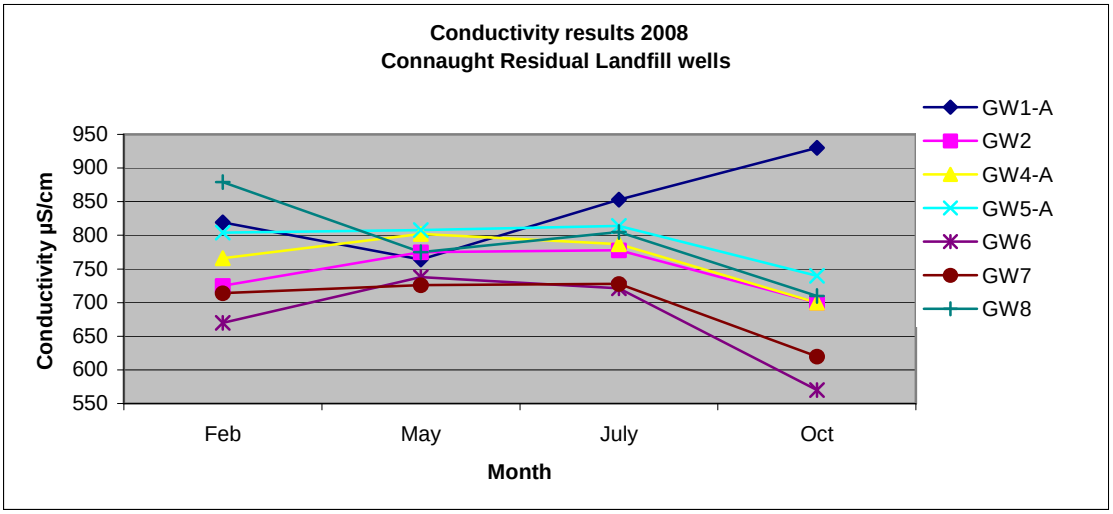

Figure 7-9 Groundwater Conductivity results – CRRL GW3

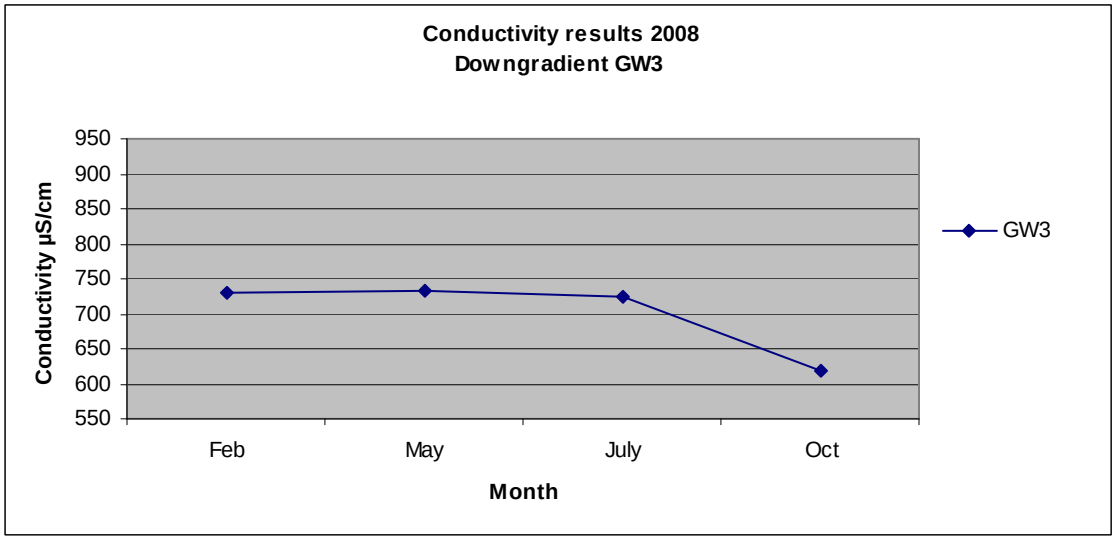

Table 7-13 Groundwater Conductivity results – CRRL 2008

Conductivity µS/cm	Feb	May	Jul	Oct
GW1-A	819	764	853	930
GW2	725	775	778	700
GW3	730	733	724	620
GW4-A	766	802	787	700
GW5-A	804	808	814	740
GW6	670	738	721	570
GW7	714	726	728	620
GW8	879	775	805	710

Figure 7-10 Groundwater Chloride results - CRRL 2008

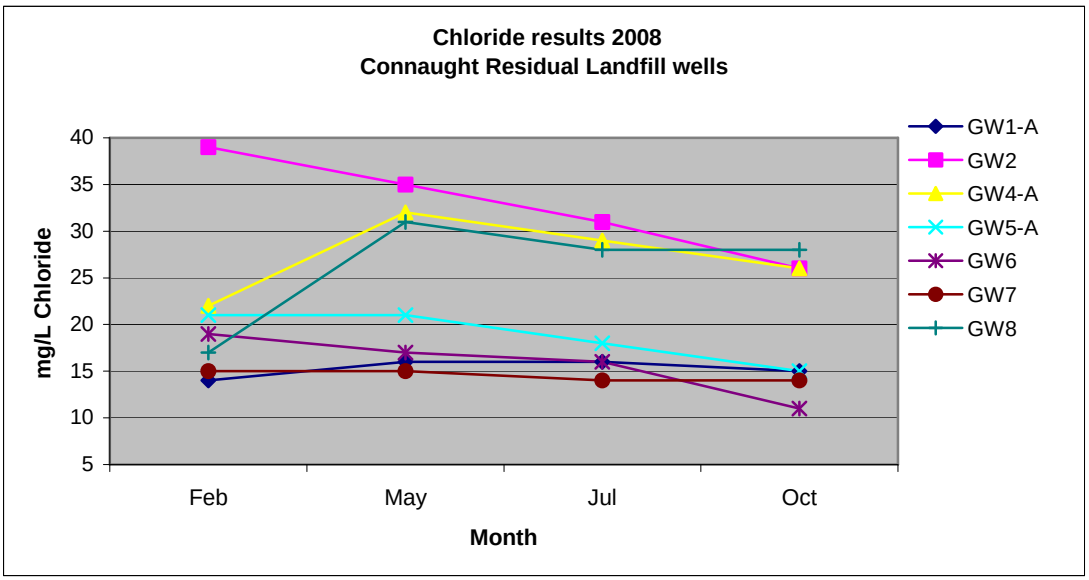

Figure 7-11 Groundwater Chloride results – CRRL GW3

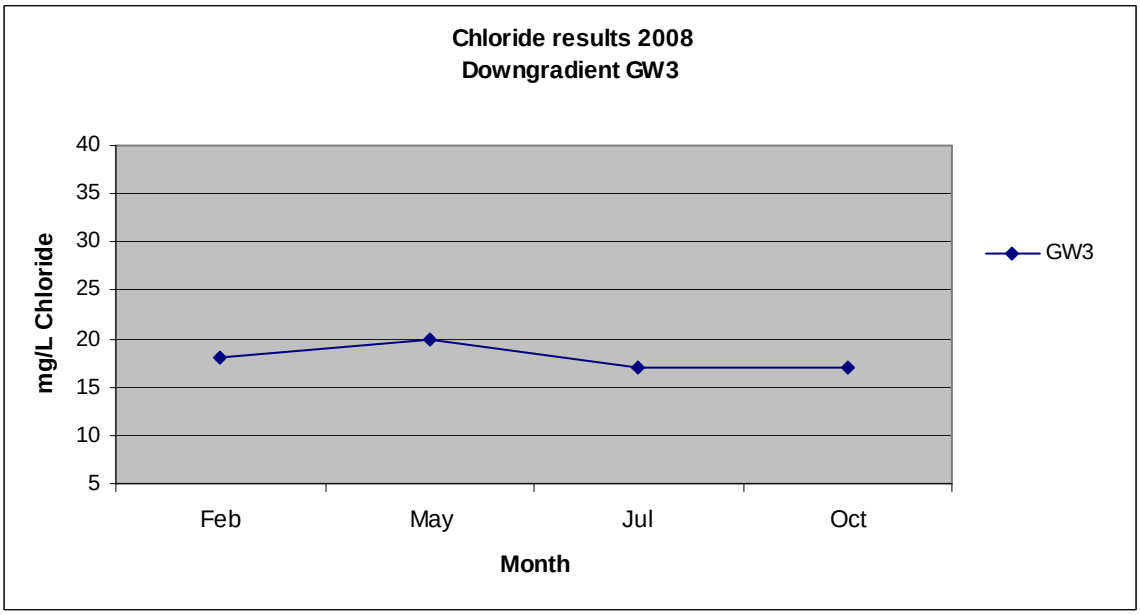

Table 7-14 Groundwater Chloride results - CRRL 2008

Chloride mg/L	Feb	May	Jul	Oct
GW1-A	14	16	16	15
GW2	39	35	31	26
GW3	18	20	17	17
GW4-A	22	32	29	26
GW5-A	21	21	18	15
GW6	19	17	16	11
GW7	15	15	14	14
GW8	17	31	28	28

Figure 7-12 Groundwater Ammoniacal Nitrogen results - CRRL 2008

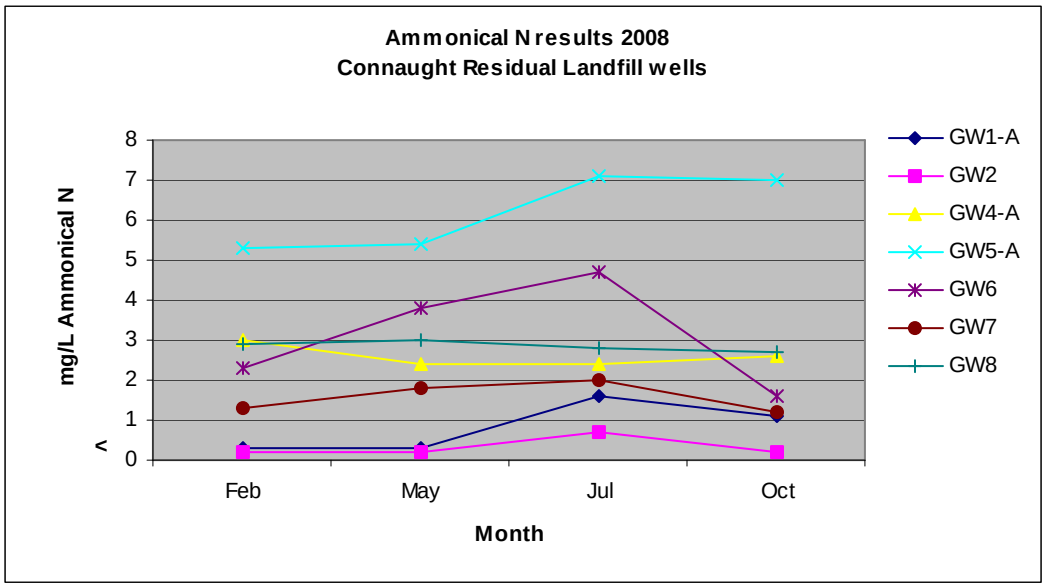

Figure 7-13 Groundwater Ammoniacal Nitrogen results - CRRL GW3

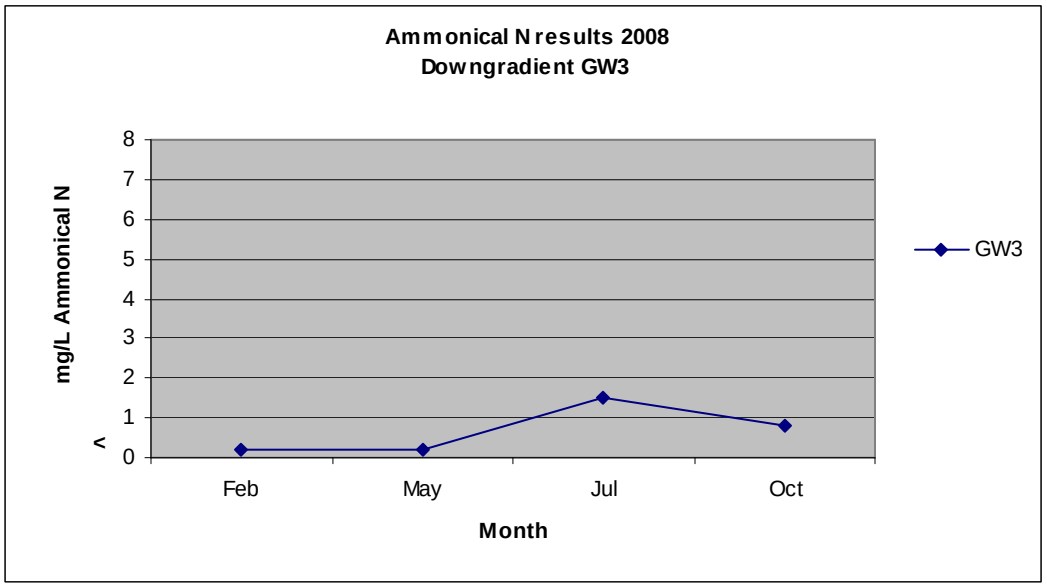

Table 7-15 Groundwater Ammoniacal Nitrogen Results - CRRL 2008

Ammoniacal N (mg/L N)	Feb	May	Jul	Oct
GW1-A	0.3	0.3	1.6	1.1
GW2	<0.2	<0.2	0.7	<0.2
GW3	<0.2	<0.2	1.5	0.8
GW4-A	3.0	2.4	2.4	2.6
GW5-A	5.3	5.4	7.1	7.0
GW6	2.3	3.8	4.7	1.6
GW7	1.3	1.8	2.0	1.2
GW8	2.9	3	2.8	2.7

Figure 7-14 Groundwater TOC results - CRRL 2008

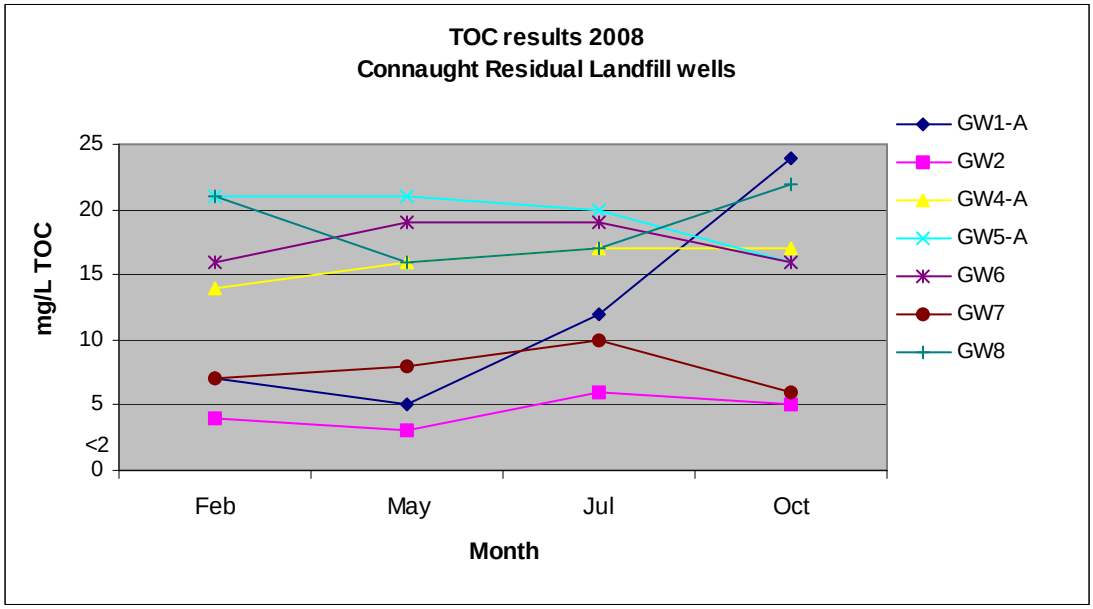

Figure 7-15 Groundwater TOC results - CRRL GW3

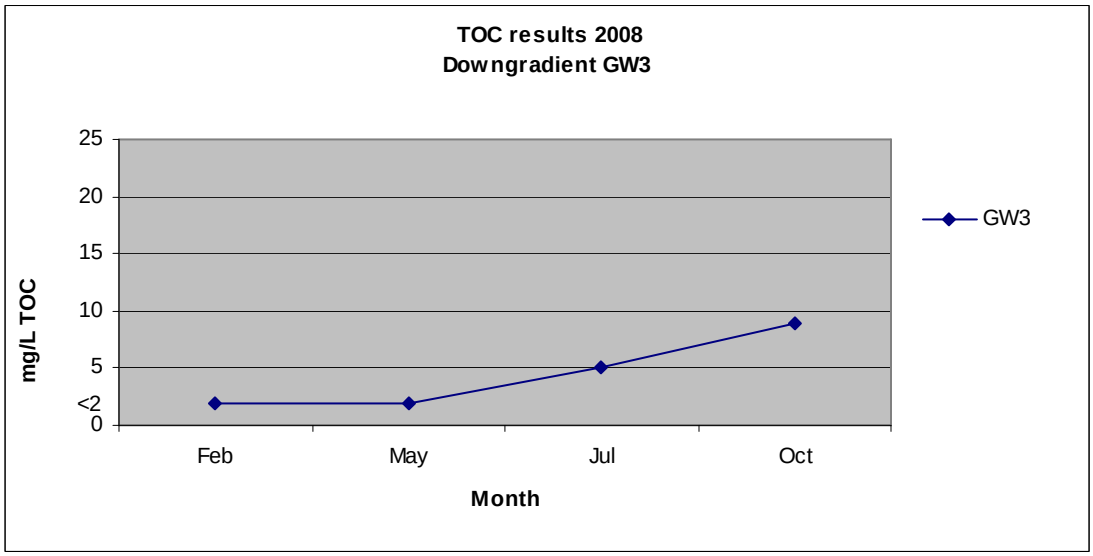

Table 7-16 Groundwater TOC results - CRRL

TOC mg/L	Feb	May	Jul	Oct
GW1-A	7	5	12	24
GW2	4	3	6	5
GW3	<2	2	5	9
GW4-A	14	16	17	17
GW5-A	21	21	20	16
GW6	16	19	19	16
GW7	7	8	10	6
GW8	21	16	17	22

7.4.1 GROUNDWATER pH RESULTS

pH concentrations were less than the corresponding trigger levels. pH results downstream at GW3 ranged from 6.7 to 7.2.

7.4.2 GROUNDWATER CONDUCTIVITY RESULTS

All conductivity measurements are are typical of uncontaminated groundwater. Conductivity results downstream at GW3 ranged from 620 uS/cm to 733 uS/cm.

7.4.3 GROUNDWATER CHLORIDE RESULTS

Chloride concentrations were below the 2007 trigger values. Chloride levels in GW4 (33 mg/l) were in slightly higher than 2006 trigger levels (31.2 mg/l). Chloride results downstream at GW3 ranged from 17 mg/L to 20 mg/L.

7.4.4 GROUNDWATER AMMONIACAL NITROGEN RESULTS

Ammoniacial Nitrogen detected in GW3 ranged from <0.2 mg/l to 1.5 mg/l in Q3. This was below the trigger value set for GW3 in the 2007 AER. Ammoniacal Nitrogen levels recorded are attributable to the continuous decay of organic peat in a natural bog environment and the use of organic fertilizers on the surrounding farmlands and are not due to landfill activities.

7.4.5 GROUNDWATER TOC RESULTS

Total Organic Carbon concentrations ranged from <2 to 24 mg/l. The TOC concentrations downgradient at GW3 ranged from < 2 mg/l to 9 mg/l, below the trigger value set for GW3 in the 2007 AER.

7.4.6 *GROUNDWATER TRIGGER LEVEL REVIEW*

A review of the groundwater trigger levels for all monitoring boreholes was carried out, and is given in

Table 7.10 and Table 7.11 at the beginning of the section. The trigger levels for each parameter at all monitoring boreholes were established, by taking the highest results over all monitoring events to date and increasing it by 20%.

7.5 DUST MONITORING

Dust monitoring was undertaken at 5(no.) locations (D1, D2, D3, D4, D5) in accordance with D.1 and D.4 of the Waste Licence.

Table 7-17 Dust Monitoring Locations

Location	Eastings	Northings
D1	171353	228591
D2	171482	229743
D3	170984	229538
D4	170992	228833
D5	171167	230253

7.5.1 DUST MONITORING METHODOLOGY

Bergerhoff gauges were used to determine total dust deposition, as specified in the German Engineering Institute VDI 2119 document "Measurement of Dustfall Using the Bergerhoff Instrument (Standard Method)". Five gauges were set up so that the glass jars were at a height of 2m from the ground at the monitoring locations. The jars were set open during the monthly monitoring events. The samples were submitted to Alcontrol Geochem Laboratories, Dublin for analysis.

7.5.2 DUST MONITORING RESULTS

The results of the dust monitoring conducted at the facility are presented below. Dust concentrations and emission limit values as detailed in Schedule C.3 of the Waste Licence are discussed in Section 8.1 above. Dust monitoring conformed to the ELV of 350mg/m^2/day throughout the quarterly monitoring periods at all five locations, with the exception of D4 in July.

Elevated results received for D4 in July can be attributed to one off event earth movements and ground improvement works that took place within close proximity of the monitoring location. Splash contamination was the most likely source of contamination at this point. Passing vehicles travelling through large puddles on the elevated haul road adjacent to D4 artificially contaminated the sample, resulting in elevated readings at this location. In order to provide further verification of the air quality in the region of dust gauge D4, additional dust monitoring was carried out at D4 from August 27th to September 24th. Results for the D4 (re-test 41mg/m2/d) during this period showed a significant reduction when compared to the July results and were considerably below the limit value of 350mg/ m2/d. The September monitoring event at D4 demonstrated that the elevated results during July were uncharacteristic and not representative of the characteristic dust deposition trend at the site during

operations.

Table 7-18 Dust Monitoring Results 2008

Date out	Date in	D 1	D 2	D 3	D 4	D 5
7.2.08	6.3.08	76	78	77	86	124
6.5.08	4.6.08	171	39	169	46	83
10.7.08	06.08.08	138	89	99	**647**	179
27.08.08	24.09.08	-	-	-	41	-
5.11.08	3.12.08	116	104	136	188	162

7.6 PM10 MONITORING

PM10 monitoring was conducted at the facility in accordance with Schedule D.3 of the Licence. In order to quantify the baseline levels of PM10 in the area, five locations (D1 – D5) were monitored for a period of 24 hours each on a quarterly basis. The PM10 monitoring locations are shown on Drawing 1322/01/101, Appendix A.

Table 7-19 PM10 Monitoring Locations

Location	Eastings	Northings
D1	171357	228602
D2	171483	229730
D3	170997	228842
D4	170997	228842
D5	171167	230253

7.6.1 METHODOLOGY

In order to obtain ambient air PM10 concentration levels for the landfill site, a battery operated gravimetric particulate sampler (Partisol) was used (as no power source is available at any of the monitoring points). Published data demonstrates strong correlation with the reference technique. This monitoring technique was used by the Irish EPA to perform PM10 monitoring of regional zones as part of the Air Quality monitoring program (EPA 2002).

Table 7-20 PM10 (ug/m3) Monitoring Results for 2008

Location	Q1	Q2	Q3	Q4
D1	12	20.8	23	18
D2	16.2	31.9	16	24
D3	15.4	30.5	18	23
D4	19.2	30.5	15	20
D5	11.4	13.8	22	15

7.6.2 RESULTS

The Licence states that PM10 from the facility measured at any location on or outside the boundary of the facility cannot exceed 50µg/m3 for a daily sample. All results comply with this limit.

7.7 NOISE MONITORING

7.7.1 NOISE MONITORING LOCATIONS

Noise monitoring was conducted at the facility on a quarterly basis throughout the reporting period in accordance with Schedule D.4 of the Licence. Noise measurements were taken at five monitoring locations, as shown in Table 7.22, in order to determine the existing noise climate at site boundary positions (N1, N2, N4) and local noise sensitive receptors N3 and N5.

The noise monitoring locations N1, N2, N3, N4 and N5 are presented in Drawing 1322/01/101, Appendix A. The results and interpretations of the monitoring exercise were reported to the Agency as part of the quarterly reports.

Table 7-21 Noise Monitoring Locations

Media	Location	Eastings	Northings
Noise	N1	171238	228600
	N2	171656	229657
	N3	171490	230181
	N4	171011	229554
	N5	171307	230351

7.7.2 SAMPLING METHODOLOGY

The measurements were made according to the requirements of *ISO 1996: Acoustics – Description and Measurement of Environmental Noise, parts 1, 2 and 3 a*nd the EPA "*Environmental Noise Guidance Document" (EPA 2003).*

7.7.3 TONAL AND IMPULSIVE CHARACTERISTICS

Tonal and impulsive characteristics elements of the noise were determined in accordance with ISO 1996 – 2. A source is described as having a tonal element at a particular frequency when it is clearly audible or exceeds the level of the adjacent band by 5dB or more. For example, a fan running inefficiently can often exhibit a tonal noise as a hum or drone. An impulsive noise is of short duration (typically less than 1 second). It is brief and abrupt; its startling effect causes greater annoyance than would be expected from a simple measurement of sound pressure level. An example is an instantaneous bang/thud that may be associated with pile driving/hammering etc.

7.7.4 SURVEY IMPLEMENTATION

As required under Schedule D.4 of Waste Licence 178-1, the primary measurement parameter was the equivalent continuous A-Weighted Sound Pressure level, LAeq, T, over 30-minute measurement intervals for the duration of the day-time monitoring survey. A statistical analysis of the measurement results was also completed so that the percentile levels, LAN, T, for N = 90% and 10% over 30-minute measurement intervals were also recorded. The percentile levels represent the noise level in dB(A) exceeded for N% of the measurement time. LA10 values are used to describe intermittent, high-energy noise events whereas LA90 values are representative of background noise levels.

In addition, frequency was measured in the 1/3-octave band at each of the four noise monitoring locations to assess the potential tonal components of ambient noise generated in the vicinity of the site. All sources of noise were noted, recorded and where possible, identified during the course of this survey.

7.7.5 NOISE MONITORING RESULTS

The noise monitoring results conducted at the facility during the reporting period are summarised below.

Table 7-22 Noise Monitoring Results

Location	27/03/08 Time	LAeq dB(A)	LA10 dB(A)	LA90 dB(A)	15/05/08 Time	LAeq dB(A)	LA10 dB(A)	LA90 dB(A)	27/08/08 TIME	LAeq dB(A)	LA10 dB(A)	LA90 dB(A)	12/11/08 TIME	LAeq dB(A)	LA10 dB(A)	LA90 dB(A)
N1 Noise Sensitive Receptor	11:35	37.9	39.3	32.5	11.00	41.3	43.6	35.5	10:37	50.1	51.4	48.2	11:02	43.6	42.3	36.1
N2	12:19	41.0	42.8	38.0	11.41	39.1	41.5	34.1	11:28	50.9	52.6	48.9	11:43	47.9	49.7	44.3
N3 Noise Sensitive Receptor	13:10	41.1	41.7	36.2	13.01	53.1	52.6	35.6	13:44	51.4	53.1	49.3	13:02	46.9	47.2	41.4
N4	10:54	39.8	42.2	33.8	10.21	45.3	47.9	36.7	12:48	51.6	52.4	49.4	10:14	52.9	51.4	44.0
N5 Noise Sensitive Receptor	9:58	62.1	63.8	34.4	12.26	66.4	63.1	34.6	12:08	68.2	68.0	48.4	12:26	69.4	69.0	37.3

8 RESOURCE AND ENERGY CONSUMPTION SUMMARY

The main resources consumed at the facility during the reporting period were electricity, water for potable supply, vehicle wheel cleaning and dust suppression, diesel fuel and hydraulic oils. Electricity consumption has increased by 35% from 2008 due to increased landfill flaring and leachate pumping. Water consumption for dust suppression was lower than that for 2007 due to higher rainfall during 2008.

Table 8-1 Energy and Resource Use 2008

Resource	**Consumption**
Electricity	190,300 (kWhr)
Water, Potable Supply	52,000 L
Water, Dust suppression	1,927,000 L
Water, Wheelwash	150,000 L
Total Water	2,129,000 L
Diesel	139,112 L
Hydraulic Oils	460 L
Grease	70 kg
Terram for road base	4,500 m2
Imported Aggregates	5,934 tonnes
Soil materials from site stockpiles	25,000 tonnes

9 DEVELOPMENT & RESTORATION WORKS

Development works undertaken in 2008

A number of development works were carried out or commenced during 2008. The main development works included:

- Commence construction of phase 2 of the landfill, i.e. cells 4 to 9 c/w all ancillary infrastructure.
- Commence construction of leachate storage lagoon c/w all ancillary infrastructure.
- The Installation of landfill gas management infrastructure. This included the installation of 20 vertical gas extraction wells in cells 2 and 3, 99 pin wells in cells 2 & 3, and an additional 2000m3/hr enclosed Haase flare.
- The Installation of geohess temporary gas barrier in cells 2 & 3.

Development works to be undertaken in 2009

The following development works are planned to be undertaken in 2009:

- Installation of a back up 2,000m3/hr enclosed Haase flare and blower station.
- Continue the installation of landfill gas infrastructure, which will include drilling vertical wells in Cells 3 & 4.
- Continue construction of phase 2 of the landfill, i.e. cells 4 to 9 c/w all ancillary infrastructure.
- Continue construction of leachate storage lagoon c/w all ancillary infrastructure.
- Commence Gas utilisation plant.
- The Installation of geohess temporary gas barrier on remainder of cell 2 & on cell 3.

The final capping of cells 1 & 2 is scheduled to commence in May 2010 with capping of cell 3 commencing in July 2011. In the interim intermediate capping of cells at the landfill is ongoing. This capping comprises 0.5m low permeability soils and Geohess temporary gas barrier which incorporates effective gas well seals and exceeds temporary capping recommendations stipulated in EPA Landfill Operational Practices Manual.

Table 9-1 Schedule of Restoration Works for Landfill Cells

Activity	Phase 1			Phase 2
	Cell 1	Cell 2	Cell 3	Cell 4
Commencement of Filling	Dec 2005	Sept 2006	Nov 2007	Jan 2009
Application of Intermediate Capping including Impermeable Temporary Barrier	Sept 06 & Aug 07	Aug 07 & Jan 08 & Mar 09	Jan 09, Mar 09, June 09 & Feb 10	Feb 2010 & July 2010
Approximate Date for Completion of Filling	April 2010	April 2010	Jan 2011	Aug 2012
Commencement of Permanent Capping	May 2010	May 2010	July 2011	July 2013

The approximate dates identified in Table 9.1 above for the completion of filling and commencement of installation of final permanent capping are dependant on several factors that include market availability of wastes and settlement rates.

The extent of the temporary Geohess impermeable gas barrier layer placed at the site at present is as follows.

Cell 1: 100% 14,000m^2
Cell 2: 66% 9,250m^2
Cell 3: 13% 1,850m^2

It is planned that temporary impermeable barrier will be extended to the remaining portion of cell 2 and a further 20% of cell 3 in March 2009. Further temporary impermeable barrier placement is scheduled for June 2009 and this will increase the capped portions of Cells 1 to 3 as follows.

	Present	March '09	June '09
Cell 1:	100%	100%	100%
Cell 2:	66%	100%	100%
Cell 3:	13%	33%	66%

10 LEACHATE TRANSPORTED OFF SITE

Table 10-1 Volume of Leachate Transported Off Site

2008	Leachate Consigned Off Site
January	2582.22
February	2370.46
March	1781.8
April	1646.54
May	1050.66
June	824.7
July	878.52
August	1013.78
September	2162.89
October	2564.95
November	3025.68
December	2660.24
Total	22562.44

11 ESTIMATED AND ANNUAL CUMULATIVE QUANTITIES OF LANDFILL GAS EMITTED FROM THE FACILITY

Table 11-1 Landfill Gas collected in 2008 – 2000 Haase Flare

MONTH	2000 Haase Flare						
	2000 (m3)	Flaring Total (m3/hr)	GAS QUALITY (% v/v)			Quantity of LFG Collected	
			CH4	CO2	O2	(kg CH_4)	(kg CO_2)
Jan-08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feb-08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar-08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Apr-08	511912.97	1471.01	39.83	30.23	2.84	146304.34	303343.85
May-08	1222424.50	1643.04	36.50	29.46	3.21	320214.75	705838.72
Jun-08	1279985.00	1777.76	36.50	29.46	3.21	335292.75	739074.66
Jul-08	1261967.10	1696.19	38.62	32.35	2.31	349733.78	800231.44
Aug-08	1227558.00	1649.94	38.62	32.35	2.31	340197.86	778412.14
Sep-08	1177620.00	1635.58	42.17	31.10	2.58	356398.75	717853.88
Oct-08	1345168.00	1808.02	41.10	31.42	1.91	396705.25	828527.57
Nov-08	1441579.00	2002.19	38.15	31.15	2.40	394650.65	880102.03
Dec-08	1638565.50	2202.37	36.80	28.10	2.56	432180.54	902422.38
Total Collected:	11,106,780.07	15,886.12	348.30	275.63	23.32	3,071,678.67	6,655,806.68

Table 11-2 Landfill Gas collected in 2008 – 750 Organics Flare

	750 Organics Flare						
			GAS QUALITY (% v/v)			Quantity of LFG Collected	
	750 (m3)	Flaring Total (m3/hr)	CH4	CO2	O2	(kg CH_4)	(kg CO_2)
Jan-08	549997.20	739.24	41.78	31.60	3.75	164691.54	340635.10
Feb-08	546157.35	752.09	39.82	30.11	4.80	155881.65	322314.69
Mar-08	545329.03	732.97	40.74	34.71	3.11	159239.62	371009.22
Apr-08	306000.14	750.00	39.83	30.23	2.84	87344.92	181326.25
May-08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jun-08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jul-08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Aug-08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sep-08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oct-08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nov-08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dec-08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Collected	1,947,483.72	2,974.31	162.17	126.65	14.50	567,157.73	1,215,285.26

Table 11-3 Landfill Gas collected in 2008 – 500 Haase Flare

	500 Haase Flare						
			GAS QUALITY (% v/v)			Quantity of LFG Collected	
	500 (m3)	Flaring Total (m3/hr)	CH4	CO2	O2	(kg CH_4)	(kg CO_2)
Jan-08	334032.89	448.97	41.78	31.60	3.75	100023.04	206879.82
Feb-08	360959.84	461.15	39.82	30.11	4.80	103023.45	213020.40
Mar-08	357527.14	480.55	40.74	34.71	3.11	104400.25	243240.06
Apr-08	193800.00	475.23	39.83	30.23	2.84	55318.43	114839.91
May-08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jun-08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jul-08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Aug-08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sep-08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oct-08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nov-08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dec-08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Collected	1,246,319.87	1,865.90	162.17	126.65	14.50	362,765.16	777,980.20

Table 11-4 Landfill Gas collected for total of 2000 Haase Flare, 750 Organics Flares and 500 Haase Flare

TOTAL	TOTAL CH_4	TOTAL CO_2
3 FLARES	**3 FLARES**	**3 FLARES**
LFG	**Methane**	**CO2**
Collected	**Collected**	**Collected**
(m3)	**(kg)**	**(kg)**
884030.09	264714.57	547514.92
907117.19	258905.10	535335.09
902856.17	263639.87	614249.28
1011713.11	288967.69	599510.01
1222424.50	320214.75	705838.72
1279985.00	335292.75	739074.66
1261967.10	349733.78	800231.44
1227558.00	340197.86	778412.14
1177620.00	356398.75	717853.88
1345168.00	396705.25	828527.57
1441579.00	394650.65	880102.03
1638565.50	432180.54	902422.38
14,300,583.65	4,001,601.56	8,649,072.13

12 ESTIMATED ANNUAL AND CUMULATIVE QUANTITY OF INDIRECT EMISSIONS TO GROUNDWATER

The potential sources of indirect emissions from the facility into the groundwater are:

- **Landfill Base**: The landfill site has a composite base lining system comprising a HDPE geomembrane and a half metre thick layer of compacted Bentonite Enhanced Soil. A leak detection survey of the HDPE geomembrane after placement of the drainage stone layer was completed and defects to the HDPE liner were repaired in accordance with industry standards.

- **Surface Water Collection & Treatment System**: Surface water from the paved access roads and landfill cell swale drain is collected and discharged into the surface water lagoon along with groundwater collected at the interceptor sump located below the landfill cells. Water from the lagoon is then piped to a reed bed, which further filters the water before it is finally discharged into the nearby stream.

- **Treated Sewage Effluent:** There is a BioCycle wastewater treatment plant located adjacent to the weighbridge which treats the canteen and office waste water prior to being pumped to the leachate holding tank via the foul-water sump. Leachate (containing foul water) is tankered off-site to a waste water treatment plant via a vacuum tanker.

In summary, as the landfill is fully contained there will be no indirect emissions to groundwater.

13 MET DATA AND POTENTIAL LANDFILL LEACHATE

The site is equipped with a Skye mini-weather station, which produces climatological data comprising wind speed (km/hr) and wind direction, rain (mm) and temperature (o C), relative humidity (%) and Atmospheric pressure (mbar). Daily meteorological data was collected onsite as well as potential Evapotranspiration data collected from the Birr Meteorological station in Co. Offaly and monthly evaporation data from Boora Co. Offaly. Monthly Rainfall, Evapotranspiration and Temperature data are depicted in Table 13.1 below.

Table 13-1 Monthly Rainfall, Evapotranspiration and Temperature data in 2008

Month	Rainfall (CRRL) (mm)	Potential Evapotranspiration (Birr) (mm)	Evaporation (Boora) (mm)
January	**Rainfall (mm)**	**Evapotranspiration (mm)**	**Evaporation (mm)**
February	**134.9**	**15.0**	**19.3**
March	**31.5**	**19.2**	**26.9**
April	**95.2**	**34.3**	**50.7**
May	**30.7**	**55.2**	**80.2**
June	**19.1**	**87.6**	**121.9**
July	**86.8**	**75.7**	**105.3**
August	**91.8**	**75.5**	**103.4**
September	**181.5**	**58.5**	**79.8**
October	**83.8**	**41.9**	**58.2**
November	**121.4**	**23.3**	**32.8**
December	**77.0**	**10.9**	**14.6**
Total	1017.4	504.5	702.7

Table 13-2 Estimated Liquid In-Waste Liquid Volume

	Consignment volumes off site m^3	Cell 1 Monthly Uncapped Area m^2	Cell 2 Monthly Uncapped Area m^2	Cell 3 Monthly Uncapped Area m^2	Monthly Uncapped Waste Area m^2	Rainfall (m) Monthly	25% of Penman value (m)	Potential in-waste liquid volume m^3
Jan	2582.22	0	4765	12380	17,145.0	0.135	0.004	2,248.4
Feb	2370.46	0	4765	12380	17,145.0	0.032	0.005	457.7
Mar	1781.8	0	4765	12380	17,145.0	0.095	0.009	1,485.2
Apr	1646.54	0	4765	12380	17,145.0	0.031	0.014	0.0
May	1050.66	0	4765	12380	17,145.0	0.019	0.022	-48.0
Jun	824.7	0	4765	12380	17,145.0	0.087	0.019	1,163.7
Jul	878.52	0	4765	12380	17,145.0	0.092	0.019	1,250.3
Aug	1013.78	0	4765	12380	17,145.0	0.182	0.015	2,861.0
Sep	2162.89	0	4765	12380	17,145.0	0.084	0.010	1,257.4
Oct	2564.95	0	4765	12380	17,145.0	0.121	0.006	1,981.4
Nov	3025.68	0	4765	12380	17,145.0	0.077	0.003	1,273.4
Dec	2660.24	0	4765	12380	17,145.0	0.064	0.002	1,060.5
Total	22562.44							14,991.0
		after 2 % absorptive capacity of the waste						
		Potential in-waste liquid volume m^3						14,691.2
Note:	The predicted figures use an assumption where the evapotranspiration rate is factored							
	at a rate of 25% of the standard Penman value taken from Birr station figures for 2008							

14 SCHEDULE OF ENVIRONMENTAL OBJECTIVE AND TARGETS

Table 14-1 Schedule of Environmental Objectives and Targets

Objective	Target
Lower the environmental impacts associated with fugitive landfill gas emissions by continually developing the Facility's Gas Utilisation Infrastructure and landfill gas management techniques.	• Undertake quarterly VOC surveys to establish the areas were fugitive emissions are most prevalent • Installation of gas extraction wells where fugitive emissions have been identified. • Apply impermiable geohess cover over filled areas of the landfill
Lower the potential environmental impacts associated with the generation of leachate. by reducing leachate generation	Reduce leachate generation by: • incorporating improved leachate reducing design features into construction of Phases 2 of the Landfill. • applying impermiable geohess cover over filled areas of the landfill .
Lower the potential environmental nuisance associated with dust by improving dust management techniques	• Investigate use of Surface water lagoon as primary water source for dust suppression
Minimise the amount of natural resources (water, power etc) consumed at the Facility.	• Ascertain the facilities performance within an energy management matrix and improve the facilities performance through adopting an Energy policy and improved Organisation, Motivation, Technology (IT), Education/Marketing & Investment.
Improve Health, Safety and Welfare	• Develop Accident Prevention Plan • Carry out Safety Statement review & Safety Statement training.
Staff Training	• Continue to train staff on a regular basis in EMS system, waste licence and Emergency Response.
Obtain ISO 14001 Environmental Management System Certification	• Pre-certification audit to be scheduled for Q2 2009 with the aim of having certification audit and being certified in Q3 2009.
Ensure all customers, contractors, site users & visitors are familiar with Greenstar's Environmental Policy	• Circulate policy to all customers & contractors who attend site. - Incorporate Environmental Policy into site inductions going forward.

15 SCHEDULE OF ENVIRONMENTAL OBJECTIVE AND TARGETS FOR 2007 – 2012

Table 15-1 Schedule of Environmental Objectives and Targets for 2007-2012

Ref. No.	Objective	Ref. No.	Target	Resources Required	Person Responsible	Time Frame for Completion	Progress as of 31st December 2008
O - 1	Lower the environmental impacts associated with fugitive landfill gas emissions by continually developing the Facility's Gas Utilisation Infrastructure and landfill gas management techniques.	T - 1.1	Undertake quarterly VOC surveys of the waste surface over the next 5 years, to establish the areas were fugitive emissions are most prevalent.	External Consultant (circa €1,800 per survey)	Site Manager	Ongoing	Surveys carried out on Monday 4th April 2008, Friday 30th May 2008, Wednesday 30th July 2008 & Thursday 4th Dec 2008.
		T - 1.2	Installation of gas extraction wells where fugitive emissions have been identified from the VOC surveys.	Circa €1,700 per borehole.	Site Manager	Ongoing	Additional vertical & horizontal gas extraction wells installed during 2008. 197 gas extraction points on site as on 31st December 2008. Further gas extraction wells to be added progressively to collection system in 2009.
		T - 1.3	Support University College Dublin Research Project commissioned to investigate the most effective cover material for achieving maximum odour neutralisation.	UCD €10,000	GM Landfill Group	Dec 2012	Project ongoing.

Ref. No.	Objective	Ref. No.	Target	Resources Required	Person Responsible	Time Frame for Completion	Progress as of 31st December 2008
		T - 1.4	Apply impermiable geohess cover over filled areas of the landfill .	€ 7/m2 approx	Site Manager	Ongoing	Geohess to be installed progressively over filled areas.
		T - 1.5	Monitor and review the effectiveness of the perimeter odour neutralising infrastructure installed in 2007 and maintain record of performance.	Assistant Site Manager (80 man hours)	Site Manager	Ongoing	Wind direction Intelligence sensor incorporated in Dec 2008 to improve efficiency of system. Continually review market developments in this field.
O - 2	Lower the potential environmental impacts associated with the generation of leachate. by reducing leachate generation	T - 2.1	Reduce leachate generation by incorporating improved leachate reducing design features into construction of Phases 2 and 3 of the Landfill.	External Consultant & Site Manager (60 man hours)	Site Manager	Ongoing	Leachate reducing design features have been incorporating into Phase 2 development by reducing cell area. Their effectiveness will be reviewed and possibly replicated in Phase 3 development.
		T - 2.2	Reduce leachate generation by applying impermiable geohess cover over filled areas of the landfill .	€ 7/m2 approx	Site Manager	Ongoing	Geohess to be installed progressively over filled areas.

Ref. No.	Objective	Ref. No.	Target	Resources Required	Person Responsible	Time Frame for Completion	Progress as of 31st December 2008
		T - 2.3	Lower the demand on WWTP's, risk of spillage, CO2 emissions associated with the off site treatment of leachate	External Consultant & Site Manager (60 man hours)	Site Manager	Ongoing	Ongoing implementation of site practices (Cell area reduction, Geohess application) plus on site leachate treatment trials – aeration.
O - 3	Lower the potential environmental nuisance associated with dust by improving dust management techniques	T - 3.1	Investigate available technology options for dust suppression activities that minimises water usage.	Assistant Site Manager (20 man hours)	Site Manager	December 2009	Use of spray bar for Water Bouser, as alternative, deemed inefficient. Investigate use of Surface water lagoon as primary water source for dust suppression.
O - 4	Lower the potential environmental impacts associated with litter by improving litter management techniques.	T - 4.1	Investigate potential for construction of wind breaker berms for operation in windy conditions.	Assistant Site Manager (20 man hours)	Site Manager	Ongoing	Not possible due to lack of desirable material available to this facility to be used in the construction of such berms. Continued review of day to day litter reducing management techniques to ensure minimal litter generation.

Ref. No.	Objective	Ref. No.	Target	Resources Required	Person Responsible	Time Frame for Completion	Progress as of 31st December 2008
O - 5	Minimise the amount of natural resources (water, power etc) consumed at the Facility.	T - 5.1	An Energy Audit of the Facility has been carried out to identify possibilities to improved energy efficiency and ascertain the facilities performance within an energy management matrix.	External Consultant (circa €5,000)	Site Manager	Sept 2009	Improve the facilities performance through adopting an Energy policy and improved Organisation, Motivation, Technology (IT), Education/Marketing & Investment.
		T – 5.2	Carry out assessment of the use of raw material at the Facility and identify opportunities for the improved efficiency in the use of raw materials.	Assistant Site Manager (40 man hours)	Site Manager	Ongoing	Material not available from Access waste. Facility actively pursues C & D materials,as a substitute for natural material, for engineering purposes. Natural material excavated during Phase 2 development to be reused on site where possible
		T - 5.3	Carry out assessment of water usage at the facility and identify opportunities for improved efficiency of water usage.	Assistant Site Manager (40 man hours)	Site Manager	Ongoing	Water requirements on various sections of site being monitored to identify potentials for reductions.
O - 6	Improve Health, Safety and Welfare	T - 6.1	Review Site safety statement	Assistant Site Manager	Site Manager GM Landfill	Sept 2009	Independent H&S audit & Safety statement review carried out in Nov 2007. Safety statement

Ref. No.	Objective	Ref. No.	Target	Resources Required	Person Responsible	Time Frame for Completion	Progress as of 31st December 2008
				(40 man hours)	Group		review & training carried out annually.
		T - 6.2	Reduce lost time injuries by 5% over the next five years		All site Personnel	Ongoing	Ongoing. Data being recorded and tracked.
		T - 6.3	Develop Accident Prevention Plan	Assistant Site Manager (80 man hours)	Site Manager GM Landfill Group	May 2009	
		T - 6.4	Identify appropriate training courses in Health and Safety management and arrange attendance for staff who hold a supervisory role	Assistant Site Manager (120 man hours)	Site Manager GM Landfill Group	Ongoing	Site manager completed IOSH certified 4 day H&S training in Jan 2008. Site supervisor completed IOSH certified 3 day training for supervisors in Nov 2007.
O-7	Training	T - 7.1	Continue to train staff on a regular basis in EMS system, waste licence and Emergency Response.	Assistant Site Manager	Site Manager	Ongoing	Ongoing
O-8	Operations	T - 8.1	Obtain ISO 14001 Environmental Management System Certification	Site Manager/Assistant Site Manager	Site Manager	Ongoing	Pre-certification audit to be scheduled for Q2 2009 with the aim of having certification audit and being certified in Q3 2009.

Ref. No.	Objective	Ref. No.	Target	Resources Required	Person Responsible	Time Frame for Completion	Progress as of 31st December 2008
		T - 8.2	Ensure all customers,contractors, site users & visitors are familiar with Greenstar's Environmental Policy	Site Manager/Assistant Site Manager	Site Manager	Ongoing	Circulate policy to all customers & contractors who attend site. Incorporate Environmental Policy into site inductions going forward.
		T - 8.3	Encourage all site hauliers to comply fully with the Waste Collection Permit Regulations	Site Manager	Site Manager	Ongoing	Ongoing
		T - 8.4	Review all Site Operational procedures	Site Manager/Assistant Site Manager	Site Manager	Ongoing	Ongoing

16 SUMMARY OF PROCEDURES DEVELOPED BY THE LICENCEE IN THE YEAR WHICH RELATES TO THE FACILITY OPERATION

The following is a description of the work procedures developed during the reporting period with respect to the operation of the facility.

CRRL 39- Landfill Gas Management Plan

The purpose of this procedure is to ensure a consistent approach to the installation of gas extraction wells as well as monitoring and reporting of gas infrastructure on site on an ongoing basis. This procedure will aid management in providing effective control measures for gas emissions, minimise the risk of migration of landfill gas beyond the perimeter of the site, minimise the risk of landfill gas migration into services and building on the site, minimise the effect on air quality and the effect of greenhouse gases on the global climate.

CRRL 40-2000m3 Haase Flare Operation: Start-Up

The procedure is a guide which details the steps involved in starting the Haase 2000m3 Flare (Connaught 1) on-site.

CRRL 41-2000m3 Haase Flare Operation: Shutdown

The procedure is a guide which details the steps involved in stopping or shutting down the Haase 2000m3 Flare (Connaught 1) on-site.

CRRL 42-2000m3 Haase Flare Operation: Start-Up Troubleshooting

The procedure is a guide which details a series of troubleshooting steps if there is a problem restarting the 2000m3 Flare (Connaught 1) on-site.

CRRL 43-2000m3 Blower Station Rosemount Analyser Calibrations

The procedure is a guide which details how to calibrate the online sensors of the 2000m3 Flare (Connaught 1) on-site. By following the procedure, all relevant staff will be able to calibrate the sensors while the flare is in operation reducing the need for down-time maintenance.

CRRL 44- Odour Management Plan

The purpose of this procedure is to ensure the a uniform approach to carrying out odour monitoring, be it on a daily basis or in relation to a complaint received by the facility. The procedure also details that VOC surveys will be carried out on a quarterly basis and outlines key operational considerations which would aid in reducing the potential for odours to arise

17 SITE TESTING AND INSPECTION REPORTS

A Slope stability assessment is contained in the Appendix D

See integrity and water testing report in Appendix E

18 REPORTED INCIDENTS AND COMPLAINTS SUMMARIES

See Table 20.8 for a list of incidents and complaints.

19 NUISANCE CONTROL

Greenstar Ltd is committed to operating the Connaught Regional Residual Landfill in the best possible manner using best available techniques to minimise impacts to the environment and local residential neighbours. The Connaught Regional Residual Landfill welcomes communications from local residents and any interested parties and all reasonable and practical measures will be implemented to eliminate or minimise any issues or nuisances.

19.1 BIRD CONTROL

During the reporting period, the facility employed the services of 'Falcon Bird Control Services' to provide an integrated approach to bird control. This involved the use of kites, heli-kites, distress calls and various birds of prey including Falcons. This method is preferred as it is non destructive to the birds and by varying the timing and use of bird control measures is a very effective method of bird control.

19.2 VERMIN CONTROL

Site personnel regularly checked for evidence of vermin on-site during regular routine inspections. Pestguard were employed throughout the duration of the reporting period in order to control potential nuisance caused by rodents. Continuous baiting was carried out by Pestguard and adjusted as necessary to prevent any infestation of vermin.

19.3 DUST & MUD CONTROL

Dust and mud control measures have been implemented since the start of the construction phase of the site and continued into the operational phase. These measures include the use of a wheelwash, road sweeper and the use of a water bowser to dampen access roads and stockpiles

during periods of dry weather.

19.4 LITTER

Litter is controlled by fencing which was installed around the landfill footprint as specified in the waste licence. Portable litter fencing is also used at the working face, which can be moved to various points around the working face depending on the wind direction. As part of operational controls all litter is collected at the end of the working day.

Good operational practices on site are the main controls to avoid nuisances. All waste deposited must be covered by the end of the working day. Adequate daily cover reduces the risk of odour, wind blown litter, vermin, flies and birds.

20 MANAGEMENT STRUCTURE, FINANCIAL PROVISON & PUBLIC INFORMAITON PROGRAMME

Financial Provisions

The financial provisions have been sourced from a report issued by O'Callaghan Moran & Associates in respect of the Environmental Liability Risk Assessment for CRRL, November 2005. The financial provision is divided into two parts: -

- The first part deals with estimated costs that may arise from accidents and unplanned events.
- The second part deals with closure, restoration and aftercare measures, including unexpected closure.

Part 1 - Unplanned Incidents

The identified risks of unplanned incidents and the likely costs of the remedial works to adequately address the associated environmental impacts are presented in Table 20.1. The table is derived from the Register of Risks presented in Section 4.5 and guidelines presented in the Agency's consultation document 'Guidance Documents and Assessment Tools on Environmental Liabilities Risk Assessments and Residual Management Plans incorporating Financial Provision Assessment'.

Table 20-1 Potential Unplanned Incidents

Risk	Risk Score*	Most Likely Cost (€)
1. Uncontrolled venting of landfill gas due to damage to cap or failure of flaring and or utilisation systems	6	50,000
2. Escape of leachate to subsoils and groundwater due to damage to lining system.	4	200,000
3 Migration of landfill gas due to damage to lining system	4	100,000
4 Escape of leachate to surface water drainage system	4	40,000
5 Escape of oil/chemicals to surface water drainage system	4	40,000

* The risk score (on a scale of 1-25) represents the risk of an incident occurring and the severity of the environmental impacts, but is not directly linked to the costs of the remedial works.

Greenstar has accidental pollution liability insurance to the value of €6.5 million, which is well in excess of any costs arising from unplanned events. It is expected that the maintenance costs will reduce significantly during the aftercare period to reflect the reduction in the monitoring frequencies agreed with the Agency.

Part 2 – Unexpected Closure

The following provisions will apply in the unlikely event of the unexpected closure of the facility in Year 3 of operation. The phased development involves the provision of all security, administrative, landfill cells, leachate and surface water drainage and landfill gas control infrastructure before waste is accepted in the new phase. Therefore there will be no capital costs associated with these items and the only capital costs will be linked to closure and restoration works.

Table 20-2 Unexpected Closure End Year 3 Capital and Recurring Costs (30 Years)

Item Description	€
Capping of cells 1, 2 & 3	€600,000
Decommissioning of Administration and Maintenance Areas	€50,000
Maintenance/Monitoring/Infrastructure	€1,189,006
Leachate Management	€301,380
Total	**€2,140,386**

Under condition 12.2.2, in year 1 Greenstar has put in place a Bank Guarantee with Bank of Ireland to the value of €1,839,279**.** Details of this bank guarantee have been submitted to the EPA. This figure will be reviewed annually in accordance with Condition 12.2.3. Based on the present calculation this figure is expected to rise to a maximum of €3,316,580 when the landfill is full.

In compliance with Condition 12.2.2 "within three months of agreement of the requirements of Condition 12.2.1, the licensee shall establish and maintain a fund or provide a written guarantee for the costs determined under Condition 12.2.1. The type of fund established and the means of its release/recovery shall be agreed by the Agency prior to its establishment."

Condition 12.3 of the waste licence states that *"the licensee shall provide a statement in writing on an annual basis as part of the AER in respect of the determination of charges for the disposal of waste".* In relation to this matter Greenstar can confirm that the gate fee for the disposal of waste at the Connaught Regional Residual Landfill is appropriate in the current market and includes financial provision for the closure, restoration and aftercare of the site.

Figure 20-1 Management and Staffing Structure and Staff Training

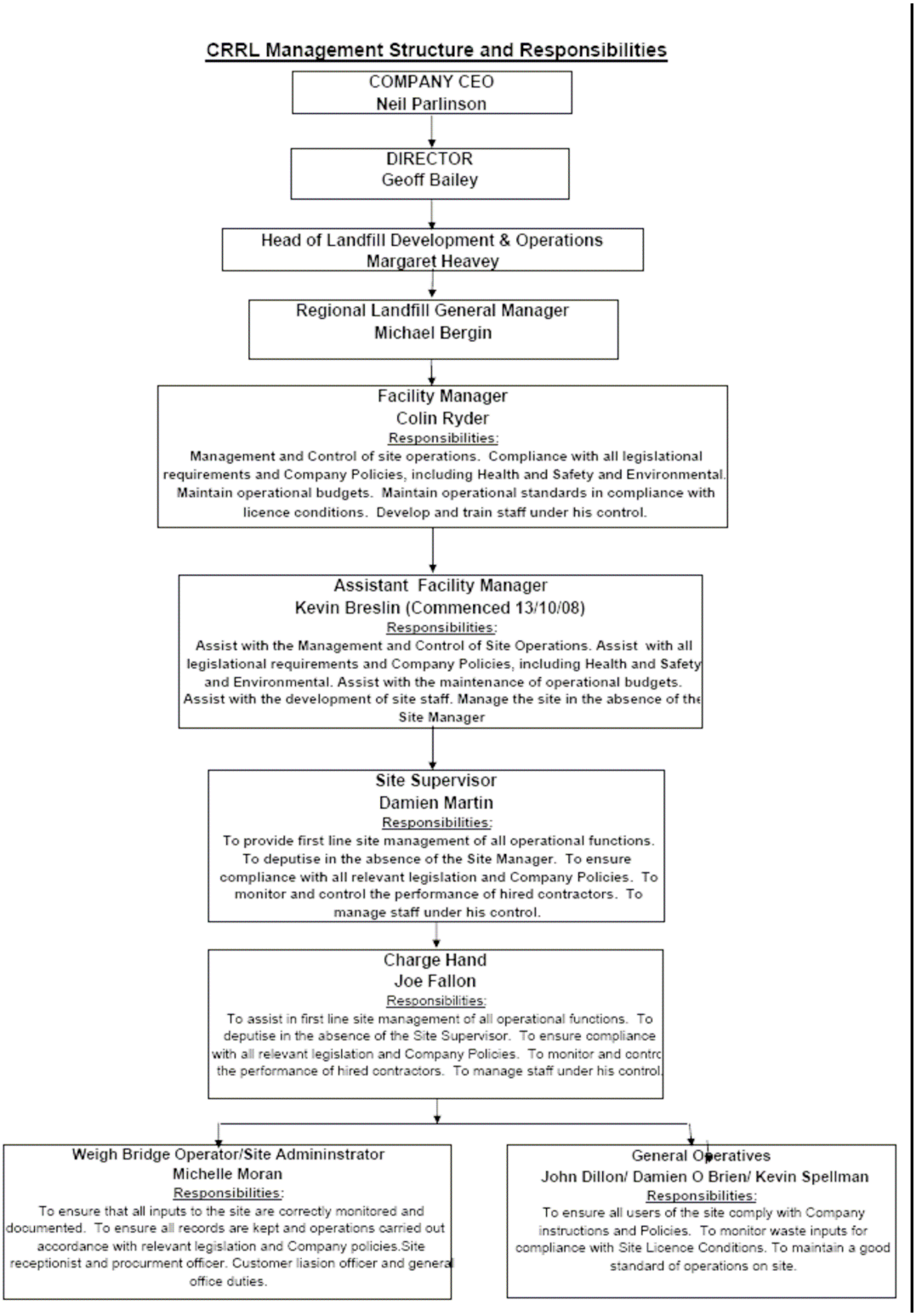

Table 20-3 Management and Staffing Structure and Staff Training - A

	CRRL Landfill	Fas Waste Management (Completed)	Safe Pass Course (Expiry Date)	Site Safety Statement	Health & Safety Instructions	First Aid (Expiry Date)	Fire Fighting	Fire Evacuation	Chemical Handling
Greenstar	Colin Ryder	Dec-05	Jul. 2009	05/02/2008	30/04/2008	May.2009	28/04/2008	30/04/2008	
	Kevin Breslin	Autumn 09	Sept. 2009	19/12/2008	03/11/2008				
	Damien Martin	March. 07	Oct. 2011	05/02/2008	30/04/2008	July. 2009	28/04/2008	30/04/2008	20/06/2008
	Joe Fallon		Feb. 2009	02/09/2008	21/08/2008				
	Michelle Moran			24/07/2008	29/07/2008				
	John Dillon		Feb. 2011	05/02/2008	30/04/2008		28/04/2008	30/04/2008	20/06/2008
	Damien O Brien		Nov. 2011	05/02/2008	30/04/2008	Oct. 2010	28/04/2008	30/04/2008	20/06/2008
	Kevin Spellman		Dec. 2011	05/02/2008	30/04/2008		28/04/2008	30/04/2008	20/06/2008
Renton	Paul McDermott		Nov. 2008	05/02/2008	30/04/2008		28/04/2008	30/04/2008	
John Daly	Alan Glynn								
John Daly	Tony Dermody		May.2012	05/02/2008	30/04/2008		28/04/2008	30/04/2008	

Table 20-4 Management and Staffing Structure and Staff Training - B

	CRRL Landfill	Manual Handling (3)	Intro to waste licence 178-1	Emergency Response Procedure	Waste Acceptance Procedures	Site Operational Procedures	Env. Monitoring	Complaints Procedure	Corrective Action Procedures
Greenstar	Colin Ryder	06/12/2006	08/01/2008	08/01/2008			26/06/2008	26/06/2008	26/06/2008
	Kevin Breslin	18/07/2007	03/11/2008	04/12/2008	04/12/2008		04/12/2008	04/12/2008	26/06/2008
	Damien Martin	14/04/2008	08/01/2008	08/01/2008	07/03/2008	07/03/2008	26/06/2008	26/06/2008	26/06/2008
	Joe Fallon		02/09/2008	25/08/2008	03/09/2008	03/09/2008			
	Michelle Moran		08/01/2008	08/01/2008	25/07/2008			25/07/2008	
	John Dillon	14/04/2008	21/04/2008	21/04/2008		21/04/2008			
	Damien O Brien	14/04/2008	08/01/2008	08/01/2008	07/03/2008	07/03/2008			
	Kevin Spellman	14/04/2008	08/01/2008	08/01/2008		07/03/2008			
Renton	Paul McDermott		08/01/2008	08/01/2008		07/03/2008			
John Daly	Alan Glynn								
John Daly	Tony Dermody		08/01/2008	08/01/2008		07/03/2008			

Table 20-5 Management and Staffing Structure and Staff Training - C

	CRRL Landfill	Landfill Compactor (Expiry date)	Excavator 360 (Expiry Date)	Dumper	Dozer	Boom and Scisors Lift (Expiry Date	VDU Guidelines	EMS Awareness Annual EMS Training
Greenstar	Colin Ryder							14/11/2008
	Kevin Breslin							14/11/2008
	Damien Martin	Feb. 2013	Dec. 2012	Feb. 2012	Feb. 2012	Dec. 2011		14/11/2008
	Joe Fallon			Feb. 2012				14/11/2008
	Michelle Moran							14/11/2008
	John Dillon			Feb. 2012				14/11/2008
	Damien O Brien			Nov. 2012		Nov. 2011		14/11/2008
	Kevin Spellman		May. 2011			May. 2012		14/11/2008
Renton	Paul McDermott	Feb. 2013						14/11/2008
John Daly	Alan Glynn							
John Daly	Tony Dermody		Nov. 2009					

Table 20-6 Management and Staffing Structure and Staff Training - D

	Colin Ryder	Kevin Breslin	Thomas Finnegan	Damien Martin	Joe Falon	Michelle Moran	John Dillon	Damien O Brien	Kevin Spellman	Paul McDermott	Tony Dermody
Training Unit	Greenstar	Greenstar	Greenstar	Greenstar	Greenstar	Greenstar	Greenstar	Greenstar	Greenstar	Renton	Daly
Fas Waste Management (Completed)	√	Autumn 09	√	√							
Safe Pass Course	√	√	√	√	√		√	√	√	√	√
Site Safety Statement	√	√	√	√	√	√	√	√	√	√	√
Health & Safety Instructions	√	√	√	√	√	√	√	√	√	√	√
First Aid	√			√				√			
Fire Fighting	√		√	√			√	√	√	√	√
Fire Evacuation	√		√	√			√	√	√	√	√
Chemical Handling (3)			√	√			√	√	√		
Manual Handling (3)	√	√	√	√			√	√	√		
Intro to waste licence 178-1	√	√	√	√	√	√	√	√	√	√	√
Emergency Response Procedure	√	√	√	√	√	√	√	√	√	√	√
Waste Acceptance Procedures	√	√	√	√	√	√		√			√
Site Operational Procedures	√	√		√	√	√	√	√	√	√	√
Env. Monitoring	√	√	√	√							
Complaints Procedure	√	√	√	√		√					
Corrective Action Procedures	√	√	√	√							
Landfill Compactor				√						√	
Excavator 360°				√					√		√
Dumper				√	√		√	√			
Dozer				√							
Boom and Scisors Lift				√				√	√		
EMS Awareness Annual EMS Training	√	√	√	√	√	√	√	√	√	√	

20.3 Programme for Public Information

Connaught Regional Residual Landfill pursues an active programme of disseminating information on its operations to interested parties. This is undertaken through a variety of means including site tours, the company website, presentations and open days.

The communications programme contains the following objectives:

- To promote public awareness of the Company's activities and environmental policies.
- To maintain an ongoing dialogue with authorities that have direct involvement with waste disposal activities.
- To make available Environmental Performance Data relating to the site
- To disseminate information relating to the operation and management of the site as appropriate.
- To encourage liaison between the site and local residents and those who may be affected by the site operations.
- To provide general information on Waste Management Issues.
- To ensure all users and customers of the site are conversant with the requirements of the Site Licence.
- To ensure that all objectives are, where possible, measurable and quantifiable.

The objectives of the programme are met through the following elements as appropriate:

- Personal Contact
- Residents Meetings/Liaison Groups
- Information Displays
- Information Packs
- Site Visits
- Web Page
- Educational Links
- Published Information

Table 20-7 List of Incidents

Number	Date	Description	Action
I-08/01	24/01/2008	Elevated CH_4 levels in landfill gas monitoring borehole's LG5 & LG9. Elevated CO_2 levels were recorded at monitoring borehole's LG4, LG5, LG7, LG8, LG9, LG15, LG16, LG18 & LG20.	Incident Report Submitted. Previous monitoring carried out by White Young Green on the 6th and 13th December 2005 prior to facility accepting waste. These two monitoring events identified elevated methane gas levels at LG14, LG16 & LG18. Elevated CO_2 at locations LG6, LG6a, LG9, LG10, LG14, LG16 &LG18. The Report concluded that elevate levels of methane gas and Carbon Dioxide could be attributed to large quantities of peat deposited in the area of the monitoring wells.
I-08/02	29/02/2008	Elevated CH_4 level in landfill gas monitoring borehole LG9. Elevated CO_2 levels were recorded at monitoring borehole's LG6, LG7, LG8, LG9, LG15, LG16, LG18 & LG20.	Incident Report Submitted.
I-08/03	27/03/2008	Elevated CO_2 levels were recorded at monitoring borehole's LG5, LG6, LG7, LG8, LG10, LG14, LG15, LG16, LG18 & LG20.	Incident Report Submitted.
I-08/04	29/04/2008	Elevated CH_4 level in landfill gas monitoring borehole LG5. Elevated CO_2 levels at LG8, LG10, LG16, LG18 & LG20.	Incident Report Submitted.
I-08/05	06/05/2008	Elevated CH_4 level in landfill gas monitoring borehole LG5. Elevated CO_2 levels at LG5, LG8, LG16 & LG18.	Incident Report Submitted.
I-08/06	04/06/2008	Elevated CH_4 level in landfill gas monitoring borehole LG5. Elevated CO_2 levels at LG4, LG5, LG8, LG10, LG15, LG16 & LG18.	Incident Report Submitted.
I-08/07	10/07/2008	Elevated CH_4 levels in landfill gas monitoring borehole LG5	Incident Report Submitted.

		& LG9. Elevated CO_2 levels at LG5, LG9, LG10 & LG15.	
I-08/08	06/08/2008	Elevated CH_4 levels in landfill gas monitoring borehole LG5 & LG9. Elevated CO_2 levels at LG5, LG8, LG9, LG10 LG16 & LG18.	Incident Report Submitted.
I-08/09	10/07/2008-07/08/2008	Elevated Dust deposition level at D4 monitoring point	Incident Report Submitted. A retest of D4 from 27/08/08 to 24/09/08 showed a result well below licence limit value and proved that the initial result was uncharacteristic. It is highly likely that the exceedance was due to splash contamination from passing site traffic.
I-08/10	03/09/2008	Elevated CH_4 level in landfill gas monitoring borehole LG5, LG9 & LG16. Elevated CO_2 levels at LG5, LG8, LG9, LG15, LG16 & LG18.	Incident Report Submitted. Previous monitoring carried out by White Young Green on the 6th and 13th December 2005 prior to facility accepting waste. These two monitoring events identified elevated methane gas levels at LG14, LG16 & LG18. Elevated CO_2 at locations LG6, LG6a, LG9, LG10, LG14, LG16 &LG18. The Report concluded that elevate levels of methane gas and Carbon Dioxide could be attributed to large quantities of peat deposited in the area of the monitoring wells.
I-08/11	16/10/2008	Elevated CH_4 level in landfill gas monitoring borehole LG5. Elevated CO_2 levels at LG4, LG5, LG6A, LG8, LG9, LG12, LG15, LG16 & LG20.	Incident Report Submitted.
I-08/12	28/10/2008	Landfill Gas Flare Failure	Incident Report Submitted.
I-08/13	05/11/2008	Elevated CH_4 level in landfill gas monitoring borehole LG5. Elevated CO_2 levels at LG4, LG5, LG8, LG15, LG16 &	Incident Report Submitted.

		LG18.	
I-08/14	03/12/2008	Elevated CH_4 level in landfill gas monitoring borehole LG5 & LG18. Elevated CO_2 levels at LG5, LG6, LG6A, LG8, LG9, LG12, LG15, LG16, LG18 & LG20.	Incident Report Submitted.

Complaints

The Connaught Regional Residual Landfill maintains a register of complaints received in compliance with Condition 10.4 of the waste licence. A total of 110[b1] complaints were received in relation to the operation of the facility for the reporting period. Complaints in relation to the operation of the facility are summarised in Table 20.8 below.

Table 20-8 List of Complaints

2008	Date	Nature of Complaint	Complainant	Method of Communication
1	04/01/2008	Odour	Mrs Maureen Kelly	Phone via EPA (Joe Hunter RPS)
2	04/01/2008	Odour	Mr Thomas Lohan	Phone via EPA (Joe Hunter RPS)
3	07/01/2008	Odour	Mrs Fiona Cawley/Cunningham	Phone via EPA (Joe Hunter RPS)
4	09/01/2008	Odour	Mrs Brenda Dwyer	Phone via EPA (Joe Hunter RPS)
5	09/01/2008	Odour	Mrs Margaret Lohan	Phone via EPA (Joe Hunter RPS)
6	09/01/2008	Odour	Mr Padraig Lohan	Phone via EPA (Joe Hunter RPS)
7	09/01/2008	Odour	Mrs Fiona Cawley/Cunningham	Phone via EPA
8	10/01/2008	Odour	Mrs Fiona Cawley/Cunningham	Phone via EPA (Joe Hunter RPS)
9	10/01/2008	Odour	Mr Thomas Lohan	Phone via EPA (Joe Hunter RPS)
10	10/01/2008	Odour	Mr Thomas Finn	Phone via EPA (Joe Hunter RPS)
11	10/01/2008	Odour	Mr Padraig Lohan	Phone via EPA (Joe Hunter RPS)
12	11/01/2008	Odour	Mrs Carmel Glynn	Phone via EPA (Joe Hunter RPS)
13	11/01/2008	Odour	Ms Geraldine Cogavin	Phone via EPA (Joe Hunter RPS)
14	11/01/2008	Odour	Ms Vicky Molloy	Phone via EPA (Joe Hunter RPS)
15	11/01/2008	Odour	Ms Geraldine Malone	Phone via EPA (Joe Hunter RPS)
16	11/01/2008	Odour	Mrs Fiona Cawley/Cunningham	Phone via EPA (Joe Hunter RPS)
17	11/01/2008	Odour	Mrs Fiona Cawley/Cunningham	Phone via EPA (Joe Hunter RPS)
18	12/01/2008	Odour	Mr Patrick Dillon	Phone via EPA (Joe Hunter RPS)
19	15/01/2008	Odour	Mrs Marie Dwyer	Phone via EPA (Joe Hunter RPS)
20	15/01/2008	Odour	Mr Billy Murphy	Phone via EPA (Joe Hunter RPS)
21	16/01/2008	Odour	Mr Thomas Finn	Phone via EPA (Joe Hunter RPS)
22	16/01/2008	Odour	Mr Sean Kenny	Phone via EPA (Joe Hunter RPS)
23	17/01/2008	Odour	Mr Thomas Lohan	Phone via EPA (Joe Hunter RPS)
24	18/01/2008	Odour	Mr Thomas Lohan	Phone via EPA (Joe Hunter RPS)
25	19/01/2008	Odour	Mr Thomas Lohan	Phone via EPA (Joe Hunter RPS)
26	19/01/2008	Odour	Mrs Fiona Cawley/Cunningham	Phone via EPA (Joe Hunter RPS)
27	19/01/2008	Odour	Mrs Margaret Lohan	Phone via EPA (Joe Hunter RPS)
28	19/01/2008	Odour	Mr Padraig Dwyer	Phone via EPA (Joe Hunter RPS)
29	21/01/2008	Odour	Mrs Fiona Cawley/Cunningham	Phone via EPA (Joe Hunter RPS)

2008	Date	Nature of Complaint	Complainant	Method of Communication
30	21/01/2008	Odour	Mr Sean Kenny	Phone via EPA (Joe Hunter RPS)
31	21/01/2008	Odour	Mr Thomas Lohan	Phone via EPA (Joe Hunter RPS)
32	21/01/2008	Odour	Mrs Kathleen Harewood	Phone via EPA (Joe Hunter RPS)
33	21/01/2008	Odour	Mrs Carmel Glynn	Phone via EPA (Joe Hunter RPS)
34	22/01/2008	Odour	Mrs Brenda Dwyer	Phone via EPA (Joe Hunter RPS)
35	22/01/2008	Odour	Mrs Bridge Donlon	Phone via EPA (Joe Hunter RPS)
36	23/01/2008	Odour	Mr Padraig Lohan	Phone via EPA (Joe Hunter RPS)
37	24/01/2008	Odour	Mrs Carmel Glynn	Phone via EPA (Joe Hunter RPS)
38	24/01/2008	Odour	Mr Thomas Lohan	Phone via EPA (Joe Hunter RPS)
39	24/01/2008	Odour	Mrs Fiona Cawley/Cunningham	Phone via EPA (Joe Hunter RPS)
40	26/01/2008	Odour	Mr Ambrose Dwyer	Phone via EPA (Joe Hunter RPS)
41	27/01/2008	Odour	Mr Padraig Cunningham	Phone via EPA (Joe Hunter RPS)
42	29/01/2008	Odour	Mr Declan Malone	Phone via EPA (Joe Hunter RPS)
43	30/01/2008	Odour	Mrs Margaret Lohan	Phone via EPA (Joe Hunter RPS)
44	01/02/2008	Odour	Mrs Fiona Cawley/Cunningham	Phone via EPA (Joe Hunter RPS)
45	05/02/2008	Odour	Mr Thomas Finn	Phone via EPA (Joe Hunter RPS)
46	06/02/2008	Odour	Mrs Maureen Kelly	Phone via EPA (Joe Hunter RPS)
47	06/02/2008	Odour	Mr Mike Kenny	Phone via EPA
48	10/02/2008	Odour	Mrs Brigid Seale	Phone via EPA (Joe Hunter RPS)
49	13/02/2008	Odour	Mrs McKeogh	Phone via EPA (Joe Hunter RPS)
50	13/02/2008	Odour	Mr John + Elizabeth Kelly	Phone via EPA (Joe Hunter RPS)
51	11/02/2008	Odour	Mrs Maureen Kelly	Letter via EPA
52	13/02/2008	Odour	Mr Tiernan McKeogh	Phone via EPA (Joe Hunter RPS)
53	15/02/2008	Odour	Mrs Marella Deely	Phone via EPA
54	15/02/2008	Odour	Mrs Geraldine Cogavin	Phone via EPA (Joe Hunter RPS)
55	16/02/2008	Odour	Mrs Maureen Kelly	Phone via EPA (Joe Hunter RPS)
56	17/02/2008	Odour	Mr Peter Kelly	Phone via EPA (Joe Hunter RPS)
57	18/02/2008	Odour	Mr Tiernan McKeogh	Phone via EPA (Joe Hunter RPS)
58	18/02/2008	Odour	Mr John Burke	Phone via EPA (Joe Hunter RPS)
59	18/02/2008	Odour	Mr Peter Kelly	Phone via EPA (Joe Hunter RPS)
60	20/02/2008	Odour	Ms Geraldine Malone	Phone via EPA (Joe Hunter RPS)

2008	Date	Nature of Complaint	Complainant	Method of Communication
61	20/02/2008	Odour	Mrs Fiona Cawley/Cunningham	Phone via EPA (Joe Hunter RPS)
62	14/02/2008	Odour	Mrs Geraldine Cogavin	Letter via EPA
63	20/02/2008	Odour	Mr Paddy Quinn	Letter via EPA
64	24/02/2008	Odour	Mr Padraig Cunningham	Phone via EPA (Joe Hunter RPS)
65	27/02/2008	Odour	Mr Thomas Lohan	Phone via EPA (Joe Hunter RPS)
66	27/02/2008	Odour	Mrs Fiona Cawley/Cunningham	Phone via EPA (Joe Hunter RPS)
67	27/02/2008	Odour	Mrs Fiona Cawley/Cunningham	Phone via EPA (Joe Hunter RPS)
68	28/02/2008	Odour	Mr Thomas Lohan	Phone via EPA (Joe Hunter RPS)
69	27/02/2008	Early arrival of Vehicles	Mrs Brigid Seale	Letter via EPA
70	27/02/2008	Early arrival of Vehicles	Mrs Rosemary Higgins	Letter via EPA
71	03/03/2008	Odour	Mrs Marie Dwyer	Phone via EPA (Joe Hunter RPS) & Phone call direct to site
72	04/03/2008	Odour	Mrs Fiona Cawley/Cunningham	Phone via EPA (Joe Hunter RPS)
73	05/03/2008	Odour	Mrs Margaret Lohan	Phone via EPA (Joe Hunter RPS)
74	04/03/2008	Odour	Ms Agnes Ward	Letter via EPA
75	18/03/2008	Odour	Mr Peter Kelly	Phone via EPA (Joe Hunter RPS)
76	25/03/2008	Odour	Mr Tom Joe Ward	Phone Site
77	31/03/2008	Odour	Mr Padraig Cunningham	Phone via EPA (Joe Hunter RPS)
78	07/04/2008	Odour	Ms Agnes Ward	Phone via EPA
79	08/04/2008	Odour	Mrs Fiona Cawley/Cunningham	Phone via EPA (Joe Hunter RPS)
80	11/04/2008	Odour	Mr Thomas Finn	Phone via EPA (Joe Hunter RPS)
81	15/04/2008	Odour	Mr Padraig Cunningham	Phone via EPA (Joe Hunter RPS)
82	29/04/2008	Odour	Mrs Angela McKeogh	Phone via EPA (Joe Hunter RPS)
83	02/05/2008	Odour	Mrs Margaret Lohan	Phone via EPA (Joe Hunter RPS)
84	02/05/2008	Odour	Mr Thomas Lohan	Phone via EPA (Joe Hunter RPS)
85	03/06/2008	Odour	Mrs Fiona Cawley/Cunningham	Phone via EPA (Joe Hunter RPS)
86	05/06/2008	Odour	Mr Thomas Lohan	Phone via EPA (Joe Hunter RPS)
87	06/06/2008	Odour + Dead Cat	Mr Thomas Lohan	Phone via EPA (Joe Hunter RPS)
88	06/06/2008	Dead Cat	Mrs Brigid Seale	Phone via EPA (Joe Hunter RPS)
89	16/06/2008	Odour	Mrs Carmel Glynn	Phone via EPA (Joe Hunter RPS)
90	16/06/2008	Odour	Ms Agnes Ward	Phone via EPA

2008	Date	Nature of Complaint	Complainant	Method of Communication
91	30/06/2008	Machinery working	Mr Tom & Bridget Seale	Phone via EPA (Joe Hunter RPS)
92	30/06/2008	Machinery working	Mrs Margaret Lohan	Phone via EPA (Joe Hunter RPS)
93	29/07/2008	Odour	Mr Padraig Dwyer	Phone via EPA (Joe Hunter RPS)
94	02/07/2008	Odour	Mrs Liza Taylor	Letter via EPA
95	11/08/2008	Odour + Excavating waste	Mrs Brigid Seale	Phone via EPA
96	12/08/2008	Odour +Noise	Mrs Carmel Glynn	Phone via EPA (Joe Hunter RPS)
97	12/08/2008	Odour	Mrs Liza Taylor	Phone Site
98	14/08/2008	Odour	Mr Padraig Cunningham	Phone via EPA (Joe Hunter RPS)
99	14/08/2008	Odour	Mrs Fiona Cunningham	Phone via EPA (Joe Hunter RPS)
100	15/08/2008	Odour	Mrs Liza Taylor	Phone Site
101	20/08/2008	Odour	MrThomas Lohan	Phone via EPA (Joe Hunter RPS)
102	19/08/2008	Odour	Mrs Carmel Glynn	Letter via EPA
103	04/09/2008	Odour	Mrs Margaret Lohan	Phone via EPA (Joe Hunter RPS)
104	07/09/2008	Odour	Mr Thomas Lohan	Phone Site
105	12/09/2008	Odour	Mr Padraig + Fiona Cunningham	Phone via EPA (Joe Hunter RPS)
106	17/09/2008	Odour	Mrs Agnes Ward	Letter via EPA
107	22/09/2008	Odour	Mrs Geraldine Cogavin	Phone via EPA (Joe Hunter RPS)
108	24/09/2008	Odour	Ms Fiona Donoghue	Letter via EPA
109	27/09/2008	Noise	Mrs Fiona Cawley/Cunningham	Phone via EPA (Joe Hunter RPS) & Phone call direct to site
110	07/09/2008	Odour	Mr Padraig Dwyer	Phone via EPA (Joe Hunter RPS)
111	03/10/2008	Odour	Mrs Geraldine Cogavin	Phone via EPA (Joe Hunter RPS)
112	03/10/2008	Odour	Mrs Carmel Glynn	Phone via EPA (Joe Hunter RPS)
113	11/10/2008	Odour	Mrs Margaret Lohan	Phone via EPA (Joe Hunter RPS)
114	14/10/2008	Odour	Ms Geraldine Malone	Phone via EPA (Joe Hunter RPS)
115	14/10/2008	Odour	Ms Bernie McDonnell	Phone via EPA (Joe Hunter RPS)
116	14/10/2008	Odour	Mrs Bridget Seale	Phone via EPA & Phone call direct to site
117	18/10/2008	Odour	Mr Thomas Lohan	Phone via EPA (Joe Hunter RPS)
118	07/10/2008	Odour	Mr Padraig Cunningham	Phone via EPA (Joe Hunter RPS)
119	11/10/2008	Odour	Mr Padraig Cunningham	Phone via EPA (Joe Hunter RPS)
120	14/10/2008	Odour	Mrs Fiona Cawley/Cunningham	Phone via EPA (Joe Hunter RPS)

2008	Date	Nature of Complaint	Complainant	Method of Communication
121	13/10/2008	Odour	Mrs Fiona Cawley/Cunningham	Phone via EPA (Joe Hunter RPS)
122	22/10/2008	Odour	Mr Thomas Lohan	Phone via EPA (Joe Hunter RPS)
123	28/10/2008	Odour	Mrs Carmel Glynn	Phone via EPA (Joe Hunter RPS)
124	28/10/2008	Odour	Mr Padraig Cunningham	Phone via EPA (Joe Hunter RPS)
125	28/10/2008	Odour	Mrs Liza Taylor	Phone via EPA (Joe Hunter RPS)
126	28/10/2008	Odour	Ms Geraldine Treacy	Phone via EPA (Joe Hunter RPS)
127	28/10/2008	Odour	Mr Patrick Dillon	Phone via EPA (Joe Hunter RPS)
128	28/10/2008	Odour	Mr Thomas Lohan	Phone via EPA (Joe Hunter RPS)
129	29/10/2008	Odour	Mrs Mary Kenny	Phone Site
130	31/10/2008	Odour	Mrs Maureen Kelly (Ballinderry Upper)	Phone via EPA (Joe Hunter RPS)
131	11/11/2008	Odour	Mrs Fiona Cawley/Cunningham	Phone via EPA (Joe Hunter RPS)
132	12/11/2008	Odour	Mr Padraig Cunningham	Phone via EPA (Joe Hunter RPS)
133	12/11/2008	Odour	Mrs Fiona Cawley/Cunningham	Phone via EPA (Joe Hunter RPS)
134	28/11/2008	Odour	Mr Padraig Cunningham	Phone Site
135	12+13/11/2008	Odour	Mr Ambrose Dwyer	Phone via EPA (Joe Hunter RPS)
136	03/12/2008	Odour	Mrs Bernie Kenny	Phone Site
137	03/12/2008	Odour	Mr Thomas & Margaret Lohan	Phone via EPA (Joe Hunter RPS)
138	05/12/2008	Odour	Mr Padraig Cunningham	Phone via EPA (Joe Hunter RPS) & Phone call direct to site
139	08/12/2008	Odour	Mr Tiernan McKeogh	Phone via EPA
140	10/12/2008	Odour	Mrs Fiona Cawley/Cunningham	Phone via EPA & Phone call direct to site
141	10/12/2008	Odour	Mr Thomas Lohan	Phone via EPA
142	11/12/2008	Odour	Ms Shirley Quinn	Phone via EPA
143	11/12/2008	Odour	Mr Padraig Dwyer	Phone via EPA
144	11/12/2008	Odour	Mrs Fiona Cawley/Cunningham	Phone via EPA & Phone call direct to site
145	13/12/2008	Odour	Mr Tom & Bridget Seale	Phone via EPA
146	13/12/2008	Odour	Mr Thomas Owens	Phone via EPA
147	24/12/2008	Operating Hours	Mrs Bridget Seale	Phone Site

APPENDIX A

E PRTR 2008

Environmental Protection Agency

AER Returns Worksheet

Version 1.1.02

REFERENCE YEAR	2008

1. FACILITY IDENTIFICATION

Parent Company Name	Greenstar Holdings Limited
Facility Name	East Galway Residual Landfill Site
PRTR Identification Number	W0178
Licence Number	W0178-01

Waste or IPPC Classes of Activity

No.	class_name
3.5	Specially engineered landfill, including placement into lined discrete cells which are capped and isolated from one another and the environment.
3.6	Biological treatment not referred to elsewhere in this Schedule which results in final compounds or mixtures which are disposed of by means of any activity referred to in paragraphs 1. to 10. of this Schedule.
3.13	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.
4.4	Recycling or reclamation of other inorganic materials.
4.11	Use of waste obtained from any activity referred to in a preceding paragraph of this Schedule.
4.13	Storage of waste intended for submission to any activity referred to in a preceding paragraph of this Schedule, other than temporary storage, pending collection, on the premises where such waste is produced.
3.1	Deposit on, in or under land (including landfill).
3.4	Surface impoundment, including placement of liquid or sludge discards into pits, ponds or lagoons.

Address 1	Killagh More
Address 2	Ballybaun (E.D. Killaan)
Address 3	Ballintober (E.D. Killaan)
Address 4	Ballinasloe, Co. Galway
Country	Ireland
Coordinates of Location	4012.000
River Basin District	IE-Western
NACE Code	382
Main Economic Activity	Waste treatment and disposal
AER Returns Contact Name	Colin Ryder (W0178)
AER Returns Contact Email Address	colin.ryder@greenstar.ie
AER Returns Contact Position	Landfill Operations Manager
AER Returns Contact Telephone Number	090-9686014
AER Returns Contact Mobile Phone Number	086-8586335
AER Returns Contact Fax Number	090-9686026
Production Volume	0
Production Volume Units	
Number of Installations	2
Number of Operating Hours in Year	2860
Number of Employees	10
User Feedback/Comments	
Web Address	

2. PRTR CLASS ACTIVITIES

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

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

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

4.1 RELEASES TO AIR

SECTION A : SECTOR SPECIFIC PRTR POLLUTANTS

RELEASES TO AIR											
POLLUTANT		METHOD						QUANTITY			
			Method Used		Flare 1	Flare 2	Hasse Flare				
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	Emission Point 2	Emission Point 3	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year	
08	Nitrogen oxides (NOx/NO2)	M	PER	Flue gas analyser, Testo 350/454 MXL	204.48	115.2	1617.0	1936.68	0.0	0.0	
11	Sulphur oxides (SOx/SO2)	M	PER	Flue gas analyser, Testo 350/454 MXL	4541.76	2712.96	7614.6	14869.32	0.0	0.0	
01	Methane (CH4)	M	PER	Signal FID 3030PM and TNMHC; It is acknowledged that the facility did not collect more LFG than was produced. GASSIM appears to under estimate the volumes produced however a high efficiency rate is expected due to the high density of gas wells and barrier capping which has been placed over approx. 50% of the fill area.	475.2	518.4	2587.2	3580.8	0.0	0.0	
03	Carbon dioxide (CO2)	M	PER	Flue gas analyser, Testo 350/454 MXL	1652740.0	990110.0	2745960.0	5388810.0	0.0	0.0	
02	Carbon monoxide (CO)	M	PER	Flue gas analyser, Testo 350/454 MXL	17.28	5.76	99.96	123.0	0.0	0.0	

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

SECTION B : REMAINING PRTR POLLUTANTS

RELEASES TO AIR								
POLLUTANT		METHOD			QUANTITY			
			Method Used					
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
					0.0	0.0	0.0	0.0

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

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

RELEASES TO AIR											
POLLUTANT		METHOD						QUANTITY			
			Method Used		Flare 1	Flare 2	Hasse Flare				
Pollutant No.	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	Emission Point 2	Emission Point 3	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year	
351	Total Organic Carbon (as C)	M	PER	Indirect Sorbent tubes in conjunction with SKC umps, sampling kit and a BIOS primary flow calibrator	23.04	20.16	164.64	207.84	0.0	0.0	

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

Additional Data Requested from Landfill operators

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

Landfill: East Galway Residual Landfill Site

Please enter summary data on the quantities of methane flared and / or utilised	**T (Total) kg/Year**	**M/C/E**	**Method Used**		**Facility Total Capacity m3 per hour**	
			Method Code	**Designation or Description**		
Total estimated methane generation (as per site model)	2748975.88	E	Estimate	GasSIM2	N/A	
Methane flared	4001601.56	M	PER	Electronic Pressure Differen	3250.0	(Total Flaring Capacity)
Methane utilised in engine/s	0.0				0.0	(Total Utilising Capacity)
Net methane emission (as reported in Section A above)	3580.8	M	PER	Signal FID 3030PM and TNMHC	N/A	

4.2 RELEASES TO WATERS

SECTION A : SECTOR SPECIFIC PRTR POLLUTANTS

Data on ambient monitoring of storm/surface water or groundwater, conducted as part of your licence requirements, shou

RELEASES TO WATERS						
POLLUTANT			Method Used		SW6	SW7
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	Emission Point 2
79	Chlorides (as Cl)	M	EN ISO 17025		3418.914	2902.645
22	Nickel and compounds (as Ni)	M	EN ISO 17025		0.692	29.047
24	Zinc and compounds (as Zn)	M	EN ISO 17025		4.841	159.068
19	Chromium and compounds (as Cr)	M	EN ISO 17025		0.035	0.035
18	Cadmium and compounds (as Cd)	M	EN ISO 17025		5484.402	0.277
20	Copper and compounds (as Cu)	M	EN ISO 17025		16.598	5.533
23	Lead and compounds (as Pb)	M	EN ISO 17025		0.692	0.692

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

SECTION B : REMAINING PRTR POLLUTANTS

RELEASES TO WATERS						
POLLUTANT			Method Used			
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year
					0.0	0.0

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

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

RELEASES TO WATERS						
POLLUTANT			Method Used		SW6	SW7
Pollutant No.	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	Emission Point 2
240	Suspended Solids	M	EN ISO 17025		2177.253	2133.2
306	COD	M	EN ISO 17025		4683.646	9535.598
303	BOD	M	EN ISO 17025		609.609	411.555
238	Ammonia (as N)	M	EN ISO 17025		1404.383	801.917
341	Sodium	M	EN ISO 17025		8921.663	414.961
338	Potassium	M	EN ISO 17025		1244.883	1244.883
343	Sulphate	M	EN ISO 17025		33888.486	16598.442
305	Calcium	M	EN ISO 17025		5484.402	7808.184
320	Magnesium	M	EN ISO 17025		579.562	12365.84
357	Iron	M	EN ISO 17025		40.113	59.478
321	Manganese (as Mn)	M	EN ISO 17025		0.692	9.682
332	Ortho-phosphate (as PO4)	M	EN ISO 17025		20.748	20.748
334	Pesticides	M	EN ISO 17025		0.007	0.0
237	Volatile organic compounds (as TOC)	M	EN ISO 17025		0.692	0.0
340	Semi-volatiles	M	EN ISO 17025		0.692	0.0

uld NOT be submitted under AER / PRTR Reporting as this only concer

QUANTITY		
T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
6321.559	0.0	0.0
29.739	0.0	0.0
163.909	0.0	0.0
0.07	0.0	0.0
5484.679	0.0	0.0
22.131	0.0	0.0
1.384	0.0	0.0

QUANTITY	
A (Accidental) KG/Year	F (Fugitive) KG/Year
0.0	0.0

QUANTITY		
T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
4310.453	0.0	0.0
14219.244	0.0	0.0
1021.164	0.0	0.0
2206.3	0.0	0.0
9336.624	0.0	0.0
2489.766	0.0	0.0
50486.928	0.0	0.0
13292.586	0.0	0.0
12945.402	0.0	0.0
99.591	0.0	0.0
10.374	0.0	0.0
41.496	0.0	0.0
0.007	0.0	0.0
0.692	0.0	0.0
0.692	0.0	0.0

4.3 RELEASES TO WASTEWATER OR SEWER

SECTION A : PRTR POLLUTANTS

OFFSITE TRANSFER OF POLLUTANTS DESTINED FOR WASTE-WATER TREATMENT OR SEWER								
POLLUTANT		METHOD			QUANTITY			
			Method Used		Leachate Tank			
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
06	Ammonia (NH3)	M	EN ISO 17025		12442.547	12442.547	0.0	0.0
79	Chlorides (as Cl)	M	EN ISO 17025		14132.747	14132.747	0.0	0.0
82	Cyanides (as total CN)	M	EN ISO 17025		0.597	0.597	0.0	0.0
18	Cadmium and compounds (as Cd)	M	EN ISO 17025		0.005	0.005	0.0	0.0
20	Copper and compounds (as Cu)	M	EN ISO 17025		0.119	0.119	0.0	0.0
23	Lead and compounds (as Pb)	M	EN ISO 17025		0.036	0.036	0.0	0.0
83	Fluorides (as total F)	M	EN ISO 17025		11.936	11.936	0.0	0.0
22	Nickel and compounds (as Ni)	M	EN ISO 17025		3.294	3.294	0.0	0.0
24	Zinc and compounds (as Zn)	M	EN ISO 17025		0.489	0.489	0.0	0.0

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

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

OFFSITE TRANSFER OF POLLUTANTS DESTINED FOR WASTE-WATER TREATMENT OR SEWER									
POLLUTANT		METHOD			QUANTITY				
			Method Used		Leachate Tank				
Pollutant No.	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	Emission Point 2	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
341	Sodium	M	EN ISO 17025		21294.612	0.0	21294.612	0.0	0.0
338	Potassium	M	EN ISO 17025		13762.718	0.0	13762.718	0.0	0.0
357	Iron	M	EN ISO 17025		16.055	0.0	16.055	0.0	0.0
321	Manganese (as Mn)	M	EN ISO 17025		4.56	0.0	4.56	0.0	0.0
320	Magnesium	M	EN ISO 17025		2855.197	0.0	2855.197	0.0	0.0

4.4 RELEASES TO LAND

SECTION A : PRTR POLLUTANTS

RELEASES TO LAND					
POLLUTANT		METHOD			
			Method Used		
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1
					0.0

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

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

RELEASES TO LAND					
POLLUTANT		METHOD			
			Method Used		
Pollutant No.	Name	M/C/E	Method Code	Designation or Description	Emission Point 1
					0.0

	QUANTITY	
	T (Total) KG/Year	A (Accidental) KG/Year
	0.0	0.0

	QUANTITY	
	T (Total) KG/Year	A (Accidental) KG/Year
	0.0	0.0

5. ONSITE TREATMENT & OFFSITE TRANSFERS OF WASTE

Transfer Destination	European Waste Code	Hazardous	Quantity T/Year	Description of Waste	Waste Treatment Operation	Method Used		Location of Treatment	Name and Licence / Permit No. of Recoverer / Disposer / Broker	Address of Recoverer / Disposer / Broker	Name and Address of Final Destination i.e. Final Recovery / Disposal Site (HAZARDOUS WASTE ONLY)	Licence / Permit No. of Final Destination i.e. Final Recovery / Disposal Site (HAZARDOUS WASTE ONLY)
						M/C/E	Method Used					
Within the Country	19 07 03	No	14653.15	Landfill Leachate	R3	M	Weighed	Offsite in Ireland	Galway County Council Wastewater Treatment Plant	Tuam, Co. Galway		
Within the Country	19 07 03	No	5493.83	Landfill Leachate	R3	M	Weighed	Offsite in Ireland	Enva W0041-01	Smithstown Industrial Estate, Shannon, Co. Clare		
Within the Country	19 07 03	No	2415.46	Landfill Leachate	R3	M	Weighed	Offsite in Ireland	Rilta Environmental Limited W192-02	Block 402, Grants Drive, Greenogue Business Park, Rathcoole, Co. Dublin		

APPENDIX B

EMP

ENVIRONMENTAL MANAGEMENT PLAN

FOR

EAST GALWAY RESIDUAL LANDFILL

WASTE LICENCE NO.W0178-01

Prepared By: -

Greenstar Ltd.,
Killagh More, Ballybaun and Ballintober,
Killconnell,
Co Galway.

Rev 1: 27th March 2009

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6.1 SCHEDULE OF OBJECTIVES AND TARGETS 31

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1. INTRODUCTION

This is the revised Environmental Management Plan (EMP) for the East Connaught Regional Landfill. The operator of the landfill is Greenstar Holdings Ltd. (Greenstar). Greenstar was granted a Waste Licence (Reg. No.W0178-01) to construct and operate the landfill by the Environmental Protection Agency (Agency) on 26th July 2004.

An initial EMP was prepared before the facility opened in 2006. This document has been updated to reflect the on-going development of the site, operational experience and the implementation of the Schedule of Objectives and Targets.

1.1 Scope

The EMP is required under Condition 2.3.2.2 of the Waste Licence (Reg. No.W0178-01). The document is based on and contains the information specified in the Agency's Manual on Landfill Operational Practices and the Draft Guidance on Environmental Management and Reporting to the Agency.

The document describes the design and operation of the facility and presents details of the operator, the waste types and volumes that have been and will be accepted for disposal and recovery, engineering details, capacity, operational controls including surface water management, leachate and landfill gas control and management, environmental monitoring programmes and closure and aftercare measures. It also contains a revised Schedule of Objectives and Targets and the methods by which those objectives and targets will be achieved.

The document is based on information compiled during the preparation of the Waste Licence application, the detailed design of the engineering works and the on-going environmental monitoring programme. The numbering system for drawings is as per the Specified Engineering Works submission under condition 3.2 of the Waste Licence and as per the EIS.

1.2 Purpose

The EMP serves as a guidance document for facility staff and describes operational control and management practices that are applied at the facility. The EMP is also a core element of the Environmental Management System (EMS) for the facility and is designed to facilitate the

management of site activities so as to comply with regulatory requirements and best landfill practice and to effectively implement the EMS.

1.3 EMS Documentation

The EMS documentation prepared for the facility in addition to this EMP includes: -

1.3.1 Corrective Action Procedures (CAP)

The objective of the Procedures (CAP) is to ensure that the appropriate corrective action is taken should the requirements of the Waste Licence and the EMS not be fulfilled. A copy of the procedures are included in Appendix 1.

1.3.2 Awareness and Training Procedures

The objective of the Procedure is to ensure that the awareness and training needs of the facility personnel are identified and the required training provided. A copy of the Procedure is included in Appendix 2.

1.3.3 Communications Programme

Greenstar has prepared a Communications Programme with the aim of effectively communicating with the public about the environmental performance of the facility.

1.4 Annual Review

The EMP will, as a core element of the EMS, be subject to an annual review throughout the facility's operational life. The review will take account of operational experience, the progressive development of the facility, changes in regulatory requirements and developments in landfill technology and operations.

2. SITE DESCRIPTION

2.1 Site Location

The site is located in the townlands of Killagh More, Ballybaun and Ballintober, Ballinasloe, Co. Galway and encompasses an area of 60.8 ha. It is approximately 2.5 km southwest of Kilconnell village and 4.5 km northwest of Cappataggle village. The site is located in a segment of land, which is bounded to the north by the Ballinasloe to Athenry Road (R348) with local roads immediately adjacent to the east and south, the L7442 and L7439 respectively. The area consists of low lying undulating topography interspersed with a number of small hills.

Residential use in the surrounding area is predominantly single dwelling with adjacent farmyards. There are only 5 No. residential dwellings within or near a 500 m radius of the landfill cell area, with the nearest being 475 m away, and only a further 13 No. within 1000 m of the footprint. The surrounding land use is mainly low intensity livestock farming, with some commercial forestry on lands to the east.

2.2 Site Development

The facility will be developed in three phases. Phase 1, which was completed in December 2005, involved the initial site development works, construction of 3 engineered landfill cells and the provision of the supporting infrastructure including the waste reception area, weighbridges, leachate holding tank, ESB substation, site offices, weather station and groundwater and surface water control measures. The layout is shown on Drawing No 2228-2600.

The two subsequent phases will each involve the construction of 6 smaller additional engineered cells per phase, i.e. 12 additional cells in total, provision and progressive expansion of an active gas management and flaring system, progressive landscape works and the progressive capping and restoration of completed landfill cells. Construction of Phase 2 commenced in Summer 2008.

2.3 Geology and Hydrogeology

The geology and hydrogeology of the area is described in detail in the EIS submitted with the Waste Licence Application and is summarised below.

2.3.1 Bedrock Geology

The bedrock beneath the site comprises Lower Carboniferous dark limestones and shales belonging to the Calp Formation. The depth to rock ranges from 3 to 9.5 m across the site.

2.3.2 Quaternary Geology

Prior to development the natural ground conditions across the site comprised the higher ground consisting of a series of hillocks composed of 0.2 - 0.3 metres of sandy clay top soil and subsoil overlying a 0.4 - 0.6 m layer of glacial deposits comprising gravelly sandy clays that graded into a silty clayey till. In the lower lying ground the subsoil consisted of peat ranging in thickness from 3 - 4 metres overlying silty clayey tills. The permeability of the till ranges from $1.08x10^{-8}$ m/s to $5.12x10^{-9}$ m/s, which are considered to be low permeability.

2.3.3 Aquifer Status

The bedrock beneath the site is classified as a Locally Important Aquifer using the classification system prepared by the Geological Survey of Ireland (GSI). The direction of groundwater flow is from the south to the north/north west.

A well search identified that there are no beneficial users of groundwater within 500 m of the site and all of the residents within 1 km of the site are connected to the Kilconnell Public Supply, which is more than 2.5 km from the landfill cell footprint.

2.3.4 Aquifer Vulnerability

The vulnerability of the bedrock aquifer is, based on the type and thickness of the subsoil categorised as High to Extreme in accordance with the classification system prepared by the GSI. The response matrix for landfill location as promoted by the GSI indicates that it is acceptable to locate engineered contained landfills in areas underlain by Locally Important Aquifers with this vulnerability rating.

2.3.5 Groundwater Quality

Groundwater monitoring carried out prior to the start of development works established that groundwater beneath the site contains elevated ammonia levels. Such levels are often associated with peat rich environments and agricultural activities. The groundwater monitoring carried out since the facility began accepting waste has confirmed that site activities have not impacted on water quality.

2.4 Hydrology

2.4.1 Drainage Pattern

The original drainage pattern comprised a network of dug field boundary drains extending across the site. The Ballintober Stream forms part of the northern boundary and there is a large drain running north to south (Killaghmore Stream) in the western area of the site. The site drainage enters tributaries of the Raford River, which is to the south-west of the site. To compensate for the loss of the internal site drains during site development perimeter drains have been installed around the landfill cell footprint to intercept surface water flow and divert it to the Ballintober Stream via a settlement lagoon.

2.4.2 Surface Water Quality

Water quality monitoring, including biological and chemical assessment, of the surface water drains around the site prior to development established that the drainage system has been impacted by surrounding agricultural land use (animal grazing) and could be classified as Slightly Polluted.

The surface water monitoring carried out since the facility began accepting waste has confirmed that site activities have not impacted on water quality.

2.5 Meteorology

The annual average rainfall is of the order of 1091 mm, with average monthly rainfall ranging from 66 mm in the drier months to 110 mm in the wetter winter months. The estimated annual evapotranspiration is approximately 445 mm. The prevailing wind is from the South-southwest, with an average wind speed of 10 knots.

3. TYPES OF WASTE ACCEPTED & CONSIGNED

3.1 Wastes Accepted

Schedules A and F of the Waste Licence (Reg. No. 178-1) defines the type and maximum quantities of waste that can be accepted for disposal and recovery. A total of 100,000 tonnes of waste can be accepted for disposal annually. The following types and maximum annual quantities of such wastes are: -

- Household 45,000 tonnes
- Commercial 27,500 tonnes
- Industrial Non Hazardous 27,500 tonnes

The amounts of the individual waste categories may be altered with the prior approval of the Agency provided that the total amount does not exceed 100,000 tonnes per annum.

The following types of inert waste can be accepted for recovery: -

- Concrete,
- Subsoil,
- Stone, Rock and Slate,
- Solid Road Planings, Solid Tarmacadam and Solid Asphalt,
- Brickwork,
- Clay.

The following information is recorded for each load of waste arriving at the facility in accordance with the requirements of Condition 10.2: -

- the date and time;
- the name and waste collection permit details;
- the vehicle registration number;

- the name of the producer(s)/collector(s) of the waste as appropriate;
- the name of the waste facility (if appropriate) from which the load originated including the waste licence or waste permit register number;
- a description of the waste including the associated EWC codes;
- the quantity of the waste, recorded in tonnes; and
- the name of the person checking the load.

3.2 Wastes Consigned

The only waste that is routinely consigned from the facility is leachate generated in the landfill cells, cleanings from the grit and oil interceptors, waste oils/filters generated during the on-site maintenance of the fixed and mobile plant used at the site and small amounts of recyclable office/canteen waste. Unsuitable waste inadvertently delivered to the facility and removed during the waste inspection procedures are consigned on an as needed basis.

Greenstar operate a source segregation policy to maximise the recovery of potential recyclables from the office waste. All recovered materials are transferred off-site to Agency approved and licensed recovery/recycling facilities.

The following information is recorded for each load either consigned, or rejected from the site in accordance with the requirements of Condition 10.2: -

- details of the date of the occurrence,
- the types of waste and the facility to which they were removed (including the waste licence/permit and waste collection permit).

3.3 Waste Records

Greenstar maintains records of all characterisation testing carried out by waste producers and confirmatory testing conducted by or on behalf of Greenstar, for a minimum of three years (Ref. Section 5.6.5).

Greenstar maintains records of all waste received, recovered, consigned and disposed at the facility for three years. The records include details of the type, quantities and EWC codes, as required by Condition 10.3 a) of the Waste Licence (Reg. No.W0178-01).

3.4 Site Capacity

The landfill design capacity for waste disposal is approximately 1.314 million m^3. The volumes of waste placed and the remaining void space are calculated annually and reported in the Annual Environmental Report (AER).

4. SITE DESIGN & DEVELOPMENT

4.1 Engineering Details

The engineering design details for the facility are shown on the Drawings listed in Table 4.1 and an overview of the design is presented in this Section.

The construction of the cells; leachate storage tank; groundwater and surface water control measures including the surface water settlement lagoon and wetlands; the installation of landfill gas flares and the final capping are all *Specified Engineering Works*, which must be carried out in accordance with Condition 3.2 of the Waste Licence Reg. No.W0178-01. The prior approval of the Agency must be obtained before any such works are carried out.

The design of the lining and capping systems are specified in Conditions 3.12 and 4.4 of Waste Licence and are in accordance with the design specifications set in the EU Directive of Landfill of Waste, the Agency's Manual on Landfill Site Design and best industry practice.

4.2 Site Development

The initial phase involved the provision of three (3) landfill cells and all of the supporting infrastructure required to operate the facility in compliance with the Waste Licence. Subsequent phases will involve the provision of additional landfill cells, which will be half the size of Phase 1 cells, and the associated expansion of leachate, landfill gas and surface water control measures.

The development works require the excavation of suitable materials from designated borrow area(s) for use in the construction of the site infrastructure. Activities in the borrow pit area are managed in accordance with Conditions 3.16.3, 5.7.1 iii) and 5.12 of the Waste Licence (Reg. No.W0178-01), which specify the surface water control, landscaping and nuisance mitigation measures. The borrow area(s) will be restored and landscaped using the natural subsoils and peat removed from the landfill cell footprint.

The Killaghmore Stream traverses the extreme southwest of the landfill footprint. Its position will necessitated the diversion of a short length of this stream. Approximately 80 m of the stream was rerouted through a new channel. The diversion occurred during Phase 2 development work.

Table 4.1 Engineering Design Details (See Appendix 1)

Drawing No.	Title
2228-2600	Specified Engineering Works - Overall Site General Arrangement Plan
2228-2601	Specified Engineering Works General Arrangement Phase 1 - Sheet 1 of 2
2228-2602	Specified Engineering Works General Arrangement Phase 1 - Sheet 2 of 2
2228-2605	Specified Engineering Works - Basal Lining System Embankment Details and Intercell Bunds
2228-2607	Specified Engineering Works - Phase I Leachate Collection
2228-2608	Specified Engineering Works - Site Surfacing Plan
2228-2609	Specified Engineering Works - Site Fencing Plan
2228-2612	Specified Engineering Works - Road Construction Details
2228-2614	Specified Engineering Works - Surface Water Lagoon and Engineered Wetland Layout Plan
2228-2615	Specified Engineering Works - Leachate Collection Tank Elevation and Section
2228-2618	Specified Engineering Works - Waste Quarantine Area General Arrangement
2228-2623	Submission to EPA - Landscaping Implementation Plan - Sheet 1 of 2
2228-2624	Submission to EPA - Landscaping Implementation Plan - Sheet 2 of 2
1322/01/101	Landfill Environmental Monitoring Locations

A natural gas pipeline runs through the southern portion of the site, approximately 370 m south of the final landfill footprint. The location of the pipeline has been identified in accordance with Condition 3.20 of the Waste Licence (Reg. No.W0178-01) so as to avoid accidental damage during development, landscaping, restoration and maintenance works.

4.3 Site Preparation and Services

The preparatory works for Phase 1 involved the clearance of vegetation, excavation of in-situ subsoils and raising to formation levels using imported clean aggregate. The excavated peat and wet silts were stored in the material storage area, constructed at the location shown on Drawing No. 2228-2600. The storage was in accordance with the Conditions 3.16.4 and 5.5 of the Waste Licence (Reg. No.W0178-01).

The facility has a 110 kW electricity supply, a water supply from a local group scheme and phone lines. The surface water drainage system is shown on Drawing Nos. 2228-2600, 2601 & 2602. Sanitary wastewater from the offices and canteen is treated in an on-site wastewater treatment plant and the treated effluent is pumped to the leachate storage tank.

4.4 Site Facilities

The site facilities include: -

- Waste Reception Area,
- Weighbridges (2 No.),
- Wheel Wash,
- Waste Quarantine & Inspection Areas,
- Landfill Cells,
- Leachate Storage Tank,
- Landfill Gas flares (4 No.)
- Surface Water Pond,
- Administration Block (offices, stores, canteen, toilets and showers),
- ESB Sub-Station,
- Standby Generator (Diesel),
- Oil Storage Tank.

The site layout is shown on Drawing No. 2228-2600. The drawing will be reviewed as required to include any new facilities provided, following in the phased development of the site.

4.5 Facility Roads, Access Roads & Hardstanding

The Specification for the roads and hardstanding areas is based on 'Specification for Roadworks', published by the National Roads Authority. The various types of surfacing are described on Drawing No. 2228-2608, with details on Drawing No. 2228-2612 and the construction complies with the requirements of Condition 3.5.1.

4.5.1 Main Access Road

The main access road linking the existing R348 to the landfill runs for approximately 820m over existing farmland (see Drawing Nos. 2228-2600 and 2228-2608). It comprises (see Drawing No. 2228-2612): -

Wearing Course	-	HSC Hot Rolled Asphalt, 40 mm thick
Base Course	-	Dense Bitumen Macadam, 60 mm thick
Roadbase	-	Heavy Duty Macadam, 150 mm thick
Sub-base	-	Clause 804, 150 mm thick
Capping	-	Granular material Grade 6F1/6F2, up to 600 mm thick (to be assessed on CBR test results).

4.5.2 Infrastructure Access Roads & Car Parking Areas

The infrastructure access road runs for approximately 150 m linking the car park, office, quarantine area and fuel bund (see Drawing No. 2228-2601). The road and car park design is the same as the main access road. Precast concrete kerbs and road gulleys are provided, with a piped gravity drainage system discharging to the surface water lagoon via an alarmed oil/water separator. Isolation joints are provided at all interfaces with concrete structures or concrete hardstanding.

4.5.3 Reinforced Concrete Hardstanding

Reinforced concrete hardstanding has been provided at locations adjacent to the fuel bund, quarantine area and leachate holding tank, where increased wear resistance is required for turning vehicles (see Drawing No. 2228-2601). The hardstand comprises 250 mm thick reinforced concrete slab, to details provided in Drawing No. 2228-2615 and 2228-2618.

4.5.4 Jeep Track

A track, as shown on Drawing No. 2228-2608, and detailed on Drawing No. 2228-2612. has been provided to allow access to the perimeter fence and monitoring infrastructure.
The pavement design of the track is as follows: -

Wearing course	-	200 mm Cl.804
Sub-base	-	depending on ground conditions up to 675 mm fill with two layers of geogrids as per specification.

4.6 Site Buildings

The locations of the administration block, weighbridge maintenance garage and ESB Sub-Station are shown on Drawing No. 2228-2600 Rev 0. The design of all of the buildings took into consideration the guidance given in the DOE publication "Protection of New Buildings and Occupants from Landfill Gas, as specified in Condition 3.15.5 of the Waste Licence (Reg. No. 178-1).

4.7 Waste Inspection and Quarantine Areas

Waste inspection and quarantine areas required under Condition 3.7.1 of the Waste Licence (Reg. No. 178-1) are located as shown on Drawing No. 2228 - 2600 Rev 0 to the details shown on Drawing No. 2228-2618. The areas are bounded on 3 sides by a 1.5 m high reinforced concrete wall. Both areas are provided with longitudinal falls to allow run-off to drain directly to a sump.

4.8 Wheel Wash

A wheel wash is provided in accordance with Condition 3.9.1 of the Waste Licence (Reg. No. 178-1) as shown on Drawing No. 2228-2618 Rev 0. Water is supplied to the wheel wash from the on-site borehole. The wheel wash drains to the leachate collection system, as specified by Condition 3.9.1.

4.9 Landfill Cells

The landfill is designed as a containment facility. Waste is only disposed in the engineered landfill cells which comprise a lining system, as specified in Condition 3.12 of the Waste Licence (Reg. No.W0178-01). The basal and side wall lining system design complies with the recommendations in the Agency's Landfill Manual Landfill Design and comprises a minimum of: -

- A composite liner consisting of a 0.5 m layer of Bentonite Enhanced Sand (BES) with a hydraulic conductivity of less than or equal to $5x10^{-10}$ m/s overlain by a 2 mm thick high density polyethylene (HDPE) layer;

- A geotextile protection layer placed over the HDPE layer;

- A 500 mm thick drainage layer placed over the geotextile layer with a minimum hydraulic conductivity of $1x10^{-3}$m/s on the base on the cell and incorporating HDPE collection drains.

Details of the engineering specification for the landfill cells constructed in Phase 1 are shown on Drawing No. 2228-2605. The construction of all the cells is the subject of a comprehensive construction quality assurance (CQA) programme. Copies of the CQA reports are submitted to the Agency for approval before waste is deposited in the cells.

4.10 Leachate

The facility is designed to minimise leachate generation. Surface water run-off and groundwater flow is directed away from the fill area by means of interceptor drains installed outside the landfill cells and an underlying groundwater drainage layer. The landfill cells are designed as fully contained areas and the construction is subject to a comprehensive construction quality assurance and validation process, details of which are submitted to the Agency.

Leachate is collected by means of a series of perforated pipes constructed on top of the basal liner which has a fall of 1: 150 towards internal collection sumps. The leachate is pumped from the sumps, using submersible pumps and a sloping shaft side riser, to the leachate transport lines from where it flows by gravity to the leachate pumping station located beside the holding tank. The leachate is pumped from the station into the holding tank. Details of the collection system are shown on Drawings No. 2228-2607 and 2228-2615.

The precast concrete leachate storage tank has a capacity of 500 m^3, which based on water balance calculations prepared as part to the application for the waste licence, provides for more than 80 hours retention when the maximum hourly rate of leachate generation will occur. The water balance calculations were based on guidance presented in the EPA Landfill Manual on Landfill Site Design.

Annual water balance calculations will be completed during the preparation of the Annual Environmental Report (AER) and based on recorded rainfall data and the volumes of leachate removed from the site. The calculations will be used to assess the suitability of the existing and proposed leachate management facilities that will be progressively provided in the additional Phases.

The leachate holding tank is provided with a lining system as shown on Drawing No. 2228-2615. A concrete spill pad is provided in the loading bay at the tank. The road tankers used to remove the leachate are parked in the bay while leachate is removed from the tank. The pad is graded to prevent the escape of any spills that may occur during tanker loading.

The leachate is removed off-site for treatment at a waste water treatment plant approved by the Agency in accordance with Condition 11.8 of the Waste Licence (Reg. No.W0178-01).

4.11 Landfill Gas

The landfill cells are fully contained by the engineered lining system (Ref. Section 4.1). An active abstraction and flaring system has been provided and gas collection wells are progressively installed in the cells and connected to the abstraction system.

The design of the gas abstraction system meets the specifications set in Condition 3.15.2 of Waste Licence (Reg. No. W178-01) and proposals for the gas equipment were agreed with the Agency as required under Condition 3.2.1.

4.12 Surface Water

All rainfall on the active landfill cells is characterised as leachate and is collected in the leachate collection system. The surface drainage from all roads, hardstanding areas and all areas of the facility where the surface water has the potential to become contaminated is directed to the surface water lagoon in the north of the site. The surface water in the administration area is directed to an oil interceptor. Run-off from the swale around the perimeter of the landfill cells is collected and discharged directly to the surface water lagoon via a separate inlet.

The lagoon is sized to accommodate run-off from a 12 hour storm event with a return period of 1:50 years. Details of the lagoon are shown on Drawing No. 2228-2614. The inlet to the pond is fitted with a Class 1 Full Oil interceptor, as specified in Condition 3.16.6 of the Waste Licence (Reg. No W178-01). Water from the lagoon outfalls to a reedbed system, as shown on Drawing No. 2228-2614.

4.13 Groundwater

To eliminate the potential for groundwater to adversely impact the construction of the landfill cells, the design incorporates a basal groundwater drainage layer. Groundwater intercepted by the drainage layer is directed to a sump from where it is be pumped to the surface water lagoon.

4.14 Site Security

The fencing layout is shown on Drawing No. 2228-2609. Anti-intruder fencing and a gateway and a CCTV system have been provided at the facility entrance.

4.15 Monitoring Infrastructure

The existing groundwater, surface water, noise, dust and PM_{10} monitoring locations are shown on Drawing 1322/01/101. Additional landfill gas, groundwater and surface water monitoring points will be provided during the progressive development of the facility as specified in Conditions 3.19 1, 3.19.2, 3.19.3 and 3.19.4 of the Waste Licence (Reg. No.W0178-01).

Any monitoring infrastructure which is damaged or proves to be unsuitable for its purpose is replaced within three (3) months of being damaged or identified as being unsuitable, as specified in Condition 3.19.5 of the Waste Licence (Reg. No.W0178-1).

4.16 Fire Control

The facility obtains its fire fighting water supply from the surface water lagoon.

4.17 Landscaping

The fill area is sited to maximise the screening value of existing boundary hedgerows. The development phasing sequence is from the north to the south, with the initial phase at the maximum distance from the nearest residence to allow time for maturing of additional screen planting. Landscaping measures are implemented in accordance with the programme prepared in compliance with Condition 5.7.1 of the Waste Licence (Reg. No. W0178-01) and the Drawings submitted 2228-2623 & 2624.

4.18 Fuel & Chemical Storage

Diesel for the mobile plant and back-up generator is stored in a 10,000 litre tank provided with a containment bund in the administration area, next to the waste inspection and quarantine areas. The bund design meets the specification in Condition 3.11 of the Waste Licence (Reg. No.W0178-01).

Small quantities of lubricating and hydraulic oils used in plant maintenance are stored on a bunded pallet inside the maintenance shed.

4.19 Capping System

The final profile will be a maximum of 124 mOD Malin and the shape will be as shown on Drawing No 2228-2623. When the final fill levels have been reached, the cells will be capped with a low permeability capping system as specified in Condition 4.4 of the Waste Licence Reg. No. W0178-01), which includes: -

- Top soil (150 - 300 mm);
- Subsoils such that the total thickness of top soil and subsoils is at least 1 m;
- Drainage layer of 0.5 m thickness having a minimum hydraulic conductivity of $1x10^{-4}$m/s (or equivalent as agreed by the Agency);
- Compacted mineral layer of a minimum 0.6 m thickness with a permeability of less than $1x10^{-9}$m/s or a geosynthetic material (e.g. GCL) or similar that provides equivalent protection; and
- Gas collection layer of natural material (minimum 0.3 m) or a geosynthetic layer.

4.20 Restoration

The fill area will be restored in accordance with detailed Restoration Plans prepared in compliance with Condition 4.1 of the Waste Licence (Reg. No.W0178-01). The Restoration Plans will include details of the planting and reinstatement end use.

5. OPERATIONAL MATTERS

5.1 General Description of the Operation

The facility is an engineered, non-hazardous landfill, with deposition and covering of treated waste in specially designed and constructed landfill cells. The cells are designed to facilitate the effective control of emissions and are provided with a low permeability composite lining and leachate collection system.

An active landfill gas extraction and flaring system has been provided and progressively extended to collect and flare landfill gas. Construction and Demolition waste is recovered on-site for use in the construction of site roads and restoration works. The only wastes regularly consigned from the facility are leachate and waste oils generated during on-site plant and equipment maintenance.

5.2 Operating Procedures

Greenstar has prepared a comprehensive set of Operating Procedures (OP) that cover all aspects of the day to day management of the facility and contingency measures. The OP's are based on the requirements of the Waste Licence, the Agency's Landfill Manual on Landfill Operations and the Agency's draft BAT for Landfill. The OPs form part of the facility's EMS and are subject to regular review based on operational experience, legislative changes and improvements in best practice.

5.3 Site Management

The Site Management Team comprises: -

- Facility Manager,
- Deputy Facility Manager,
- Weighbridge Operator,
- Foreman,
- Plant operators,
- General Operatives,
- Administration.

The Facility Manager and Deputy Manager(s) are suitably qualified and experienced and have undergone appropriate training, as specified by Conditions 2.1.1 and 2.1.2 of the Waste Licence (Reg. No.W0178-01) and the training and awareness requirements of the EMS. Greenstar maintains training records of all training provided to facility personnel.

The roles and responsibilities of all members of facility staff are set out in the Management Structure, which is specified in Condition 2.2 of the Waste Licence (Reg. No.W0178-01). This document is subject to annual review and will be amended to reflect any change in facility personnel.

5.4 Operational & Waste Acceptance Hours

The operational and waste acceptance hours are specified in Condition 1.6.1 of the Waste Licence (Reg. No.W0178-01). The facility is operational between 7.30 and 18.30 Monday to Friday and. 7.30 to 14.30 on Saturday Waste can be accepted at the facility for disposal between 8.00 and 17.45, Monday to Friday and 8.00 to 13.45 on Saturday.

5.5 Access Control

The only access point to the facility is off the R348. The internal traffic control system requires all waste vehicles entering the facility to pass the weighbridges. The access gates are locked shut outside of operational hours.

Signage is provided on the eastern approach to the entrance off the R348 identifying the site and the access point. Access to the weighbridges is controlled by means of automated barriers. All visitors must report to the administration building and provide their name, company/organisation, vehicle registration number and purpose of visit.

5.6 Waste Acceptance Procedures

5.6.1 Treatment of Waste

Condition 1.5.4 of the Waste Licence (Reg. No.W0178-01) stipulates that, with the exception of inert waste, only treated waste is accepted at the facility for disposal. The method by which this is achieved is described in the Waste Acceptance Procedures prepared in accordance with Condition 11.5.1 of the Waste Licence (Reg. No.W0178-01).

5.6.2 Waste Collection Permits

Greenstar only accepts waste from holders of waste collection permits under the Waste Management (Collection) Permit Regulations 2007 (as may be amended) unless exempted, or from licensed/permitted facilities as stipulated in Condition 1.5.1 of the Waste Licence (Reg. No.W0178-01). Greenstar must be provided with copies of up to date collection permits before waste is accepted from a waste collector.

5.6.3 Waste Characterisation

Greenstar may require waste producers to characterise the waste prior to acceptance at the facility in accordance with procedures approved by the Agency, as specified in Condition 11.5.1 of the Waste Licence (Reg. No. 178-1).

Such waste characterisation must meet all waste acceptance criteria set by Greenstar including methods to distinguish between inert, non-hazardous and hazardous waste as defined in the European Council Decision of 19th December 2002 establishing the criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 and Annex II of the Directive 1999/31/EC on the landfill of waste. The producer/holder of the waste must, if requested, provide documentation that the waste meets Greenstar's specification. Waste not conforming to Greenstar's specification will neither be accepted nor deposited at the site.

5.6.4 Waste Inspection

All documentation accompanying waste delivery records is checked at the weighbridge and the waste is also visually inspected at the weighbridge using overhead CCTV cameras where practical. If the checks identify that the waste does not comply with Greenstar's specifications it is not be accepted.

Where there are doubts about the nature of the waste, the delivery vehicle is directed to the waste inspection area, where it may be off-loaded. If following inspection the waste is considered to be acceptable it is, where practical, reloaded on to the delivery vehicle and moved to the active fill area. If this is not practical the waste is removed to the fill area by Greenstar plant.

If the material is identified as not suitable it is, where practical, loaded onto the delivery vehicle and the driver instructed to remove it off-site. If this is not practical the waste is moved to the Waste Quarantine Area for storage pending removal by the waste producer/waste collector. Unsuitable waste shall not be stored in the Quarantine Area for more than one month as specified in Condition 5.2 of the Waste Licence (Reg. No.W0178-01).

All waste placed in the landfill cells is inspected by Greenstar personnel at the waste face to confirm that the wastes are suitable. Where the machine operators identify

unsuitable waste this is, if practical, reloaded onto the delivery vehicle and removed from the facility. If this is not possible the waste is removed from the active fill area and stored in the Waste Quarantine Area, pending removal off-site by the waste producer/waste collector.

5.6.5 Waste Records

The following information on each waste load delivered to the facility is recorded as required by Condition 10.2 of the Waste Licence (Reg. No. W0178-01): -

- The date and time,
- The name and Waste Collection Permit details,
- Vehicle registration number,
- The name of the producer(s) / collector(s) of the waste as appropriate,
- The name of the waste facility (if appropriate) from which the load originated, including the waste licence or waste permit register number,
- Description of the waste including the associated EWC codes,
- Quantity of waste (in tonnes),
- Name of person checking loads and,
- Where loads of waste are removed or rejected details of the date of occurrence, the types of waste and the facility to which they were removed (including the waste licence/permit and or waste collection permit details).

5.7 Phasing of Filling

The facility will be developed in series of three (3) Phases and each Phase will involve the construction of a number of landfill cells. Phase 1 was completed December 2005 and involved the construction of 3 cells. The construction of Phase 2 commenced in the summer of 2008. Phase 2 involves the construction of 6 cells. Phase 2 cells are half the size of cells in Phase 1.

The landfill cells are filled sequentially. For practical reasons it is not be possible to fill to final levels in any one cell without filling in the adjacent cell(s). The progress of the filling and the future development of the phases will be reviewed annually and amendments incorporated into the EMP.

5.8 Equipment

The following plant may be used at the facility for waste activities:

- Landfill Compactors (2: 1 No Duty & 1 No Standby.),
- Back-hoe Excavator (2 No.),
- Tractor and trailer (1 No.),
- Roadsweeper (1 No.),
- Water Bowser (1 No.),
- Landfill Gas flares (4 No.)
- Standby Generator (1 No.),
- Duty and Standby electrical and diesel powered pumps (6 No.).

The plant list will be revised annually to reflect any changes or additions arising from amendments to waste activities. The list does not include plant and equipment used in the phased site development works.

5.9 Waste Placement

Unless otherwise agreed with the Agency only one working face is in use in the active landfill cell, as required by Condition 5.3 of the Waste Licence (Reg. No.W0178-01). The working face is limited to 2.5 m in height after compaction, 25 m wide and a slope of 1:3.

The residual household, commercial and industrial waste is deposited directly on the surface of the immediately preceding layer of waste close to the advancing tipping face by the waste delivery vehicle. The waste is spread in shallow layers, on the inclined surface and compacted using a steel wheeled compactor. All large, hollow objects or other large items are crushed or flattened using the compactor. The working face is covered with suitable material at the end of each working day.

With the exception of the works associated with the installation of the landfill gas collection system the deposited waste is not excavated or disturbed without the prior approval of the Agency, as specified in Condition 5.8.3 of the Waste Licence (Reg. No.W0178-01).

The completed areas of the landfill cells are profiled so that there are no depressions where water may accumulate. The filled cells will be permanently capped within 12 months of the cells reaching the final fill levels, as specified in Condition 5.8.5 of the Waste Licence (Reg. No.W0178-01).

5.10 Cover Requirements

The waste is covered at the end of every working day using suitable material-150 mm of inert material, as specified in Condition 5.8.3 of the Waste Licence (Reg. No.W0178-01**).** Adequate stockpiles of cover material are maintained on-site at all times. The daily cover material is either imported or recovered on-site from the Construction and Demolition wastes or taken from the onsite borrow pit.

The active fill area is inspected daily and where the daily and intermediate cover material has been eroded, washed off or otherwise removed this material is replaced by the end of the working day as required by Condition 5.4.1 to the Waste Licence (Reg. No.W0178-01).

5.11 Off-Site Disposal and Recovery

Wastes consigned from the facility must be conveyed by waste contractors approved by the Agency, as specified by Condition 5.11.1 of the Waste Licence (Reg. No.W0178-01). Greenstar maintains and regularly updates a register of approved waste contractors.

All waste transferred from the facility must go to an appropriately licensed/permitted facility agreed by the Agency, as specified in Condition 5.11.2 of the Waste Licence (Reg. No.W0178-01). Greenstar maintains and regularly updates a register of approved facilities.

All wastes consigned from the facility must be transported in a manner that does not adversely affect the environment, as specified in Condition 5.11.3 of the Waste Licence (Reg. No.W0178-01). Greenstar personnel inspect each vehicle transporting waste off-site to ensure that it is suitable to transport the particular waste.

5.12 Water, Leachate and Gas Control Measures

5.12.1 Surface Water Control Measures

Separate inlets to the surface water lagoon are provided for the perimeter swale and site roads. Isolation valves are provided on both inlets to stop inflow where necessary, as specified in Condition 3.16.5 of the Waste Licence (Reg. No. 178-1). Surface water from impermeable areas of the site where there is the potential for contamination passes through a grit trap and a Class 1 Full Oil interceptor before discharge to the lagoon, as specified in Condition 3.16.6. of the Waste Licence (Reg. No.W0178-01).

The water in the lagoon discharges to the Ballintober Stream via a reed bed system. The reed bed design was based on consultation with the Western Regional Fisheries Board as required by Condition 3.16.5 of the Waste Licence (Reg. No.W0178-01). The

outfall from the pond to the wetland area is controlled by an actuated penstock. The penstock also allows the retention of water within the pond in the event that monitoring indicates contamination of the surface water.

5.12.2 Leachate Management

Leachate accumulating in the cells is pumped from collection sumps located inside the cells via side risers to the leachate main from where it flows to a leachate pumping station located adjacent to the above ground leachate storage tank.

The leachate is pumped from the station to the tank, which has a capacity of 500 m^3. The pumps are controlled by means of a systems control and data acquisition system (SCADA) that continuously monitors the level in the landfill cells, pumping chambers and storage tanks and activates the pumps to ensure the level does not exceed 1 m above the liner as specified in Condition 5.13.1 of Waste Licence (Reg. No.W0178-01).

High level alarms are fitted in the pump chambers and in the storage tank. A freeboard of 0.75m is maintained in the storage tank as required by Condition 5.13.1 of the Waste Licence (Reg. No.W0178-01). The maintenance of the 0.75 m freeboard at all times in the storage tank requires the regular removal of leachate from the tank. The leachate is removed using fully enclosed road tankers operated by a permitted waste collector.

The leachate is treated at an off-site waste water treatment plant (WWTP). The WWTP's currently used are Galway County Council Tuam STP, Rilta Industrial WWTP, Rathcoole and Enva Industrial WWTP Shannon which were agreed in advance with the Agency, as specified in Condition 5.13.3 and 11.8.1 b) of the Waste Licence (Reg. No.W0178-01).

Greenstar has prepared written procedures for the proper handling of leachate at the site, as specified in Condition 11.8.1 e) of the Waste Licence (Reg. No.W0178-01). The procedure specifies the corrective actions to be taken in the event of a spill at the ground surface. Greenstar maintains an adequate supply of containment booms and/or suitable absorbent material to contain and absorb any spill at the facility. Facility personnel have been provided with appropriate training to deal with any such incidents.

It is not intended to pre-treat the leachate at the facility. If at some time in the future pre-treatment is being considered Greenstar will submit details to the Agency for prior approval. Leachate may be recirculated in cells that have been capped and restored to the Agency's satisfaction and subject to the Agency's prior approval, as required by Condition 5.13.4 of Waste Licence (Reg. No. 178-1).

5.12.3 Landfill Gas Control Measures

The primary measures to prevent landfill gas migration and to allow the efficient collection of gases for flaring and possible utilisation are the landfill lining system, supported by active abstraction. Greenstar have completed an assessment of the feasibility of the utilisation of landfill gas in accordance with Condition 11.7 of the Waste Licence (Reg. No.W0178-01). The assessment concludes that utilisation is feasible depending on cost and timeframe to secure grid connection. Greenstar will install gas utilisation system within the timeframe agreed with the Agency.

5.13 Noise Emission Controls

Noise emissions are mitigated by the following methods, which are based on the requirements of Condition 7. 6.1 of the Waste Licence (Reg. No.W0178-01): -

- Low sound level plant is used on-site,
- Speed restrictions on all internal site roads,
- Fitting of acoustic panels on the engine bays and exhaust silencers on all heavy machinery used on-site, and
- Compliance with BS 5528 Noise Control on Construction and Open Sites.

5.14 Odour Emission Controls

Odour emissions are controlled by the following operational procedures and engineering controls: -

- The daily working area is limited in size,
- Daily covering of waste,
- Provision and progressive expansion of an active gas abstraction and flaring system in operational cells,
- Provision of a low permeability cap incorporating a landfill gas collection system on completed cells.

5.15 Litter Control

Litter control is achieved by the following methods which are specified in Condition 7.3 of the Waste Licence (Reg. No. W0178-01) and also best practice: -

- Daily covering of the waste,
- Suspension of waste disposal during adverse weather conditions,
- Provision and maintenance of permanent and portable litter fencing and netting around the perimeter of all waste disposal areas. The fencing is provided prior to the placement of waste,
- Daily inspection of litter control infrastructure. All defects are repaired by the end of the working day on which the defect was discovered. If it is only possible to effect a temporary repair on the day a permanent repair must be completed within three days,
- Loose litter or other waste occurring on or in the vicinity of the site is collected immediately or no later than 10 am of the next working day after such waste is discovered in compliance with Condition 7.3.4,
- Greenstar requires all vehicles delivering waste to and removing waste and materials from the facility to be appropriately covered.

5.16 Dust Emission Controls

Dust emissions are minimised and controlled by the following, which are specified in Conditions 7.4 and 7.5 of the Waste Licence (Reg. No.W0178-01) and also best practice: -

- Paved roads,
- Mandatory use of the wheel wash by waste vehicles leaving the site except those whose exemption has been approved by the Agency,
- Routine road sweeping,
- Daily cover of the deposited waste,
- Capping and seeding of landfill cells,
- Vegetation of soil stockpiles,
- Use of water bowser to dampen roads and stockpiles as required.

5.17 Bird Control

The primary measure for the prevention of birds gathering and feeding at the facility is the appropriate daily covering of waste. The use of birds of prey and/or other bird scaring

techniques are employed on a daily basis, as required by Condition 7.7.1 of the Waste Licence (Reg. No.W0178-01). Gas operated scaring devices are not used.

5.18 Vermin and Other Pest Control

Vermin control is carried out in accordance with the Programme for the Control and Eradication of Insect and Rodent Infestations at the Facility, prepared under Condition 11.6.1 of the Waste Licence (Reg. No.W0178-01). Greenstar maintains records of the vermin control programme implemented at the facility, as required by Condition 10.6 of the Waste Licence (Reg. No.W0178-01).

The records include: -

- Date and time when spraying of insecticide is carried out;
- Contractor details;
- Contractor logs and inspection reports;
- Details of the rodenticide(s) and insecticide(s) used;
- Operator training details;
- Details of any infestation;
- Mode, frequency, location and quantity of application; and
- Measures to contain sprays within the facility boundary.

5.19 Wheel Wash

The wheel wash is inspected daily as specified in Condition 5.14.4 of the Waste Licence (Reg. No.W0178-01). Solid material removed from the wheel wash is disposed of in the landfill. Dirty water is directed to the leachate collection system as specified in Condition 3.9.1 of the Waste Licence (Reg. No.W178-01).

5.20 Operational and Safety Rules and Emergency Response Procedures

Greenstar has prepared operating procedures that cover all aspects of facility operations (Ref. Section 5.2). Greenstar has prepared a Health & Safety Plan and, as specified in Condition 9.2 of the Waste Licence (Reg. No.W0178-01), has also prepared Emergency Response Procedures (ERP). All Greenstar personnel and contractors working on-site must be familiar with and adhere to Greenstar's Health & Safety and ERP requirements.

5.21 Environmental Monitoring Programme

Greenstar implements a comprehensive environmental monitoring programme at the facility in compliance with Conditions 8.1 to 8.12 of the Waste Licence (Reg. No.W0178-01). The type of monitoring, monitoring locations and frequency is set out in Schedule D of the Waste Licence and summarised in Table 5.1. Any amendments to the frequency, locations, methods and scope of the monitoring can only be made with the prior approval of the Agency as specified in Condition 8.2 of the Waste Licence (Reg. No.W0178-01).

Greenstar maintains records of all the monitoring carried out at the facility. The records include the names and qualifications of all the persons who carry out all sampling and monitoring and who provide the interpretation of the sampling and monitoring results, as specified in Condition 10.3 (e) of the Waste Licence (Reg. No.W0178-01).

Table 5.1 Environmental Monitoring Programme

Condition	Monitoring Item		Frequency
Table D.1. & Table D.3.	Dust samples (5 number)		Quarterly
Table D.1. & Table D.3.	PM_{10} (5 number)		Quarterly
Table D.1. & Table D.4.	Noise (5 number locations)		Quarterly
Table D.1. & Table D.5.	Ground water (8 number)	Levels Analysis Analysis	Monthly Quarterly Annually
Table D.1. & Table D.5.	Surface water (7 number)	Inspection Analysis Analysis	Monthly Quarterly Annually
Table D.1. & Tables D.2 and D7	Landfill Gas		
Table D.1. & Table D.5.	Leachate		
8.8.1	Biological Assessment (4 locations)		Annually
8.7	Topographical Survey		Annually
8.9	Archaeological Assessment		*
8.10	Stability Assessment		Annually
8.11.1	Nuisance Monitoring		Weekly
Table D6	Meteorological Monitoring		Daily

* To be carried out prior to development of any undisturbed area:

5.22 Incidents

Greenstar will, where an incident occurs, notify the Agency in accordance with Condition 9.1 of the Waste Licence (Reg. No.W0178-01).

An incident is defined as follows: -

- An emergency;
- Any emission that does not comply with the requirements of the licence;
- Any exceedance of the daily duty capacity of the waste handling equipment;
- Any trigger level specified in the licence which is attained or exceeded;
- Any indication that environmental pollution has, or may have taken place.

Greenstar will, in accordance with Condition 11.2 of the Waste Licence (Reg. No.W0178-01) notify the Agency as soon as is practicable and in any case no later than 10 am the following working day of the occurrence of an incident and submit a written report within 5 days of the occurrence of the incident, or earlier if practicable. Where the incident involves a discharge to surface water Greenstar will inform the WRFB no later than 10 am the following working day after the incident.

Where follow up actions are taken in response to the incident e.g. clean-up Greenstar will, as specified in Condition 11.2 of the Waste Licence (Reg. No. W0178-01), prepare and submit a report to the Agency on the actions no later than 10 days after the start of the works.

5.23 Complaints

Greenstar has established a procedure for recording and responding to complaints received in relation to the management and operation of the facility. All complaints are recorded in a Complaint Log, as specified in Condition 10.4 of the Waste Licence (Reg. No.W0178-01). The information recorded includes: -

- Date and time of the complaint;
- Name of the complainant;
- Details of the nature of the complaint;
- Actions taken on foot of the complaint and the results of such actions; and
- The response made to each complainant.

The Facility Manager or nominated Deputy Manager must be informed of the complaint and are responsible for the investigation of the complaint and the implementation of any corrective measures. In the event that corrective actions are required to address the cause of the complaint Greenstar records the actions on the Complaint log and communications to the complainant.

5.24 Reports

The full reporting requirements are set out in Schedule E of the Licence and are summarised in Table 5.2. The reports, in conjunction with the AER, is required under Condition 11 of the Waste Licence (Reg. No. W0178-01), also meet the reporting requirements of the EMS. The preparation of the AER involves a review of the progress in achieving the EMS Objectives and Targets, reports on site development works, resource consumption, changes to existing or introduction of new operating procedures and an assessment of the impacts of site activities.

Table 5.2 Reporting Requirements

Report	Frequency	Submission Date
EMS Updates	Annually	1 month after reporting year
AER	Annually	1month after reporting year
Incidents	As they occur	Within 5 days of the incident
Bund, tank, integrity testing	3 years	1 month after end of 3 year period
Specified Engineering Works	As they arise	2 months prior to works
Landfill Gas monitoring	Quarterly	10 days after reporting quarter
Surface Water Monitoring	Quarterly	10 days after reporting quarter
Groundwater Monitoring	Quarterly	10 days after reporting quarter
Leachate Monitoring	Quarterly	10 days after reporting quarter
Meteorological Monitoring	Annually	1 month after reporting year
Dust Monitoring	3 times a year	10 days after reporting period
Noise Monitoring	Bi-Annually	1 month after the reporting period
Any other monitoring	As they occur	Within 10 days of obtaining results

6. SCHEDULE OF OBJECTIVES & TARGETS

Objectives and Targets should cover both the short, medium and long term and be based on operational experience in order to ensure that they are both realistic and achievable. They should not be confined solely to compliance with regulatory requirement as this is the minimum performance criteria and the aim of the EMS is to achieve continual improvement environmental performance.

The Schedule of Objectives and Targets for 2007 -2012 is presented in Table 6.1. It includes details of the resources required, responsible person and target completion date.

6.1 Schedule of Objectives and Targets

Programme of Objective and Targets – 2007 to 2012

Ref. No.	Objective	Ref. No.	Target	Resources Required	Person Responsible	Time Frame for Completion	Progress as of 31st December 2008
O - 1	Lower the environmental impacts associated with fugitive landfill gas emissions by continually developing the Facility's Gas Utilisation Infrastructure and landfill gas management techniques.	T - 1.1	Undertake quarterly VOC surveys of the waste surface over the next 5 years, to establish the areas were fugitive emissions are most prevalent.	External Consultant (circa €1,800 per survey)	Site Manager	Ongoing	Surveys carried out on Monday 4th April 2008, Friday 30th May 2008, Wednesday 30th July 2008 & Thursday 4th Dec 2008.
		T - 1.2	Installation of gas extraction wells where fugitive emissions have been identified from the VOC surveys.	Circa €1,700 per borehole.	Site Manager	Ongoing	Additional vertical & horizontal gas extraction wells installed during 2008. 197 gas extraction points on site as on 31st December 2008. Further gas extraction wells to be added progressively to collection system in 2009.
		T - 1.3	Support University College Dublin Research Project commissioned to investigate the most effective cover material for achieving maximum odour neutralisation.	UCD €10,000	GM Landfill Group	Dec 2012	Project ongoing.
		T - 1.4	Apply impermiable geohess cover over filled areas of the landfill .	€ 7/m2 approx	Site Manager	Ongoing	Geohess to be installed progressively over filled areas.

		T - 1.5	Monitor and review the effectiveness of the perimeter odour neutralising infrastructure installed in 2007 and maintain record of performance.	Assistant Site Manager (80 man hours)	Site Manager	Ongoing	Wind direction Intelligence sensor incorporated in Dec 2008 to improve efficiency of system. Continually review market developments in this field.
O - 2	Lower the potential environmental impacts associated with the generation of leachate. by reducing leachate generation	T - 2.1	Reduce leachate generation by incorporating improved leachate reducing design features into construction of Phases 2 and 3 of the Landfill.	External Consultant & Site Manager (60 man hours)	Site Manager	Ongoing	Leachate reducing design features have been incorporating into Phase 2 development by reducing cell area. Their effectiveness will be reviewed and possibly replicated in Phase 3 development.
		T - 2.2	Reduce leachate generation by applying impermiable geohess cover over filled areas of the landfill .	€ 7/m2 approx	Site Manager	Ongoing	Geohess to be installed progressively over filled areas.
		T - 2.3	Lower the demand on WWTP's, risk of spillage, CO2 emissions associated with the off site treatment of leachate	External Consultant & Site Manager (60 man hours)	Site Manager	Ongoing	Ongoing implementation of site practices (Cell area reduction, Geohess application) plus on site leachate treatment trials – aeration.
O - 3	Lower the potential environmental nuisance associated with dust by improving dust management techniques	T - 3.1	Investigate available technology options for dust suppression activities that minimises water usage.	Assistant Site Manager (20 man hours)	Site Manager	December 2009	Use of spray bar for Water Bouser, as alternative, deemed inefficient. Investigate use of Surface water lagoon as primary water source for dust suppression.
O - 4	Lower the potential environmental impacts associated with litter	T - 4.1	Investigate potential for construction of wind breaker berms	Assistant Site Manager	Site Manager	Ongoing	Not possible due to lack of desirable material available to this facility to be

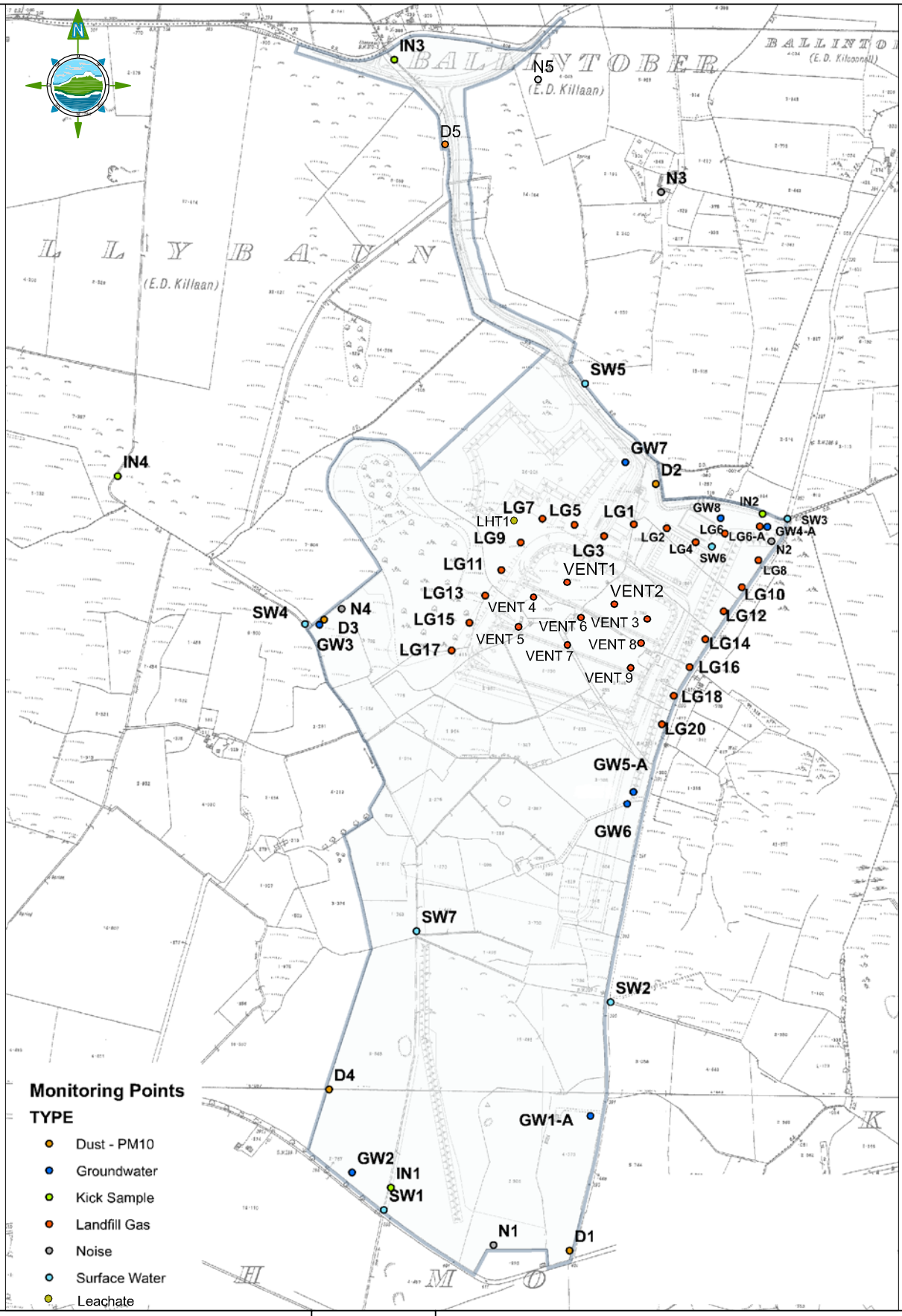
	by improving litter management techniques.		for operation in windy conditions.	(20 man hours)			used in the construction of such berms. Continued review of day to day litter reducing management techniques to ensure minimal litter generation.
O - 5	Minimise the amount of natural resources (water, power etc) consumed at the Facility.	T - 5.1	An Energy Audit of the Facility has been carried out to identify possibilities to improved energy efficiency and ascertain the facilities performance within an energy management matrix.	External Consultant (circa €5,000)	Site Manager	Sept 2009	Improve the facilities performance through adopting an Energy policy and improved Organisation, Motivation, Technology (IT), Education/Marketing & Investment.
		T – 5.2	Carry out assessment of the use of raw material at the Facility and identify opportunities for the improved efficiency in the use of raw materials.	Assistant Site Manager (40 man hours)	Site Manager	Ongoing	Material not available from Access waste. Facility actively pursues C & D materials,as a substitute for natural material, for engineering purposes. Natural material excavated during Phase 2 development to be reused on site where possible
		T - 5.3	Carry out assessment of water usage at the facility and identify opportunities for improved efficiency of water usage.	Assistant Site Manager (40 man hours)	Site Manager	Ongoing	Water requirements on various sections of site being monitored to identify potentials for reductions.
O - 6	Improve Health, Safety and Welfare	T - 6.1	Review Site safety statement	Assistant Site Manager (40 man hours)	Site Manager GM Landfill Group	Sept 2009	Independent H&S audit & Safety statement review carried out in Nov 2007. Safety statement review & training carried out annually.

		T - 6.2	Reduce lost time injuries by 5% over the next five years		All site Personnel	Ongoing	Ongoing. Data being recorded and tracked.
		T - 6.3	Develop Accident Prevention Plan	Assistant Site Manager (80 man hours)	Site Manager GM Landfill Group	May 2009	
		T - 6.4	Identify appropriate training courses in Health and Safety management and arrange attendance for staff who hold a supervisory role	Assistant Site Manager (120 man hours)	Site Manager GM Landfill Group	Ongoing	Site manager completed IOSH certified 4 day H&S training in Jan 2008. Site supervisor completed IOSH certified 3 day training for supervisors in Nov 2007.
O-7	Training	T - 7.1	Continue to train staff on a regular basis in EMS system, waste licence and Emergency Response.	Assistant Site Manager	Site Manager	Ongoing	Ongoing
O-8	Operations	T - 8.1	Obtain ISO 14001 Environmental Management System Certification	Site Manager/Assistant Site Manager	Site Manager	Ongoing	Pre-certification audit to be scheduled for Q2 2009 with the aim of having certification audit and being certified in Q3 2009.
		T - 8.2	Ensure all customers,contractors, site users & visitors are familiar with Greenstar's Environmental Policy	Site Manager/Assistant Site Manager	Site Manager	Ongoing	Circulate policy to all customers & contractors who attend site. Incorporate Environmental Policy into site inductions going forward.
		T - 8.3	Encourage all site hauliers to comply fully with the Waste	Site Manager	Site Manager	Ongoing	

			Collection Permit Regulations				Ongoing
		T - 8.4	Review all Site Operational procedures	Site Manager/Assistant Site Manager	Site Manager	Ongoing	Ongoing

APPENDIX 1

Engineering Design Maps



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Project: ENVIRONMENTAL MONITORING AT CONNAUGHT RESIDUAL WASTE LANDFILL	Checked: Morgan Burke Date: 30-03-06	
Title: LANDFILL ENVIRONMENTAL MONITORING LOCATIONS	Project Director: Morgan Burke Scale: N.T.S	Drawing No. 1322/01/101

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APPENDIX 2

Corrective Action Procedures

CORRECTIVE ACTION PROCEDURES

Scope

Greenstar has prepared Corrective Action Procedures (CAP) to ensure that corrective action is taken should specified requirements of the EMS not be fulfilled. This Procedure describes the content and applicability of the CAPs and assigns responsibility for their implementation, maintenance and update.

Content

The Procedure set out the approach to be taken to identify a non-compliance with the EMS, investigate the root cause, implement corrective actions and report on the non-compliance. They also identify the need to amend Operating Procedures and provide training or retraining to avoid the recurrence of the non compliance. The CAPs deal with: -

Facility Operation	:	CAP-2
Environmental Monitoring	:	CAP-3
Reports	:	CAP-4

Application

This CAP apply to the Galway Landfill operated under Waste Licence Registration No. 178-1.

Applicable Documents

The following documents constitute part of the CAP to the extent specified in each Procedure. Unless otherwise specified the latest issue of each document applies.

- Waste Licence Registration No. 178-1,
- Operating Procedures,
- Site Inspection Reports,
- Environmental Management Plan (EMP),

- Emergency Response Procedures (ERP),
- Awareness & Training Procedure,
- Document Control Procedure.

Responsibilities

It shall be the responsibility of Greenstar to ensure that the CAPs are implemented.

It shall be the responsibility of the Facility Manager to revise and amend the CAP in response to findings of the root cause of a non-compliance.

It shall be the responsibility of the Facility Manager to maintain copies of the most recent CAPs at the facility, ensure that they are available to all relevant site operatives, including Greenstar sub-contractors, and ensure that all site operatives have a thorough understanding of the CAPs relevant to their roles and areas of responsibilities.

FACILITY OPERATION

Scope

This Procedure addresses the day to day operation of the facility to ensure that corrective action is taken should the specified requirements of the Environmental Management Plan (EMP) and/or the Waste Licence not be fulfilled.

Application

The procedure applies to all site operations covered and includes: -

- Waste acceptance,
- Waste placement,
- Cover material stockpile,
- Condition of landfill cells,
- Condition of site entrance and access roads,
- Litter screens and control,
- Nuisance control, including, dusts, odours, birds, litter and vermin,
- Leachate and Landfill gas management,
- Surface water management,
- Wheel wash,
- Site security and environs,
- Complaints,
- Fires,
- Fuel storage,
- Record keeping.

Responsibility

greenstar is responsible for ensuring the facility is operated in accordance with the EMP, the Waste Licence and facility Operating Procedures or any other procedures and plans and reports prepared in compliance with licence conditions.

It is the responsibility of the Facility Manager or nominated Deputy Manager to ensure that all site operatives, including *greenstar* sub-contractors, have a thorough understanding of the EMP, the Waste Licence and the relevant Operating Procedures.

It is the responsibility of all staff, including *greenstar* sub-contractors, to immediately notify the Facility Manager or the nominated Deputy Manager of any actual or potential non-compliance with the EMP and/or Waste Licence conditions.

The Facility Manager or nominated Deputy Manager shall be responsible for implementing corrective action where site operations are identified as not meeting the objectives of the EMP or the Waste Licence Conditions. In implementing the corrective actions the Facility Manger or nominated Deputy Manager shall have regard to the facility Emergency Response Procedures to ensure that the proposed actions do not present a risk to Health and Safety.

Corrective Action

Where a non-compliance is identified, either by site personnel during daily operations, routine inspections by the facility personnel or in the investigation of a complaint by a member of the public, the Facility Manager or nominated Deputy Manager will immediately initiate action to bring operations into compliance.

The scope and extent of the corrective actions will be based on the nature and scale of the non-compliance, the objectives of the EMP and relevant Licence Conditions. The corrective actions will, at a minimum, be sufficient either to immediately rectify the non-compliance or minimise environmental risk pending completion of required works.

If the non-compliance constitutes an incident which might result in environmental pollution the Facility Manager or nominated Deputy Manager shall initiate any environmental monitoring considered necessary to evaluate environmental pollution.

If the non-compliance constitutes an incident requiring notification to the Agency or other regulatory bodies, the Facility Manager or nominated Deputy Manager shall notify the Agency and regulatory bodies in accordance with the Reporting Procedure and the Waste Licence Conditions

The Facility Manager or nominated Deputy Manager shall monitor implementation of the corrective action to ensure that actions are carried out and are effective.

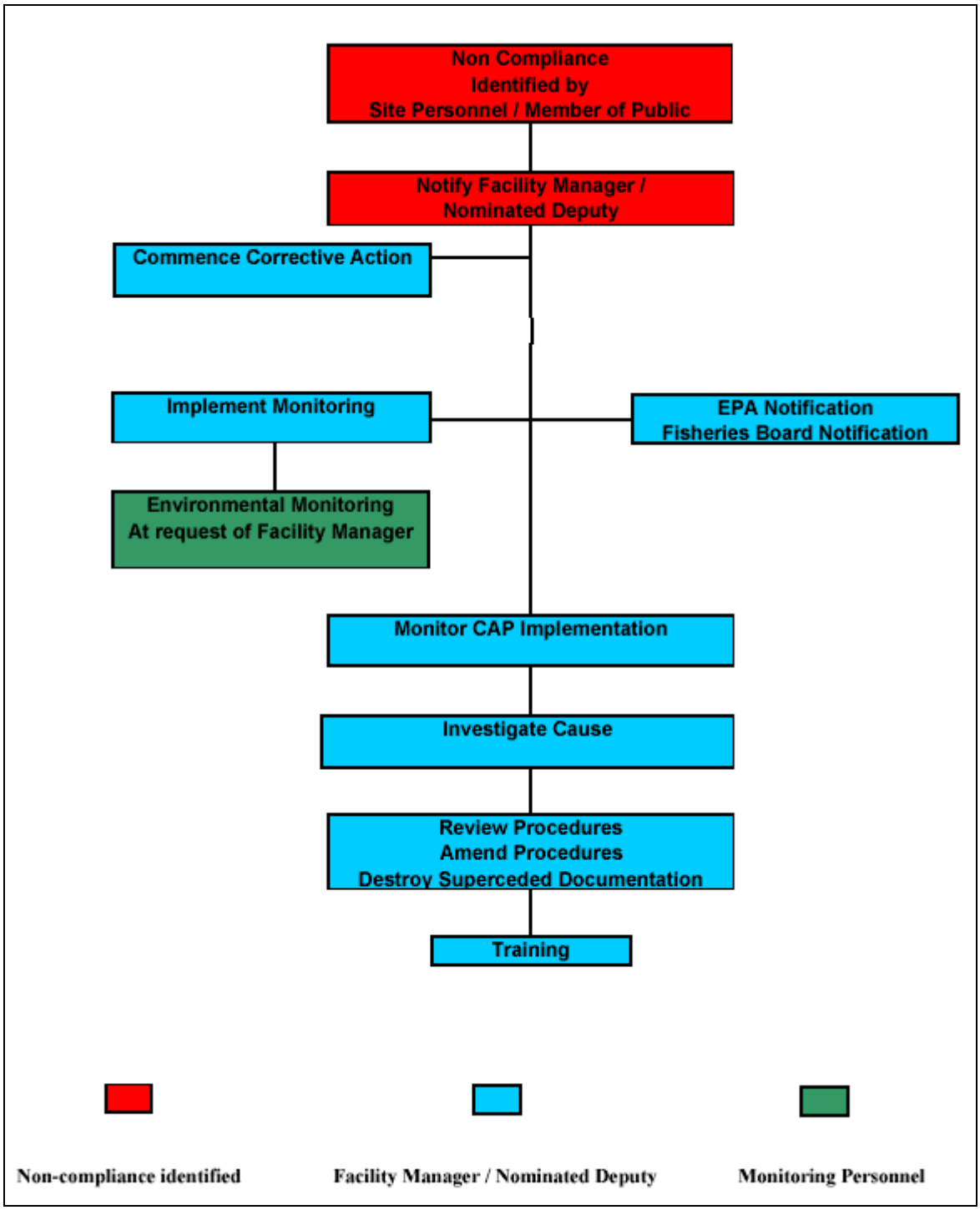
Following the completion of the corrective action the Facility Manager or nominated Deputy Manager will carry out an investigation to identify the root cause of the non-compliance. Where the cause is the result of inadequate or improperly applied procedures or site practices, the Facility Manager or nominated Deputy Manager will review and amend the procedures and practices to avoid a reoccurrence of the non-compliance. If documented procedures or operational practice sheets are amended the Facility Manager shall ensure that the superseded documents are destroyed.

If the cause of the non compliance is due to a lack of understanding of operational practices, the EMP, or licence conditions the Facility Manager or nominated Deputy Manager shall ensure that the site staff, including greenstar sub-contractors, receive the necessary instruction or training to ensure future avoidance of a recurrence of the non compliance.

Key Elements

A flow diagram that summarises the key elements of the CAP is attached.

CAP-2 Site Operation



ENVIRONMENTAL MONITORING

Scope

This Procedure addresses the environmental monitoring programme at the facility to ensure that corrective action is taken should specified requirements of the EMP and or the Waste Licence not be fulfilled.

Application

The Procedure applies to all emissions, environmental impacts and monitoring of emissions and environmental media covered under the EMP and Waste Licence Conditions, subject to any written agreements with the Agency and includes: -

- Surface water,
- Groundwater,
- Noise,
- Dust,
- PM_{10},
- VOC, and
- Odours.

Responsibility

greenstar shall be responsible for providing the necessary resources to ensure the environmental monitoring programme is carried out in accordance with the EMP and the Waste Licence conditions.

It is the responsibility of the Facility Manager or nominated Deputy Manager to have a thorough understanding of the requirements of the EMP, Waste Licence, and Operating Procedures in relation to environmental monitoring.

The Facility Manager or nominated Deputy Manager will be responsible for arranging for the implementation of the specified environmental monitoring programme.

The Facility Manager or nominated Deputy Manager will be responsible for implementing corrective actions in the event that monitoring identifies an emission that exceeds emission limit/trigger level or where operations are identified as impacting on the receiving environment.

Corrective Action

Where in-situ monitoring identifies an impact on the receiving environment, the Facility Manager or nominated Deputy Manager will be immediately informed. The Facility Manager or nominated Deputy will carry out an inspection of the area surrounding the monitoring location to identify the source of the impact.

If the source of the impact is identified as an emission from the waste activities, the Facility Manager or nominated Deputy Manager shall be responsible for taking corrective action to isolate the source and identify and execute measures to minimise the effects of the emission.

The Facility Manager or nominated Deputy Manager may, depending on the nature of the impact, instruct the amendment of the routine monitoring programme to include additional monitoring to determine the extent of the impact. The number and location of these monitoring points will be established in consultation with the monitoring personnel.

The Facility Manager or nominated Deputy Manager will notify the Agency and, in the case of surface water or groundwater impacts, the Western Regional Fisheries Board in accordance with the Waste Licence notification requirements.

Where the in-situ monitoring indicates satisfactory conditions, but subsequent laboratory test results indicate an impact by an emission from site activities e.g. surface water or groundwater quality, the Facility Manager or nominated Deputy Manager will carry out a visual inspection of the monitoring points to identify a possible source. If a source cannot be identified the Facility Manager or nominated Deputy Manager may, depending on the nature of the results, either immediately initiate further monitoring or await the following scheduled sampling event to obtain more information on the cause of the impact.

The Facility Manager or nominated Deputy Manager will monitor implementation of the corrective action to ensure that actions are carried out and are effective.

Following the completion of the corrective action the Facility Manager or nominated Deputy Manager will investigate and document the cause of the emission. The Facility Manager or nominated Deputy Manager will submit a report on the investigation to the Agency in accordance with the Waste Licence notification and reporting requirements.

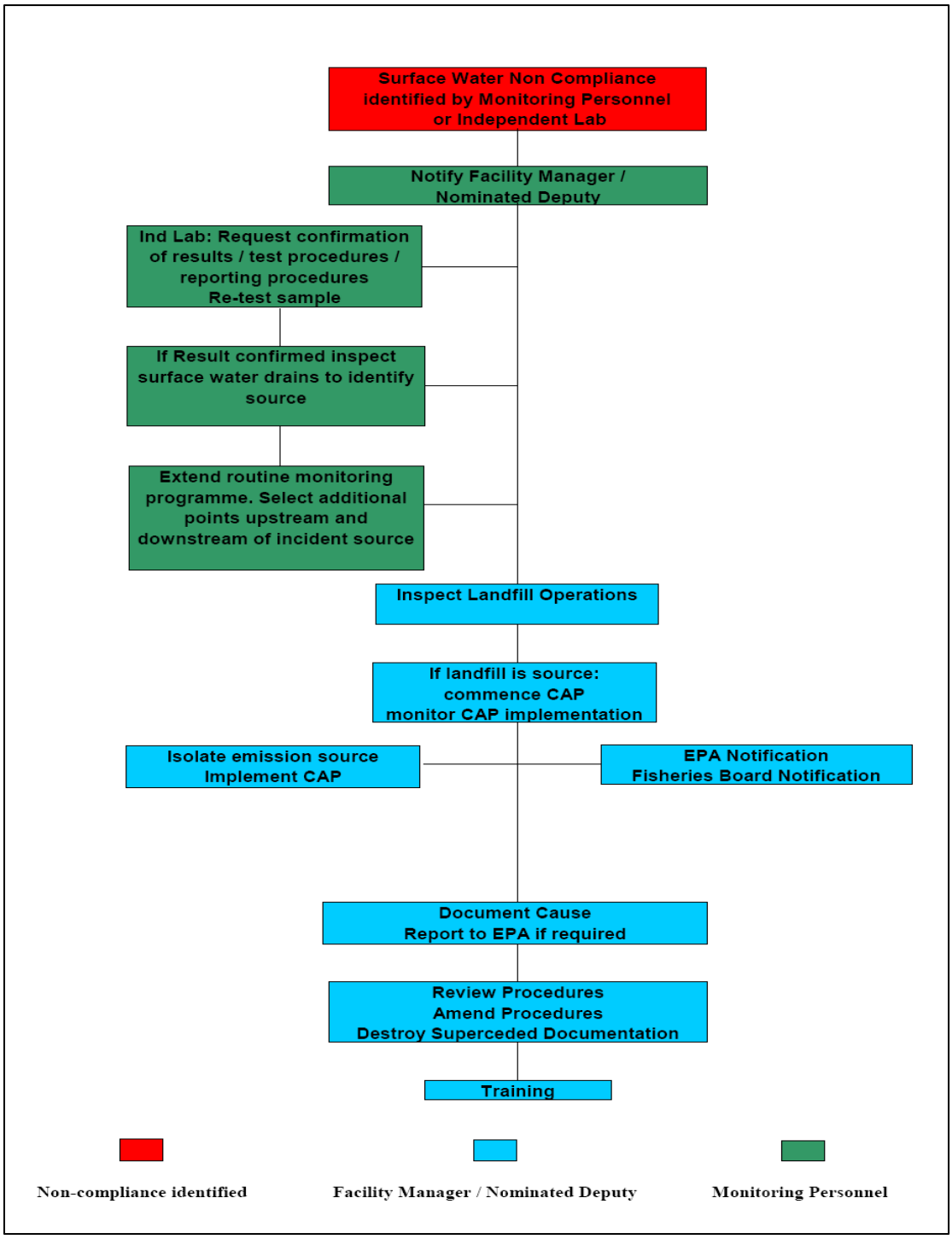
Where the cause is the result of failure or inadequacy of the design or implementation of specified engineering works, *greenstar* shall ensure that the design or construction deficiencies are rectified to avoid a reoccurrence of the non-compliance.

Where the cause is the result of inadequate or improperly applied procedures or site practices the Facility Manager shall review and amend the procedures and practices to avoid a reoccurrence of the non-compliance. If documented procedures or work instructions are amended the Facility Manager shall ensure that the superseded documents are destroyed.

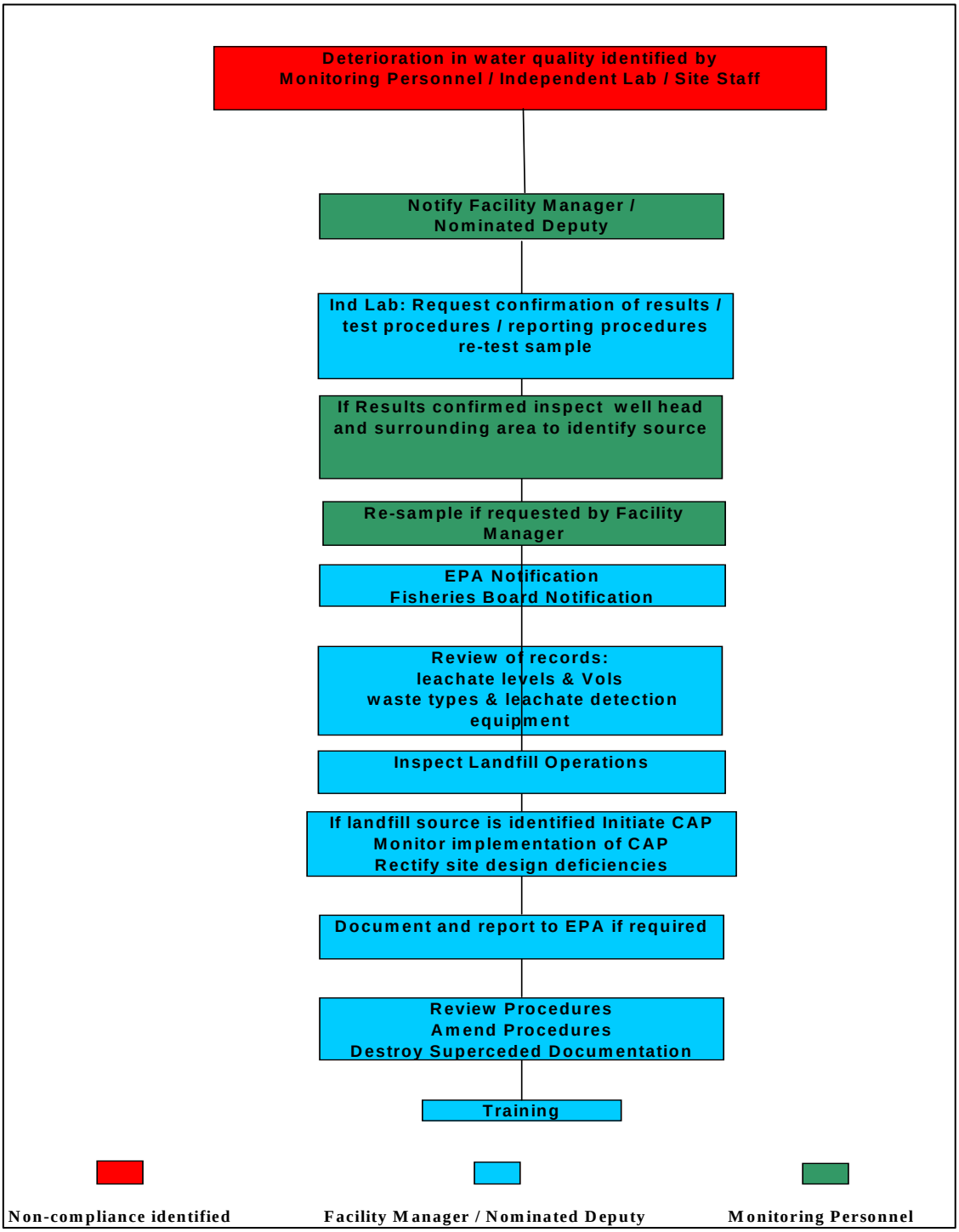
If the cause of the non compliance is due to a lack of understanding of operational practices or licence conditions the Facility Manager or nominated Deputy Manager shall ensure that the site operatives, including *greenstar* sub-contractors, receive the necessary instruction or training to ensure future avoidance of a recurrence of the non compliance.

Flow diagrams showing the actions to be taken in the event of non-compliance identified during the environmental monitoring programme are attached.

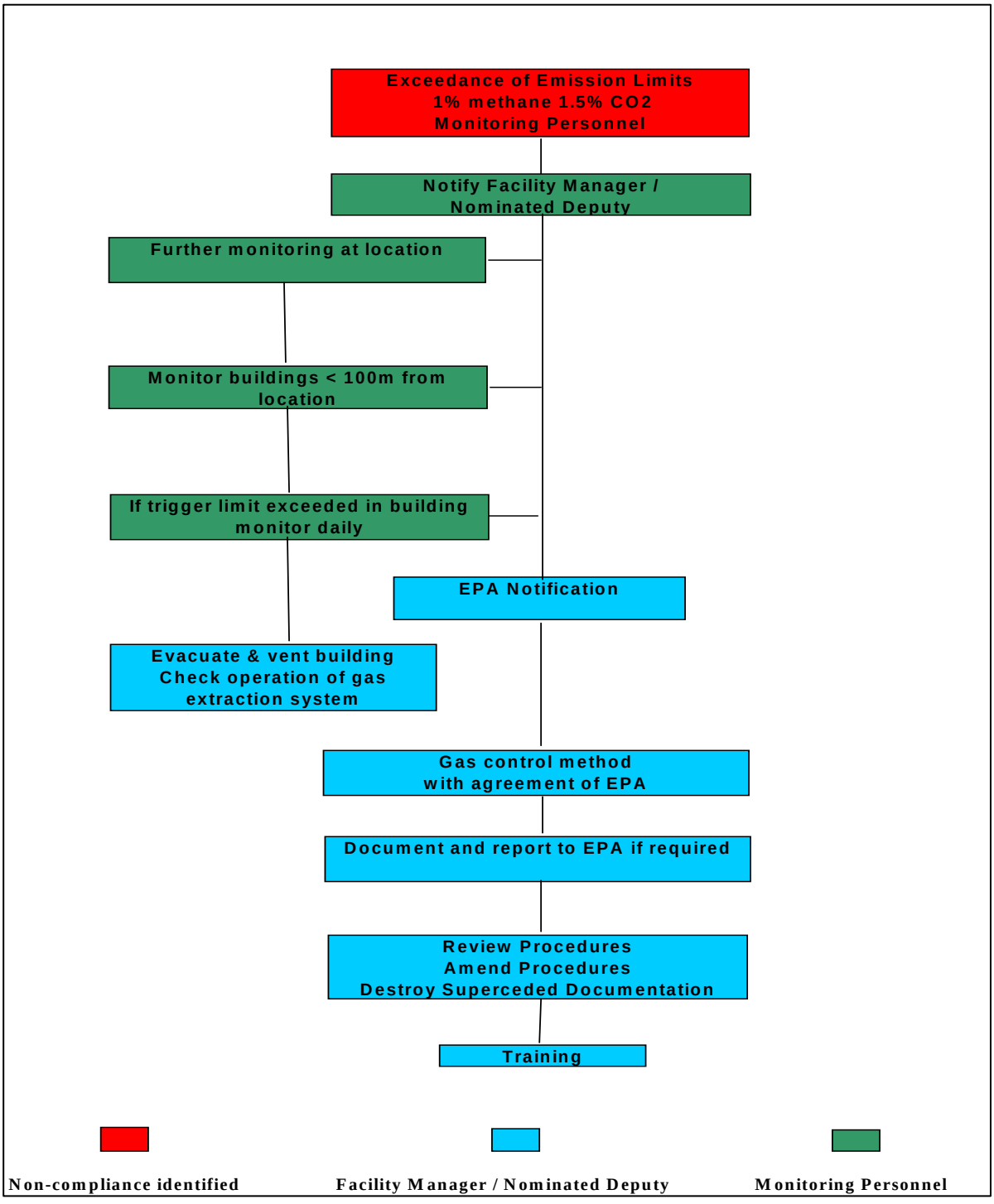
CAP-3 Surface Water



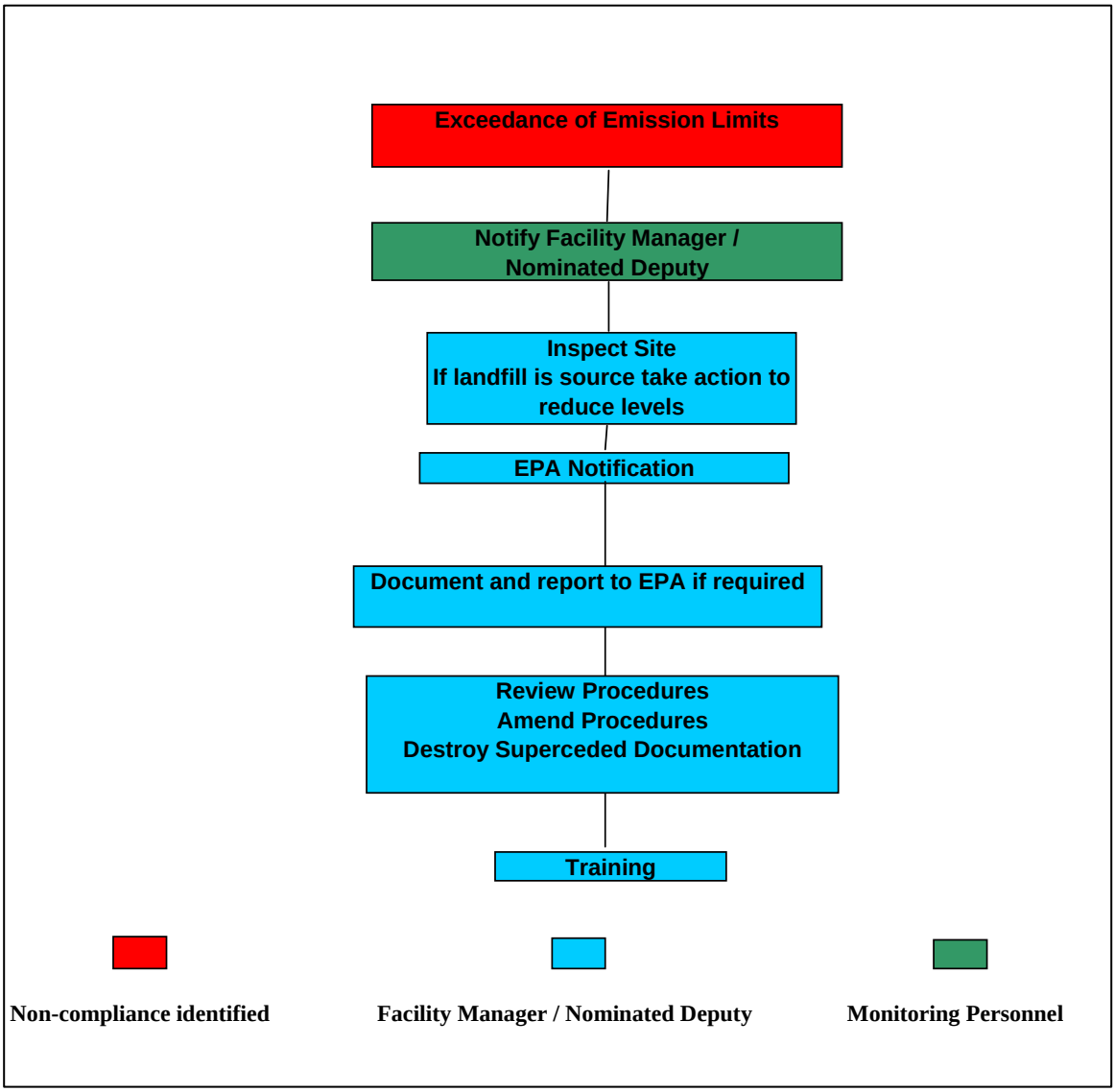
CAP-3 Groundwater



CAP-3 Landfill Gas



CAP-3 Noise


Exceedance of Emission Limits
Notify Facility Manager / Nominated Deputy
Inspect Site
If landfill is source take action to reduce levels
EPA Notification
Document and report to EPA if required
Review Procedures
Amend Procedures
Destroy Superceded Documentation
Training
Non-compliance identified
Facility Manager / Nominated Deputy
Monitoring Personnel

REPORTS

Scope

This Procedure addresses reporting to ensure that corrective action is taken should specified requirements of the Waste Licence not be fulfilled.

Application

The Procedure applies to all reports and notifications required under the EMP and the Waste Licence, subject to any written agreements with the Agency.

Responsibility

greenstar shall be responsible for ensuring the resources are provided to complete the required reports in accordance with the schedules specified in the EMP and set in the individual conditions and *Schedule E* of the Waste Licence.

It is the responsibility of the Facility Manager or nominated Deputy Manager to have a thorough understanding of the EMP and Waste Licence Conditions in relation to reporting requirements.

The Facility Manager or nominated Deputy Manager shall be responsible for arranging the completion of the stipulated reports and submission to the Agency within the timeframe set in the EMP and the Waste Licence.

The Facility Manager or nominated Deputy shall be responsible for implementing corrective actions in the event that reports will not be prepared or submitted to the Agency within the specified timeframe.

Corrective Action

If the Facility Manager or nominated Deputy Manager identifies that a report will not be prepared and submitted to the Agency by the scheduled date he (she) shall identify the cause of the delay.

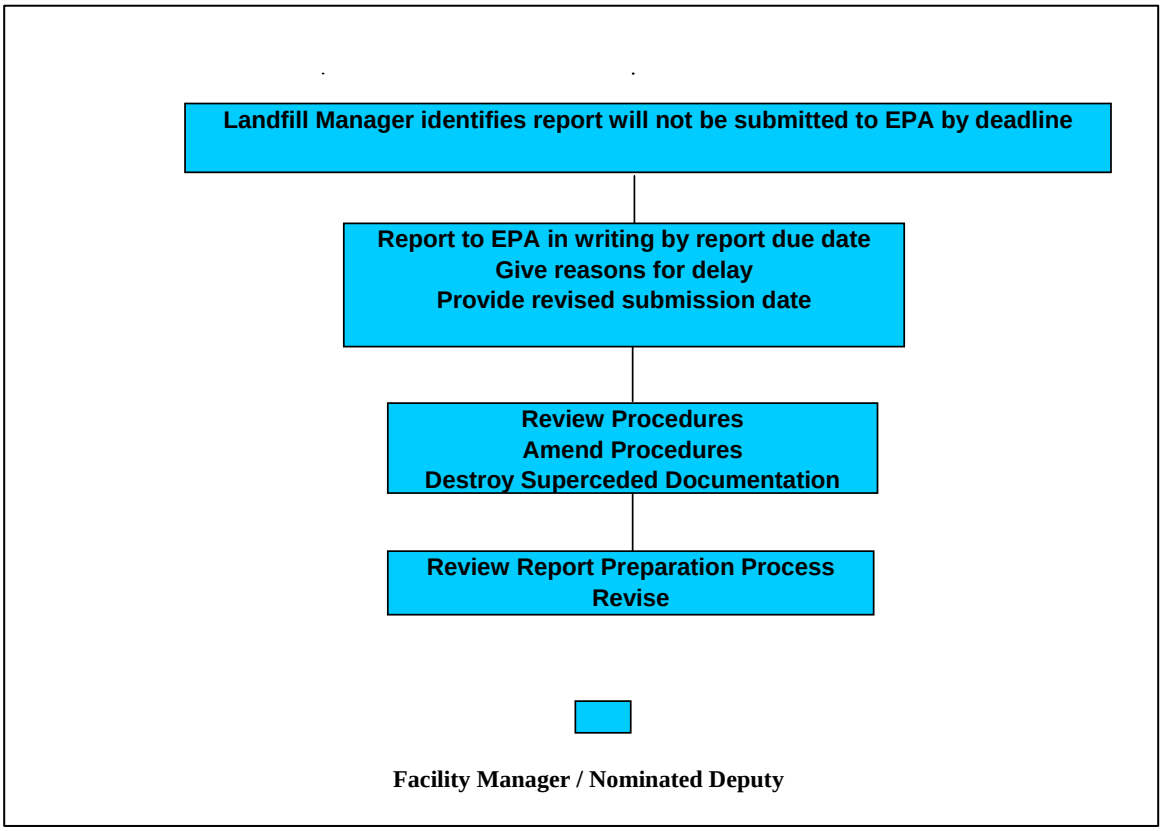
The Facility Manager or nominated Deputy Manager will inform the Agency in writing that the report will not be submitted by the due date. This notification will be submitted to the Agency preferably before, but at a minimum no later than the report due date.

The Facility Manager or nominated Deputy Manager will include in the written notification the reason(s) for the failure to submit the report on time and provide a revised submission date for the Agency's agreement.

Following the submission of the report the Facility Manager or nominated Deputy Manager shall review that particular report preparation process to identify the root cause of failure to meet the deadline. Based on the review the Facility Manager or nominated Deputy shall if necessary revise the report preparation process to avoid a recurrence of the non-compliance.

A flow diagram showing the actions to be taken in the event of non-compliance with the reporting programme is attached.

CAP-4 Reports



APPENDIX 3

Awareness & Training Procedures

AWARENESS AND TRAINING PROCEDURE

Scope

Greenstar has prepared this Awareness and Training Procedure (Procedure) to ensure that the awareness and training needs of all relevant facility personnel are identified and the required training provided.

Application

This Procedure applies to all personnel whose work is related to the Galway Landfill, including Greenstar staff and any subcontractors working at the facility on behalf of the Greenstar.

Applicable Documents

The following documents constitute part of the Procedure to the extent specified. Unless otherwise specified the latest issue of each document applies: -

- Waste Licence Registration No. 178-1,
- Operating Procedures,
- Site Inspection Reports,
- Environmental Management Plan (EMP),
- Emergency Response Procedures,
- Management Structure,
- Corrective Action Procedures.

Responsibilities

It shall be the responsibility of Greenstar to ensure that this Procedure is implemented.

It shall be the responsibility of the Facility Manager and/or nominated Deputy Manager(s) to identify training needs and arrange for the provision of the appropriate awareness and training programmes to all relevant personnel.

It shall be the responsibility of the Facility Manager and/or nominated Deputy Manager(s) to maintain written records of all awareness and training programmes received by site personnel.

Programmes

The Facility Manager shall identify the awareness and training needs of all personnel by means of Management Structure documents and the Training Evaluation Matrix. The Management Structure document assigns responsibilities to site personnel. The Matrix sets out positions, training needs and a programme delivery timeframe.

The Facility Manager or nominated Deputy Manager(s) will arrange for the delivery of the awareness and training programmes. The programme may include internal training provided by Greenstar personnel who have the necessary skills and experience to deliver the programmes, and external training provided by appropriately experienced and recognised training organisations.

The programmes shall include education and instruction on: -

- Compliance with Waste Licence conditions, Operating Procedures and EMP objectives and targets relating to site operation,
- Awareness of the implications of non compliance with EMP objectives and Licence conditions,
- Environmental Monitoring Programmes,
- Dealing with Complaints,
- Corrective Action Procedures,
- Health & Safety,
- Emergency Response Procedures.

The Facility Manager or Nominated Deputy Manager(s) shall ensure that all personnel receive the required training and shall maintain records of training provided. The records shall include the names of the trainees, the date of the training and the topics covered.

The Facility Manager shall review and amend the awareness and training programmes based on the corrective action investigation of non-compliances.

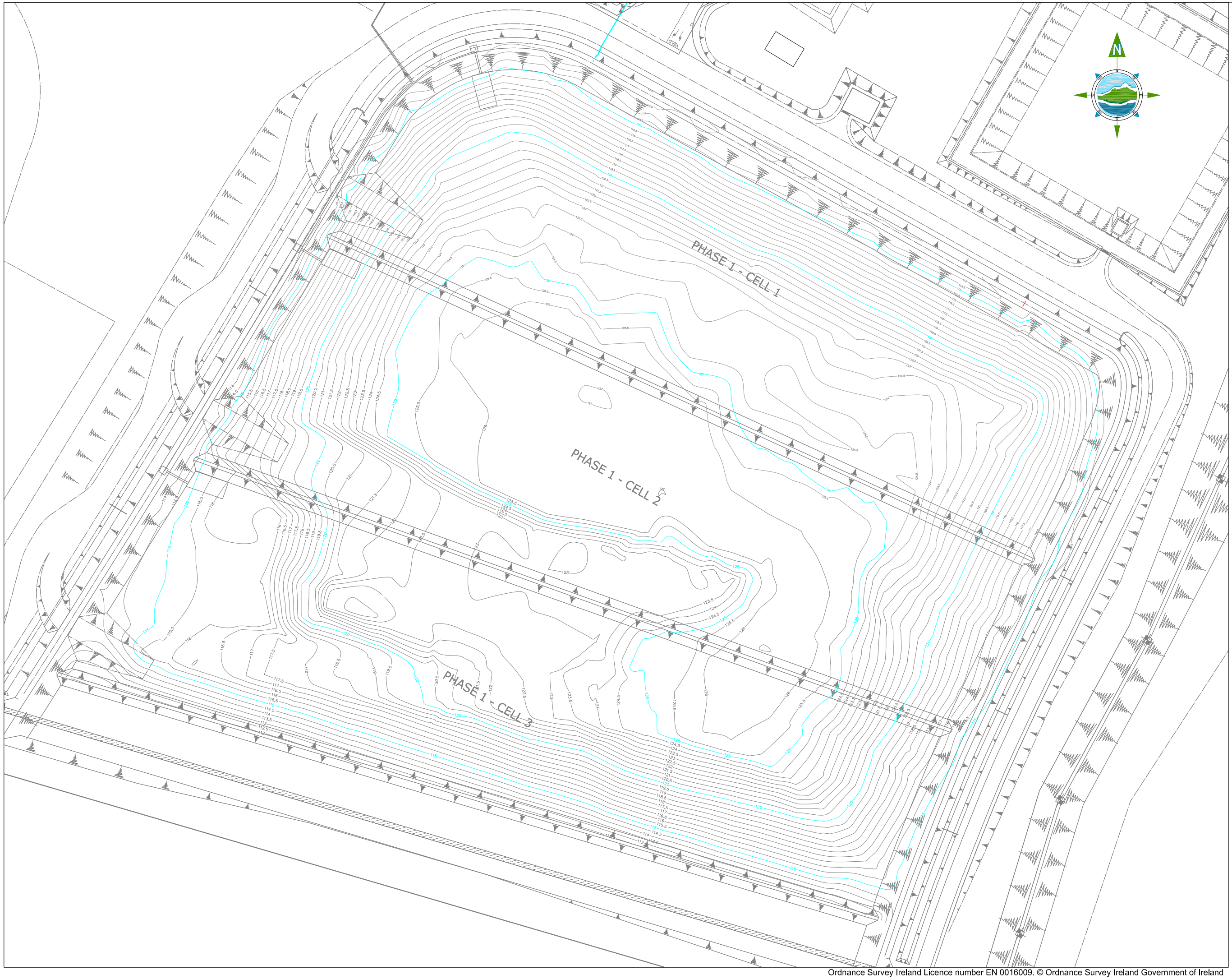
Awareness & Training Matrix

Date:

Programme	Scope	
	Person Affected	**Frequency**
Operations	All personnel.	Annual.
Environmental Awareness (EMS, ISO 14001 etc)	All personnel	Annual
Environmental Monitoring	Facility Manager, Nominated Deputy.	Initial and following licence review.
Complaints	Facility Manager, Nominated Deputy, Receptionist.	Initial and following licence review.
Corrective Action Procedures	Facility Manager, Nominated Deputy.	Initial and following any licence amendments.
Health & Safety	All personnel.	Initial and following any licence amendments.
Emergency Response Procedures	All personnel.	Initially and following any procedure amendments.

APPENDIX C

Topographical Survey



NOTES:

1. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
2. ALL DRAWINGS TO BE CHECKED BY THE CONTRACTOR ON SITE
3. ENGINEER/EMPLOYERS REPRESENTATIVE, AS APPROPRIATE, TO BE INFORMED BY THE CONTRACTOR OF ANY DISCREPANCIES BEFORE ANY WORK COMMENCES
4. THE CONTRACTOR SHALL UNDERTAKE A THOROUGH CHECK FOR THE ACTUAL LOCATION OF ALL SERVICES/UTILITIES, ABOVE AND BELOW GROUND, BEFORE ANY WORK COMMENCES
5. ALL LEVELS SHOWN RELATE TO ORDNANCE SURVEY DATUM AT MALIN HEAD

Rev	Date	Description	By	Chkd.
B	24-03-09	JANUARY 2009 SURVEY	MN	OMcA

Client: GREENSTAR

Project: CONNAUGHT REGIONAL RESIDUAL LANDFILL 2008 AER

Title: SITE SURVEY JANUARY 2009

Scale @ A1: 1:500

Prepared by:	Checked:	Date:
M. Nolan	O. McAlister	March 2009

Project Director: D. Grehan

Drawing Status: Draft

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Drawing No.: 3128-01-02

Revision: B

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APPENDIX D

Slope Stability Assessment

greenstar
setting the standard

Connaught Regional Residual Landfill Site, Kilconnell, County Galway

SLOPE STABILITY ASSESSMENT

February 2009

TOBIN CONSULTING ENGINEERS

TOBIN
Patrick J. Tobin & Co. Ltd.

SLOPE STABILITY ASSESSMENT

PROJECT: **Connaught Regional Residual Landfill**

CLIENT: ***greenstar*** **Ltd.**
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Document Amendment Record

Client:	**greenstar Ltd.**
Project:	**Connaught Regional Residual Landfill**
Title:	**Slope Stability Assessment**

PROJECT NUMBER: 3588				**DOCUMENT REF: 3588-Slope Stability Assess Rev A 2008**			
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Revision	**Description & Rationale**	**Originated**	**Date**	**Reviewed**	**Date**	**Authorised**	**Date**
TOBIN Consulting Engineers							

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1.0 INTRODUCTION

Tobin Consulting Engineers have been appointed by *greenstar* to carry out a visual slope stability assessment of the Connaught Regional Residual Landfill in accordance with Waste Licence Ref. No. 178-1

The status of the landfill at the time of the assessment was

Cells 1 & 2	Filling complete
Cell 3	Receiving waste

The side slopes were checked for signs of instability that include tension cracks, seepages, bulges at the toe, rotation of pipework, scars of slope failure and offset of surface drains. The face of each side slope and the condition of the top of the landfill were inspected and the stability status of each slope is described below:

2.0 SITE DESCRIPTION

The assessment carried out was purely visual and did not include any site specific ground investigations. However the computerised slope stability analysis of the landfill slopes will be carried out and the design parameters were based on the previous ground investigation and empirical methods. Thus the results of computerised slope stability analysis should be treated as for information/guidance only.

The top level of the Landfill mound is 127.00mOD, dipping to 113.5mOD to the North and West, and 111.5 to the East.

All side slopes of Cell 1 and 2 were covered by an impermeable liner overlain by a green fine mesh, i.e. free from rainwater infiltration into the mound. Cell 3 was partly covered by thin grass.

Drawing No. 3588-1600 (Rev D) shows the most recent topographical survey of the landfill and also shows the areas of the landfill as outlined in Section 4 of this Report. Refer to Figure 1 for site location plan.

3.0 INFORMATION SOURCES

A site walkover was carried out and the following documents were provided and used in the stability assessment:-

- Site Walkover
- Previous Ground Investigations
- Construction records
- Topographic Survey
- Leachate Level Monitoring Records

4.0 SITE WALKOVER

A site walkover was carried out on 10th December 2008 to establish the condition of the side slopes of the landfill. The slopes on each side of the landfill and the temporary side slope between Cell three (3) and Phase 2 were inspected. The stability status of each slope is described below:

4.1 NORTHERN SLOPE

The side slope showed no signs of instability. This section of the landfill was covered with an impermeable liner overlain by green fine mesh. The slope is approximately 200m in length and the maximum side slopes grade is 1:3(V:H).

Photo 1: General view of Northern Slope

4.2 WESTERN SLOPE

The side slope showed no signs of instability. The side slope was covered with an impermeable liner overlain by green fine mesh over a distance of approximately 150m and was partly capped with glacial till covered with thin grass over a distance of approximately 70m. The maximum side slope grade is 1:3(V:H) except for a short section of the lower 1.5m which is inclined at 1:1(V:H).

Photo 2: General view of Western Slope

4.3 EASTERN SLOPE

The side slope showed no signs of instability. The side slope was covered with an impermeable liner overlain by green fine mesh over a distance of approximately 120m and was partly capped with peaty topsoil covered by thin grass over a distance of approximately 60m. The maximum side slope grade is 1:3(V:H)

Photo 3: General view of Eastern Slope

4.4 TEMPORARY SOUTHERN SLOPE

The side slope was in a stable condition during inspection, however minor soil erosion was found across the southern slope. The southern slope is temporary and waste will be deposited against it as Phase 2 is filled with waste therefore preventing further soil erosion. The slope is approximately 250m in length and the maximum side slope grade is 1:2 (V:H).

Photo 4: General view of Southern Slope for Cell 3

5.0 GROUND PROFILE

The results of previous ground investigations, construction records and site walkover were used to establish the ground geology for the side slope stability analysis. The stratification for the centre of the landfill mound is given in Table 5.1.

Material	Thickness Range
Capping	0.5m
Domestic Waste	10-12m
Rockfill	2.0-4.0m
Firm Clay	>10m

Table 5.1 Ground Profile Beneath Cells 1 to 3

The cells are underlain by 2.0m to 4.0m of crushed rockfill. This provided a rigid platform for the construction of the basal liner during construction and for the deposition of waste materials.

6.0 GEOTECHNCIAL PARAMETERS

For the purposes of the slope stability analysis the following range of effective stress parameters were derived from the site investigation information, construction records and previous experience in other landfills. These parameters, presented in Table 6.1, are considered representative of the materials encountered in the Landfill:

Material	Unit Weight kN/m³	Cohesion kN/m³	Angle of Shearing Resistance/degrees
Waste	14	0	28
Firm Clay	20	0	30

Table 6.1 Design Parameters

7.0 HYDRAULIC CONDITIONS

Leachate Levels are maintained at below 1.0m above the top of the basal liner by pumping from a sump located on the western side of each cell. For the purpose of an analysis of a worst-case scenario, a level 1.0m above the upper surface of the BES layer has been used to assess the effect of leachate levels on side slope stability.

8.0 SLOPE STABILITY ANALYSIS

Four cross sections, one for each side slope were selected for analysis by computer programme “Slope/ W”. The results were reviewed in terms of the advice given in BS6031 Code of Practice for Earthworks, 1981. The standard recommends that a Factor of Safety of at least 1.3 should be adopted

as the design Factor of Safety for permanent slopes. A Factor of Safety of 1.1 is acceptable for temporary slopes

The results of the Slope Stability Assessment are presented in Table 8.1. The location of the Sections is shown in Quarterly Survey Drawing 3588-1600 (Rev D) in Appendix B and details of the analysis are presented in Appendix C.

Slope	Minimum Factor of Safety
Section A-A, Northern Slope	2.142
Section B-B, Eastern Slope	2.357
Section C-C, Western Slope	1.730
Section D-D, Temporary Southern Slope	1.365

Table 8.1 Results of Slope Stability Analysis

Each Section modelled takes account of the existing slope gradients, leachate levels, and construction materials.

The results indicate that all of the permanent side slopes of the landfill mound are stable. The stability of the temporary southern internal slope, onto which waste material will be deposited in the future, is also satisfactory. However, as mentioned in Section 2, the results of slope stability analysis are for information/guidance only, due to lack of site specific ground investigation and laboratory testing.

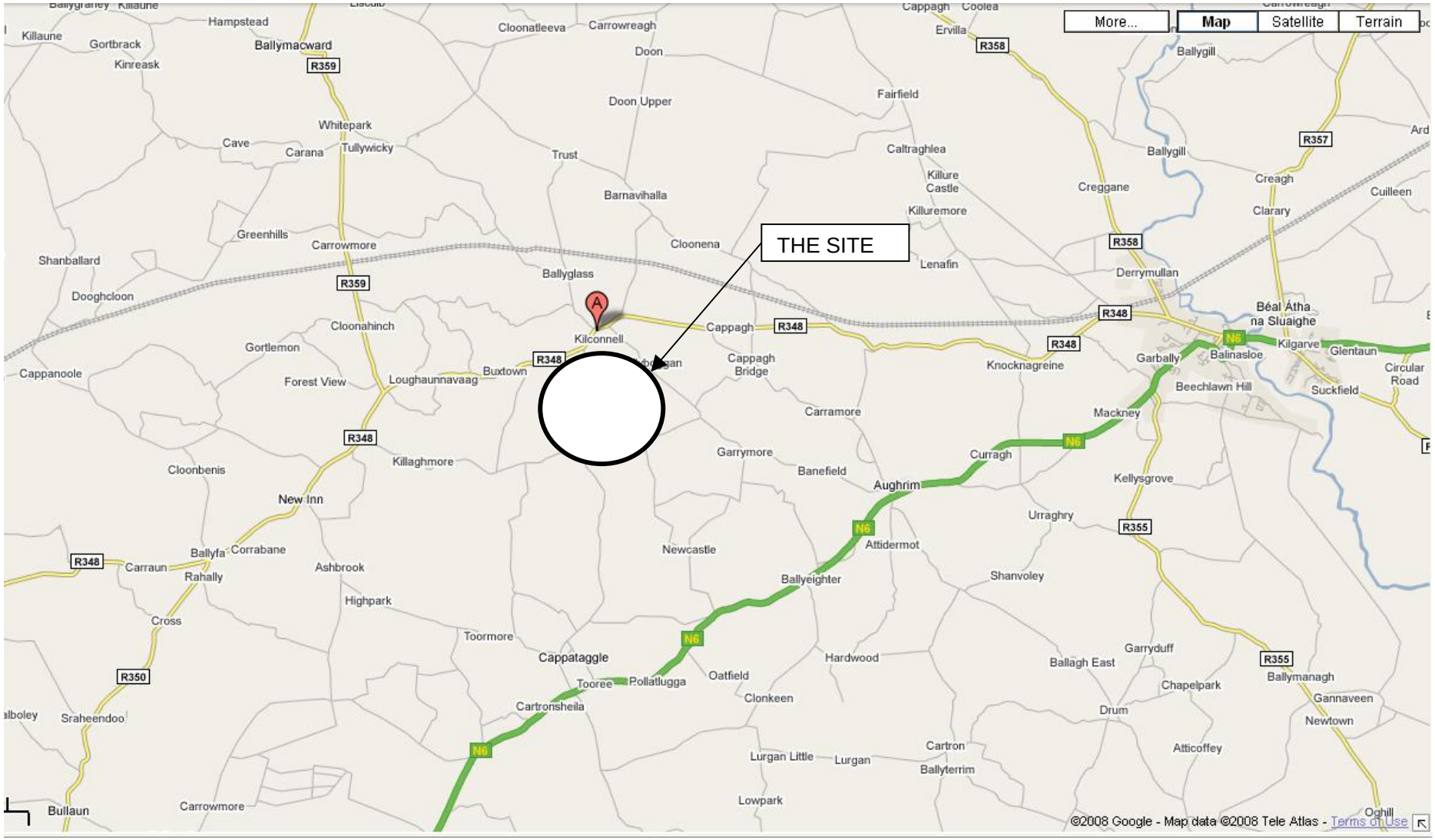
9.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the visual inspection, and a review of the topographic survey and leachate levels, the stability of the side slopes of the landfill are satisfactory subject to continuing control of leachate levels.

If any significant change of slope condition arises as mentioned in Section 1, then a geotechnical professional must be consulted to ensure the stability of the slope is maintained.

APPENDIX A

Figure 1: Site Location Plan


THE SITE
More...
Map
Satellite
Terrain
Killaune
Gortbrack
Kinreask
Hampstead
Ballymacward
R359
Cloonatleeva
Carrowreagh
Doon
Doon Upper
Fairfield
Ervilla
R358
Ballygill
Whitepark
Cave
Carana
Tullywicky
Trust
Caltraghlea
Killure Castle
Killuremore
Barnavihalla
Creggane
R357
Creagh
Clarary
Cuilleen
Greenhills
Carrowmore
Cloonena
Lenafin
Derrymullan
Shanballard
Ballyglass
Dooghcloon
R359
R348
Béal Átha na Sluaighe
Kilconnell
Cappagh
Cloonahinch
Gortlemon
Cappanoole
Forest View
Loughaunnavaag
Buxtown
Cappagh Bridge
Knocknagreine
Garbally
Balinasloe
N6
Kilgarve
Glentaun
Circular Road
Beechlawn Hill
Suckfield
Carramore
Mackney
Garrymore
Killaghmore
Cloonbenis
Banefield
Curragh
Aughrim
Kellysgrove
New Inn
Urraghry
R355
Newcastle
Attidermot
Ballyfa
Corrabane
Carraun
Rahally
Ashbrook
Ballyeighter
Shanvoley
Highpark
Cross
Toormore
Cappataggle
Hardwood
Garryduff
Ballagh East
Ballymanagh
Chapelpark
Gannaveen
Newtown
Drum
Tooree
Pollatlugga
Oatfield
Clonkeen
Cartronsheila
Sraheendoo
R350
Lurgan Little
Lurgan
Cartron
Ballyterrim
Atticoffey
Lowpark
Bullaun
Carrowmore
Oghill
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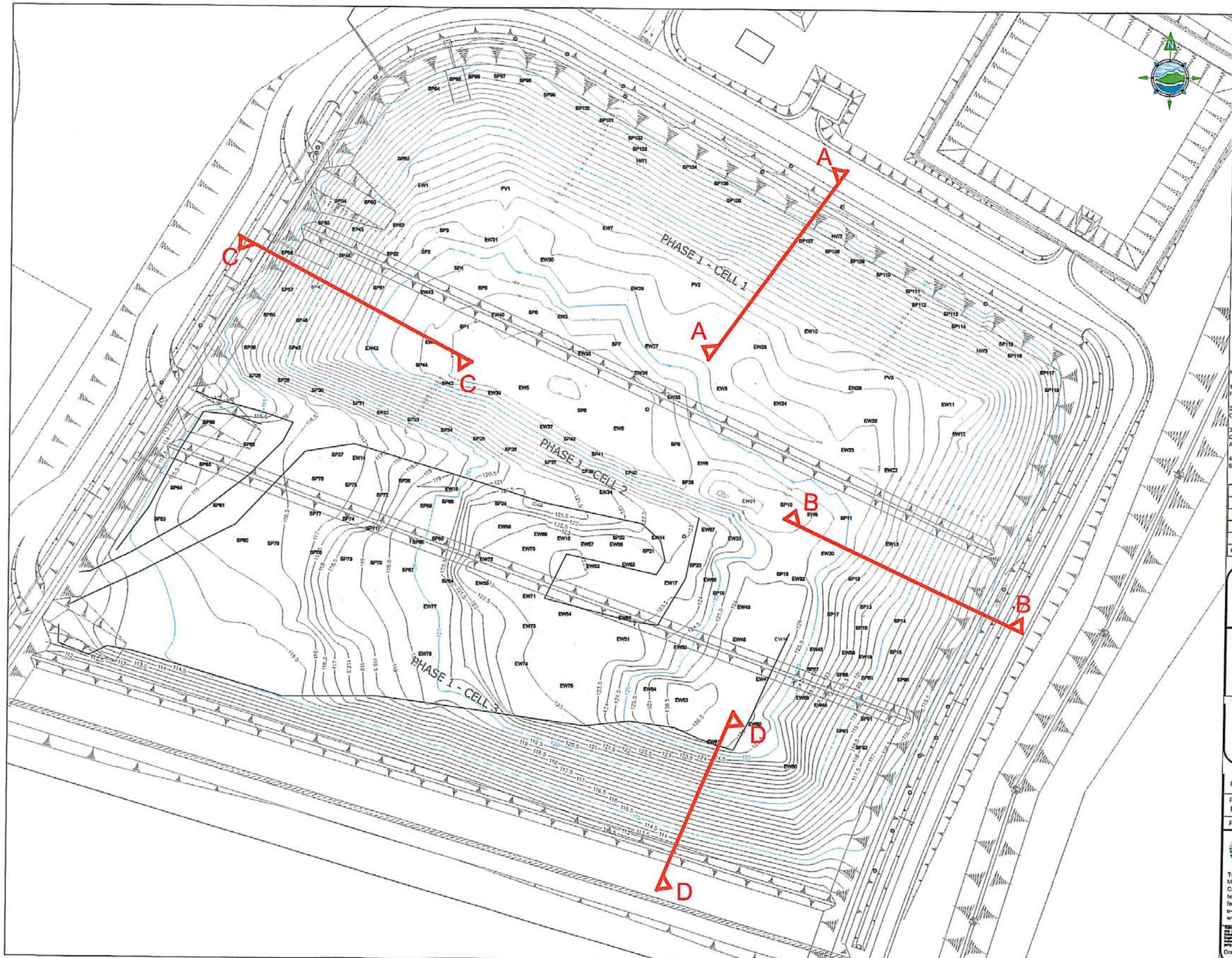
APPENDIX B

Quarterly Survey Drawing 3588-1600 (Rev D)



LEGEND

335mm Ø PIPELINE
250mm Ø PIPELINE
160mm Ø PIPELINE
90mm Ø PIPELINE
63mm Ø PIPELINE
KNOCKOUT POT
GAS EXTRACTION WELL
SPIKE WELL
VALVE
GAS FLARE

NOTES

1. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING
2. ALL DRAWINGS TO BE CHECKED BY THE CONTRACTOR ON SITE
3. ENGINEER TO BE INFORMED BY THE CONTRACTOR OF ANY DISCREPANCIES BEFORE ANY WORK COMMENCES
4. ALL LEVELS SHOWN RELATE TO ORDNANCE SURVEY DATUM AT MALIN HEAD

Rev	Date	Description	By	Chkd.
D	21.10.08	NEW WELLS ADDED AND SOME PIPEWORK RELOCATED	R.K.	C.McG.
C	28.07.08	NEW WELLS ADDED AND SOME PIPEWORK RELOCATED	R.K.	C.McG.
B	29-04-08	CONTOURS REMOVED FOR CLARITY AT CLIENTS REQUEST	R.K.	C.McG.
A	29-04-08	ISSUED TO CLIENT	R.K.	C.McG.

Client: CONNAUGHT REGIONAL RESIDUAL LANDFILL

Project: QUARTERLY SURVEY

Title: SITE SURVEY SHOWING GAS INFRASTRUCTURE IN CELLS 1, 2 & 3

Scale @ A1: 1 : 500

Prepared by: R.K. Checked: C.McG. Date: APRIL '08

Project Director: MICHAEL F. GARRICK

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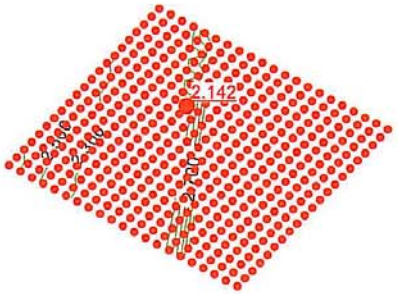
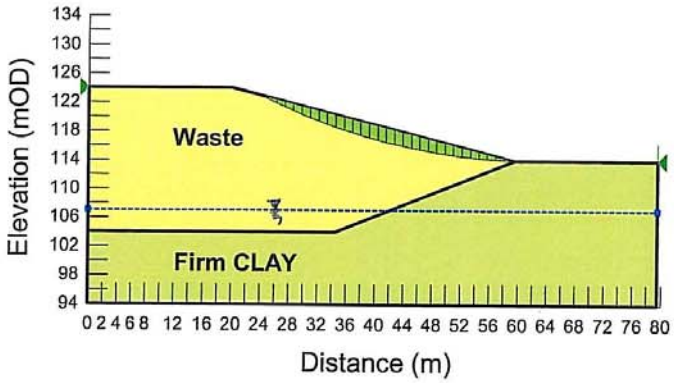
Drawing No.: 3588-1600 Revision: D

APPENDIX C

Slope Stability Analysis

Section A-A: Northern Slope Analysis
Scale: 1:800

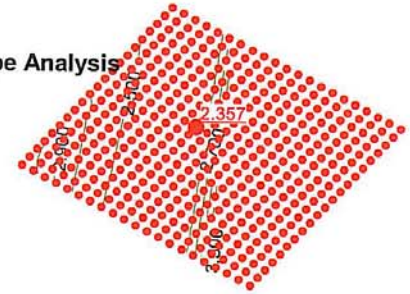


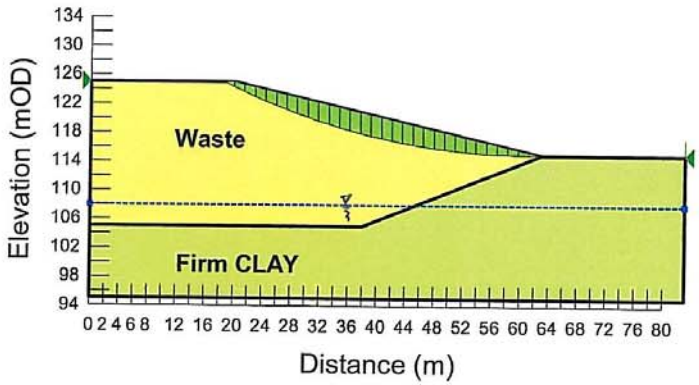


Name: Waste
Model: Mohr-Coulomb
Unit Weight: 14 kN/m³
Cohesion: 0 kPa
Phi: 28 °
Piezometric Line: 1

Name: Firm CLAY (Longterm)
Model: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Piezometric Line: 1

Section B-B: Eastern Slope Analysis
Scale: 1:800

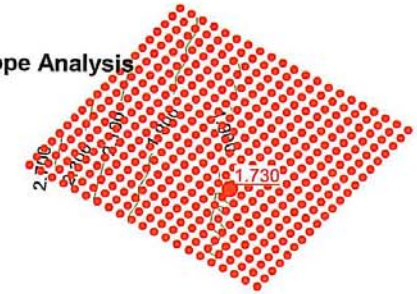


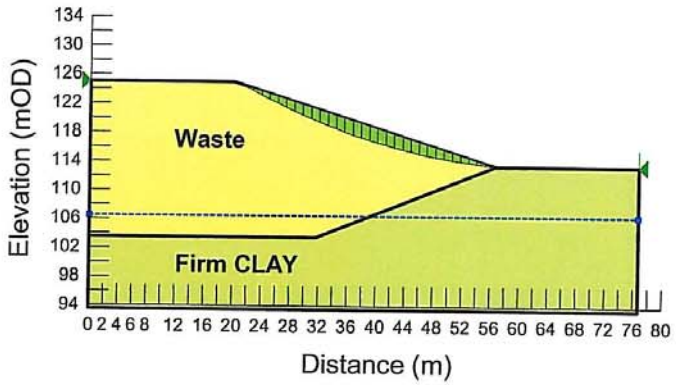


Name: Waste
Model: Mohr-Coulomb
Unit Weight: 14 kN/m³
Cohesion: 0 kPa
Phi: 28 °
Piezometric Line: 1

Name: Firm CLAY (Longterm)
Model: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Piezometric Line: 1

Section C-C: Western Slope Analysis
Scale: 1:800

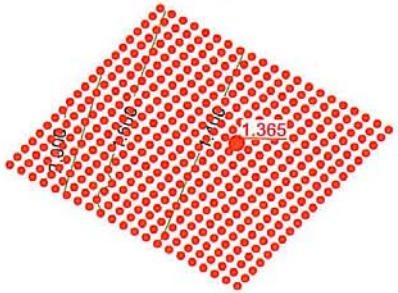


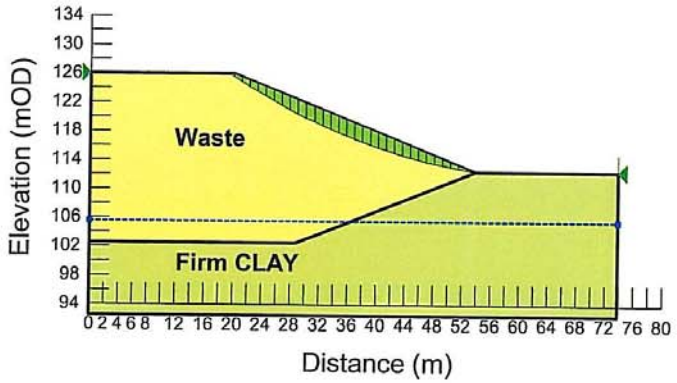


Name: Waste
Model: Mohr-Coulomb
Unit Weight: 14 kN/m³
Cohesion: 0 kPa
Phi: 28 °
Piezometric Line: 1

Name: Firm CLAY (Longterm)
Model: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Piezometric Line: 1

Section D-D: Temporary Southern Slope Analysis
Scale: 1:800





Name: Waste
Model: Mohr-Coulomb
Unit Weight: 14 kN/m³
Cohesion: 0 kPa
Phi: 28 °
Piezometric Line: 1

Name: Firm CLAY (Longterm)
Model: Mohr-Coulomb
Unit Weight: 20 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Piezometric Line: 1

APPENDIX E

Integrity & Water tightness report

Connaught Regional Residual Landfill Site,
Kilconnell, County Galway

INTEGRITY AND WATER TIGHTNESS TESTS AT CONNAUGHT REGIONAL RESIDUAL LANDFILL

December 2008

TOBIN CONSULTING ENGINEERS

TOBIN
Patrick J. Tobin & Co. Ltd.

INTEGRITY AND WATER TIGHTNESS TESTS

PROJECT: **Integrity and Water Tightness Tests at Connaught Regional Residual Landfill**

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Document Amendment Record

Client: greenstar Ltd.

Project: Integrity and Water Tightness Tests at Connaught Regional Residual Landfill

Title: Report on Integrity and Water Tightness Tests

PROJECT NUMBER: 5067				DOCUMENT REF: 5067 TR01 Final Report			
B	Minor Revisions	DOS	13/01/09	CÓM	19/01/09	CMcG	14/01/09
A	First Issue	DOS	19/12/08	CÓM	22’12’08	CMcG	22’12’08
Revision	**Description & Rationale**	**Originated**	**Date**	**Reviewed**	**Date**	**Authorised**	**Date**
TOBIN Consulting Engineers							

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1.0 INTRODUCTION

1.1 Requirement to Carry Out Testing

As part of the requirements of Waste Licence No. 178-1, Condition 3.11.5, the integrity and water-tightness of tanks, bunds and containers are required to be tested by the licensee at time of construction and at least once every three years thereafter, and the results are to be reported to the Environmental Protection Agency on each occasion.

Condition 3.11.5 states:

> "*The integrity and water tightness of all bunds and their resistance to penetration by water or other materials stored therein shall be confirmed by the licensee and shall be reported to the Agency following its installation and prior to its use as a storage area.*

The confirmation shall be repeated at least once every three years thereafter and reported to the Agency on each occasion."

In addition, Condition 5.14.2 states:

> "*The surface water lagoon shall be inspected and certified fit for purpose every three years by an independent and appropriately qualified chartered engineer."*

1.2 Integrity and Water-Tightness Testing

TOBIN Consulting Engineers were appointed to carry out the integrity testing and water-tightness tests for the following bunds/tanks at Connaught Regional Residual Landfill Site:

1) Leachate holding tank & surrounding concrete bunded area
2) Wheelwash
3) Diesel storage concrete bunded area (beside Quarantine Bay)
4) 4 x storage trays (at Odour Neutralising System)

The methodology used for the tests was in accordance with BS8007: 1987 Code of Practice for Design of Concrete Structures for Retaining Aqueous Liquids, (Section 9 – Inspection and Testing of the Structure). Due to operational constraints at the facility, the tests could not be carried out for a full seven-day period as set out in the code of practice.

A preliminary inspection of the leachate holding tank, wheelwash, diesel storage bunded area and Storage trays was carried out on 3rd November 2008. A series of tests were carried out on these on consecutive days between 5th November 2008 and 10th November 2008 with the

exception of the wheelwash. Due to the need to keep the wheelwash in operation, this was tested from midday on 8th November 2008 to the morning of 10th November 2008.

A visual inspection of the surface water lagoon and its embankments was carried out on the 19th November 2008 by Ciaran McGovern (Chartered Engineer).

1.3 Criteria for Passing Water-tightness Test

The permissible drop of the liquid surface as measured every 24 hours and the total drop over a period of five days (or two days in the case of the wheelwash), after allowing for evaporation and rainfall, shall not exceed 1/500 of the average water depth of the tank or 10mm, whichever is less.

2.0 METHOD EMPLOYED IN TESTS

2.1 Preliminary Inspection of the BUNDS / Tanks

Preliminary inspection of the bunds, tank and Storage trays was carried out on 3rd November 2008 by Matthew Gill of TOBIN Consulting Engineers and Colin Ryder, Facility Manager (greenstar).

The preliminary inspection consisted of an external visual inspection of the tank structure and a visual inspection of the interior of the structure above the level of the leachate surface. A full visual inspection of the other elements was carried out.

All defects and signs of deterioration in the structure were noted.

2.2 Hydrostatic Tests on the Leachate Holding Tank

The leachate holding tank was filled to a level approximately 1200mm beneath the top of the tank, the diesel storage bunded area was filled to a level approximately 100mm below the top of the concrete bund, the wheelwash was filled to a level approximately 35mm below the top of the concrete bund. A stabilisation period of 24 hours was allowed as it is considered that no significant absorption takes place in an existing, operational service tank or bunded area.

For each of the bunds / tanks, a datum was established above the level of the liquid surface by scribing a mark at the access hatch on the tank and on the bunds of the other elements being tested.

Measurements were taken as per the method outlined below for 5 consecutive days.

Although BS8007 recommends the use of a Vernier gauge this was considered impractical and futile due to the fact that the liquid surface of the bunded areas being open to the skies and unprotected from the wind, is constantly moving. Therefore it was considered that it would be very difficult to get Vernier scale accuracy in measuring to a moving surface. It was considered therefore that a measurement to an accuracy of 1 mm would suffice.

The way in which the liquid surface moves in a tank under the influence of wind forces can be described by very complex mathematical equations. Due to the fact that in this instance the variables in such an equation are mostly fixed, e.g. tank/bund geometry, distance below top of tank/bund wall, datum location, predominant wind direction, it was considered reasonable to measure the depth to liquid surface as follows:

- Take a measurement to the lowest point that is reached by the liquid surface over the space of 10 seconds - giving maximum value;
- Take a measurement to the highest point that is reached by the liquid surface over the space of 10 seconds - giving minimum value;
- Calculate the mean value for the two measurements – giving daily measured level of surface - millimetres beneath Datum.

All valves on the inlet and outlet pipework of the leachate holding tank were closed before beginning the test.

The measurements in accordance with the above method were taken by Matthew Gill, Resident Engineer, TOBIN Consulting Engineers between 8.00am and 8.30am on consecutives days between 5th November 2008 and 10th November 2008.

An open container known to be watertight was used to simulate the effects of the weather (rainfall or evaporation) on the liquid surface level in the open bunded areas and Storage trays. A barrel was filled with water and stored on a dry, flat concrete indoor area for a period of 24 hours. The concrete below the barrel was examined for any signs of leaks and none were found. This confirmed the water tightness of the barrel. The barrel was placed outside for the duration of the tests. The level of water in the barrel was measured simultaneously with the measurements taken on the bunded areas being tested. The measurements were adjusted by the change in the liquid surface level in the watertight barrel for each of the tanks / bunded areas. The adjusted measured daily values for liquid surface level for each of the tanks / bunds (the measured levels with the effects of the weather excluded) were taken as the sum of:

- daily measured level
- total change in level from Day 1 to Day 5*

**measured from the watertight barrel*

The '100% water-tightness' theoretical liquid surface level on any day (with the effects of the weather included) was taken as the sum of

- measured level on beginning of Day 1 (+ value)
- cumulative change in level (due to evaporation (+) and rainfall (-) from Day 1 until Day 5*

**measured from the watertight barrel*

3.0 TEST RESULTS

3.1 Visual Inspection of the Tank, Bunds and Trays

3.1.1 General Description of Leachate Holding Tank

The leachate tanks comprise 27 No. Pre-cast pre-stressed concrete units standing vertically on an impermeable seal on a poured in-situ reinforced concrete base. The pre-cast units were assembled to form a cylindrical tank. The pre-cast units were glued together at their adjoining sides and kept in tight position during glue-setting using 12 No. stressing cables around the external periphery of the cylinder. Reinforced concrete containment rings were cast monolithically with the base slab inside and outside the base of the cylindrical wall. The tank is 4.5m high internally from base to brim and 12.830m in internal diameter. The tank is above ground level and is closed to the sky by a precast reinforced concrete roof slab with two access hatches and gas vents. The visual inspection revealed no obvious defects with the leachate holding tank.

3.1.2 Diesel Storage Bunded Area

The diesel storage bunded area is constructed from in-situ reinforced concrete. The bunded area measures 14.4 metres x 4.8 metres x 0.6 metres deep. The bund walls are 0.25 metres thick. The entire bund is above ground level and is open to the sky. The visual inspection revealed no obvious defects with the diesel storage bunded area.

3.1.3 Wheelwash

The wheelwash consists of an in-situ reinforced concrete chamber with ramps at either end to allow the entry and exit of vehicles. The main chamber of the wheelwash is below ground level and is open to the sky. The visual inspection revealed no obvious defects with the wheelwash.

3.1.4 Storage Trays

There are two types of Storage trays at the facility of differing dimensions. Both are constructed from moulded HDPE. Storage Trays Nos. 1, 2 and 3 are Type 1 with the following dimensions: 1.33 metres x 1.33 metres x 0.25 metres deep. Storage Tray No. 4 is Type 2 with the following dimensions: 1.33 metres x 0.26 metres x 0.43 metres deep. The visual inspection revealed no obvious defects with the Storage trays.

3.2 Results of Water-Tightness Test and Evaluation

3.2.1 Recorded Daily Rainfall and Evaporation

A reading was taken from the watertight barrel every day at a time between 8.15am and 9.50am. The readings were used to simulate the combined effect of rainfall and evaporation on the water containing units exposed to the sky. The results are shown in Table 3.1 below.

Reading No.	Date	Time	Reading	Daily Change (mm)
1	05/11/2008	9.50	130	0
2	06/11/2008	9.10	131	1
3	07/11/2008	8.35	120	-11
4	08/11/2008	8.43	119	-1
5	10/11/2008	8.15	100	-19

Table 3.1 – Rainfall / Evaporation Readings

3.2.2 Leachate Holding Tank - Measured Leachate Levels

The measured leachate levels for the tank are shown in Table 3.2 below.

Reading No.	Date	Time	Reading (mm)	Mean Value (mm)
1	05/11/2008	8.00	1.215	1.213
2	05/11/2008	8.00	1.210	
1	06/11/2008	8.10	1.215	1.213
2	06/11/2008	8.10	1.210	
1	07/11/2008	8.00	1.215	1.213
2	07/11/2008	8.00	1.210	
1	08/11/2008	8.05	1.215	1.213
2	08/11/2008	8.05	1.210	
1	10/11/2008	8.20	1.211	1.208
2	10/11/2008	8.20	1.204	

Table 3.2 – Measured levels in Leachate Holding Tank

3.2.2.1 Assessment of Water-Tightness based on Data Recorded

The average water depth in the Leachate Holding Tank is c. 3751mm. From Section 1.3 above, therefore the permissible drop shall not exceed the lesser of 7.5mm or 10mm i.e. 8.0mm (to an accuracy of 1mm).

The calculations in Table 3.4 show the following:

Maximum 24-hour leakage = None

Sum of daily leakages = None

Overall drop in liquid level (The effect of rainfall and evaporation is excluded, as the tank is not open to the sky) = -5mm (an increase in water level of 5mm).

3.2.3 Diesel Bunded Area - Measured Liquid Levels

The measured liquid levels for the bunded area are shown in Table 3.3 below.

Reading	Date	Time	Reading	Mean Value (mm)
1	05/11/2008	8.10	116	112.5
2	05/11/2008	8.10	109	
1	06/11/2008	8.15	115	111
2	06/11/2008	8.15	107	
1	07/11/2008	8.10	99	93.5
2	07/11/2008	8.10	88	
1	08/11/2008	8.15	90	86
2	08/11/2008	8.15	82	
1	10/11/2008	8.33	53	50
2	10/11/2008	8.33	47	

Table 3.3 – Measured levels in Diesel Storage Bunded Area

3.2.3.1 Assessment of Water-Tightness based on Data Recorded

Watertightness – Diesel Bunded Area - Calculations

The average water depth in the bunded area is c. 488mm. From Section 1.3 above, therefore the permissible drop shall not exceed the lesser of 0.98mm or 10mm i.e. 1.0mm (to an accuracy of 1mm).

		Begin. Of Day 1 5th	**End of Day 1 6th**	**End of Day 2 7th**	**End of Day 3 8th**	**End of Day 5 10th**
A. Measured Level (mm) (incl. rainfall & evaporation & leakage) (+)	Daily	112.5	111	93.5	86	50
Rainfall (-)	Daily	0.0	0.0	11	1	19
Evaporation (+)	Daily	0.0	1.0	0.0	0.0	0.0
B. Adjusted Measured Level (mm) (excl. daily rainfall & evaporation)	Daily	112.5	110.0	103.5	97.0	80.0
C. 100% Watertightness Theoretical Level (mm) (excl. rain & evaporation)	Daily	112.5	112.5	112.5	112.5	112.5
D. 100% Watertightness Theoretical Level (mm) (incl. daily rainfall & evaporation)	Daily	112.5	113.5	102.5	101.5	82.5
Permissible Drop	Daily	-	1.0	1.0	1.0	1.0
	Cum.	-	1.0	1.0	1.0	1.0
Drop due to Leakage (mm)	Daily	0	-2.5	-6.5	-6.5	-17
	Cum.	0	-2.5	-9.0	-15.5	-32.5

Table 3.4 – Diesel Storage Bunded Area - A. measured liquid level; B. adjusted measured level (subtracting effects of weather); C. 100% watertightness theoretical level (excluding effects of weather); D. 100% watertightness theoretical level (including effects of weather); E. permissible drop; and F. calculated leakage

Assessment of the calculations in Table 3.4 show the following:

Maximum 24-hour leakage = None

Sum of daily leakages = None

Overall drop in liquid level, when the effect of rainfall and evaporation is excluded, after five days = None, the water level actually rose by 32.5mm.

3.2.4 Wheelwash - Measured Liquid Levels

The measured liquid levels for the wheelwash are shown in Table 3.5 below.

Reading No.	Date	Time	Reading	Mean Value (mm)
1	08/11/2008	12.55	350	343
2	08/11/2008	12.55	335	
1	10/11/2008	8.09	251	246
2	10/11/2008	8.09	241	

Table 3.5 – Measured levels in Wheelwash

3.2.4.1 Assessment of Water-Tightness based on Data Recorded

Watertightness – Wheelwash - Calculations

The average water depth in the bunded area is c. 555mm. From Section 1.3 above, therefore the permissible drop shall not exceed the lesser of 1.11mm or 10mm i.e. 1.0mm (to an accuracy of 1mm).

		Begin. Of Day 1 8th	**End of Day 3 8th**
A. Measured Level (mm) (incl. rainfall & evaporation & leakage) (+)	Daily	343	246
Rainfall (-)	Daily	1.0	19.0
Evaporation (+)	Daily	0.0	0.0
B. Adjusted Measured Level (mm) (excl. daily rainfall & evaporation)	Daily	344	266
C. 100% Watertightness Theoretical Level (mm) (excl. rain & evaporation)	Daily	343	343
D. 100% Watertightness Theoretical Level (mm) (incl. daily rainfall & evaporation)	Daily	342	323
Permissible Drop	Daily	-	1.0
	Cum.	-	1.0
Drop due to Leakage (mm)	Daily	0	-78
	Cum.	0	-78

Table 3.6 – Wheelwash - A. measured liquid level; B. adjusted measured level (subtracting effects of weather); C. 100% watertightness theoretical level (excluding effects of weather); D. 100% watertightness theoretical level (including effects of weather); E. permissible drop; and F. calculated leakage

Assessment of the calculations in Table 3.6 show the following:

Maximum 24-hour leakage = None

Sum of daily leakages = None

Overall drop in liquid level, when the effect of rainfall and evaporation is excluded, after two days = None, the water level actually rose by 78mm.

3.2.5 Storage Tray No. 1 - Measured Liquid Levels

The measured liquid levels for Storage Tray No. 1 are shown in Table 3.7 below.

Reading No.	Date	Time	Reading	Mean Value (mm)
1	05/11/2008	8.30	62	60.5
2	05/11/2008	8.30	59	
1	06/11/2008	8.05	62	60.5
2	06/11/2008	8.05	59	
1	07/11/2008	8.30	40	38
2	07/11/2008	8.30	36	
1	08/11/2008	8.55	69	68
2	08/11/2008	8.55	67	
1	10/11/2008	8.15	22	20.5
2	10/11/2008	8.15	19	

Table 3.7 – Measured levels in Storage Tray No. 1

3.2.5.1 Assessment of Water-Tightness based on Data Recorded

Watertightness – Storage Tray No. 1 - Calculations

The average water depth in the bunded area is c. 190mm. From Section 1.3 above, therefore the permissible drop shall not exceed the lesser of 0.38mm or 10mm i.e. 1.0mm. (to an accuracy of 1mm).

		Begin. Of Day 1 5th	**End of Day 1 6th**	**End of Day 2 7th**	**End of Day 3 8th**	**End of Day 5 10th**
A. Measured Level (mm) (incl. rainfall & evaporation & leakage) (+)	Daily	60.5	60.5	38	68	20.5
Rainfall (-)	Daily	0.0	0.0	11	1	19
Evaporation (+)	Daily	0.0	1.0	0.0	0.0	0.0
B. Adjusted Measured Level (mm) (excl. daily rainfall & evaporation)	Daily	60.5	59.5	48	79	50.5
C. 100% Watertightness Theoretical Level (mm) (excl. rain & evaporation)	Daily	60.5	60.5	60.5	60.5	60.5
D. 100% Watertightness Theoretical Level (mm) (incl. daily rainfall & evaporation)	Daily	60.5	61.5	50.5	49.5	30.5
Permissible Drop	Daily	-	1.0	1.0	1.0	1.0
	Cum.	-	1.0	1.0	1.0	1.0
Drop due to Leakage (mm)	Daily	0	-1	-11.5	31	-28.5
	Cum.	0	-1	-12.5	18.5	-10

Table 3.8 – Storage Tray No. 1 - A. measured liquid level; B. adjusted measured level (subtracting effects of weather); C. 100% watertightness theoretical level (excluding effects of weather); D. 100% watertightness theoretical level (including effects of weather); E. permissible drop; and F. calculated leakage

Assessment of the calculations in Table 3.8 show the following:

Maximum 24-hour leakage = 31mm

Sum of daily leakages = 31mm

Overall drop in liquid level, when the effect of rainfall and evaporation is excluded, after five days = -10mm

3.2.6 Storage Tray No. 2 - Measured Liquid Levels

The measured liquid levels for Storage Tray No. 2 are shown in Table 3.9 below.

Reading No.	Date	Time	Reading	Mean Value (mm)
1	05/11/2008	8.30	88	95.5
2	05/11/2008	8.30	103	
1	06/11/2008	8.05	88	95
2	06/11/2008	8.05	102	
1	07/11/2008	8.30	70	77.5
2	07/11/2008	8.30	85	
1	08/11/2008	8.55	82	87.5
2	08/11/2008	8.55	93	
1	10/11/2008	8.15	42	48.5
2	10/11/2008	8.15	55	

Table 3.9 – Measured levels in Storage Tray No. 2

3.2.6.1 Assessment of Water-Tightness based on Data Recorded

Watertightness – Storage Tray No. 2 - Calculations

The average water depth in the bunded area is c. 155mm. From Section 1.3 above, therefore the permissible drop shall not exceed the lesser of 0.31mm or 10mm i.e. 1.0mm. (to an accuracy of 1mm).

Assessment of the calculations in Table 3.10 show the following:

		Begin. Of Day 1 5th	**End of Day 1 6th**	**End of Day 2 7th**	**End of Day 3 8th**	**End of Day 5 10th**
A. Measured Level (mm) (incl. rainfall & evaporation & leakage) (+)	Daily	95.5	95	77.5	87.5	48.5
Rainfall (-)	Daily	0.0	0.0	11	1	19
Evaporation (+)	Daily	0.0	1.0	0.0	0.0	0.0
B. Adjusted Measured Level (mm) (excl. daily rainfall & evaporation)	Daily	95.5	94	87.5	98.5	78.5
C. 100% Watertightness Theoretical Level (mm) (excl. rain & evaporation)	Daily	95.5	95.5	95.5	95.5	95.5
D. 100% Watertightness Theoretical Level (mm) (incl. daily rainfall & evaporation)	Daily	95.5	96.5	85.5	84.5	65.5
Permissible Drop	Daily	-	1.0	1.0	1.0	1.0
	Cum.	-	1.0	1.0	1.0	1.0
Drop due to Leakage (mm)	Daily	0	-1.5	-6.5	11	-20
	Cum.	0	-1.5	-8.0	3	-17

Table 3.10 – Storage Tray No. 2 - A. measured liquid level; B. adjusted measured level (subtracting effects of weather); C. 100% watertightness theoretical level (excluding effects of weather); D. 100% watertightness theoretical level (including effects of weather); E. permissible drop; and F. calculated leakage

Maximum 24-hour leakage = 11mm

Sum of daily leakages = 11mm

Overall drop in liquid level, when the effect of rainfall and evaporation is excluded, after five days = -17mm

3.2.7 Storage Tray No. 3 - Measured Liquid Levels

The measured liquid levels for Storage Tray No. 3 are shown in Table 3.11 below.

Reading No.	Date	Time	Reading	Mean Value (mm)
1	05/11/2008	8.30	106	122.5
2	05/11/2008	8.30	139	
1	06/11/2008	8.05	108	123.5
2	06/11/2008	8.05	139	
1	07/11/2008	8.30	90	105
2	07/11/2008	8.30	120	
1	08/11/2008	8.55	110	123
2	08/11/2008	8.55	136	
1	10/11/2008	8.15	66	81.5
2	10/11/2008	8.15	97	

Table 3.11 – Measured levels in Storage Tray No. 3

3.2.7.1 Assessment of Water-Tightness based on Data Recorded

Watertightness – Storage Tray No. 3 - Calculations

The average water depth in the bunded area is c. 128mm. From Section 1.3 above, therefore the permissible drop shall not exceed the lesser of 0.27mm or 10mm i.e. 1.0mm. (to an accuracy of 1mm).

Assessment of the calculations in Table 3.12 show the following:

		Begin. Of Day 1 5th	**End of Day 1 6th**	**End of Day 2 7th**	**End of Day 3 8th**	**End of Day 5 10th**
A. Measured Level (mm) (incl. rainfall & evaporation & leakage) (+)	Daily	122.5	123.5	105	123	81.5
Rainfall (-)	Daily	0.0	0.0	11	1	19
Evaporation (+)	Daily	0.0	1.0	0.0	0.0	0.0
B. Adjusted Measured Level (mm) (excl. daily rainfall & evaporation)	Daily	122.5	122.5	115	134	111.5
C. 100% Watertightness Theoretical Level (mm) (excl. rain & evaporation)	Daily	122.5	122.5	122.5	122.5	122.5
D. 100% Watertightness Theoretical Level (mm) (incl. daily rainfall & evaporation)	Daily	122.5	123.5	112.5	111.5	92.5
Permissible Drop	Daily	-	1.0	1.0	1.0	1.0
	Cum.	-	1.0	1.0	1.0	1.0
Drop due to Leakage (mm)	Daily	0	0	-7.5	19	-22.5
	Cum.	0	0	-7.5	11.5	-11

Table 3.12 – Storage Tray No. 3 - A. measured liquid level; B. adjusted measured level (subtracting effects of weather); C. 100% watertightness theoretical level (excluding effects of weather); D. 100% watertightness theoretical level (including effects of weather); E. permissible drop; and F. calculated leakage

Maximum 24-hour leakage = 19mm

Sum of daily leakages = 19mm

Overall drop in liquid level, when the effect of rainfall and evaporation is excluded, after five days = -11mm

3.2.8 Storage Tray No. 4 - Measured Liquid Levels

The measured liquid levels for Storage Tray No. 4 are shown in Table 3.13 below.

Reading No.	Date	Time	Reading	Mean Value (mm)
1	05/11/2008	8.30	181	202.5
2	05/11/2008	8.30	224	
1	06/11/2008	8.05	184	205
2	06/11/2008	8.05	226	
1	07/11/2008	8.30	162	183.5
2	07/11/2008	8.30	205	
1	08/11/2008	8.55	173	194
2	08/11/2008	8.55	215	
1	10/11/2008	8.15	135	155.5
2	10/11/2008	8.15	176	

Table 3.13 – Measured levels in Storage Tray No. 4

3.2.8.1 Assessment of Water-Tightness based on Data Recorded

Watertightness – Storage Tray No. 4 - Calculations

The average water depth in the bunded area is c. 228mm. From Section 1.3 above, therefore the permissible drop shall not exceed the lesser of 0.46mm or 10mm i.e. 1.0mm (to an accuracy of 1mm).

		Begin. Of Day 1 5th	End of Day 1 6th	End of Day 2 7th	End of Day 3 8th	End of Day 5 10th
A. Measured Level (mm) (incl. rainfall & evaporation & leakage) (+)	Daily	202.5	205	183.5	194	155.5
Rainfall (-)	Daily	0.0	0.0	11	1	19
Evaporation (+)	Daily	0.0	1.0	0.0	0.0	0.0
B. Adjusted Measured Level (mm) (excl. daily rainfall & evaporation)	Daily	202.5	204	193.5	205	185.5
C. 100% Watertightness Theoretical Level (mm) (excl. rain & evaporation)	Daily	202.5	202.5	202.5	202.5	202.5
D. 100% Watertightness Theoretical Level (mm) (incl. daily rainfall & evaporation)	Daily	202.5	203.5	192.5	191.5	172.5
Permissible Drop	Daily	-	1.0	1.0	1.0	1.0
	Cum.	-	1.0	1.0	1.0	1.0
Drop due to Leakage (mm)	Daily	0	1.5	-21.5	11.5	-19.5
	Cum.	0	1.5	-20	-8.5	-28

Table 3.14 – Storage Tray No. 4 - A. measured liquid level; B. adjusted measured level (subtracting effects of weather); C. 100% watertightness theoretical level (excluding effects of weather); D. 100% watertightness theoretical level (including effects of weather); E. permissible drop; and F. calculated leakage

Assessment of the calculations in Table 3.14 show the following:

Maximum 24-hour leakage = 11.5mm

Sum of daily leakages = 13mm

Overall drop in liquid level, when the effect of rainfall and evaporation is excluded, after five days = -28mm

3.3 Evaluation of Calculations and Results:

3.3.1 Leachate Holding Tank

Analysis of the tabulated readings and calculations show a negative value for the drop due to leakage. As the leachate is pumped to the tank, the explanation that leachate is leaking inwards is ruled out. It must be appreciated that due to the relatively crude method of taking measurement to the liquid surface and due to some possible movement within the surface, there may be inaccuracies in the measurements of leachate surface levels. However, in my opinion, the results certainly show that the changes in levels were of a very small degree.

In my opinion, the test has shown that the Leachate Holding Tank has passed the water-tightness criteria. This is backed up by the visual assessment of the tank that indicates no visible signs of leakage.

3.3.2 Diesel Storage Bunded Area

Analysis of the tabulated readings and calculations show a negative value for the drop due to leakage. There is no connections to allow the flow of water into the bunded area, nor was there leakage of diesel into the bunded area. It must be appreciated that due to the relatively crude method of taking measurement to the liquid surface and due to some possible movement within the surface that is open to the sky on an exposed site, there may be inaccuracies in the measurements of water surface levels. However, in my opinion, the results certainly show that the changes in levels were of a very small degree.

The presence of some high sided structures within the bunded area and the fact that these structures could catch driven rain, may explain the overall rise in levels above that which can be otherwise explained by the readings for evaporation and rainfall from the watertight barrel.

In my opinion, the test has shown that the Diesel Storage Bunded Area has passed the water-tightness criteria. This is backed up by the visual assessment of the bunded area that indicates no visible signs of leakage.

3.3.3 Wheelwash

Analysis of the tabulated readings and calculations show a negative value for the drop due to leakage over two days. The visual assessment of the wheelwash indicated that it is in very

good condition. Therefore due to the relatively crude method of taking measurement to the liquid surface and due to some possible movement within the surface that is open to the sky on an exposed site, there may be inaccuracies in the measurements of water surface levels. However, in my opinion, the results certainly show that the changes in levels were of a very small degree.

We would recommend that another test would be undertaken in the near future, to confirm whether the result obtained was due to reading error or actual leakage.

3.3.4 Storage Trays

Analysis of the tabulated readings and calculations for each of the four Storage trays show a drop due to leakage on a number of days. However the overall drop in liquid for all four trays indicate a negative value for the drop due to leakage. There are possible reasons for the calculations that indicate leakage such as the fact the trays were partially covered during the test by the tanks. This would have prevented the expected amount of rainfall collecting in them. Also due to the relatively crude method of taking measurement to the liquid surface and due to some possible movement within the surface that is open to the sky on an exposed site, there may be inaccuracies in the measurements of water surface levels. However, in my opinion, the results certainly show that the changes in levels were of a very small degree.

The presence of some high sided structures within the trays and the fact that these structures could catch driven rain, may explain the overall rise in levels above that which can be otherwise explained by the readings for evaporation and rainfall from the watertight barrel.

The visual assessment of the trays indicates that their integrity is intact and that they are fit for purpose.

4.0 RECOMMENDATIONS AND CONCLUSIONS

The results of the tests show that the structural integrity of all tanks, bunded areas, and Storage trays is adequate. The results of the test show that all the tanks, bunded areas, and Storage trays have passed the water-tightness criteria laid down in the licence terms as outlined in Section 1.0 above. Therefore no further action is needed in this regard.

We would recommend that the wheelwash should be retested in the near future to verify if there is indeed leakage occurring.

5.0 VISUAL INSPECTION OF SURFACE WATER LAGOON

A visual inspection of the surface water lagoon and its embankments was carried out on the 19th November 2008 by Ciaran McGovern (Chartered Engineer) of TOBIN Consulting Engineers.

The surface water lagoon is located in the northeast of the Connaught Regional Residual Landfill site. The lagoon measures 67 metres x 63 metres from anchor trench to anchor trench. It retains water at a maximum depth of 2 metres and has a freeboard of 1.85 metres during normal operation. The construction of the lagoon consists of earth embankments and is lined with 0.5 metres of Bentonite enhanced soil and a 2mm thick HDPE liner. The jeep track surrounding the lagoon is constructed on top of the embankment and consists of a 300mm thick layer of compacted Clause 804 material on a geotextile that continues down the outside of the embankment. The jeep track is 4 metres wide. The lagoon embankment on the southern side is bounded by the landfill access road, on the eastern side by a screening bund, on the north by the engineered wetlands and on the west by an area filled with a peaty material. These areas outside of the lagoon embankments have been filled up against the embankments.

The full perimeter of the lagoon was inspected and the following observations were made.

- There are no signs of damage or failures to the liner visible above water level
- There is no evidence of failure or any movement in the northern, eastern or southern embankments.
- Tension cracking in the Clause 804 material was observed at the top of the western embankment near the north-west cornor of the lagoon

5.1 Conclusions and Recommendations

The tension cracking was examined in detail and it was determined that the cracking is not due to any failure in the embankment but is in fact a failure of the 300mm thick layer of Clause 804.

In my opinion the cause of this is as follows: The fill material on the outside of the embankment was a wet peaty material when it was filled to a level equal to the top of the embankment. This material has settled by approximately 1.5 metres since its construction three years ago. This is most likely due to a) pore pressure dissipation of the material and b) the lowering of the natural groundwater level by pumping.

As the material settled, the geotextile layer below the jeep track was pulled down the outside of the embankment. This lead to the layer of Clause 804 slumping towards the edge of the embankment and failing by means of tension cracks in the material.

In my opinion the integrity of the surface water lagoon and its embankments is intact and that they are fit for the purpose intended.

We would recommend that the jeep track be repaired where the damaged has occurred and that the local lowering of the groundwater table be discontinued to prevent further settlement of the peat.

Signed:

pp

Ciaran McGovern
Chartered Engineer

APPENDIX F

Flare testing (OMI)

Not previously reported in Quarterly submissions

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AIR EMISSION TESTING OF TWO LANDFILL FLARES LOCATED IN EAST GALWAY LANDFILL, KILLAGH MORE, BALLYBAUN (E.D. KILLAAN), BALLINTOBER (E.D. KILLAAN), BALLINASLOE, CO. GALWAY

PREFORMED BY ODOUR MONITORING IRELAND ON BEHALF OF GREENSTAR RECYCLING HOLDINGS LIMITED

PREPARED BY:	Dr. John Casey
ATTENTION:	Mr. Micheal Bergin & Mr. Tom Finnegan
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Project: Air emission testing of two Landfill flares located in East Galway Residual landfill, Killagh More, Ballybaun (E.D. Killaan), Ballintober (E.D. Killaan), Ballinasloe, Co. Galway

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2. Materials and Methods

This section provides brief details of the methodology employed to perform emission testing of the two enclosed landfill flares located in at East Galway Residual Landfill, Killagh More, Ballybaun (E.D. Killaan), Ballintober (E.D. Killaan), Ballinasloe, Co. Galway

2.1 Volumetric flow rate and temperature measurement

The volumetric flow rate of the landfill flare was determined from theoretically calculated total volumetric flow rates using the assumptions presented in *Appendix II*. The inlet landfill gas velocity measurements were calculated from the CEMS monitoring system within the landfill flare control building. In addition, airflow measurement was performed on the inlet header gas main using a pitot tube and differential manometer connected to a Testo 454/350. A magnesium oxide K type and PT100 thermocouple was used for measuring temperature in the landfill flares gas streams.

2.2 In stack analysis

Flue gas analysis was performed using a pre-calibrated Testo 350 MXL/454 flue gas analyser. Concentrations of oxygen, sulphur dioxide, carbon dioxide, temperature, carbon monoxide and oxides of nitrogen were measured using electrochemical cells within the analyser box and all data was logged electronically in 1 minute intervals during the sampling exercise. Data was downloaded from the control handheld using the Com soft software and average concentrations calculated are presented within. All results presented are at 273.15 K, 101.3 kPa on a dry gas basis.

2.3 Total organic carbon (TOC)

Total organic carbon (TOC's) gas concentrations on the landfill flare were determined using a sorbent tube train containing a charcoal/anasorb tubes through indirect sampling. A high temperature-sampling probe was placed within the flare stack and sample air was drawn through a sampling dilution system, heated PTFE sample line and a charcoal tube at a controlled flow rate established using a primary flow calibrator. Sorbent tubes were sealed and transported to a UKAS accredited laboratory for analysis (RPS Analytical laboratory, Manchester, UK).

3. Results-Emission testing

This section will present the results of the monitoring exercise.

3.1 Sampling time

Table 3.1 summarises the sampling times for stack monitoring. *Table 3.2* illustrates the inlet landfill gas parameters as characterised from the CEMS analyser system operating within the landfill flare control panel. In addition, manual monitoring was performed using a GA2000 landfill gas analyser.

All outlet gas samples were taken approximately 1.80 metres below the top of the stack for the landfill flares. All sampling was performed through the existing 25mm sampling ports on the landfill flares. A one-plane oxygen and temperature traverse was performed to assess any difference in oxygen concentrations and temperature across the sampling plane. Temperature and Oxygen differences were less than the 15% deviation level as recommended by the UK Environmental Agency (Guidance for monitoring enclosed Landfill flares, 2002).

3.2 Volumetric flow rate

Table 3.3 summarises the theoretical airflow rate calculations for the Landfill gas flare.

3.3 Flue gas concentrations

Flue gas concentrations were monitored using a pre-calibrated Testo 350/454 MXL flue gas analyser. The results of SO_2, NO_x as NO_2 + NO, CO, and O_2 are presented in *Tables 3.4 and 3.5.* The results of ppm have been converted to mg Nm^{-3} at 273.15 K, 101.3 kPa, on a dry gas basis with correction for oxygen content. In accordance with EPA flare/gas utilisation engine monitoring requirements, Oxygen correction to 3% should be performed for landfill gas flares. The average temperature of the gas analyser on the day of sampling was 284.15 K.

3.4 Total Organic Carbon (TOC)

TOC concentrations were monitored using a sampling train containing a charcoal/anasorb tube and analysed via GCFID. The results of total TOC's are presented in *Table 3.4 and Table 3.5.* The results are expressed in mg Nm^{-3} at the reference standard conditions of 273.15 K, 101.3 kPa, with correction for oxygen content (3% (v/v).

3.5 Hydrogen chloride (HCL) and Hydrogen fluoride (HF)

Hydrogen chloride and hydrogen fluoride concentrations were monitored using an impinger train containing 0.1 molar sodium hydroxide and deionised water solution, in which such gases are readily soluble. The results of hydrogen chloride and hydrogen fluoride are presented in *Tables 3.4 and 3.5.* The results of mg m^{-3} have been converted to mg Nm^{-3} at 273.15 K, 101.3 kPa, with correction for oxygen content. In accordance with EPA flare/gas utilisation engine monitoring requirements, Oxygen correction to 3% should be performed for landfill gas flares.

3.6 Total methane concentration

Total Methane concentrations were monitored using a pre-calibrated Signal 3030 PM analyser connected to a total non methane hydrogen cutter. The results of total methane concentrations are presented in *Tables 3.4 to 3.5.* The results of ppm have been converted to mg Nm^{-3} at 273.15 K, 101.3 kPa, with correction for oxygen content. Conversion from ppm to

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

Landfill Flare No. 1	Conc.	Units[2]	Adjusted units (mg/m^3)	Theoretical Volumetric flow rate (m^3/hr)	Normalised Volumetric flow rate (m^3N/hr)	Vol. flow rate (Nm^3/s)	Normalised Emission concentration (mgN/m^3)	Oxygen corrected emission concentration to 3% (mgN/m^3)	Mass emission rate (Kg N/hr) at 3% O_2	Emission limit Values
Total Organic Carbon	<2	mg/m^3	3.2	5,235	1,078	0.30	<4.37	<6.99	<0.008	10 mg Nm^{-3}
Average Hydrogen chloride	<2.55	mg/m^3	2.55	5,235	1,078	0.30	<3.48	<5.57	<0.006	50 mg Nm^{-3} (at mass flows >0.3 kg/hr)
Average Hydrogen fluoride	<0.55	mg/m^3	0.55	5,235	1,078	0.30	<0.75	<1.20	<0.0013	5 mg Nm^{-3} (at mass flows >0.05 kg/hr)
Temperature	1053	degrees	1326.15 K	5,235	1,078	0.30	--	--	--	--
CO	3.0	ppm	3.75	5,235	1,078	0.30	3.75	6.00	0.006	50 mg Nm-3
O_2	9.71	%	9.71	5,235	1,078	0.30	-	--	--	--
Total NOx [as NO_2]	20	ppm	41.07	5,235	1,078	0.30	41.07	65.70	0.071	150 mg Nm^{-3}
SO_2	320	ppm	914.28	5,235	1,078	0.30	914.29	1462.53	1.577	--
CO_2	8.91	%	8.91	5,235	1,078	0.30	--	--	--	--
Total Methane Concentration	36	ppm	57.60	5,235	1,078	0.30	95.53	152.81	0.165	-

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

4. Discussion of results

Tables 3.1 to *3.5* present the results of the emission monitoring carried out on the two landfill flares located in East Galway Residual Landfill.

A high temperature Inconel 625 and ceramic probe (Testo, Germany) was used to prevent variations in CO emissions data.

Correction of data to 3% oxygen was performed. Due to possible inaccuracies in airflow rate measurement, it was not possible to determine the oxygen intake of the flare through the louver system using measurement. Since the volume of intake air required for complete combustion was known and the oxygen concentration in the exhaust flue gas was known, the volume of intake excess fuel air could be theoretically calculated through numerous iterations using the Solver program (i.e. Microsoft Excel). This allows for the calculation of the volume of intake excess air through the louver landfill flare intake system. These calculations were validated through use of the published Environment Agency equation (see *Eqn 8.3.1*) (Environment Agency, 2002).

Landfill methane destruction efficiency was not calculated using the flue gas analyser as this would lead to the presentation of erroneous results. Since the combustion of methane is for the most part $CH_4 + 2O_2 = CO2 + 2H_2O$, every mole of oxygen used in combustion can be assumed to generate a mole of water. The overall oxygen content of the intake (landfill gas + air mixture) and the oxygen content of the emissions must be known to calculate the difference between the two to calculate the increase in moisture content. However, this would be required to be added to the amount of moisture already in the landfill gas/air intake to get the total moisture content of emissions. This would lead to in-depth analysis of moisture content, which would b difficult. Using the flue gas analyser, the ratio of CO_2 to CO does not tell you the methane destruction efficiency, only how much of the methane that is destroyed and is converted to CO (a relatively small amount as per *Table 3.4 and 3.5*) and CO_2. The only other method is to measure inlet methane and outlet methane concentration and based on this fact; calculate the destruction removal efficiency (DRE) of the landfill flare (McVay, M., per comm., 2003). Using the inlet methane loading concentration in *Table 3.2*, and the outlet total methane exhaust concentration in *Tables 3.4 and 3.5*, it is suggested that the two landfill flares are achieving a methane destruction efficiency of 99.99% and 99.98%, respectively. The complete combustion of methane results in the formation of CO_2 and H_2O. The incomplete combustion of methane results in the formation of CO. CO concentration levels were low in the flue gas of the landfill flares.

7. Appendix 1-Sampling, analysis and calculation details

7.1.1 Location of Sampling

East Galway Residual landfill, Killagh More, Ballybaun (E.D. Killaan), Ballintober (E.D. Killaan), Ballinasloe, Co. Galway

7.1.2 Date & Time of Sampling

21st January 2008

7.1.3 Personnel Present During Sampling

Dr. John Casey, Odour Monitoring Ireland, Trim, Co. Meath.
Dr. Brian Sheridan, Odour Monitoring Ireland, Trim, Co. Meath.

7.1.4 Instrumentation

Testo 350 MXL/454 in stack analyser;
Federal Method 2 S type pitot and MGO coated thermocouple;
L type pitot tube
Testo 400 handheld and appropriate probes.
Ceramic and Inconel 625 sampling probes.
SKC pump and BIOS primary flow calibrator
Signal 3030PM Hydrocarbon analyser and Signal methane cutter and associated heated lines.

8.2 Additional calculations and correction of Oxygen concentration measured to reference Oxygen concentration of 3% (v/v) for 41.07 mg N m^{-3} of NO_X as NO_2 for Landfill flare.

If excess air is added to an enclosed landfill flare (i.e. to promote better combustion), measured flue gas emission concentration of non-combustion species will fall. Emission concentrations appear to be reducing, whilst in reality mass emission rates have remained constant (Environment Agency, 2002). Therefore, it is necessary to compare concentrations at a standard oxygen concentration.

The relationship between the measured oxygen concentration and measured emission species concentration is non-linear as oxygen from air is added or removed. For example, a halving of the flue gas oxygen content does not result in a doubling of the emission concentration. The oxygen concentration in the flue gases is a measure of the excess air over that required for theoretical complete combustion (i.e. stiochiometric air requirement). Therefore, the measured oxygen level is a measure of the dilution of the flue gases from the stoichiometric condition. The concentration of oxygen in dry air is 20.9% (v/v) and the proportion of excess air (X/V) can therefore be calculated from the following:

$$\frac{X}{V} = \frac{(O_2)_m}{(20.9 - (O_2)_m)} \quad \textbf{(Eqn 8.3.1)}$$

Where: X is the volume of excess air (m^3);
V is the stoichiometric volume of the flue gas (m^3);
$(O_2)_m$ is the percentage of oxygen (v/v) in the flue gas (on a dry basis).

If we know and calculate the following:

The volume of landfill gas was 618 m^3 hr^{-1} with a methane and oxygen concentration of 36 % (v/v) and 5.30 %(v/v) as taken from the landfill gas analyser.

This equates to a methane and oxygen volume of 222.48 m^3 hr^{-1} and 32.75 m^3 hr^{-1}, respectively.

The stiochiometric ratio of oxygen to methane for combustion is **2:1** as shown below:

$$\mathbf{1}CH_4 + \mathbf{2}O_2 + 7.52\ N_2 \longrightarrow CO_2 + 2H_2O + 7.52\ N_2 + \text{Heat} + \text{Light}$$

Ambient air contains 20.9% (v/v) oxygen, therefore stiochiometric volume ratio of air required for complete combustion of methane is **9.97 times** methane volume.

Since the volume of oxygen in inlet landfill gas and stiochiometric ratio required is known, the total amount of intake air required for complete combustion is:

$$(222.48\ m^3\ h^{-1} \times 9.97) - 32.75\ m^3\ hr^{-1} = \mathbf{2{,}185.37\ m^3\ hr^{-1}}.\ \textbf{(Eqn 8.3.2)}$$

Therefore the total volume of flue gases exhausted through stack assuming total combustion and 0% (v/v) oxygen in flue gas is:

Volume of landfill gas + Volume of Inlet air = Total Volume of flue gas

$$618\ m^3\ hr^{-1} + 2{,}185.37\ m^3\ hr^{-1} = \mathbf{2{,}803.37\ m^3\ hr^{-1}}\ \textbf{(Eqn 8.3.3)}$$

In reality excess inlet air is taken into the landfill flare gas burner to ensure complete combustion.

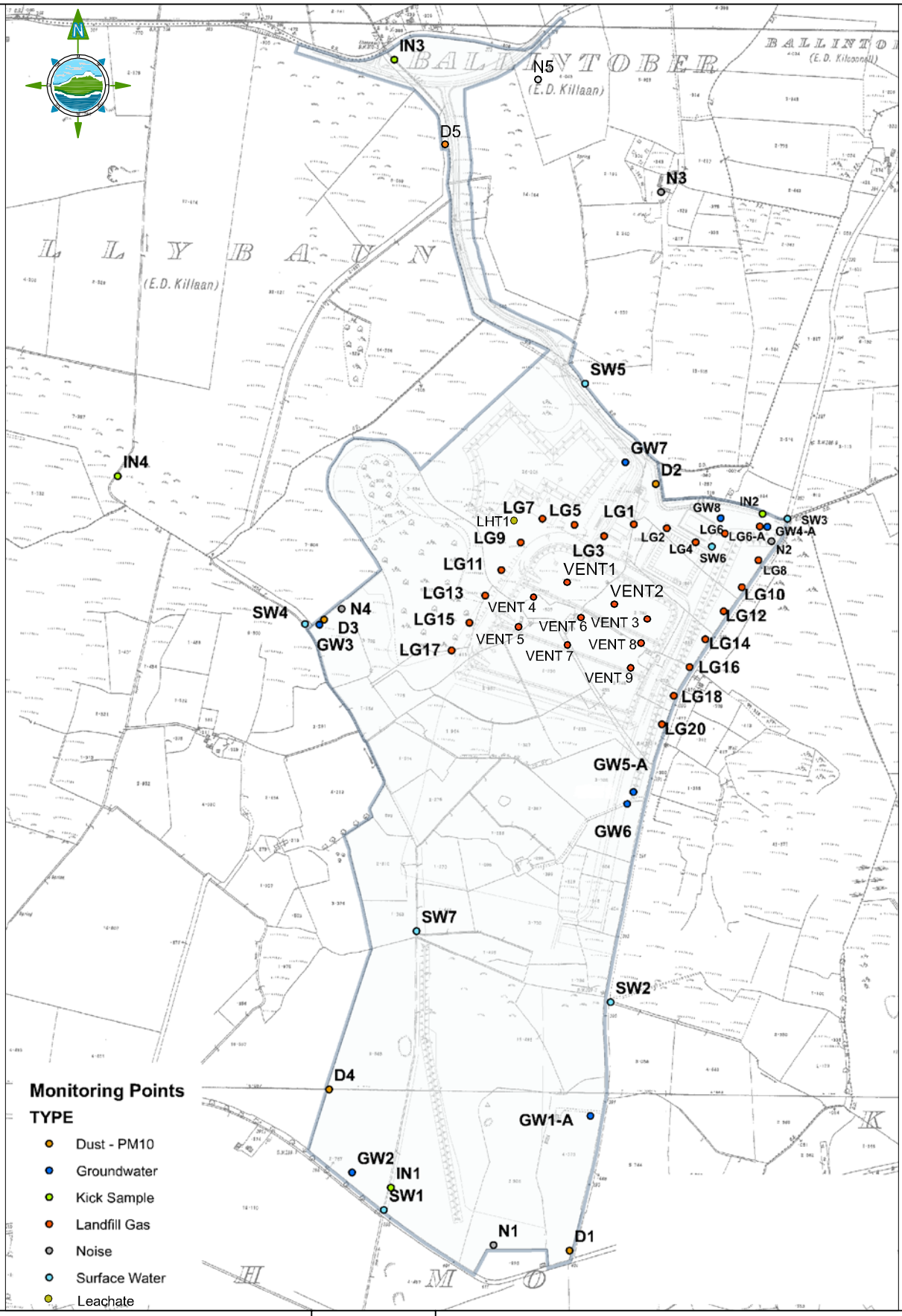
The measured oxygen concentration within the flue gas of the landfill flare 1 in East Galway Landfill was 9.71% (v/v) dry gas basis.

For a NO_2 concentration of 41.07 mg Nm^{-3} then the oxygen corrected value (3% (v/v)) would be as follows:

$$C_r = 41.07 \times 1.59$$ **= 65.69 mg m^{-3} at referenced to 3% oxygen (v/v) dry gas.**

APPENDIX G

Site Layout Drawing



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Project: ENVIRONMENTAL MONITORING AT CONNAUGHT RESIDUAL WASTE LANDFILL	Checked: Morgan Burke Date: 30-03-06	
Title: LANDFILL ENVIRONMENTAL MONITORING LOCATIONS	Project Director: Morgan Burke Scale: N.T.S	Drawing No. 1322/01/101

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