



## **GREENSTAR LTD - KNOCKHARLEY LANDFILL, CO. MEATH**

### **ANNUAL ENVIRONMENTAL REPORT:**

**Report Period: January 2010 – December 2010**

**WASTE LICENCE REF. NO. W0146-02**

**Original  
March 2011**







ENVIRONMENTAL BALANCE IN DESIGN AND CONSTRUCTION

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
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**Abstract:** This report details the Annual Environmental Report for the Knockharley Landfill, Co. Meath for the reporting period from 1<sup>st</sup> January 2010 to 31<sup>st</sup> December 2010. This report was prepared in order to fully comply with the requirements of the EPA Waste Licence Reg. No. W0146-02.



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# Section 1

## Introduction





## 1. INTRODUCTION

The Environmental Protection Agency (EPA) issued Greenstar with Waste Licence Reg. No. W0146-01 for a landfill at Knockharley, Navan, Co. Meath on 19<sup>th</sup> of March, 2003. A revision of the licence, W0146-02 was issued by the EPA on 23<sup>rd</sup> of March 2010.

The facility has been in operation since 2004 and is being developed on a phased basis and the most recent cells, Cell 11 and Cell 12 were constructed during 2009. Waste placement in these Cells did not occur during 2010.

Greenstar retained Fehily Timoney & Company (FTC) to prepare the Annual Environmental Report (AER) for the facility for the reporting period January 2010 to December 2010. This report has been prepared in accordance with Condition 11.7 and Schedule E & F of the waste licence.

The site is located in a rural area, approximately 1.5 km north of Kentstown Village and 7 km south of Slane, just off the N2 (Dublin to Derry Road). The licensed area encompasses 135.2 ha. The landfill footprint, where waste is deposited in engineered landfill cells, is located in the centre of the site and will eventually occupy an area of approximately 25 ha. A buffer of 100 m is maintained between the active landfill footprint and the site boundary.

A site location map is provided in Appendix I.

This report addresses Condition 11.11 of the waste licence for the facility.

Condition 11.7 states that:

### *1 1.7 Annual Environmental Report*

*11.7.1 The licensee shall submit to the Agency for its agreement by 31st March of each year an Annual Environmental Report (AER) covering the previous calendar year.*

*11.7.2 The AER shall include as a minimum the information specified in Schedule F: Content of Annual Environmental Report of this licence and shall be prepared in accordance with any relevant written guidance issued by the Agency.*

This report addresses the items listed in *Schedule G: Content of Annual Environmental Report* of the waste licence for the facility. This AER covers the reporting period from 1<sup>st</sup> January 2010 up to 31<sup>st</sup> December 2010.

### **1.1. Statement of compliance of facility with any updates of the relevant waste Management Plan**

Compliance is considered during the planning and licensing processes and on that basis the facility is compliant.

### **1.2. Statement on the achievement of the waste acceptance and treatment obligations**

In compliance with licence Condition 5.3 and in line with the facility's Environmental Management System (EMS) all waste accepted at this facility is in accordance with comprehensive waste acceptance procedures. Following a review of the facility licence in 2010, revised and updated Waste Acceptance Procedures (KNKP 24, KNKP 24B, KNKP 25) were submitted to the Agency on 1st October 2010.

In compliance with Condition 1.6 only waste that has been subject to treatment is accepted for disposal at the facility. Furthermore, this facility submits quarterly summary reports to the Agency on the quantity of MSW and BMW accepted at the landfill during the preceding quarter and on a cumulative basis for the calendar year.

### 1.3. Reporting Period

The reporting period for the AER is 1<sup>st</sup> January to 31<sup>st</sup> December 2010.

# Section 2

## Waste Activities & Records







## 2. WASTE ACTIVITIES & RECORDS

### 2.1. Waste Activities Carried out at the Facility

Knockharley Landfill is a fully engineered and contained landfill site. It is licensed to accept 175,000 tonnes per annum of waste, as follows:

**Table 2.1: Waste Acceptance Categories and Quantities**

Waste Type	Maximum (Tonnes per Annum)
Household	100,000
Commercial	45,000
Industrial	30,000
<b>Subtotal Total</b>	<b>175,000</b>
Construction & Demolition for recovery at the facility	25,000
<b>TOTAL</b>	<b>200,000</b>

Waste activities at the facility are restricted to those outlined in *Part 1 - Activities Licensed* of the Waste Licence.

#### Licensed waste disposal activities, in accordance with the Third Schedule of the Waste Management Acts 1996 to 2008

- Class 1**      **Deposit on, in or under land (including landfill)**  
This 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**      **Specially engineered landfill, including placement into lined discrete 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 of 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 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 was 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.

#### Licensed waste recovery activities, in accordance with the Fourth Schedule of the Waste Management Acts 1996 to 2008

- 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 9**      **Use of any waste principally as a fuel or other means to generate energy:**  
This activity is limited to the utilisation of landfill gas

**Class 11 Use of waste obtained from any activity referred to in a preceding paragraph of this 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.

## 2.2. Waste Quantities and Composition 2005 - 2010

The quantities and types of wastes accepted for disposal and recovery at Knockharley Landfill are presented in Table 2.1 for the years 2004, 2005, 2006, 2007, 2008, 2009 and 2010.

Table 2.2: Waste Quantities Accepted at Knockharley Landfill from 2004 – 2010

Waste Type – European Waste Code Categories	Description	Total Accepted 2004 (tonnes)	Total Accepted 2005 (tonnes)	Total Accepted 2006 (tonnes)	Total Accepted 2007 (tonnes)	Total Accepted 2008 (tonnes)	Total Accepted 2009 (tonnes)	Total Accepted 2010 (tonnes)
Waste for disposal								
EWC 02 02 03	Wastes from the preparation and processing of meat, fish and other foods of animal origin - materials unsuitable for consumption or processing	-	7					
EWC 02 06 01	Confectionary waste							17.08
EWC 06 05 03	Effluent Sludge (Non Hazardous)					52.42		
EWC 08 03 15	Ink sludges other than those mentioned in 08 03 14					147.38		113.9
EWC 10 03 05	Waste Alumina					10.48		
EWC 11 01 10	Industrial Filter Cake (Non Hazardous)					537.38		331.78
EWC 12 01 17	Paint Stripping Waste (Non Hazardous)					110.78		104.92
EWC 16 03 04	Stabilised Inorganic Filter Cake					735.98		
EWC 17 06 04	Insulation Materials					1.7		
EWC 17 09 04	Mixed Construction and Demolition Waste							154.62
EWC 18 02 03	Wastes from human or animal health care and/or related research	-	0.22					
EWC 19 02 03	Physio/Chemical Treated Waste					315.84		589.32
EWC 19 03 05	Stabilised Inorganic Filter Cake					48.28		7.6
EWC 19 08 99	Bio Plant Residual Solids							2.7
EWC 19 09 02	Filter cake from water treatment					17.24		
EWC 19 09 05	Filter cake from water treatment					39.88		
EWC 19 12 12	Residual municipal and commercial waste	-	98,125.18	-	92,009.82	101,380.76	92,304.54	75,116.59
EWC 19 13 02	Solid wastes from soil remediation	-	-	-	-	9,107.30		
EWC 20 01 01	Paper and Cardboard							38.02
EWC 20 01 39	Plastics							16.38
EWC 20 01 99	Other MSW not specified	-	-	-	27.5	-		
EWC 20 03 01	Mixed Municipal Waste	909.54	37,988.84	133,119.48	44,144.59	23,126.38	12,576.38	26,635.48
EWC 20 03 03	Street cleaning waste						69.46	99.84
EWC 20 03 07	Municipal Bulky Waste	-	-	-	-	144.44	27,105.50	32,700.70

## Section 2

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Knockharley Landfill  
Annual Environmental Report: 2010

<b>Total waste for disposal</b>		<b>909.54</b>	<b>136,121.24</b>	<b>133,119.48</b>	<b>136,181.91</b>	<b>133,758.88</b>	<b>134,073.24</b>	<b>135,928.93</b>
<i>Waste for recovery</i>								
EWC 11 01 10	Sludges and filter cakes				103.96	230.30		
EWC 16 03 04	Inorganic wastes					388.28		
EWC 17 01 01	Concrete					106.84		
EWC 17 05 04	Soil and Stone			26,622.46	22,314.04	17,800.62		2,930.56
EWC 17 09 04	Mixed Construction and Demolition wastes		768.88		2,743.12	1,814.24	514.76	
EWC 19 05 03	Off specification compost		120.22	2,754.10	2,990.30	6,785.90	39,155.02	25,336.42
EWC 19 09 02	Sludges from water clarification					8.12		
EWC 19 12 02	Ferrous metal				176.06			
EWC 19 12 07	Woodchip	112.94	7,358.34	7,397.28	9,534.76	6,183.50	5,382.86	5,149.60
EWC 19 12 09	Minerals	371.24	25,434.80	22,924.03	24,926.73	16,821.46	23,292.02	28,749.24
EWC 19 12 12	Other waste from the mechanical treatment of waste					9,953.64		
EWC 20 01 38	Woodchip						38.70	
<b>Total Waste for Recovery</b>		<b>484.18</b>	<b>33,682.24</b>	<b>59,697.87</b>	<b>62,788.97</b>	<b>60,092.90</b>	<b>68,383.36</b>	<b>62,165.82</b>

**Table 2.3: Waste Quantities Consigned from Knockharley Landfill, 2010**

European Waste Code Categories	Description	Tonnes	Destination
EWC 19 07 03	Leachate	29,672.16	Navan WWTP
<i>Total waste consigned</i>		29,672.16	

### 2.3. Calculated Remaining Capacity of the Facility

The most recent topographic survey for the landfill cell footprint is included in Appendix I. The total capacity of the facility is estimated to be 3,282,500 m<sup>3</sup>. It is estimated that approximately 1,191,000 m<sup>3</sup> of void space has been used to December 2010. The remaining capacity is approximately 2,091,500 m<sup>3</sup>.

### 2.4. Methods of Deposition of Waste

The waste accepted for disposal is residual waste predominantly from the Northeast region, from household, commercial and industrial sources.

Waste is delivered to Knockharley Landfill facility in heavy goods vehicles (HGVs) with the appropriate covers in place to prevent any loss of load. Each HGV passes over the incoming weighbridge prior to proceeding to the active waste disposal area and the weight of the vehicle plus load is recorded. The weighbridge operator and/or facility manager may, at their discretion, request that 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. The vehicles weigh out at the outgoing weighbridge and receive an individual weighbridge docket before exiting the site.

Waste is deposited directly on a surface of waste close to and above the advancing tipping face. In accordance with Condition 5.6.1 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. Waste is covered daily with recovered inert materials which have been approved by the Agency. Fabric cover systems are also utilised as appropriate.

The site operatives inspect the deposited waste for items that are not acceptable under the Waste Licence, such as tyres, gas bottles, batteries etc. These are removed and stored in appropriate areas for later removal from the site.

Each day's waste input is deposited to form a 'block', which is compacted and covered. The following day a new 'block' of waste is deposited adjacent to this block. This ordered method of waste deposition enables areas, which have been filled and are to be left for a period, to be progressively restored over the site life, minimising the areas of active waste deposition.



# Section 3

## Report on Environmental Emissions







### 3. REPORT ON ENVIRONMENTAL EMISSIONS

This section of the AER has been compiled in accordance with emission limit values (ELVs) for the following media as detailed in Condition 6 and Schedule C of the waste licence for the facility.

#### 3.1. Dust Deposition Limits

Dust deposition emission limit values (ELV) are stipulated in Schedule C.3 of the waste licence, as presented in Table 3.1.

**Table 3.1: Dust Deposition Emission Limit Value**

Level (mg/m <sup>2</sup> /day)
350

Dust monitoring was conducted at eight locations on a monthly basis during the 2010 reporting period. Monitoring of dust was carried out at the locations shown on Figure 2.1, in Appendix I. Oldcastle Laboratories Ltd. carried out the analysis of the dust deposition results from the facility, with Southern Scientific Services Ltd. carrying out the analysis of dust results during October. The certificates of analysis were included in the quarterly reports issued to the Agency.

Dust monitoring showed dust deposition at the facility was recorded below the ELV on all monitoring occasions during the reporting period.

Bird litter contamination of samples February, D5 and D8; April D2; July D7; August D3 and D5 and December D7 were recorded.

#### 3.2. Noise Emissions

Noise limits are stipulated in Schedule C.1 of the waste licence, as presented in Table 3.2.

**Table 3.2: Noise Limits**

Day dB L <sub>Aeq</sub> (30 minutes)	Night dB L <sub>Aeq</sub> (15 minutes)
55	45

Noise monitoring was conducted at four locations on a quarterly basis during the 2010 reporting period undertaken at the four locations outlined in Figure 2.1, Appendix I. The results were issued to the Agency as part of the quarterly reports.

The measured noise levels, as represented by the L<sub>Aeq</sub> over a 30-minute period, were breached on one single occasion during the reporting period. During monitoring for Quarter 3, in August a L<sub>Ar</sub> (the equivalent continuous A-weighted sound pressure level (L<sub>A0</sub>) with specified adjustments/ rating allowance for tonal character and/or impulsiveness of the sound) was 59 dB at N2. N2 traffic movements and the motorbike, both off-site noise sources, contributed to the dominant noise at the monitoring location. The actual L<sub>Aeq</sub> of 54 dB was under the noise limit, but the identification of a tonal element resulted in a L<sub>Ar</sub> of 59 dB.

The noise environment was noted to be quiet and no tonal or impulsive noises were noticeable or audible based on a subjective assessment by the observer while monitoring.

Following monitoring, all measurements were subject to a one-third octave band analysis to identify potential tonal components. On occasions where tones are identified in the 1/3 octave analysis, a 5 dB penalty is applied to the  $L_{Aeq}$  as per the 'Guidance Note for Noise In Relation To Scheduled Activities, 2nd Edition', (2006).

On assessment, tonal elements were identified at N3 during Quarter 2 and at N2 an N3 during Quarter 3.

### 3.3. Landfill Gas Concentrations (in any buildings on/adjacent to the facility)

Landfill gas ELVs are stipulated in Schedule D, Table 1.1, Table 1.2 and Condition 6.3.1 of the waste licence, as presented in Table 3.3.

**Table 3.3: Landfill Gas Trigger levels**

Methane	Carbon Dioxide
1.0 % LEL (1% v/v)	1.5% v/v

#### 3.3.1. Landfill gas monitoring wells

Monthly monitoring of landfill gas (LFG) levels is carried out in the perimeter gas boreholes and in the in-waste gas boreholes, in accordance with Schedule D.2 of the waste licence. The wells are at 50m intervals around the landfill footprint and two per cell. Monitoring of landfill gas parameters was carried out at the locations indicated on Figure 2.1, Appendix I.

Measured methane concentrations were recorded above the emission limit value at 1 no. well during Quarter 1 (LG-03). Levels were not above the emission limit in any well during the reporting period.

Elevated carbon dioxide concentrations were recorded during the reporting period. The levels of carbon dioxide exceeded the emission limit:-

- ◆ in 20 no. wells during Quarter 1 (LG-01, LG-02, LG-03, LG-04, LG-05, LG-06, LG-07, LG-08, LG-09, LG-15, LG-16, LG-20, LG-21, LG-23, LG-24, LG-25, LG-50, LG-51, LG-52, LG-53)
- ◆ 5, LG6, LG6-A, LG8, LG12, LG15, LG16, LG18 and LG20),
- ◆ in 14 no. wells in Quarter 2 (LG-01, LG-02, LG-03, LG-04, LG-06, LG-15, LG-16, LG-20, LG-23, LG-50, LG-51, LG-52, LG-53 and LG-54.
- ◆ In 14 no. wells during Quarter 3 (LG-01, LG-02, LG-03, LG-04, LG-06, LG-15, LG-16, LG-20, LG-22, LG-23, LG-25, LG-50, LG-52 and LG-53)
- ◆ In 14 no. wells during Quarter 4 (LG-01, LG-02, LG-03, LG-04, LG-05, LG-06, LG-12, LG-15, LG-16, LG-18, LG-25, LG-50, LG-52 and LG-53)

Since monitoring began in 2004, high concentrations of naturally occurring carbon dioxide have been detected in the *in-situ* subsoils and these were confirmed in 2010. Studies have shown high concentrations of carbon dioxide can occur naturally at shallow depths of up to 2 metres due to microbiological activity associated with the roots of many types of vegetation, providing concentrations of up to 7% by volume in certain soils such as the silty clays which underlie the site.

### 3.4. Surface Water Discharge Limits (measured at SW9)

Surface water monitoring was carried out at 8 no. monitoring locations in accordance with Schedule D of the licence and these are shown on the Figure 2.1 in Appendix I.

Surface water discharge emission limit values at monitoring location SW9 are stipulated in Schedule C.4 of the waste licence, as follows:

**Table 3.4: Surface water discharge Emission Limit Values**

Level (Suspended Solids mg/l)
35

Suspended solids concentrations were under the limit of 35 mg/l specified for SW9 in the waste licence during the reporting period.



# Section 4

## Summary of Environmental Results





## 4. SUMMARY ENVIRONMENTAL RESULTS

Environmental monitoring was carried out at the facility throughout the reporting period in accordance with Schedule D of the waste licence. All monitoring results were presented to the Agency in the quarterly reports and a summary of the monitoring results is presented below. The locations of all monitoring points are illustrated in Figure 2.1, Appendix I.

### 4.1. Biological Assessment

#### 4.1.1. Macroinvertebrate Survey

Biological monitoring of surface water quality was undertaken in accordance with Schedule D of the waste licence on the 23<sup>rd</sup> March 2010 at four locations, IN1 – IN4. These monitoring locations are shown on Figure 2.1.

#### 4.1.2. Methodology

Samples were taken according to standard EPA methodology for kick-sampling (EPA, 2002<sup>1</sup>; EPA, 2005)<sup>2</sup>. Four kick samples were taken from two watercourses – the Knockharley Stream and the River Nanny. The kick samples were taken in the most suitable gravel-stone substrate present and in a riffle area where it was available. Samples were taken using a kick-sample net with a 1 mm mesh for duration of 2 minute.

The samples were preserved in the field with 70% alcohol and transferred to the laboratory where they were identified and analysed by an FTC ecologist. The appropriate values were assigned using the EPA scheme of Biotic Indices or Quality (Q) Values and their relationship to water quality (EPA, 2005), as set out in Tables 4.1 and 4.2.

**Table 4.1: The Biological River Quality Classification System (Q Values)**

Q VALUE	COMMUNITY DIVERSITY	WATER QUALITY	CONDITION
Q1	Very low	Bad	Unsatisfactory
Q2	Low	Poor	Unsatisfactory
Q3	Much reduced	Doubtful	Unsatisfactory
Q4	Reduced	Fair	Satisfactory
Q5	High	Good	Satisfactory

**Table 4.2: Relationship between Q Values & Water Quality**

BIOTIC INDEX	QUALITY CLASS
Q5, Q4-5, Q4	Class A
Q3-4	Class B
Q3, Q2-3	Class C
Q2, Q1-2, Q1	Class D

<sup>1</sup> EPA. (2002). Water Quality in Ireland 1998-2000. Appendix 1. PO Box 3000, Johnston Castle Estate, Co. Wexford.

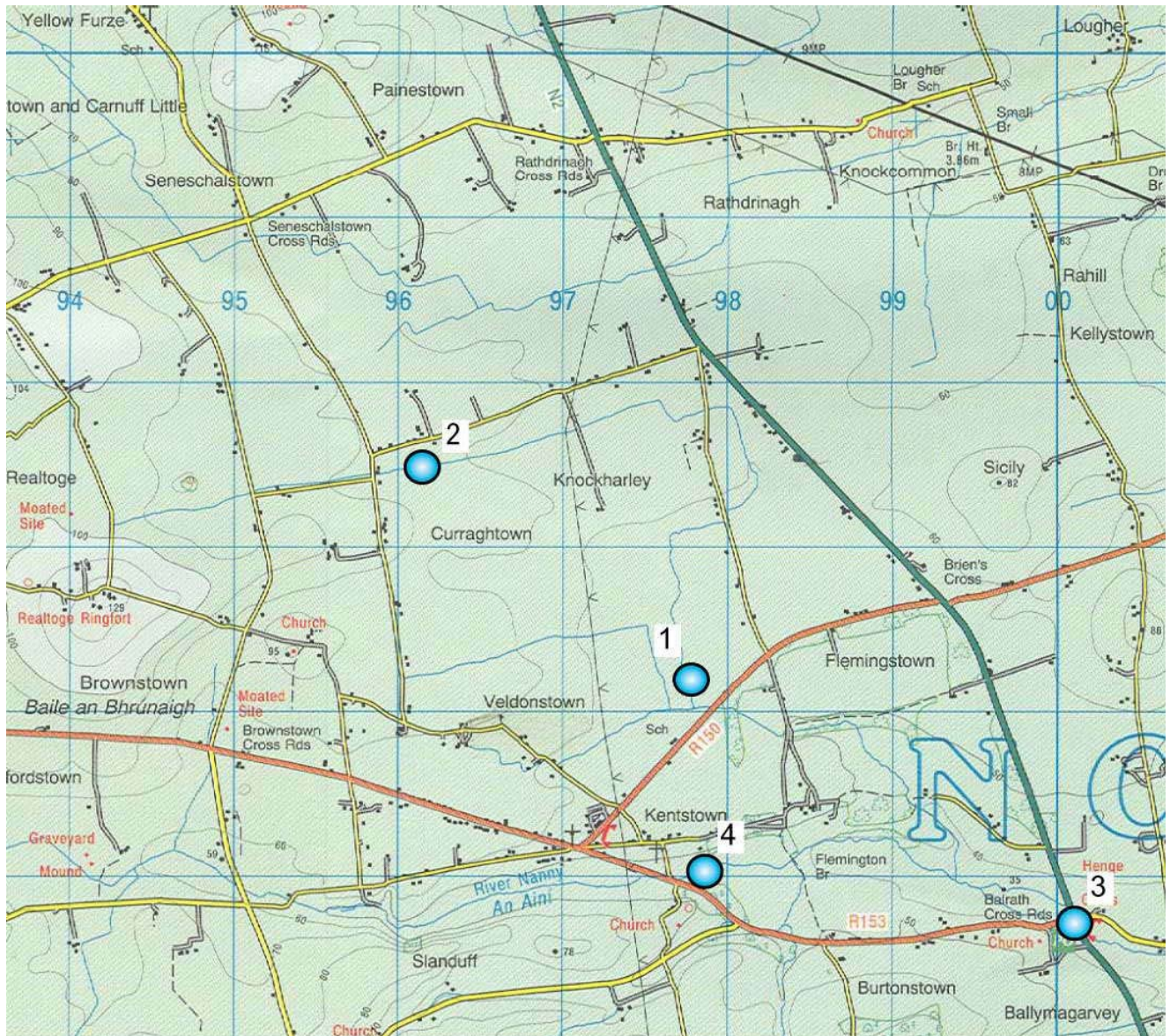
<sup>2</sup> EPA. (2005). Water Quality in Ireland 2001-2003. Appendix 1. PO Box 3000, Johnston Castle Estate, Co. Wexford.

4.1.3. Monitoring Location Descriptions

Biological monitoring of surface water quality by an assessment of the macroinvertebrate community present was undertaken in accordance with Schedule D of the waste licence on the 17<sup>th</sup> September 2010 at four locations, Site 1 – 4. The monitoring locations are resented in Figure 4.1 and Table 4.2.

**Table 4.3: Summary of Macroinvertebrate Survey Locations**

Sample	Location
Site 1	Less than 1 km downstream receptor site on the Knockharley stream
Site 2	Upstream control site on the Knockharley stream
Site 3	Downstream receptor site (corresponds with the EPA site 08/N/01/ 200) on the River Nanny
Site 4	Upstream control site (Corresponds with EPA site 08/N/01/0110) on the River Nanny



**Figure 4.1: Biological monitoring locations at Knockharley - 2010**



*Site 1 - Knockharley Stream*

This site is located less than 1 km downstream of Knockharley Landfill on the Knockharley stream. The monitoring location is approximately 1 – 1.5 m wide at the sample location and approximately 0.1 m deep. A low flow was recorded at the time of monitoring. The substrate was observed to be stony, with silt present. The location is very overshadowed, with trees and shrubbery. The water was clear with no detectable odour.

*Site 2 – Knockharley Stream*

This site is located upstream of Knockharley Landfill on the Knockharley stream. The monitoring location was approximately 0.5 m in width and approximately 0.05 – 0.1 m in depth. A low flow with slight riffles was recorded at the time of monitoring. The substrate was observed to be gravelly and covered in mud and silt. The banks were covered with vegetation and trees overhanging the stream. The water was clear with no detectable odour.

*Site 3 – River Nanny*

This site is located downstream of Knockharley Landfill on the River Nanny. The monitoring location was approximately 2.5 – 3.0 m in width and up to 0.5 m in depth. The kick sample was taken at a location that was only 0.2 m in depth. The substrate was observed to be stony and gravelly with some silt. Trees and vegetation was observed to be on the banks. The water was clear with no detectable odour.

*Site 4 – River Nanny*

This site is located upstream of Knockharley landfill on the River Nanny. The monitoring location is approximately 1 – 1.5 m in width and approximately 0.4 m in depth. Low flow was observed at the time of sampling. The substrate was observed to be rocky and muddy. Vegetation on banks, including trees were shading the monitoring location. A small fish was sampled at the site and released back into the water.

4.1.4. Results

A summary of the results from the survey is presented in the table below.

**Table 4.4: Summary of Macroinvertebrate Survey Results 2010**

Sample	Water Quality	Quality Status	Q Index
1	Poor	Seriously Polluted	Q2
2	Doubtful	Moderately polluted	Q3
3	Doubtful	Moderately polluted	Q3
4	Doubtful	Moderately polluted	Q3

**Table 4.5: Abundance of each faunal group present in each sample.**

Sample	A – sensitive	B – less sensitive	C – tolerant	D – very tolerant	E – most tolerant	Total	Q Index
1	0	0	24	197	0	221	Q2
2	0	1	14	4	0	19	Q3
3	0	1	48	13	18	80	Q3
4	0	3	68	37	2	110	Q3

**Table 4.6: Percentage of each faunal group present in each sample**

Sample	A – sensitive	B – less sensitive	C – tolerant	D – very tolerant	E – most tolerant	Q Index
1	0	0	11	89	0	Q2
2	0	5	74	21	0	Q3
3	0	1	60	16	23	Q3
4	0	3	62	34	2	Q3

**Table 4.7: Taxa present in each sample**

Macro-invertebrate taxa	Group	Tolerance	Sample			
			1	2	3	4
Ecdyonuriidae/Heptageniidae	A	Sensitive				
Perlidae	A	Sensitive				
Baetidae (excl. B. rhodani)	B	Less sensitive		1		3
Ephemeraeidae	B	Less sensitive			1	
Leuctridae	B	Less sensitive				
Nemouridae	B	Less sensitive				
Cased Trichoptera	B	Less sensitive				
Beatis rhodani	C	Tolerant				
Gammarus	C	Tolerant	22	11	44	68
Coleoptera	C	Tolerant		1		
Uncased Trichoptera	C	Tolerant				
Uncased Trichoptera - Psychomyiidae	C	Tolerant				
Uncased Tricoptera - Rhyacophilidae	C	Tolerant				
Cased Tricoptera - Limnephilidae	C	Tolerant				
Ancylidae	C	Tolerant				
Simuliidae	C	Tolerant			1	
Tipulidae	C	Tolerant	2	2	3	
Hemiptera - Aphelocheiridae	C	Tolerant				
Hydroptilidae	C	Tolerant				
Asellus	D	Very tolerant	33		2	13
Mollusca	D	Very tolerant	1			
Hirudinea	D	Very tolerant	11	1	3	20
Chironomidae	D	Very tolerant	152	3	8	4
Tubificidae	E	Most tolerant				2
Chironomus	E	Most tolerant				
Oligochaeta	N/A	N/A			18	
<b>Total individuals</b>			<b>221</b>	<b>19</b>	<b>62</b>	<b>110</b>
<b>Q Index</b>						

#### 4.1.5. Interpretation of Results

Benthic macro-invertebrates are widely considered a good indicator of ecosystem change for many reasons. The duration of their life cycles allow long-term exposure to substances in their environment. Furthermore, they exist in close contact with the substrate, which increases their contact with many substances. Consequently, any changes in the macro-invertebrate community will reflect changes in the pollution status of the ecosystem, particularly because many of these organisms are relatively sessile.

Whereas chemical data can provide an illustration of ambient conditions at any given moment, biotic data can supply a cumulative indicator of conditions in the ecosystem over time, depending on the lifetime of the organisms being studied. It is widely accepted that assessment of the health of a river's or stream's ecosystem can be achieved through analysis of the benthic macro-invertebrate community structure and this is the basis of the EPA Q rating system. The results of the biological assessment of the four watercourses presented in Table 4.4 and are discussed below.

**Table 4.8: Comparison of Q values obtained from 2007-2010**

Sampling Period	Site 1	Site 2	Site 3	Site 4
2007	Q2 – Q3	Q2 – Q3	Q3 – Q4	Q3
2008	Q3	Q2	Q3	Q3 – Q4
2009	Q3	Q3	Q3 – Q4	Q3
2010	Q2	Q3	Q3	Q3

Table 4.8 presents the results of biological assessments undertaken at these locations since 2007. These results show that biological water quality appears to have deteriorated slightly at Site 1 and site 3 (both downstream), but has remained the same at site 2 and site 4 (both upstream).

#### 4.1.6. EPA Results

The most recent EPA monitoring took place in 2009. The EPA report noted that the River Nanny was in an "unsatisfactory" state (moderately polluted, with a Q rating of 3-4). The nearest EPA station on the River Nanny upstream of the site is at Kentstown (EPA site code 08N010110. ) where water quality has been recorded as Q2-5 in 2008, 2005, 2001 and 1998.

The Nanny Bridge, the nearest EPA monitoring station downstream of the site (EPA site code 08N010280) recorded satisfactory results (good status, Q4) in 2008 and 2005.

#### 4.1.7. Conclusion

As indicated in the EPA monitoring results, the upper reaches of the River Nanny have a history of "unsatisfactory" biological water quality. From the current and previous biological assessments, any impacts from the site on water courses in the area are not evident. The trend since 2007 suggests that there is no evidence that the landfill operations are having any effect on the water quality of the receptor streams.

Based on EPA results it is likely that diffuse sources of pollution, existing prior to the development of the landfill, such as agricultural sources (run-off from grassland or sediment from tilled land) in the area, are likely to be influencing biological water quality in the area upstream of the site. EPA monitoring results downstream of the site indicate satisfactory results (good status, Q4) in 2008 and 2005.

## 4.2. Surface Water

Surface water monitoring was carried out quarterly at 8 no. monitoring locations in accordance with Schedule D of the licence and these are shown on the Figure 2.1 in Appendix I.

### 4.2.1. Monitoring Locations

Surface water monitoring was carried out at 8 no. monitoring locations. The locations are shown on the Figure 2.1 in Appendix I. Table 4.9 shows the location of the monitoring points in relation to the site.

**Table 4.9: Surface Water Monitoring Locations**

Monitoring Location	Easting	Northing	Description
SW1	296706	267600	Upstream
SW2	297464	267862	Upstream
SW3	298087	267634	Upstream
SW5	297764	267116	Upstream
SW6	297663	266562	Downstream
SW7	297510	266525	Downstream
SW8	297916	266029	Downstream
SW9	297587	266621	Discharge from the surface water wetland

#### 4.2.2. Surface Water Monitoring Results – Visual Assessment

Greenstar carries out weekly inspections of the surface water drainage system. The inspections completed in the reporting period did not identify the presence of any impact on the drainage system associated with site activities. Detailed visual assessment results were reported to the Agency in the quarterly reports.

#### 4.2.3. Surface water Monitoring Results - Chemical Assessment

Two surface water bodies are sampled on a quarterly basis, namely the Knockharley Stream and the Nanny River. Surface water samples were analysed for a range of parameters as specified in Schedule D of the waste licence.

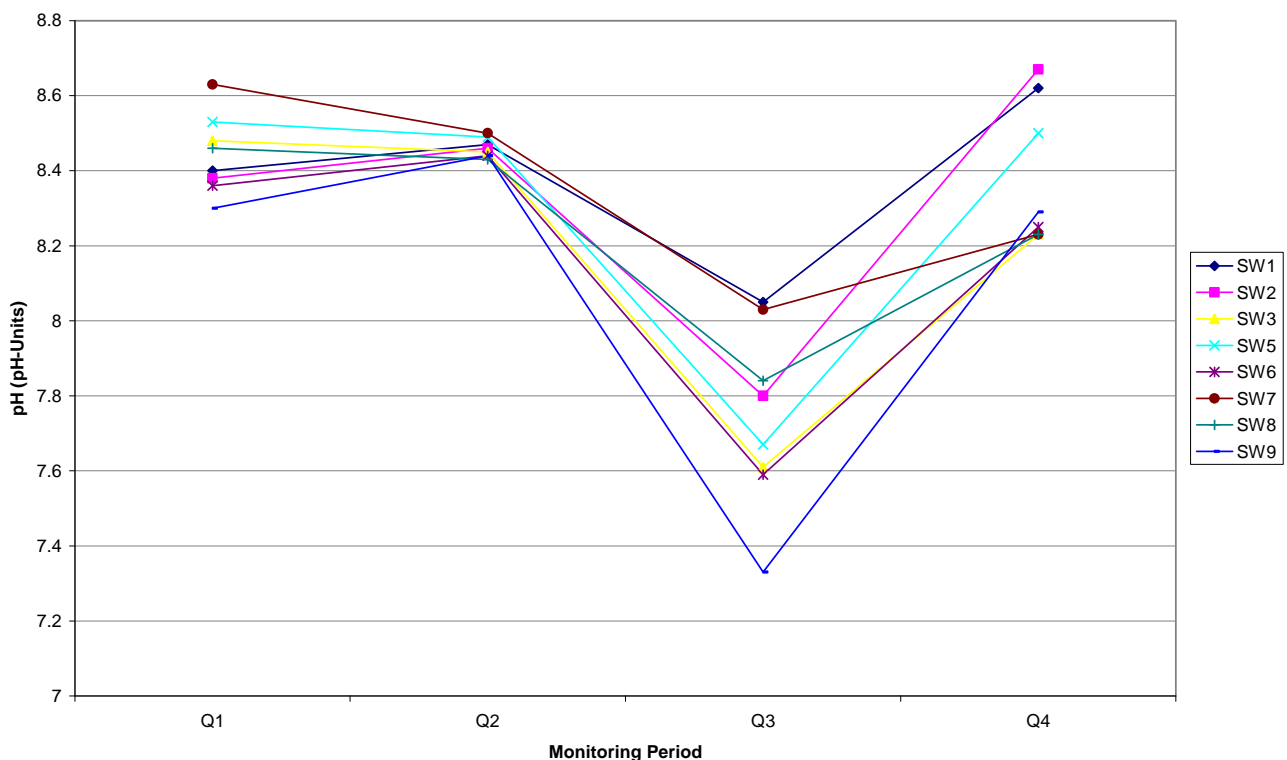
The figures below present the summary results of the main surface water monitoring parameters undertaken during the four quarters of the reporting period. The baseline monitoring results are presented in Table 4.10. Annual surface water monitoring parameters are discussed below.

**Table 4.10: Baseline Surface Water Quality**

Parameter	Units	SW1	SW2	SW3	SW5	SW6	SW7	SW8
pH	pH Units	7.94-8.20	7.7-8.44	7.75-7.98	7.61-8.07	7.76-8.06	7.42-8.37	7.63-8.02
Electrical Conductivity	mS/cm	0.613-0.730	0.653-0.682	0.593-0.688	0.549-0.726	0.625-0.698	0.590-0.694	0.662-0.720
Ammoniacal Nitrogen	mg/l	<0.2-0.6	<0.2	<0.2-1.1	<0.2-0.5	<0.2-0.5	<0.2-1.7	<0.2-0.4
Dissolved Oxygen	mg/l	5.3-9.4	4.7-8.9	5.1-8.6	4.4-8.4	5.0-8.9	5.0-8.7	4.6-8.5
Chloride	mg/l	21-31	23-56	29-36	29-35	28-33	24-36	30-54
Total Suspended Solids	mg/l	<10-48	<10-46	<10-34	<10	<10-11	<10-10	<10-15
BOD	mg/l	<2-2	<2-12	<2-5	<2-4	<2-3	<2-3	<2-3
COD	mg/l	<15-41	<15-25	<15-46	<15-43	<15-41	<15-29	<15-31
Potassium	mg/l	9	2.6	10.8	11.6	11.8	17.6	2.4
Sodium	mg/l	13.5	8.1	13	14	15	9.8	15
Total Oxidised Nitrogen	mg/l	4.1	7.9	5.4	5.1	5.3	3.7	4.3
Calcium	mg/l	95.44	99.93	77.87	74.7	72.58	99.99	93.66

Parameter	Units	SW1	SW2	SW3	SW5	SW6	SW7	SW8
Cadmium	µg/l	3.5	3.5	3.5	3.5	<0.4	<0.4	<0.4
Chromium	µg/l	4	4	3	4	<1	<1	<1
Copper	µg/l	10	8	8	9	6	6	<5
Iron	µg/l	75	47	112	132	123	38	55
Lead	µg/l	<5	<5	<5	<5	<5	<5	<5
Magnesium	mg/l	6.48	4.44	5.38	5.3	5.23	8.89	6.73
Manganese	µg/l	11	10	10	9	5	6	4
Mercury	µg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Sulphate	mg/l	25	24	29	29	30	30	29
Zinc	µg/l	<5	<5	<5	<5	<5	<5	<5
Total Alkalinity as CaCo3	mg/l	300	220	200	90	250	270	250
Total Phosphorous	mg/l	0.44	0.09	0.34	0.56	0.54	0.54	0.32

pH results, presented in Figure 4.2, were relatively consistent but the levels at all locations decreased slightly in the quarter 3 2010 monitoring event. The electrical conductivity results, presented in Figure 4.3, were also relatively consistent throughout the reporting period. Results decreased at all monitoring locations in quarter 2, only to increase slightly again in quarter 3, with the exception of SW7 which decreased for a second consecutive quarter. Electrical conductivity levels all fall within the range from 225 – 935 µS/cm range. All results for pH and conductivity were within normal ranges for surface water.



**Figure 4.2: pH Results for Surface Water**

The results for chloride, Figure 4.4 and ammoniacal nitrogen, Figure 4.5 in the surface waters surrounding the Knockharley facility are presented below.

The results for chloride levels, similar to the electrical conductivity levels remain consistent through the reporting period. Some variation in levels was recorded at SW1, with results decreasing in quarter 2, increasing in quarter 3 and decreasing again in quarter 4.

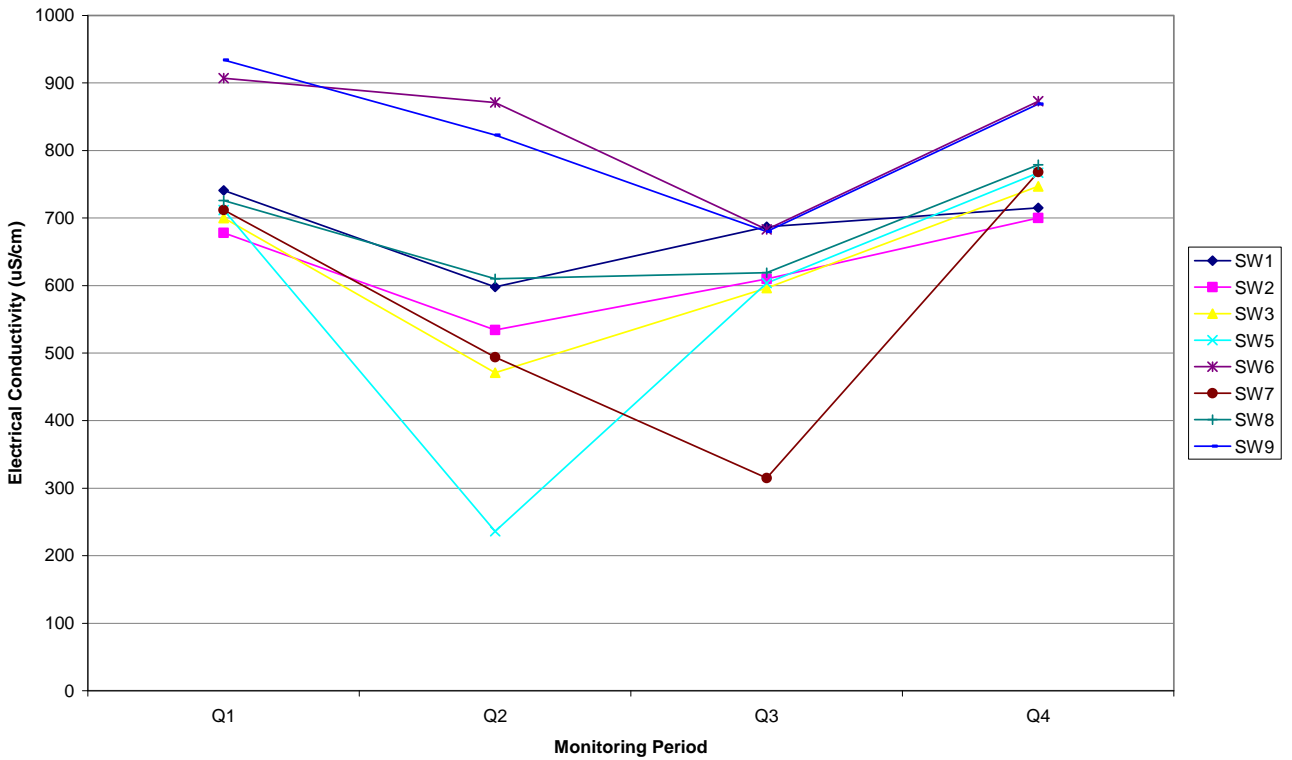


Figure 4.3: Electrical Conductivity Results for Surface Water

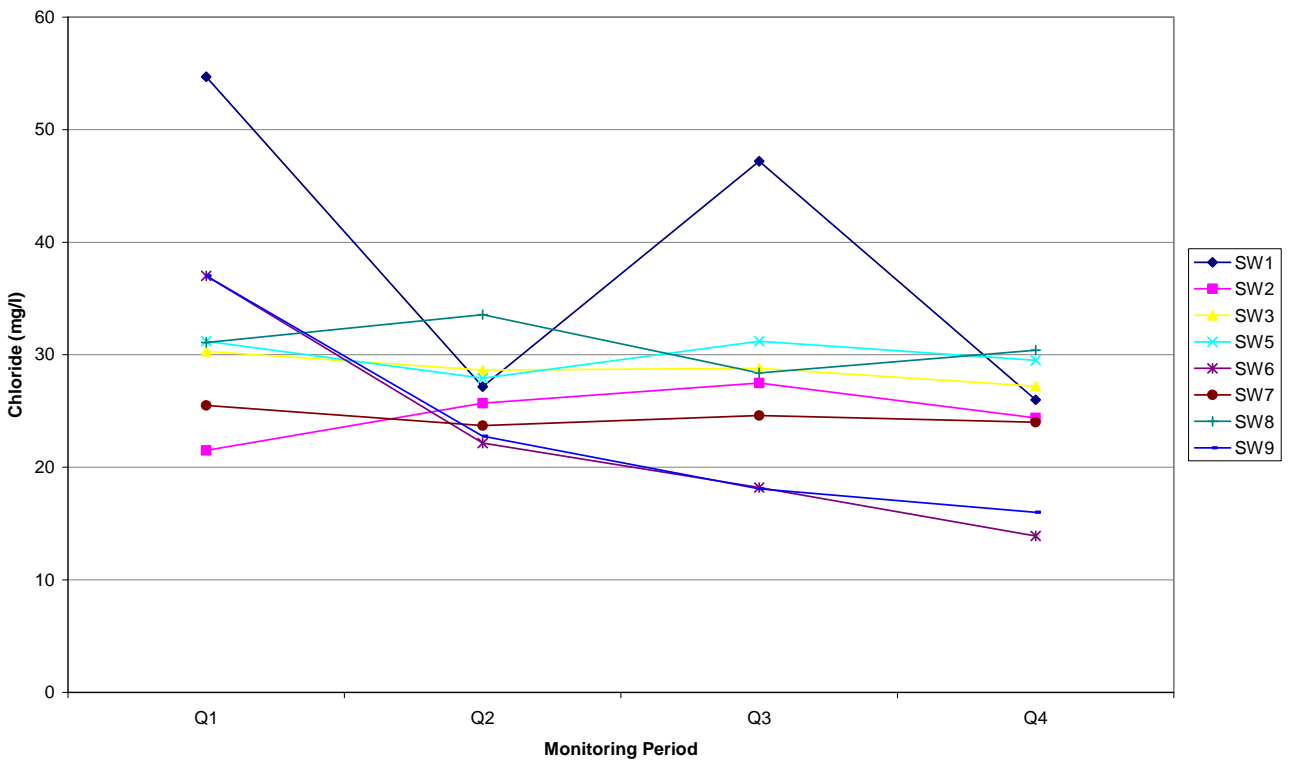
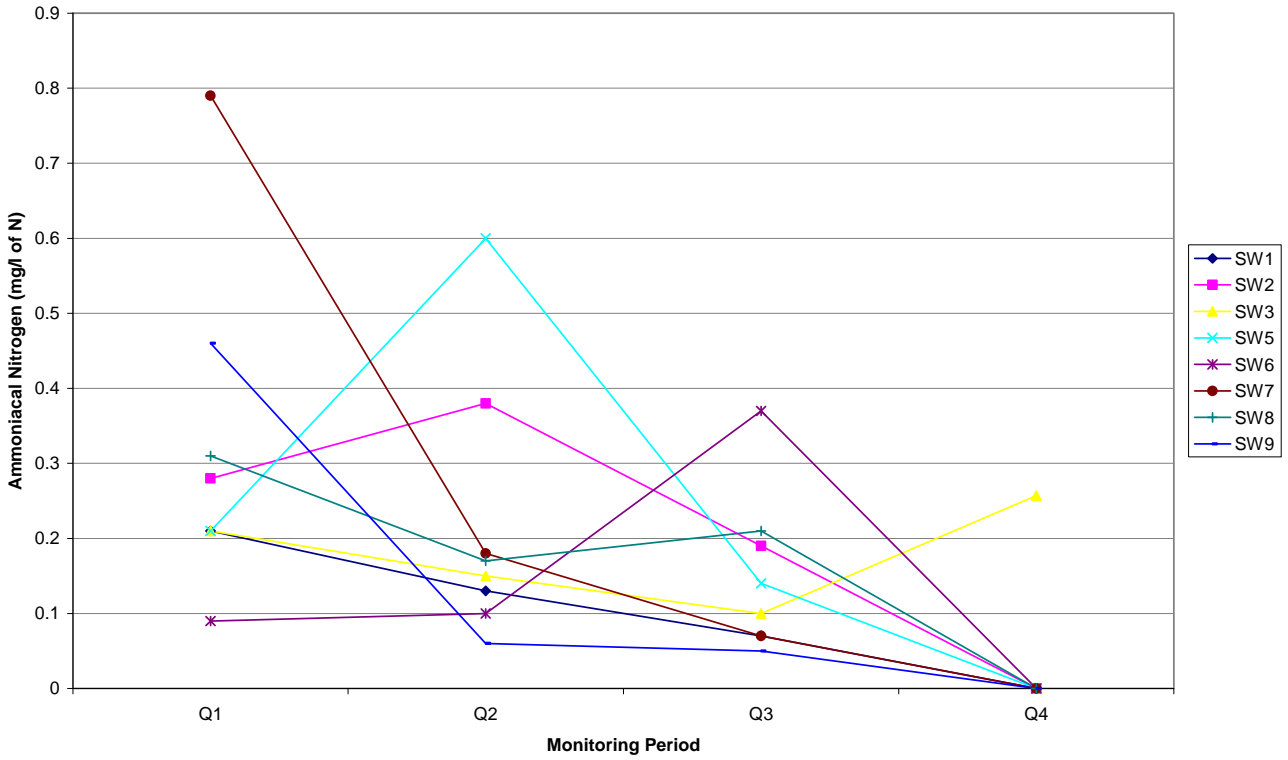
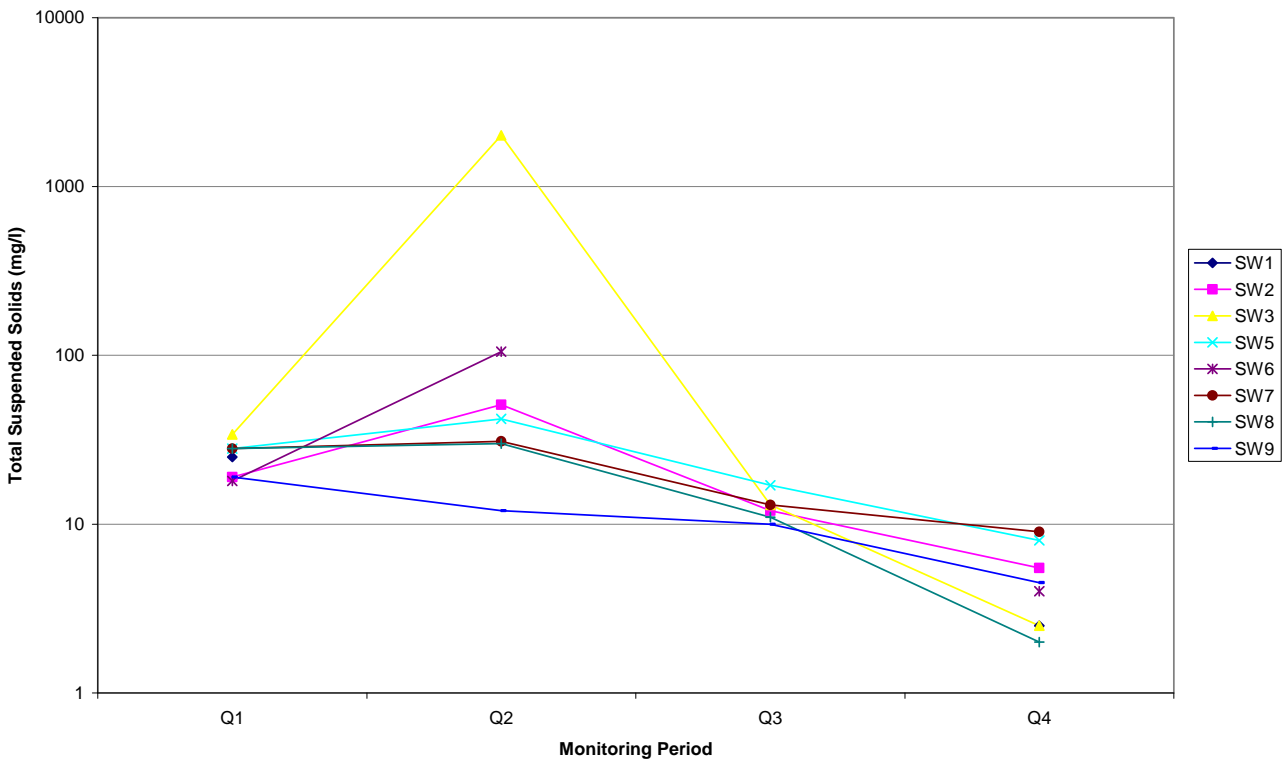


Figure 4.4: Chloride Results for Surface Water

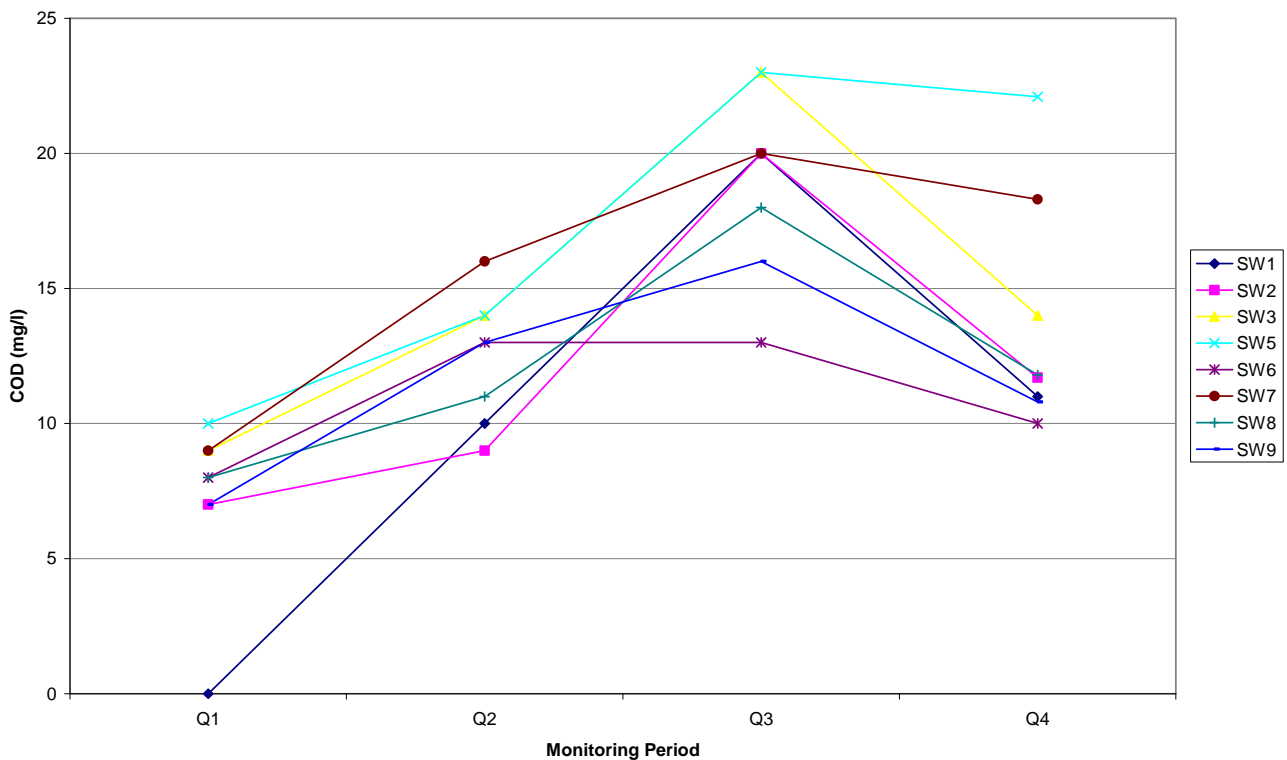


**Figure 4.5: Ammoniacal Nitrogen Results for Surface Water**

While there is slightly more variation in the ammoniacal nitrogen results for the reporting period all the results were recorded below 0.8 mg/l as N. The majority of the results fall below 0.4 mg/l as N. The results for most monitoring locations were so low that they were under the laboratory limit of detection during quarter 4.



**Figure 4.6: Total Suspended Solids Results for Surface Water**



**Figure 4.7: Chemical Oxygen Demand Results for Surface Water**

Levels of total suspended solids (TSS), Figure 4.6, were all within the normal range for surface waters with the exception of a dramatic peak of 2009 mg/l recorded at SW3 in quarter 2. Location SW3 is located upstream of the site and the elevated levels of TSS is not likely to be caused by site activity. It is possible that sampling low surface water levels, during the summer period causing sampling difficulties contributed to the atypical TSS levels. The levels for quarter 3 and quarter 4 follow the decreasing trend observed at all other monitoring locations.

COD levels, Figure 4.7, were observed to follow an increasing trend through the reporting period, however stabilising and decreasing slightly in quarter 4. The results all fall within the baseline monitoring range, established prior to landfill activities started on-site.

Regarding the annual surface water monitoring parameters, the results for potassium range from 3.78 mg/l to 11.10 mg/l. The results are slightly elevated over the baseline range at SW2 and SW8. All other monitoring locations, SW1, SW3, SW5, SW6 and SW7 are within the baseline range.

Sodium levels at SW7 and SW8 are below the baseline range and located downstream. All other locations are marginally above the baseline levels. Of these, SW1, SW2, SW3 are located upstream of the site, SW5 is located to the east of the site. Only SW6 is located downstream of the site. Given the levels of sodium upstream of the site it is likely that sodium is entering the surface water from a source other than landfilling activity.

Calcium levels range from 133 mg/l to 162 mg/l. The levels are over the baseline range at all monitoring locations, upstream and down stream of the site.

Cadmium levels at all monitoring locations were recorded below the limit of detection for the laboratory (<0.03 µg/l) which indicates levels are under the baseline range. Iron levels were also recorded under the limit of detection for the laboratory (<0.019 µg/l), under the baseline range. Copper levels ranging from 0.91 µg/l to 1.51 µg/l are all under the baseline range. Lead levels range from 0.04 µg/l to 0.14 µg/l and are under the baseline range at all monitoring locations. Mercury levels are all under the laboratory limit of detection of <0.01 µg/l. Zinc levels ranging from 1.19 µg/l to 2.27 µg/l are under the baseline range at all monitoring locations.



Chromium levels range from 2.51 µg/l to 6.44 µg/l and are slightly elevated above the baseline range at all locations, both upstream and down stream of the site.

Recorded magnesium levels range from 11.10 mg/l to 17.50 mg/l and are elevated above the baseline levels at all locations. Manganese levels range from 5.61 µg/l to 186 µg/l and are elevated above the baseline levels at all locations.

Sulphate levels range from 24.40 mg/l to 289 mg/l. The results at SW3 and SW5 are under the baseline range, while the results at SW1, SW2, SW6, SW7 and SW8 are all elevated above the baseline range.

#### 4.2.4. Conclusion

Annual monitoring records that calcium, chromium magnesium and manganese levels are over the baseline range at all monitoring locations, upstream and down stream of the site. TSS levels at SW9, the surface water emission point decreased thought the reporting period.

In general, surface water quality in the surface water bodies surrounding the site is good and operations at the site have not resulted in any adverse impacts on the water quality during the reporting period.

### 4.3. Groundwater

Groundwater monitoring was undertaken at 7 no. groundwater wells on the site during the reporting period and the results were reported to the Agency as part of the quarterly reports for the facility. The wells were monitored in accordance with Schedule D.5.1 of the waste licence and shown on Figure 2.1, Appendix I. The direction of groundwater flow on the site is from northwest to southeast. Groundwater wells MW1d, MW2d, MW3d and MW7d are located up-gradient of the landfill and MW5d, MW6d and MW16d are located downgradient of the landfill.

The groundwater trigger levels (GWTL) have been revised and forwarded to the EPA for approval. Subject to EPA approval, the revised GWTL will be used in the assessment of groundwater quality. For the present reporting period and until the approval of the GWTL's, groundwater quality is assessed against baseline groundwater results, presented in Table 4.9.

**Table 4.11: Baseline Groundwater Quality**

Parameter	Units	MW1d	MW2d	MW3d	MW5d	MW6d	MW7d	MW16d
pH	pH units	7.39-7.60	7.24-7.96	7.20-8.00	7.27-8.32	7.47-7.87	7.38-7.88	7.28-7.61
Conductivity	mS/cm	0.586-0.654	0.685-0.705	0.796-0.858	0.626-0.861	0.604-0.660	0.621-0.685	0.627-0.689
Ammoniacal Nitrogen	mg/l	<0.2-0.3	<0.2	0.4-1.4	<0.2-0.5	<0.2-0.6	0.3-1.3	0.4-0.7
Dissolved Oxygen	mg/l	4.9-8.5	4.5-8.3	4.7-8.1	4.7-8.1	3.7-8.2	3.8-8.1	4.4-7.8
Chloride	mg/l	22-27	18-19	24-26	13-26	15-17	16-18	17-18
Total Organic Carbon	mg/l	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Potassium	mg/l	1.8-7.2	2.0-3.0	3.0-4.2	2.0-5.0	2.0-3.6	2.4-4.2	2.2-3.6
Sodium	mg/l	16-62	29-62	39-142.5	25-84.5	21-55	31.5-79	25.5-41.5
Total Oxidised Nitrogen (as N)	mg/l	<0.3-3.4	<0.3-0.4	<0.3-0.5	<0.3-5.0	<0.3-0.8	0.4-0.9	<0.3
Phenols	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Parameter	Units	MW1d	MW2d	MW3d	MW5d	MW6d	MW7d	MW16d
Total Coliforms	no./100ml	2-140	0-24	0-56	0-780	0-18	0-28	0-4
Faecal Coliforms	no./100ml	0-2	0-3	0-37	0-9	0-17	0-2	0-2

4.3.1. Groundwater Monitoring Results - Levels

The groundwater levels were recorded on a monthly basis and the results are presented in Figure 4.6. The levels remained relatively stable throughout the reporting period.

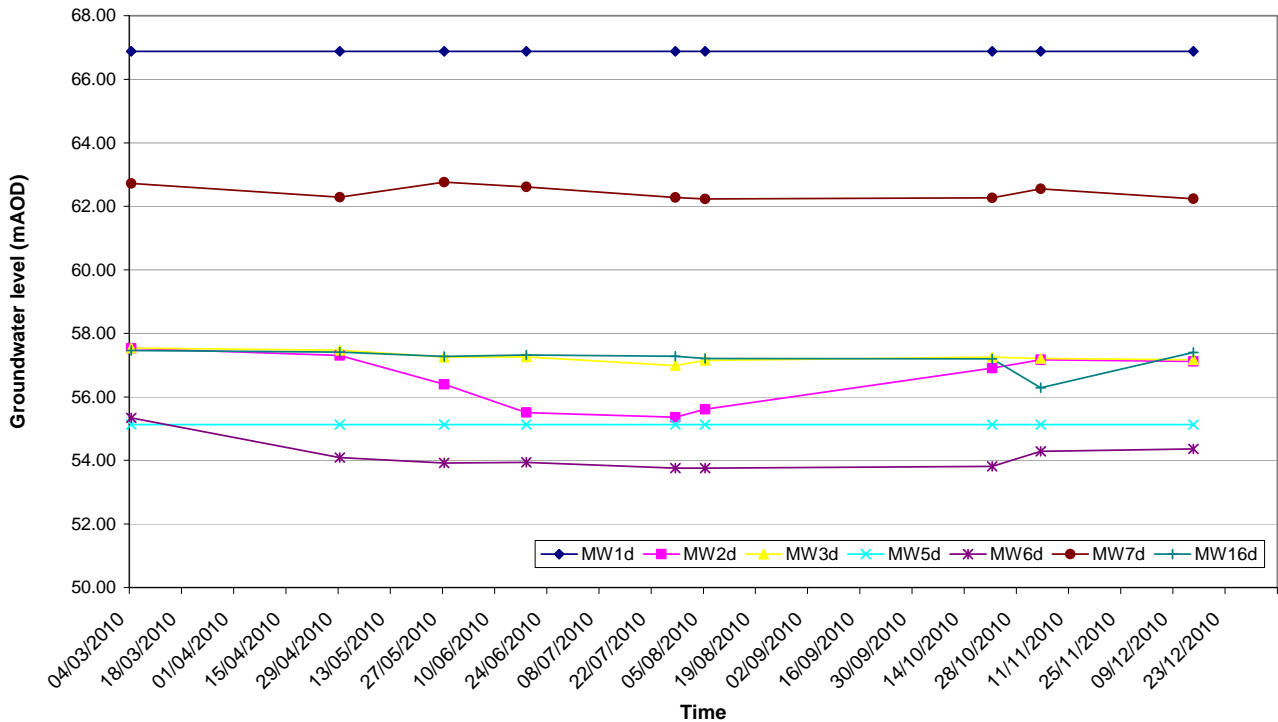


Figure 4.8: Groundwater Levels

4.3.2. Groundwater Monitoring Results – Chemical Assessment

The pH and electrical conductivity levels recorded in the groundwater were within the normal ranges. pH levels, Figure 4.9, increased slightly at all monitoring locations during quarter 2 before decreasing in quarter 3 and quarter 4. Electrical conductivity levels, Figure 4.10, remained relatively consistent through the reporting period. The results for MW3d remained consistently higher than all other locations. The pH and electrical conductivity levels are all consistent with unpolluted groundwater.

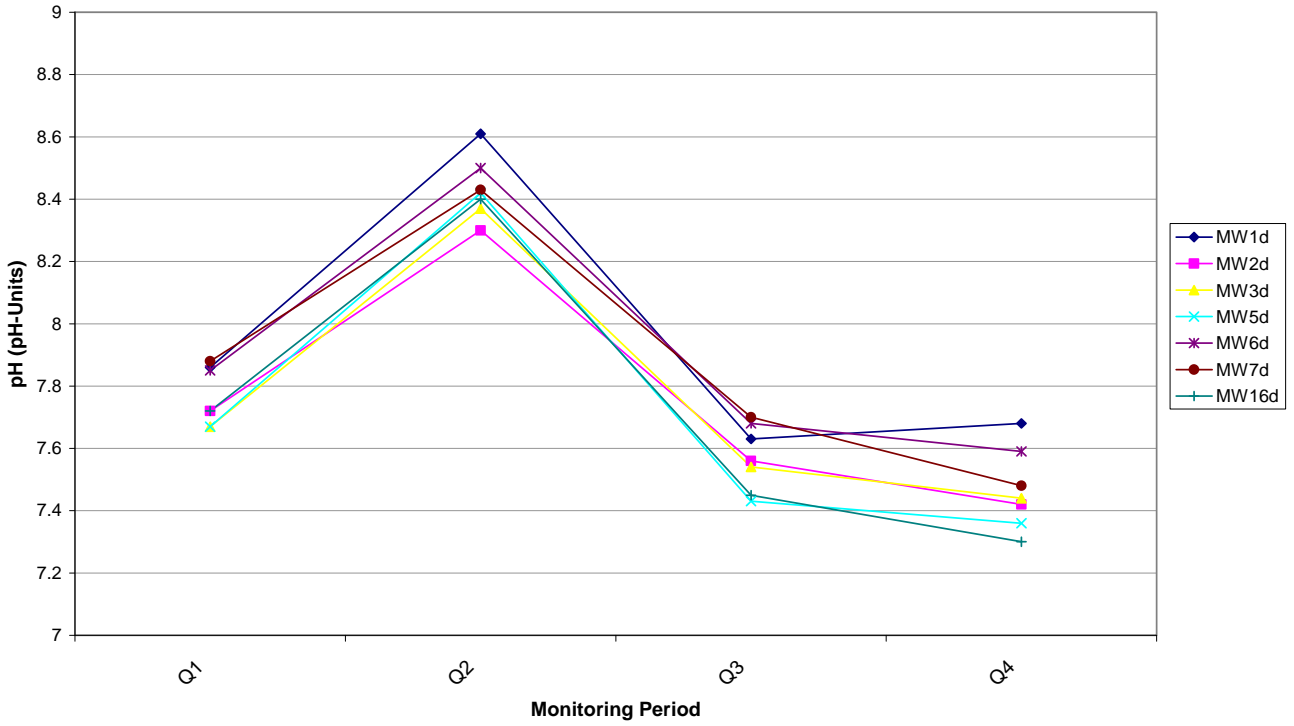


Figure 4.9: pH Results for Groundwater

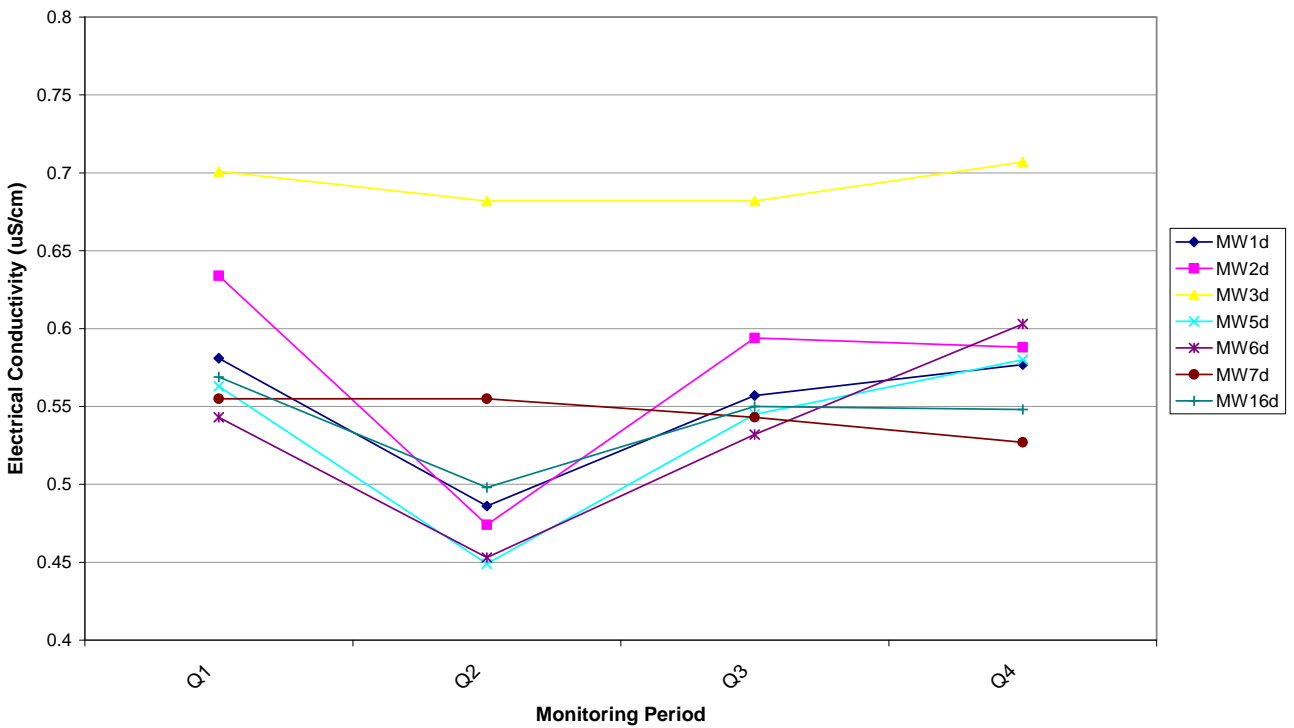


Figure 4.10: Electrical Conductivity Results for Groundwater

The levels of ammoniacal nitrogen, chloride, and total organic carbon (TOC) in groundwater for the reporting period are presented below in Figure 4.11, Figure 4.12 and 4.13 respectively. The results are relatively consistent over the reporting period and all levels recorded were within the baseline range.

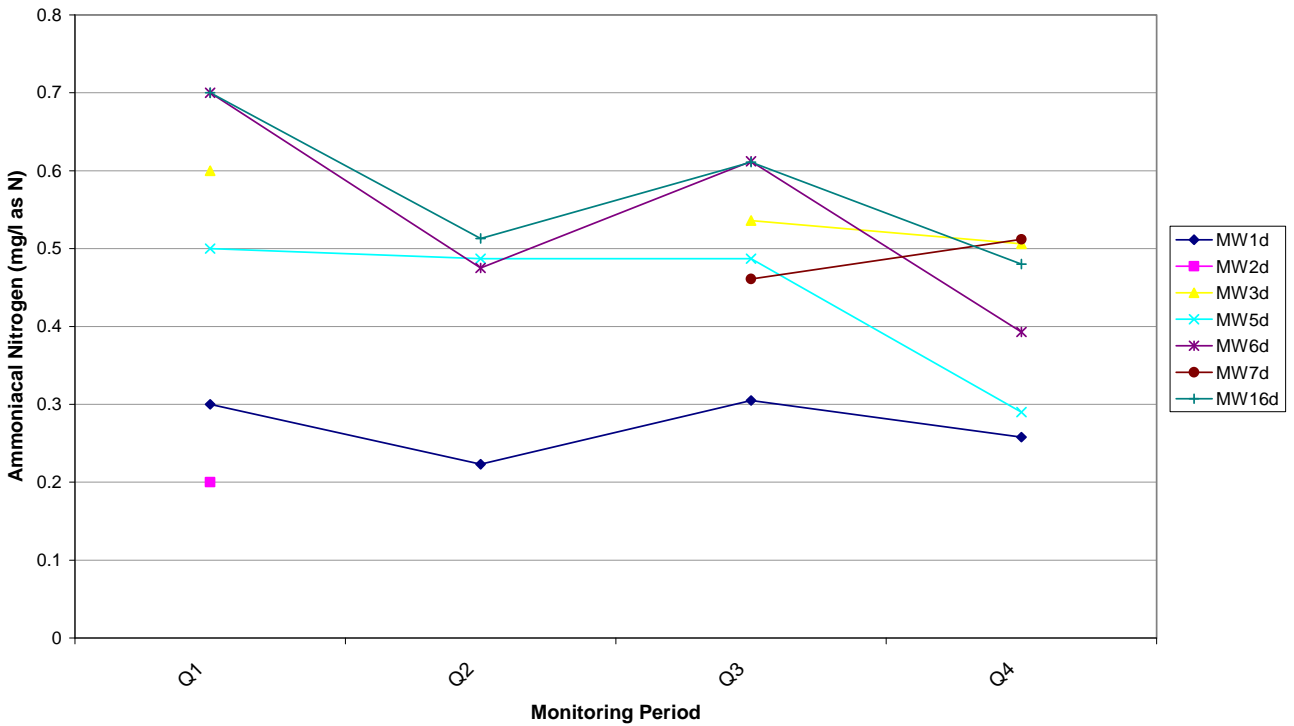


Figure 4.11: Ammoniacal Nitrogen Results for Groundwater

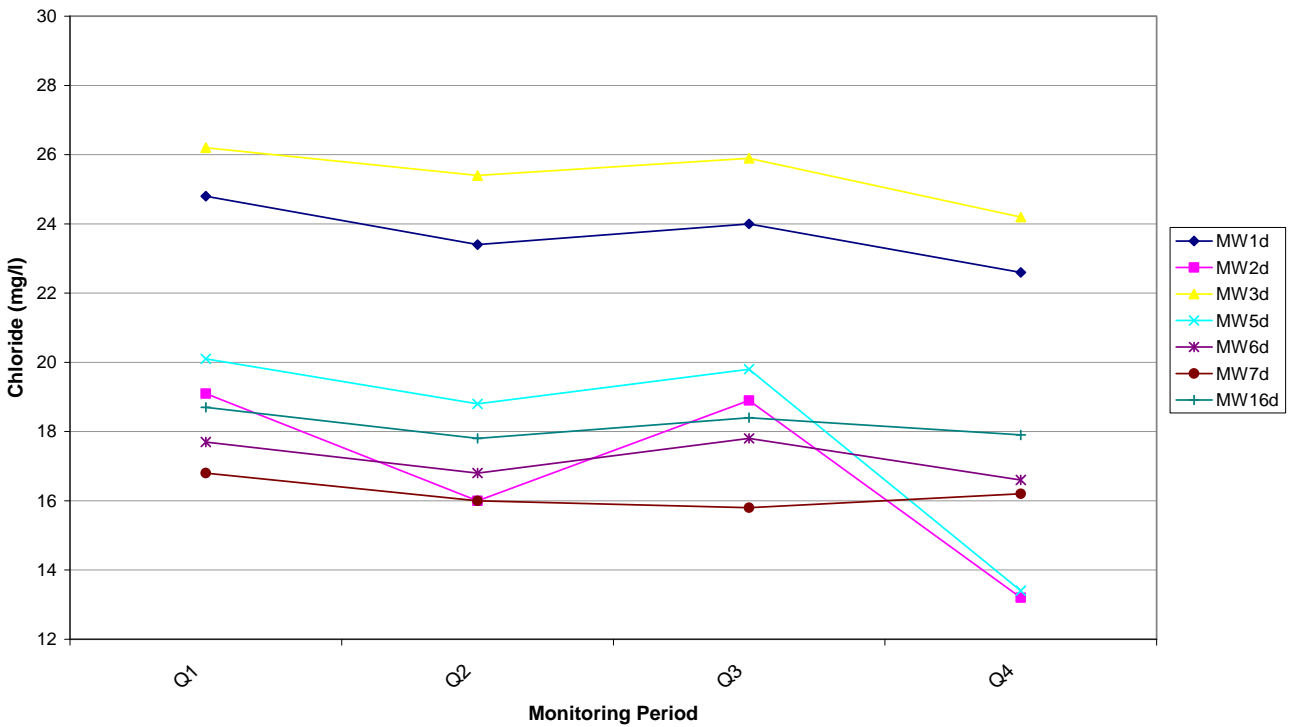
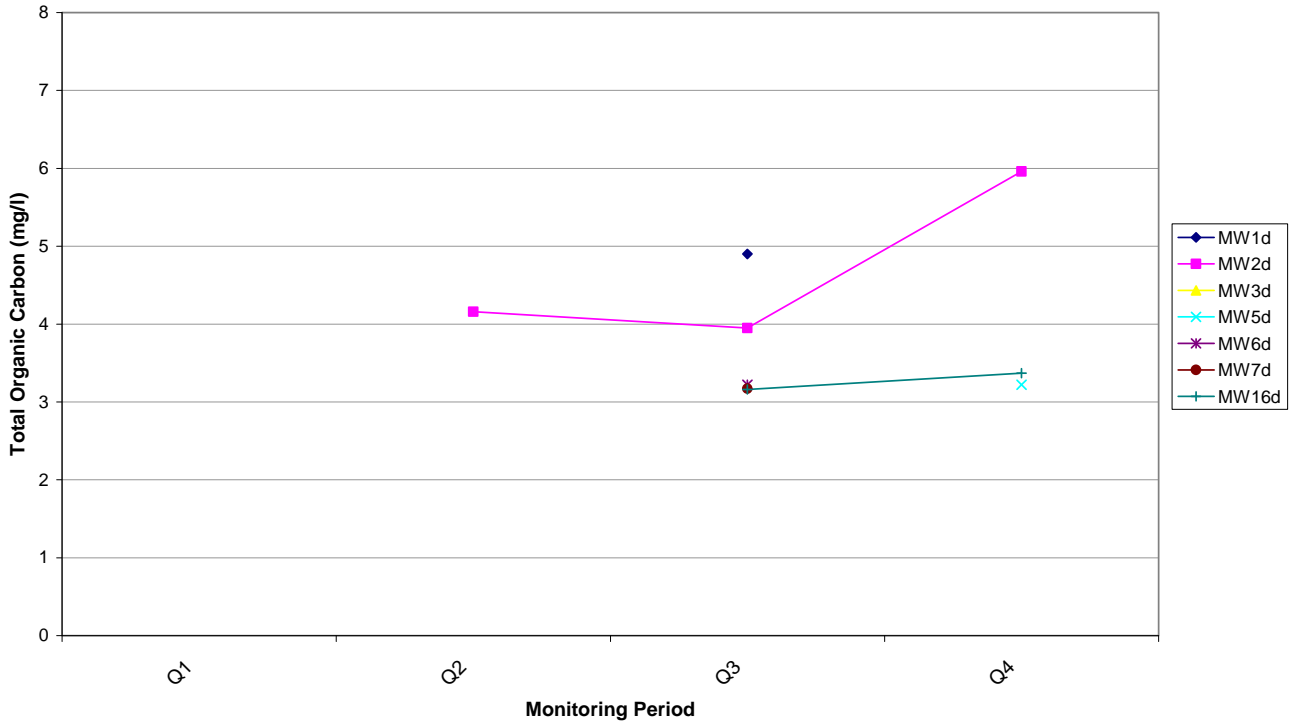


Figure 4.12: Chloride Results for Groundwater

While the total organic carbon (TOC), Figure 4.13, levels during quarter 1 and quarter 2 were predominately under the baseline levels, during quarter 3, up-gradient of the landfill the TOC levels increased at MW1d and MW2d. Levels at these wells are above baseline levels. The TOC levels are also up slightly in MW6d, MW7d and MW16d from the recorded levels in Quarter 2.

Levels recorded during quarter 4 TOC levels were similar to quarter 3 ranging from 3.22 mg/l to 5.96 mg/l. Up-gradient of the landfill the TOC levels decreased at MW1d (from 4.9 mg/l in quarter 3 to <3 mg/l in quarter 4) and MW7d (3.17 mg/l in quarter 3 to 3 mg/l in quarter 4) and increased at up-gradient at MW2d (from 3.95 mg/l in quarter 3 to 5.96 mg/l in quarter 4). The TOC levels are also increased slightly from quarter 3 levels at MW5d (from <3 mg/l to 3.22 mg/l in quarter 4) and down-gradient at MW16d (from 3.16 mg/l in quarter 3 to 3.37 mg/l in quarter 4). Down-gradient levels in MW6d have decreased from 3.22mg/l in quarter 3 to <3 mg/l in quarter 4.



**Figure 4.13: TOC Results for Groundwater**

Groundwater potassium levels remained relatively consistent through the reporting period. Levels ranged between 2.8 and 4.2 mg/l and were within baseline levels.

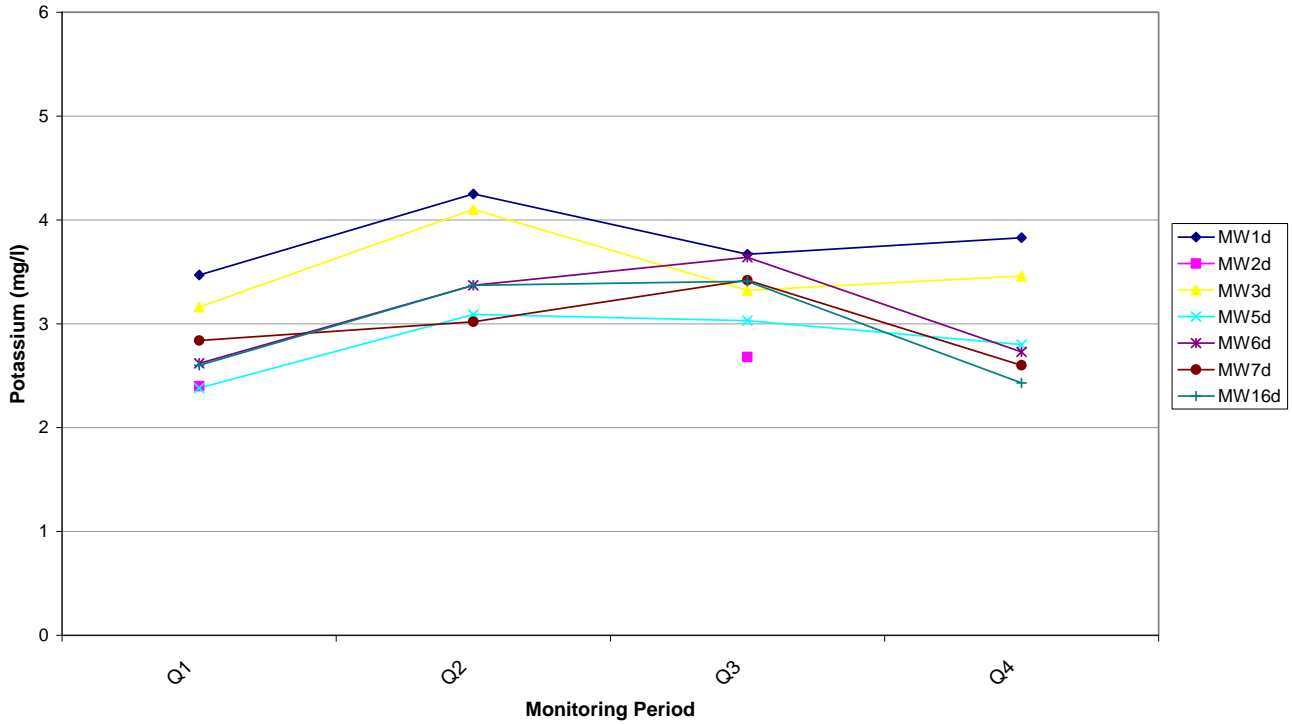


Figure 4.14 Potassium Results for Groundwater

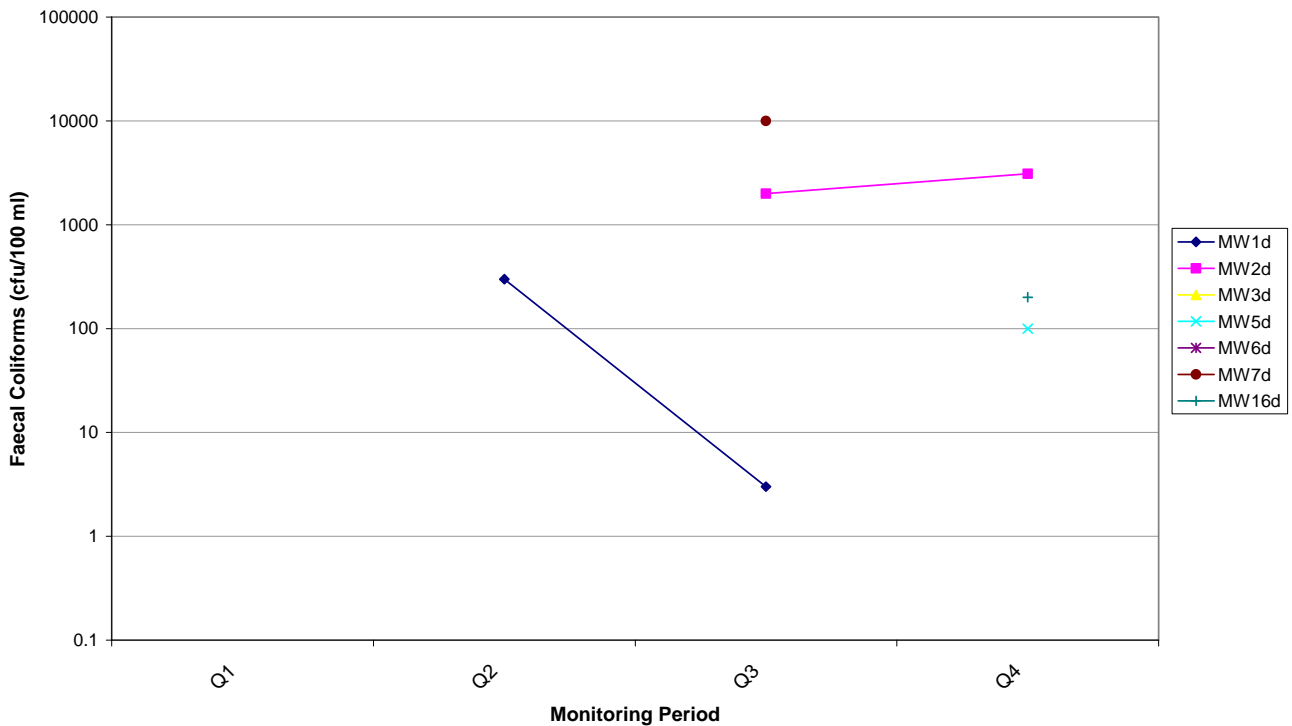


Figure 4.15: Faecal Coliform Results for Groundwater

Variable levels of faecal and total coliforms, Figure 4.15 and Figure 4.16 respectively, were recorded in a number of wells during the reporting period. Historically total and faecal coliforms have been detected in all groundwater monitoring boreholes around the site. All the monitored groundwater boreholes are dedicated monitoring wells and not used for any other purpose than groundwater monitoring.

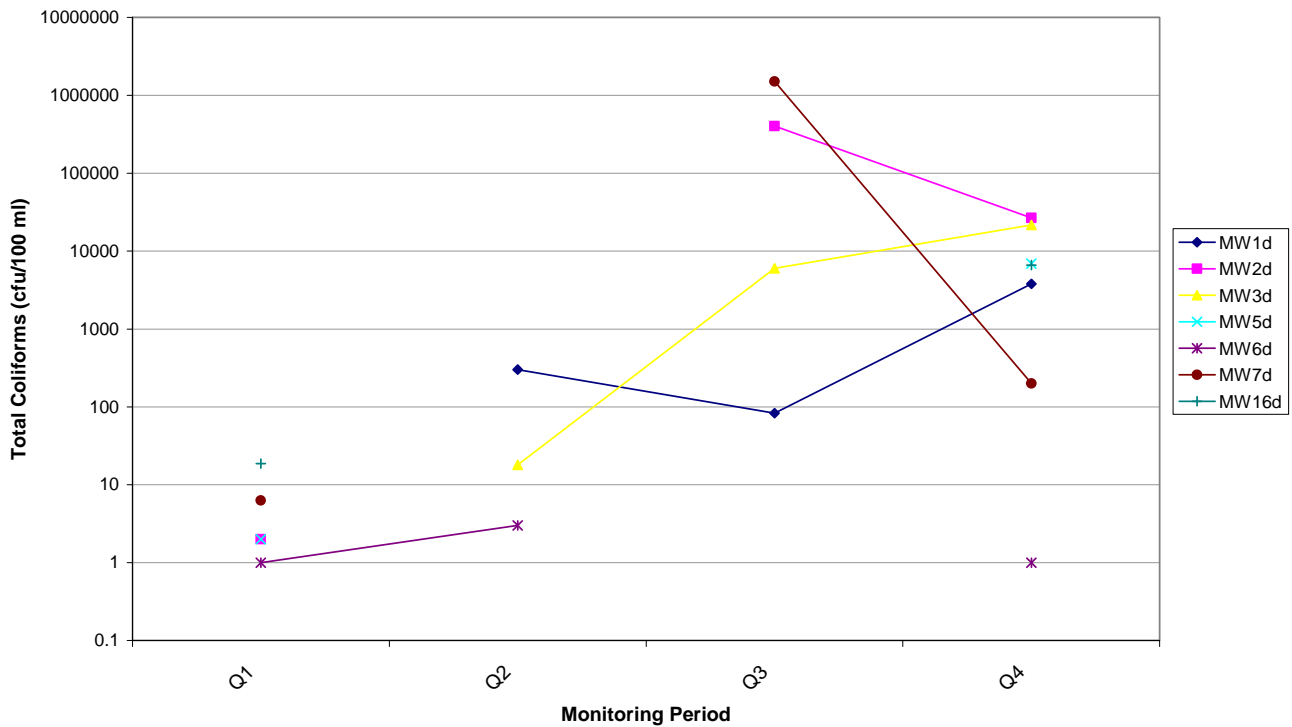


Figure 4.16: Total Coliform Results for Groundwater

4.3.3. Conclusion

In general, groundwater conditions at the site have not altered significantly from the baseline results. Levels of faecal and total coliforms outside the baseline range are observed at a number of groundwater locations upgradient of the landfill. These parameters will continue to be closely observed during coming monitoring events.

The monitoring program confirms that site activities are not impacting on groundwater quality.

4.4. **Dust and PM<sub>10</sub> Monitoring**

As discussed in Section 3.1, no dust levels were recorded above the limit at the facility during the reporting period. The monitoring results were reported to the Agency as part of the quarterly reports.

PM<sub>10</sub> levels are monitored on a quarterly basis at six locations around the perimeter of the facility. These locations are presented on Figure 2.1, Appendix I. The results of this monitoring, including the certificates of analysis, were submitted to the Agency as part of the quarterly reports.

4.4.1. Conclusion

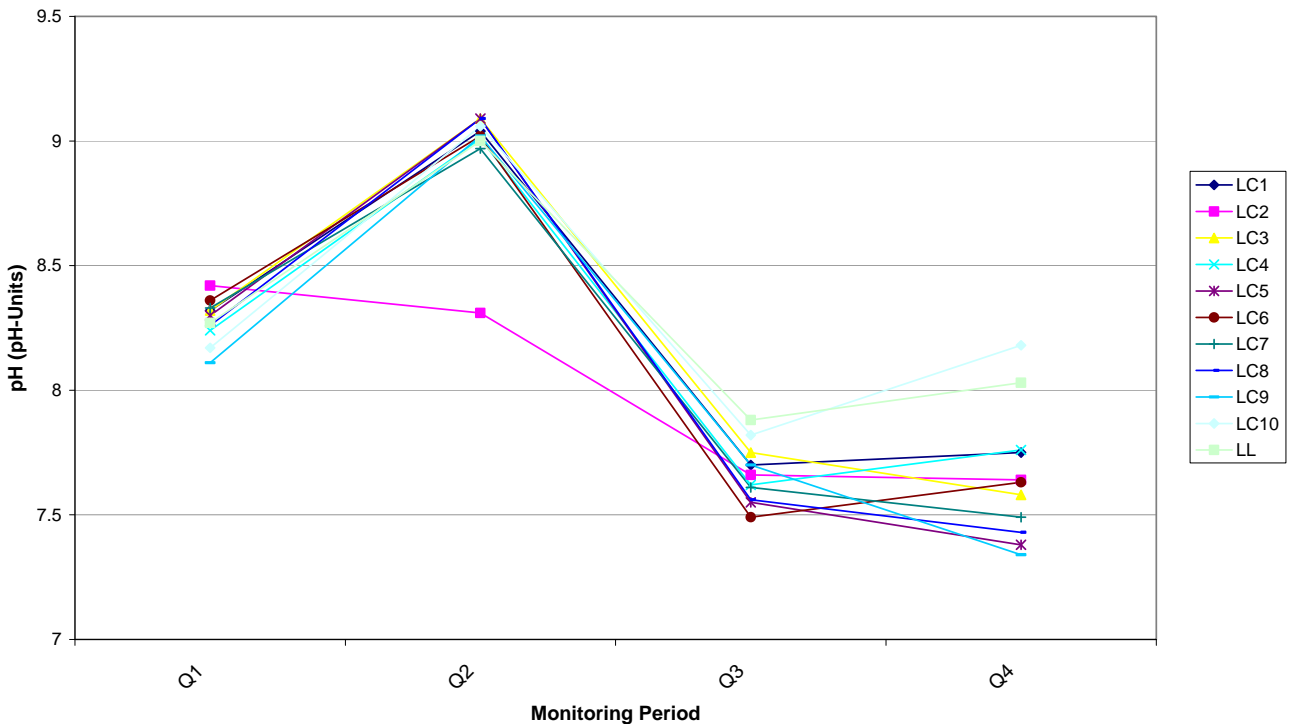
The PM<sub>10</sub> trigger level, as set out in the waste licence condition 6.8.1 of 50 µg/m<sup>3</sup> was not exceeded at any location during the monitoring period.

### 4.5. Leachate Monitoring

Leachate monitoring was carried out at ten locations (LC1, LC2, LC3, LCE4, LC5, LC6, LC7, LC8, LC9, LC10 and LL) during the reporting period. LC1 to LC10 are sumps within Cells 1 to 10 respectively and LL is at the leachate lagoon.

Chemical analysis of leachate samples is undertaken in accordance with Schedule D of the waste licence. The results were reported to the Agency as part of the quarter 4 2010 report. The main indicator parameter results are summarised below.

The pH level, Figure 4.17, for leachate samples, though showing variation between quarters, follows a similar trend for all sample locations. The pH level indicates that the leachate is becoming slightly more acidic in all cells.



**Figure 4.17: pH Results for Leachate**

The electrical conductivity (EC), readings Figure 4.18, show greater variation, though all sample locations follow a generally similar trend, with high EC levels observed in all cells.



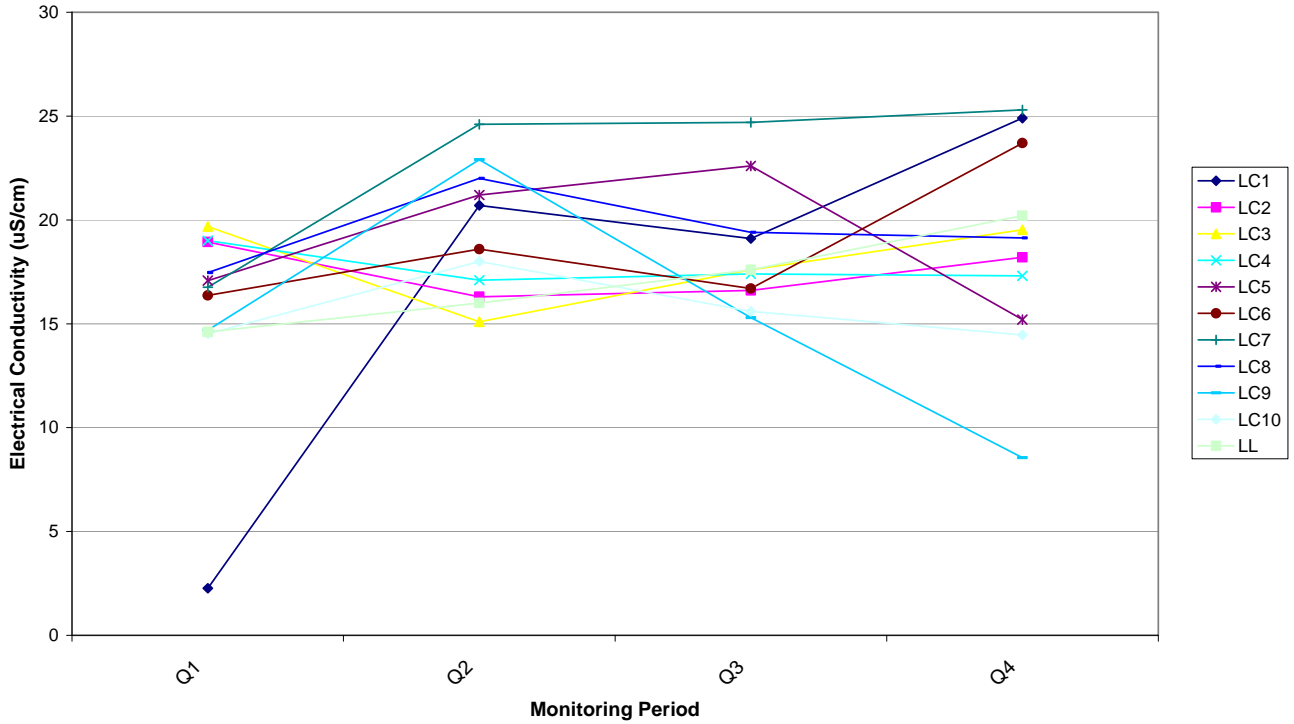


Figure 4.18: Electrical Conductivity Results for Leachate

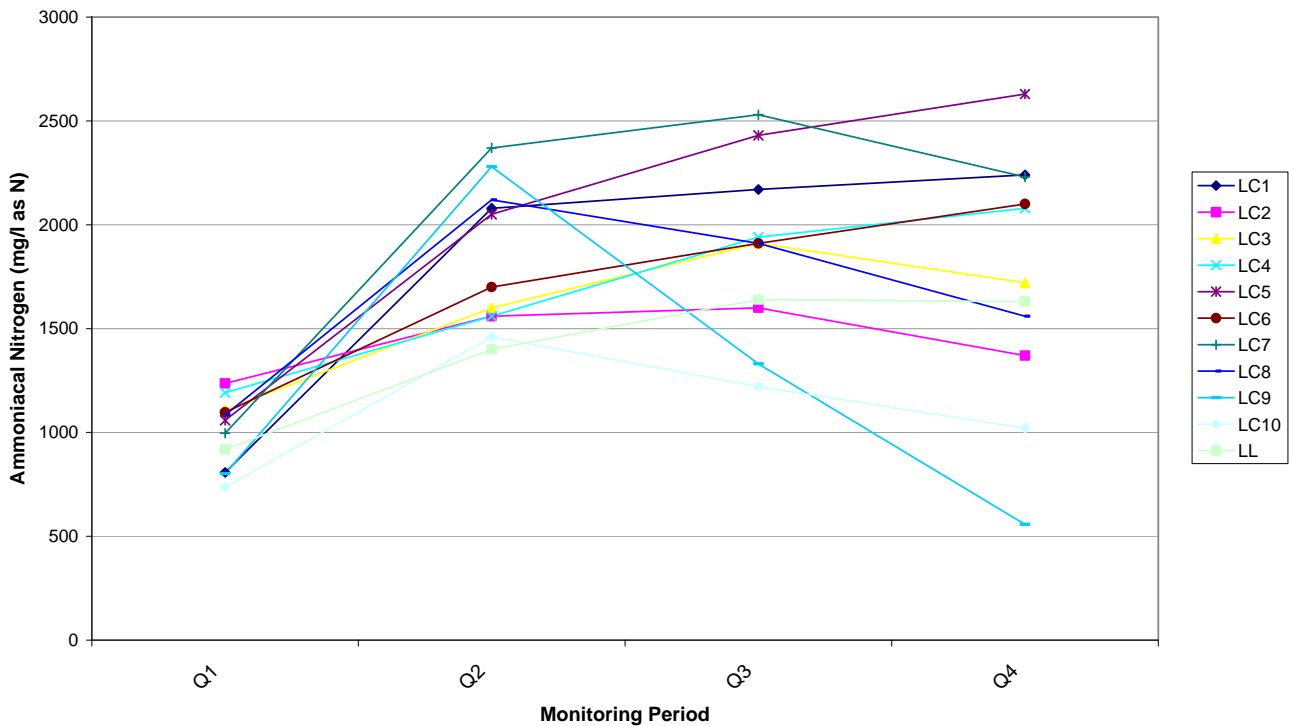


Figure 4.19: Ammoniacal Nitrogen Results for Leachate

There is a general trend indicating increasing ammoniacal nitrogen, Figure 4.19 and chemical oxygen demand, Figure 4.20 in leachate sampled through the reporting period. All cells follow the trend through quarter 1 and quarter 2 with greater variation in the samples observed in quarter 3 and quarter 4.

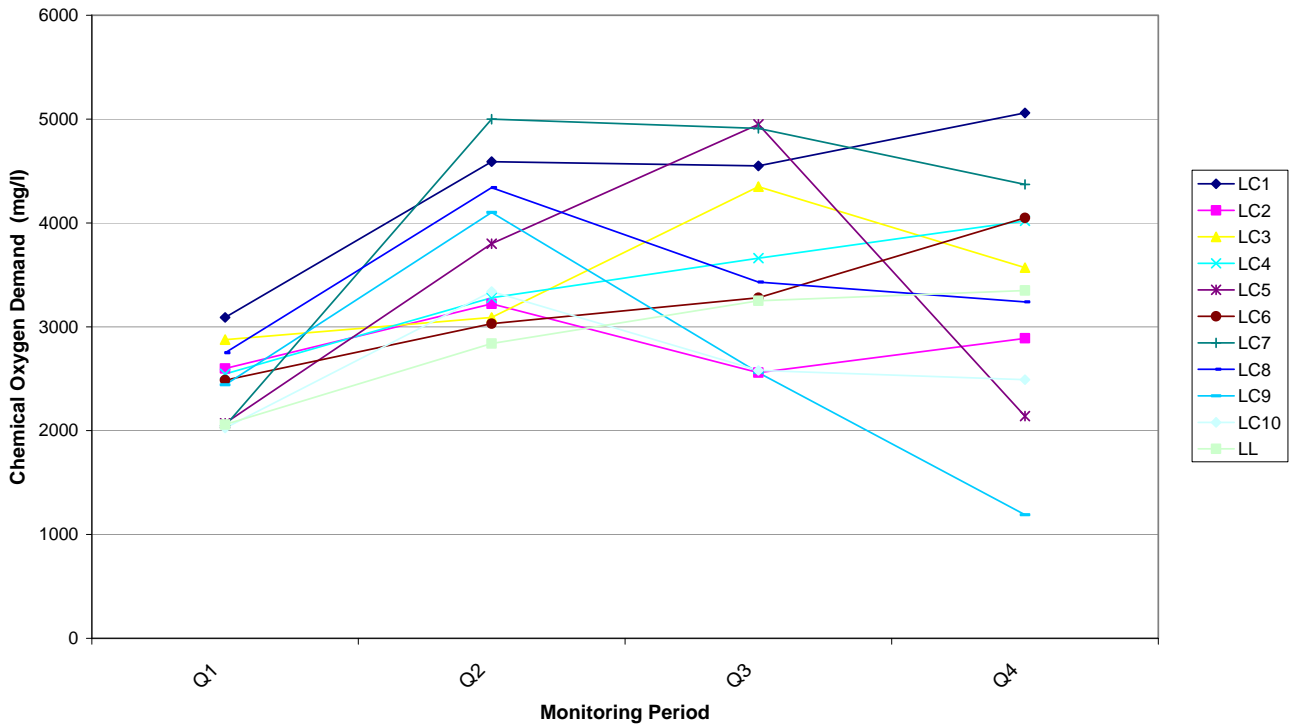


Figure 4.20: Chemical Oxygen Demand Results for Leachate

4.5.1. Conclusion

In general, the reported concentrations for the leachate sample are consistent with the typical composition of leachate sampled from large landfills and in line with the levels presented in the Environmental Protection Agency (EPA) Landfill Manual on Landfill Site Design (2000). The 2010 general results indicate an increase in leachate strength throughout the reporting period, which is expected given the age of the facility.

Leachate is removed off site to a Waste Water Treatment Plant (WWTP) as agreed with the Agency.

4.6. Noise Monitoring

Noise monitoring was discussed in Section 3.2 above. Monitoring of noise emissions from the facility is carried out on a quarterly basis at four locations outlined in Figure 2.1, Appendix I. The results were reported to the Agency as part of the quarterly reports but are summarised below.

Table 4.12:  $L_{Aeq}$  Results for Noise Recorded

Location	Quarter 1	Quarter 2	Quarter 3	Quarter4
N1	52	45	47	41
N2	54	54	<b>59</b>	51
N3	51	51	49	47
N4	50	42	51	44

With the exception of noise recorded in quarter 3 at N2, all other results were within the 55dB limit for daytime noise at the facility boundary. During quarter 3 monitoring a  $L_{Ar}$  (the equivalent continuous A-weighted sound pressure level ( $L_{Aeq}$ ) with specified adjustments/ rating allowance for tonal character and/or impulsiveness of the sound) was 59 dB at N2. The N2 traffic movements and a motorbike, both off-site noise sources, contributed to the dominant noise at the monitoring location.

# Section 5

## Resource and Energy Consumption





## 5. RESOURCE AND ENERGY CONSUMPTION

The main resources consumed at the facility during the reporting period were electricity, water for potable supply & vehicle wheel cleaning, diesel fuel and hydraulic oils. The details are listed in Table 5.1 below.

**Table 5.1: Energy and Resource Consumption at Knockharley, 2010**

Resource	Consumption
Electricity	214,300 kWh
Water, Mains	Unavailable
Diesel(green)	165,096 litres
Hydraulic Oils	250 litres
Odour Neutralisers	2050 litres

An Energy Efficiency Audit was completed in September 2010 in compliance with Condition 2.5.1. The audit was carried out in accordance with the Agency's "Guidance Note on Energy Efficiency Auditing" (2003).



# Section 6

## Development & Restoration Works







## 6. DEVELOPMENT & RESTORATION WORKS

### 6.1. Development Works Undertaken in 2010

A number of development works were carried out during 2010. The main development works included:

- One 2,500m<sup>3</sup>/hr enclosed flare and two 1MW landfill gas engines were commissioned.
- Approximately 30,000m<sup>2</sup> of temporary impermeable cover was installed on the flanks of the landfill footprint and terraced area of Cells 9 and 10.
- A planning application was submitted to An Bord Pleanála. The proposed development comprises the biological treatment of biodegradable municipal waste using anaerobic digestion as its core technology followed by maturation/composting, an office, a soil treatment building, a temporary tonnage increase, modification of the remaining five phases of the landfill footprint, the establishment of a second deposition face for stable and inert wastes and provision of enhanced perimeter screening to the north, north-east and west of the landfill.

### 6.2. Proposed Development Works to be undertaken in 2011

The following development works are planned to be undertaken in 2011:

- Further capping works are intended to be carried out during 2011

### 6.3. Restoration of Completed Cells/Phases

Progressive intermediate capping of cells at the landfill is ongoing. The facility will be developed in seven phases. Each phase contains four cells. To date, three phases of seven have been constructed and waste has been placed in ten cells. Final capping of the perimeter of cells 1 to 4 was completed in 2009.

### 6.4. Updates of the Restoration and Aftercare Plan

A restoration and aftercare plan was submitted to the Agency for agreement on 6th April 2005.

### 6.5. Site Survey

In accordance with Condition 8.9 of the waste licence a topographical survey of the facility is carried out annually. The survey for the 2010 reporting period is included in Appendix II.



# Section 7

## Leachate Volumes





## 7. LEACHATE

The Annual leachate management structure Report (Condition 3.14.5) was submitted to the Agency on 24<sup>th</sup> September 2010.

### 7.1. Volume of Leachate Transported Off Site

The volume of leachate tankered off-site was 29,672.16 tonnes. All this leachate was consigned to Navan Wastewater Treatment Plant.



# Section 8

## Landfill Gas







## 8. LANDFILL GAS

There were two gas utilisation engines and three enclosed flares in operation on-site during the reporting period.

Two high temperature enclosed landfill gas flares (each a *Haase 1,500m<sup>3</sup>/hr*) were installed at a dedicated gas management area east of the waste cells in 2007 and February 2009 respectively. A high temperature enclosed landfill gas flare (*Haase 2,500m<sup>3</sup>/hr*) was installed at a dedicated gas management area east of the waste cells in December 2009. A temporary open flare (*Flaretech 500m<sup>3</sup>/hr*) has been operated since 2005 as a standby flare within the active waste cells of the Site.

Two landfill gas utilisation engines were installed within the same gas management compound.

Table 8.1 and Table 8.3 present data on the flaring and utilisation of methane occurring on-site during the reporting period.

The flare emissions report was submitted to the Agency on 19<sup>th</sup> April 2010 and the engine emission report was submitted to the Agency on 9<sup>th</sup> August 2010.

GasSim modelling for the site shows that landfill gas generation peaks in Scenario 1 in 2010 at 2,300 m<sup>3</sup>/hr and in Scenario 2 at 2,650 m<sup>3</sup>/hr in 2018 (at 95%ile) and gas recovery peaks in Scenario 1 in 2012 at 1,900 m<sup>3</sup>/hr and in Scenario 2 at 2,100 m<sup>3</sup>/hr in 2019 (at 95%ile).

Scenario 1 models the base case (present landfill rate and conditions) while Scenario 2 models the planned case (planned landfilling rate and conditions). For both scenarios the GasSim modeled gas generation for the reporting period, 2010 is 2,300 m<sup>3</sup>/hr. The average methane going to the flares and engines during the reporting period was 40.60%. At a standard density of methane of 0.717 m<sup>3</sup>/kg this gives a predicted methane generation of 5,865,266.93kg/yr methane from GasSim.

Based on actual data recorded in-situ on-site at the flares and engines and entered into the EPA Gas Combustion spread sheet for annual summation, the flare utilisation figure is 4,418,458.18 kg/yr and the engine utilisation is 2,281,803.9 kg/yr CH<sub>4</sub>.



Table 8.1 Summary of Landfill Gas Flared at Knockharley, 2010

Month	Flare 1				Flare 2				Flare 3				Total Methane Collected (m <sup>3</sup> /hr)	Total Methane Collected (kg/yr)
	Total run time (hrs/mth)	Flaring Total (m <sup>3</sup> /hr)	Quantity of LFG Collected		Total run time (hrs/mth)	Flaring Total (m <sup>3</sup> /hr)	Quantity of Methane Collected		Total run time (hrs/mth)	Flaring Total (m <sup>3</sup> /hr)	Quantity of Methane Collected			
			Total CH <sub>4</sub> (m <sup>3</sup> )	Total CH <sub>4</sub> (kg/yr)			Total CH <sub>4</sub> (m <sup>3</sup> )	Total CH <sub>4</sub> (kg/yr)			Total CH <sub>4</sub> (m <sup>3</sup> )	Total CH <sub>4</sub> (kg/yr)		
January	499.0	1,180.0	238,419.1	155,193.5	707.0	1,135.0	314,590.5	205,633.0	0.0	0.0	0.0	0.0	1,505.0	174,862.2
February	384.0	615.0	62,190.4	40,184.8	672.0	750.0	215,051.8	142,327.7	672.0	495.0	145,885.9	96,849.9	1,860.0	279,362.3
March	744.0	530.0	107,744.0	69,399.3	708.5	585.0	177,671.9	118,799.3	744.0	390.0	126,106.4	84,234.4	1,505.0	272,432.9
April	663.0	505.0	102,423.3	65,413.8	696.0	630.0	205,327.0	137,150.8	720.0	515.0	171,432.0	114,393.3	1,650.0	316,957.9
May	677.5	620.0	114,774.5	74,162.3	716.5	610.0	201,635.6	134,685.0	744.0	560.0	188,088.0	125,507.6	1,790.0	334,354.9
June	390.0	650.0	68,262.5	44,201.3	684.0	645.0	194,361.8	128,502.0	720.0	670.0	214,431.6	142,940.1	1,965.0	315,643.4
July	0.0		0.0	0.0	709.5	725.0	172,124.3	106,645.1	744.0	1,340.0	445,132.7	296,725.3	2,065.0	403,370.4
August	0.0		0.0	0.0	712.5	935.0	196,538.6	121,771.7	744.0	1,440.0	458,199.2	305,435.5	2,375.0	427,207.3
September	0.0		0.0	0.0	692.0	940.0	197,056.4	121,958.3	720.0	1,585.0	479,030.1	318,668.5	2,525.0	440,626.8
October	0.0		0.0	0.0	716.5	870.0	195,627.5	122,007.1	744.0	1,515.0	483,179.7	322,416.7	2,385.0	444,423.8
November	0.0		0.0	0.0	636.0	590.0	142,279.8	88,153.9	720.0	1,555.0	487,697.8	321,775.9	2,145.0	409,929.9
December	72.0	610.0	14,653.0	9,568.0	670.5	555.0	141,468.0	88,518.6	744.0	1,425.0	481,765.5	315,235.6	2,590.0	413,322.2
<b>Total</b>	<b>3,429.5</b>		<b>708,466.7</b>	<b>458,123.0</b>	<b>8,321.0</b>		<b>2,353,733.3</b>	<b>1,516,152.4</b>	<b>8,016.0</b>		<b>3,680,948.9</b>	<b>2,444,182.8</b>	<b>24,360.0</b>	<b>4,232,494.0</b>

Table 8.2: Summary of Landfill Gas Utilised at Knockharley, 2010

Month	Engine 1				Engine 2				Total methane collected (m <sup>3</sup> /hr)	Total Methane Collected (kg/yr)
	Total run time (hrs/month)	Utilisation Total (m <sup>3</sup> /hr)	Quantity of Methane Collected		Total run time (hrs/month)	Utilisation Total (m <sup>3</sup> /hr)	Quantity of Methane Collected			
			Total CH <sub>4</sub> (m <sup>3</sup> )	Total CH <sub>4</sub> (kg/yr)			Total CH <sub>4</sub> (m <sup>3</sup> )	Total CH <sub>4</sub> (kg/yr)		
January	0.0		0.0	0.0	0.0		0.0	0.0	0.0	0.0
February	670.0	600.0	174,524.3	115,862.1	0.0	550.0	0.0	0.0	1,150.0	115,862.1
March	742.0	600.0	191,533.9	127,937.5	0.0	550.0	0.0	0.0	1,150.0	127,937.5
April	719.0	600.0	197,434.5	131,744.3	0.0	550.0	0.0	0.0	1,150.0	131,744.3
May	742.0	600.0	198,951.0	132,756.2	501.0	550.0	123,137.8	82,167.5	1,150.0	214,923.8
June	719.0	600.0	189,824.6	126,537.1	718.0	550.0	173,763.9	115,831.0	1,150.0	242,368.0
July	743.0	600.0	197,034.7	131,343.3	742.0	550.0	180,372.0	120,236.0	1,150.0	251,579.2
August	743.0	600.0	188,733.9	125,810.0	743.0	550.0	173,006.1	115,325.8	1,150.0	241,135.8
September	718.0	600.0	179,006.0	119,081.4	718.0	550.0	164,088.8	109,158.0	1,150.0	228,239.4
October	742.0	600.0	188,916.2	126,060.2	742.0	550.0	173,173.2	115,555.2	1,150.0	241,615.4
November	718.0	600.0	185,761.0	122,562.4	719.0	550.0	170,518.0	112,505.3	1,150.0	235,067.7
December	743.0	600.0	200,529.8	131,213.5	742.0	550.0	183,571.5	120,117.1	1,150.0	251,330.6
<b>Total</b>	<b>7,999.0</b>		<b>2,092,249.8</b>	<b>1,390,908.0</b>	<b>5,625.0</b>		<b>1,341,631.4</b>	<b>890,895.9</b>	<b>12,650.0</b>	<b>2,281,803.9</b>



# Section 9

## Summary Annual Water Balance





## 9. METEOROLOGICAL DATA & ANNUAL WATER BALANCE

### 9.1. Meteorological Data

Meteorological data for the site was obtained from Dublin Airport and is presented below.

**Table 9.1: Total Rainfall (millimetres)**

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2010	45.2	36.7	54.8	26.7	38.0	50.3	78.5	48.0	104.3	30.8	100.0	58.1	<b>671.4</b>

The total annual rainfall was recorded as 671.4 mm, with the wettest month recorded as September with 104.3 mm of rainfall and the driest month recorded as April with 26.7 mm of rainfall.

**Table 9.2: Mean Temperature (degrees Celsius)**

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2010	1.7	2.3	4.9	7.7	9.6	14.1	16.0	13.9	13.1	10.1	5.2	-0.1	<b>8.2</b>

The warmest month was recorded as July with a mean temperature of 14.1 °C, while the coolest month was recorded as December with a mean temperature of -0.1 °C.

### 9.2. Indirect Emissions to Groundwater

The Knockharley is a fully engineered and contained landfill and there are no indirect emissions to groundwater from the facility.

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

<b>Landfill Base:</b>	The landfill site has a composite base lining system comprising a HDPE geomembrane and a 0.5 m 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. A CQA report was then completed and submitted to the Agency.
<b>Surface Water Collection and Treatment System:</b>	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
<b>Treated Sewage Effluent:</b>	There is a BioCycle wastewater treatment plant located adjacent to the weighbridge which treats the canteen and office wastewater 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.

### 9.3. Groundwater Trigger Levels

In accordance with Condition 6.6 of the waste licence the groundwater trigger levels (GWTL) have been revised and forwarded to the EPA for approval. Subject to EPA approval, the revised GWTL will be used in the assessment of groundwater quality. For the present reporting period and until the approval of the GWTL's, groundwater quality is assessed against baseline groundwater results.

### 9.4. Water Balance Calculation

An annual water balance calculation was completed for the site. The calculation is based on a waste input of 135,929 tonnes of waste.

The calculation indicated a leachate production of 27,633.1 m<sup>3</sup> yr<sup>-1</sup> while leachate tankered off site was recorded at 29,672.16 tonne yr<sup>-1</sup>. A greater volume of leachate was tankered off site than was calculated to have been produced during the reporting period.



## 9.5. Estimated Liquid In-Waste Volume

Year	Rainfall	Evaporation	Effective Rainfall †	Waste Input	Active area	Intermediate restoration area (cell 5-10)	Final restoration (cells 1,2,3,4)	Active Infiltration *	Intermediate Infiltration **	Capped Infiltration* **	Liquid Waste	Absorptive Capacity ††	Active Leachate	Total Leachate Production
	(mm)	(mm)	(mm)	(tonnes)	(m <sup>2</sup> )	(m <sup>2</sup> )	(m <sup>2</sup> )	(m <sup>3</sup> )	(m <sup>3</sup> )	(m <sup>3</sup> )	(m <sup>3</sup> )	(m <sup>3</sup> )	(m <sup>3</sup> )	(m <sup>3</sup> )
2010	671.4	67.14	604.26	135,929	42,420	26167	20485	25,632.7	10,277.6	1,237.8	0	9,515.0	16,117.7	27,633.1

**Notes:**

The calculation was carried out using MS Excel following the method from the EPA Landfill Manual on Landfill Site Design, as shown:

$$L_o = [ER(A) + LW + IRCA + ER(I)] - a(W);$$

where:

- Lo = leachate produced(m3)
- ER = effective rainfall, [(ER) is defined as Total Rainfall (R) minus Actual Evapotranspiration (AE) i.e. ER=R-AE]
- A = area of cell (m2)
- LW = liquid waste (m3)
- IRCA = infiltration through restored and capped areas (m3)
- I = surface area of lagoons (m2)
- a = absorptive capacity of waste (m3/t)
- W = weight of waste deposited (t/a)

Cell Area (m2) 8907

† Evapotranspiration calculated at 10% of actual rainfall

†† Absorptive Capacity (m3/tonne) 0.07

\* Active infiltration rate 100%

\*\* Intermediate Infiltration 65%

\*\*\* Final infiltration 10%



# Section 10

## Environmental Management System





## 10. ENVIRONMENTAL MANAGEMENT SYSTEM

### 10.1. Environmental Management System

In accordance with Condition 2.3 of the waste licence an Environmental Management System is maintained at the facility. The EMS proposal completed as part of the Environmental Management Plan was sent to the Agency on the 23rd July 2004 and was approved on the 23rd December 2004.

Updates on the EMS are presented in the following sections of the AER.

### 10.2. Updates on the Landfill Environmental Management Plan (LEMP)

The Landfill Environmental Management Plan was revised and updated in compliance with Condition 2.3.2.2 in November 2010.

Updates included change of waste licence from W0146-01 to W0146-02, changes to landfill gas infrastructure through the addition of a 2,500m<sup>3</sup>/hr enclosed flare and two 1MW landfill gas engines, change of management staff structure, updated objectives and targets and progress on capping.

### 10.3. Report on Staff Training

All training was carried out as scheduled in the training plan for 2010. Details are as follows: -

- ◆ Occupational First Aid – Acting Landfill Manager, Acting Assistant Landfill Manager, Foreman (refresher) and 1 General Operative (refresher)
- ◆ Safe Pass – Weighbridge Operator
- ◆ Butt Welding Training - Chargehand
- ◆ Artic Dump Truck Training – Chargehand and 2 General Operatives
- ◆ Introduction to Weighbridge Operations – Acting Assistant Landfill Manager
- ◆ ISO14001 and Environmental Awareness – Acting Assistant Landfill Manager
- ◆ Spill Training/Chemical Awareness – Acting Assistant Landfill Manager
- ◆ Introduction to Complaints Procedure – Acting Assistant Landfill Manager
- ◆ Introduction to Waste Licence 146-02 – All staff
- ◆ Safe Use of Lifting Equipment – All staff
- ◆ Use of Personal Gas Meter – All staff
- ◆ Emergency Preparedness and Response Procedure – All staff
- ◆ Various site specific procedure training and H&S tool box talks- All staff

Any facility staff who performs duties which involve interpretation of monitoring results or site inspections receive the appropriate training by the General Manager or nominated deputy, prior to carrying out such duties.

### 10.4. Management and Staffing Structure

The day to day management of the facility and supervision of waste activities are the responsibility of the General Manager, nominated Deputy Manager(s) and the site operatives. The positions and names of the persons who provide management and supervision are set out as follows: -

General Manager	John Jones
Acting Landfill Manager	Heather Miller*
Acting Assistant Landfill Manager	Neil Menzies*
Site Foreman	Robert Hughes*
Chargehand	Sean Smith*
Weighbridge Operator	Michael Noone
General Operatives	Ainars Elbergs, Martin Maguire & Donal Blaney

\*Nominated Deputy in accordance with W0146-02 Condition 2.1.

Suitably experienced and qualified plant operators are supplied by Plant Hire Contractor, Renton Plant.

#### 10.4.1. Responsibilities

Greenstar, as the licensee, is responsible for ensuring that the requisite resources are provided to operate the facility in accordance with the objective of the LEMP and the Waste Licence conditions.

The General Manager or nominated Deputy is responsible for ensuring that the day to day operation of the facility is carried out in accordance with the LEMP, the Waste Licence conditions and the Operating Procedures.

### 10.5. New Procedures Developed During 2010

New operational procedures developed in for the site are presented below. Additionally a revision to the Odour Management Plan, OMP and an up to date Nuisance Inspection Procedure are attached in Appendix III.

<b>KNKP 37</b> Surface Water Monitoring Procedure	Details the method used for surface water monitoring to ensure that representative measurements of surface water are collected and documented using appropriate safety procedures.
<b>KNKP 38</b> Safe Use of Lifting Equipment	The purpose of this procedure is to ensure that lifting operations are conducted in a safe manner, operatives are aware of their responsibilities and the dangers associated with improper use of lifting equipment.
<b>KNKP 39</b> Environmental Monitoring Procedure	This document outlines the environmental monitoring protocol with respect to self monitoring of water, perimeter gas wells and air emissions. This policy complies with Condition 8 of site Waste Licence W0146-02 and EPA correspondence 'EPA's Requirements on the Quality of Self Monitoring Compliance Data at Licensed Facilities'.
<b>KNKP 40</b> Late Load Procedure	The purpose of this procedure is to ensure that a system is in place to be followed in the event of loads arriving after the normal hours of waste acceptance.
<b>KNKP 42</b> Procedure for Installation of Horizontal Wells	This procedure details the method to be used by landfill staff when installing horizontal gas extraction wells within the body of the landfill.
<b>KNKP 43</b> Reporting of Environmental Incidents	This procedure applies to Waste Licence W0146-02 Condition 9.1 concerning the reporting of incidents to the Environmental Protection Agency.

### 10.6. Summary Schedule of Environmental Objectives and Targets

This section of the report presented the program of environmental objectives and targets for 2011. The progress against the 2010 objectives and targets are also discussed.

Table 10.1: Programme of Environmental Objectives and Targets proposed for 2011

Ref. No.	Objective	Aspect	Target	Deadline	Responsibility
1	Gas Management	1. Generation of LFG 4. Release of LFG	Hold Gas Management meetings every 6 months to review existing infrastructure and discuss maintenance and upgrading as required.	On-going	AM/FM
			In accordance with condition 6.10.5 of the waste licence W0146-02, the site will aim to reduce the number of fugitive VOC emissions from the landfill at each survey. Records are kept showing results of surveys.	On-going	All
			All waste filled to final levels during 2011 to have permanent capping installed within 24 months	2013	FM/AM
			Flow meters to be installed on gas engines to give better optimisation whilst balancing gas wells	March/April 2011	CetCo
			Reduce O2 level in bad gas stream to for optimal operational efficiency of flares once temporary capping in place	Apr-11 Dec-11 Jun-12	AM/FM
			-5%		
			-4.50%		
			-3.50%		
Maintain engines at O2 level of 2.5% and below for optimal running and output	On-going	AM/FM			
Extend existing measures to further insulate pipes and flares to prevent against potential downtime during cold months. Use of light bulbs to keep pumps warm.	Sept/Oct 2011	AM/FM			
Increase use of double lifts and horizontal wells along exposed outer flanks of landfill.	On-going	AM/FM			

Ref. No.	Objective	Aspect	Target	Deadline	Responsibility
2	Leachate Management	12. Generation of leachate	Continue to monitor and control leachate through quarterly leachate quality monitoring and weekly leachate level checks.	Weekly, Quarterly, On-going	FM
			Implement recirculation of leachate at the landfill.	When final capping sufficient and Agency approval given	
			Continually assess and upgrade infrastructure as necessary.	Continual	FM
			Construct leachate processing plant on site.	Q4, 2011	AM/FM
			Permanent capping to all finished areas of landfill and extra clay capping on intermediate areas.	Start 2011 - 2013	AM/FM
3	Landscaping	2/26.Generation of GHG's	Maintain and continue to improve all on site landscaping and the wetland area.	On-going	FM
		20. Emissions to air 17. Visual Impact	Employ a landscape contractor to assess plantations, replace failed trees/plants and improve the overall general appearance of the landfill site.	On-going (Seasonal)	FM



Ref. No.	Objective	Aspect	Target	Deadline	Responsibility
			Implement planting of fruit and nut trees as part of landscaping in planning application.	End 2011	AM/FM
4	Environmental Control / Nuisance		Review relationships with neighbours and interested parties on a continual basis and review communications programme annually.	Annually & On-going	AM/FM
			Review the number and composition of complaints to determine any trends.	Monthly	FM
		3/6/8. Generation of dust	Extend litter picking to include inner boundary road as illegal dumping appears to have increased here.	On-going from March	AM/FM
		6. Birds/vermin/flies	Continue to hold regular meetings with local residents	Quarterly, On-going	AM/FM
		4. Release of LFG	Finish cells 9/10 and go into cells 11/12 where visual aspect can be minimised.	End 2011	FM
		5/9. Litter	Continue with litter patrols and litter picking	On-going, weekly	AM/FM
		13/15/19.Noise	Actively encourage site visits from interested parties i.e. local community groups, schools, clubs, etc.	On-going	AM
		17. Visual Impact	Review relationships with neighbours and interested parties on a continual basis and review communications programme annually.	Annually & On-going	AM/FM
		Aspects 1-28	Continue distribution of newsletter to local people at regular intervals.	Spring and Autumn 2011	AM/FM
		11/16/23. Use of energy	Continue to provide sponsorship of interested local parties, clubs, etc.	On-going	FM
		2. Generation of GHG's	Establish relationship with 1 new groups/clubs per year	Annually	AM/FM
			Keep Public Information Room updated and current.	On-going	AM

Ref. No.	Objective	Aspect	Target	Deadline	Responsibility
5	Education and Environmental Awareness		Update as part of newsletter, progress on planning permission	Autumn 2011	AM/FM
			Review Communications Programme	Autumn 2011	FM
			Investigate possibility of establishing fruit and nut orchard in perimeter land as a natural habitat and as an educational area for local schools and residents	End 2011	AM/FM
			Implement an updated Energy Awareness Programme incorporating the recommendations from the 2010 energy audit.	Sept 2010 Onwards	AM/FM
			Look into changing all light bulbs to energy saving versions	Jun-11	AM
			Implement a review of energy consumed per area of the site.	May-11	AM
			Fix water leak and regain costs lost as a direct result by issuing a leak rectifying report to Meath Co Co	Jun-11	AM/FM
			Put energy use and energy saving report into Autumn Newsletter	Autumn 2011	AM
			Install new energy saving dishwasher	Mar-11	FM
6	Reduce energy usage on-site	11/16/23. Use of energy 2. Generation of GHG's	Implement an updated Energy Awareness Programme incorporating the recommendations from the 2010 energy audit.	Sept 2010 Onwards	AM/FM
			Look into changing all light bulbs to energy saving versions	June 2011	AM
			Implement a review of energy consumed per area of the site.	May 2011	AM
			Fix water leak and regain costs lost as a direct result by issuing a leak rectifying report to Meath Co Co	June 2011	AM/FM
			Put energy use and energy saving report into Autumn Newsletter	Autumn 2011	AM
			Install new energy saving dishwasher	Mar-11	FM

Table 10.2: Schedule &amp; progress against Environmental Objectives and Targets for 2010

Ref. No.	Objective	Aspect	Target	Deadline	Responsibility	Progress
1	Gas Management	1. Generation of LFG 7. Release of LFG	Hold Gas Management meetings every 6 months to review existing infrastructure and discuss maintenance and upgrading as required.	On-going	AM/FM	2 meetings were held in 2010.
2	Leachate Management	2. Generation of leachate	Continue to monitor and control leachate through quarterly leachate quality monitoring and weekly leachate level checks.	Weekly, Quarterly  On-going	FM	On-going.
			Implement recirculation of leachate at the landfill.	When final capping sufficient		Infrastructure installed under final cap. Not in use at present.
			Continually assess and upgrade infrastructure as necessary.	Continually	FM	On-going.
			Assess the potential for alternatives outlets for leachate, e.g. Anaerobic Digestion	2011/2012	Donal Monaghan	Proposals in progress.
3	Landscaping	4. Generation of GHG's 14. Emissions to air 17. Visual Impact	Maintain and continue to improve all on site landscaping and the wetland area.	On-going	FM	On-going.
			Employ a landscape contractor to assess plantations, replace failed trees/plants and improve the overall general appearance of the landfill site.	On-going (seasonal)	FM	On-going. Contractor engaged.
4	Public Relations	5/9/12. Generation of dust 6. Birds/vermin/flies 7. Release of LFG 8/13. Litter 16/18.Noise	Review relationships with neighbours and interested parties on a continual basis and review communications programme annually.	Annually and on-going	AM/FM	Communications Programme updated during 2010.

		17. Visual Impact	Review the number and composition of complaints to determine any trends.	Monthly	FM	Reviewed monthly and quarterly during Env Mgmt Meetings.
			Establish a newsletter for distribution to local people at regular intervals.	On-going bi-annual publication	AM	Community News Issue 4 June 2010.
			Continue to hold regular meetings with local residents.	Quarterly On-going	AM/ FM	Scheduled meetings held quarterly.
5	Education and Environmental Awareness	5/9/12. Generation of dust 6. Birds/vermin/flies 7. Release of LFG 8/13. Litter 16/18.Noise 17. Visual Impact	Actively encourage site visits from interested parties i.e. local community groups, schools, clubs, etc.	On-going	AM	Visits from local schools "Green Team", members of public and Open Day on 14 <sup>th</sup> June.
			Continue to provide sponsorship of interested local parties, clubs, etc.	On-going	FM	On-going.
			Keep Public Information Room updated and current.	On-going	AM	New displays made in 2010.
			Organise Open Day for 2010	Quarter 2/3	AM/FM	Held on 14 <sup>th</sup> June 2010.
6	Reduce energy usage on site	3/10/15. Use of energy 4. Generation of GHG's	Carry out an annual review of energy usage	Annually On-going	AM/FM	Energy Audit undertaken Sept 2010.
			Employ an energy consultant to carry out a follow up energy audit and report every 3 years	June 2010	FM	As above.
			Implement an Energy Awareness Programme incorporating the recommendations from the 2007 energy audit.	Ongoing	AM/ FM	Implemented and on-going.
			Implement a review of energy consumed versus energy generated on site.	September 2010	AM	Included in Energy Audit.

## 10.7. Review of Nuisance Controls

Greenstar Ltd is committed to operating the Knockharley facility in the best possible manner using the best available techniques to minimise impacts on the environment and local residential neighbours. Knockharley 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.

### 10.7.1. Odour

In addition to the landfill gas abstraction system, good operational practices on-site are the main controls to avoid odour nuisances. The handling, depositing and covering of waste at the facility is carried out in accordance with the Agency's Landfill Manual "Landfill Operational Practices". In addition Greenstar have developed a site specific Odour Management Plan (KNKP 033) a copy of which is included in Appendix III. The plan specifies the operational requirements for the waste placement, the landfill gas management infrastructure and addresses all aspects of odour control.

Any loads with a particular potential for generation of odours are rejected in accordance with the waste acceptance procedures, which are in operation at the facility as submitted to and agreed by the Agency in December 2004.

The waste delivery trucks are unloaded at the working face and the waste is compacted within 3 to 4 minutes. The level areas of the working face are covered on a continuous basis during the day. The slope of the working face is covered completely with artificial cover sheets at the end of each working day, which can easily be removed again the following day prior to commencement of operations.

An odour neutralizing misting spray is installed along several sections of the litter fencing to mitigate potential waste odours. A mobile misting unit and contact neutralizer are also available on site and are used as necessary.

### 10.7.2. Vermin Control

The methods used for vermin control are as detailed in Nuisance Inspection Procedure (KNKP 32) in Appendix III. A specialist contractor is employed by Greenstar to carry out a vermin control programme. Measures used include internal and external bait boxes, rodenticides and insect control measures. The specialist contractor visits the site at regular intervals throughout the year to inspect the control measures and assess their effectiveness. These control measures have found to be successful.

The fly monitoring, which was undertaken throughout the summer months using a Scudder grid and fly counting technique revealed low fly numbers.

### 10.7.3. Birds

Greenstar employs one of the leading bird control specialists, Falcon Bird Control Services, who operate a seven day dawn to dusk programme. An aviary is provided at the site, which houses the birds of prey used by the contractor. The main aim of the Programme is to create an association of danger, so that birds choose not to fly around the area where bird control is active. This association is achieved using a variety of methods such as visual and audible deterrents in compliance with the licence. To date these measures have proven to be successful.

### 10.7.4. 6.4 Dust

Dust and mud control measures were implemented at 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. To date these measures have proven to be successful.

10.7.5. Litter Control

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 and litter has not been an issue at the facility.

## 10.8. Reported Incidents and Complaints Summary

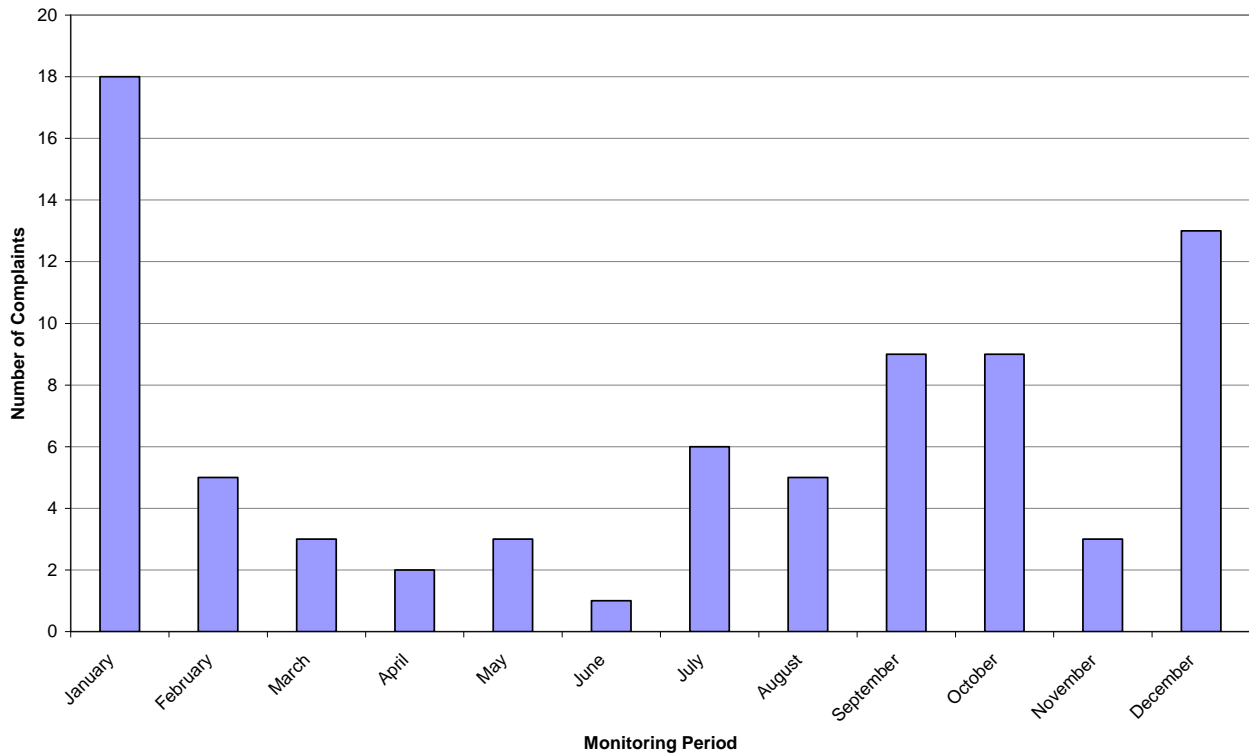
There were three incidents on-site during the reporting period. One was a small fire on the exhaust of a trailer. Two were for volatile organic compound, VOC Surface Emission exceedances in accordance with Condition 6.10.5 of WL W0146-02.

Greenstar maintains a register of complaints in compliance with Condition 10.14. Details of all complaints received during the reporting period and the action taken by Greenstar are available at the facility. Data showing the composition of the complaints presented in Table 11.4.

**Table 10.3: Summary of Complaints**

Month	Odour	Other	Total
January	18	0	18
February	5	0	5
March	3	0	3
April	2	0	2
May	3	0	3
June	1	0	1
July	6	0	6
August	5	0	5
September	9	0	9
October	9	3	12
November	3	1	4
December	13	0	13

As observed from the data in Table 11.4 odour complaints dominate the register during the reporting period. The breakdown of odour complaints through the reporting period is presented in Figure 11.1.



**Figure 10.1: Breakdown of odour complaints to the site during the reporting period**

### 10.9. Site Testing and Inspection Reports

As per Schedule E and Condition 3.11.6 of the waste licence, the integrity of the bunds and tanks are carried out every three years. Testing of bunds, tanks and containers was undertaken in May 2008 so is due May 2011.

### 10.10. European Pollutant Release and Transfer Register

Under the European Pollutant Release and Transfer Register Regulation (EC) No. 166/2006 Greenstar are required to submit information annually to the Agency. A copy of the information submitted to the Agency via the web-based data reporting system is included in Appendix IV.

### 10.11. Statement of Measures for prevention of environmental damage and financial provisions/ELRA

In compliance with waste licence Condition 12.2 Greenstar has put in place a Bank Guarantee with Bank of Ireland to the value of €2,717,820. Details of this bank guarantee have been submitted to the EPA.

In compliance with waste licence condition 12.1.2 a comprehensive and fully costed Environmental Liabilities Risk Assessment (ELRA) has been completed.

Condition 12.3 of the waste licence states, *'In accordance with the provisions of Section 53A of the Waste Management Acts 1996 to 2010, the licensee shall ensure the costs involved in the setting up and operation of the facility, as well as the costs of closure and after-care (including cost of provision of financial security) for a period of at least 30 years (post closure) shall be covered by the price to be charged for the disposal of waste at the facility'*.

In relation to this matter Greenstar can confirm that the gate fee for the disposal of waste at the Knockharley Landfill is appropriate in the current market and includes financial provision for the closure, restoration and aftercare of the site.

## 10.12. Public Information Programme

Knockharley 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 required by Condition 2.4.1 of the waste licence, was established three months before the start of waste activities and has been submitted to the Agency. This document is reviewed and updated at regular intervals.

A public Open Day was held on 14<sup>th</sup> June 2010. An information marquee was open to the public from 1pm to 7pm. Displays describing landfill activities, a short DVD about the facility and guided tours of the landfill and gas utilisation plant were available to all visitors. Landfill staff and consultants answered questions and guests were encouraged to take home information leaflets and fact sheets.

A dedicated public information room is maintained at the facility and an open door policy is encouraged.



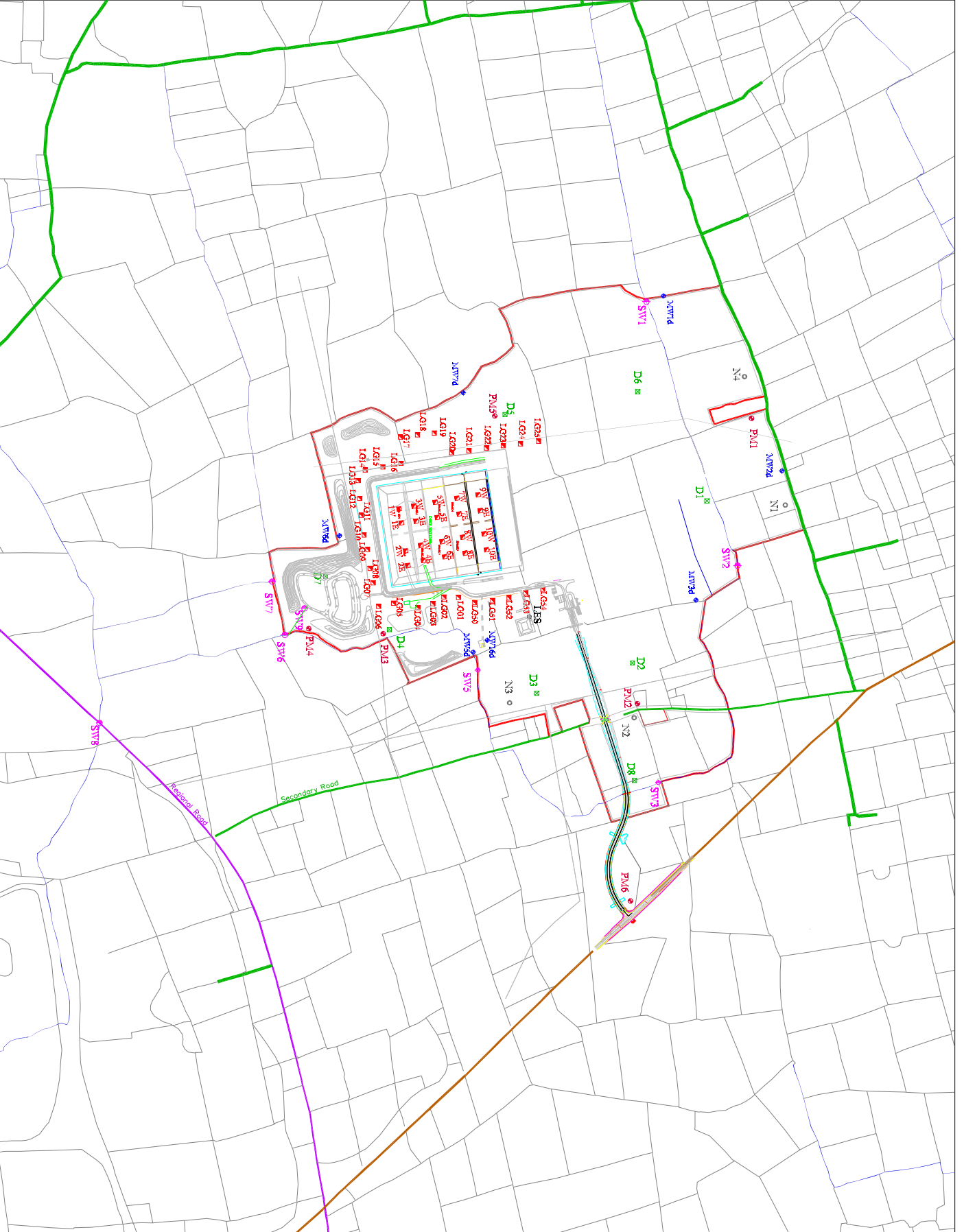


ENVIRONMENTAL BALANCE IN DESIGN AND CONSTRUCTION

# Appendix I

Maps





NOTES

No	Id	Easting	Northing
1	STV1	287718	267774
2	D1	287714	267680
3	D2	287811	267626
4	D3	287808	267584
5	D4	287804	267542
6	D5	287800	267500
7	D6	287896	267446
8	D7	287892	267404
9	D8	287888	267362
10	PM1	287884	267320
11	PM2	287981	267266
12	PM3	287977	267224
13	PM4	287973	267182
14	PM5	287969	267140
15	PM6	287965	267098
16	STV2	287961	267056
17	STV3	287957	267014
18	STV4	287953	266972
19	STV5	287949	266930
20	STV6	287945	266888
21	STV7	287941	266846
22	STV8	287937	266804
23	STV9	287933	266762
24	STV10	287929	266720
25	STV11	287925	266678
26	STV12	287921	266636
27	STV13	287917	266594
28	STV14	287913	266552
29	STV15	287909	266510
30	STV16	287905	266468
31	STV17	287901	266426
32	STV18	287897	266384
33	STV19	287893	266342
34	STV20	287889	266300
35	STV21	287885	266258
36	STV22	287881	266216
37	STV23	287877	266174
38	STV24	287873	266132
39	STV25	287869	266090
40	STV26	287865	266048
41	STV27	287861	266006
42	STV28	287857	265964
43	STV29	287853	265922
44	STV30	287849	265880
45	STV31	287845	265838
46	STV32	287841	265796
47	STV33	287837	265754
48	STV34	287833	265712
49	STV35	287829	265670
50	STV36	287825	265628
51	STV37	287821	265586
52	STV38	287817	265544
53	STV39	287813	265502
54	STV40	287809	265460
55	STV41	287805	265418
56	STV42	287801	265376
57	STV43	287797	265334
58	STV44	287793	265292
59	STV45	287789	265250
60	STV46	287785	265208
61	STV47	287781	265166
62	STV48	287777	265124
63	STV49	287773	265082
64	STV50	287769	265040
65	STV51	287765	264998
66	STV52	287761	264956
67	STV53	287757	264914
68	STV54	287753	264872
69	STV55	287749	264830
70	STV56	287745	264788
71	STV57	287741	264746
72	STV58	287737	264704
73	STV59	287733	264662
74	STV60	287729	264620
75	STV61	287725	264578
76	STV62	287721	264536
77	STV63	287717	264494
78	STV64	287713	264452
79	STV65	287709	264410
80	STV66	287705	264368
81	STV67	287701	264326
82	STV68	287697	264284
83	STV69	287693	264242
84	STV70	287689	264200
85	STV71	287685	264158
86	STV72	287681	264116
87	STV73	287677	264074
88	STV74	287673	264032
89	STV75	287669	263990
90	STV76	287665	263948
91	STV77	287661	263906
92	STV78	287657	263864
93	STV79	287653	263822
94	STV80	287649	263780
95	STV81	287645	263738
96	STV82	287641	263696
97	STV83	287637	263654
98	STV84	287633	263612
99	STV85	287629	263570
100	STV86	287625	263528

- MONITORING LOCATIONS LEGEND:**
- Detects water gas monitoring location
  - + Detects volatile monitoring location
  - + Detects groundwater monitoring location
  - + Detects subterranean monitoring location
  - + Detects noise monitoring location
  - + Detects dust monitoring location
  - + Detects PM10 monitoring location
  - + Detects meteorite monitoring location

REV	DATE	DESCRIPTION	BY	CHK	APP
A	29/11/20	ISSUE	WJF	JOC	JOC
B			WJF	JOC	JOC

TITLE  
MONITORING LOCATIONS  
KNOCKHARLEY  
LANDFILL

CLIENT  
GREENSTAR LTD

SCALE  
1:5,000  
A3

FIGURE 2.1

REV  
B





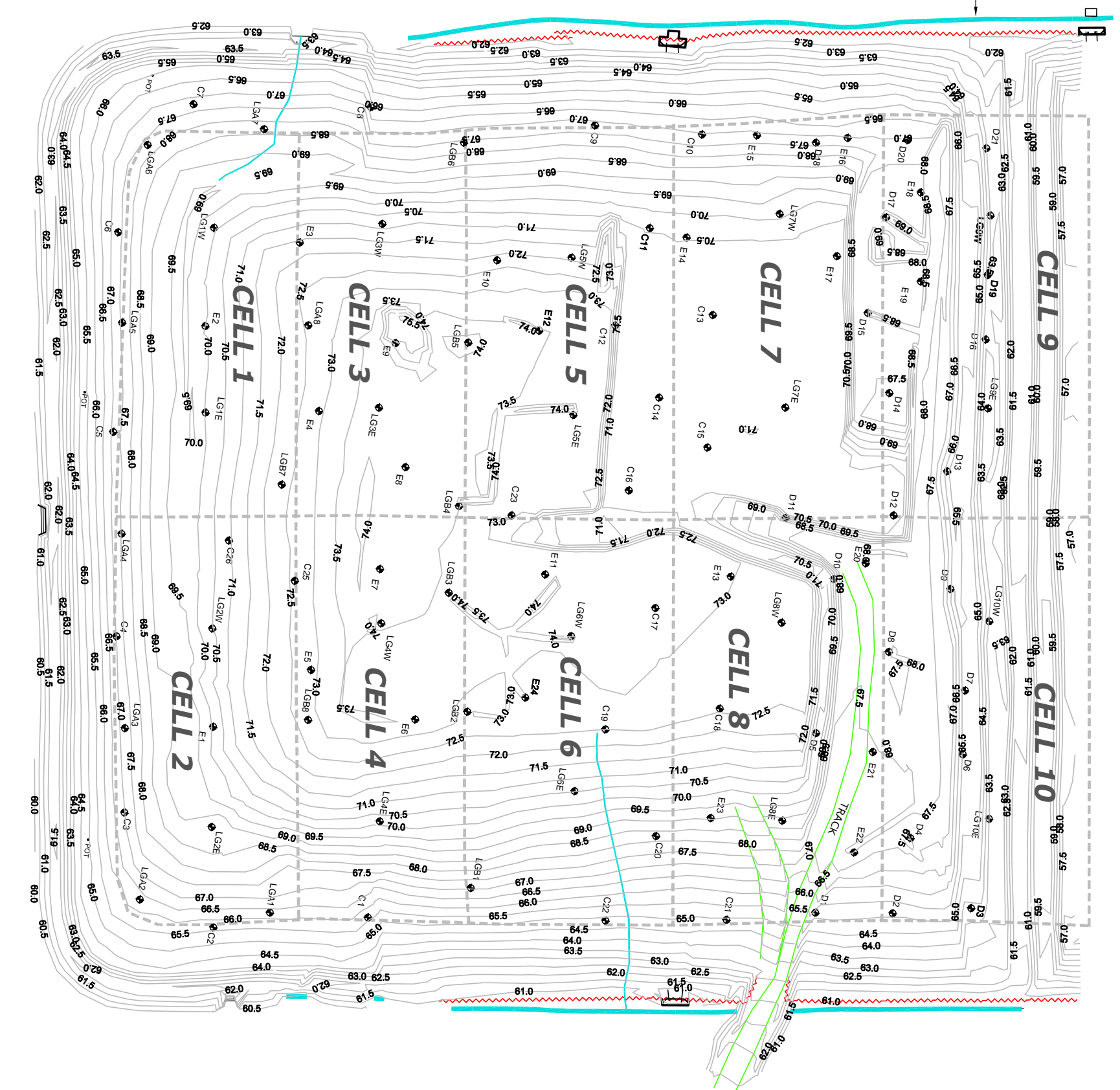
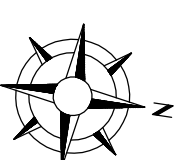
ENVIRONMENTAL BALANCE IN DESIGN AND CONSTRUCTION




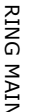
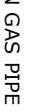
# Appendix II

## Topographical Survey





**LEGEND**

-  WASTE CONTOUR (SURVEYED 18/01/11)
-  RING MAIN GAS PIPE (355mmØ)
-  EXISTING GAS WELL

Client: **greenstar**  
 Location: **KNOCKHARLEY LANDFILL CO. MEATH**  
 Project: **WASTE VOID VOLUME SURVEY**

Title: **WASTE CONDITIONS AS SURVEYED 18TH JAN. 2011**  
 Scale: **1:1,500 A3**

Project number: **09.50719.0114**  
 File Location: **GREENSTAR/KNOCKHARLEY/GOLDER DWGS/WASTE SURVEY/WS-18-01**  
 Ordnance Survey Ireland Licence Number: **AR0056010**

Issue to	Date	Version	Drawing
TO CLIENT	Jan. '11	A	

W-S 18/1







ENVIRONMENTAL BALANCE IN DESIGN AND CONSTRUCTION




# Appendix III

Updated Procedures

- Odour Management Plan
- Nuisance Inspection Procedure



<b>Title</b>	Odour Management Plan					
<b>Ref</b>	KNKP 33	<b>Rev</b>	3	<b>Date</b>	30/11/10	
<b>Issued.</b>	HM	<b>App.</b>	JJ	<b>Pg</b>	67/3	

01. Scope

This procedure addresses all aspects of odour control and landfill gas management.

02. Responsibility

The Facility Manager will implement this procedure. The nominated deputy (s) and site staff are responsible for implementing odour prevention and abatement measures, ensuring this procedure is correctly followed. Consultants and external experts will be used to carry out and manage specialist monitoring under the terms of the licence.

03. References

GS 001	Daily Site Condition Report
GS 002	Weekly Site Condition Report
GS 003	Weekly Inspection Sheet
GS 005	Odour Inspection Record
GS 037	Flare Downtime Log
KNKP 03	Training and Awareness Procedure
KNKP 14	Operation Start Up and Shut Down Procedure
KNKP 23	Completion of Daily Site Condition Reports
KNKP 24	Waste Acceptance and Handling Procedure
KNKP 30	Weekly Inspection Procedure
KNKP 32	Nuisance Inspection Procedure
KNKP 34	Operation of Landfill Gas Flare
KNKP 42	Installation of Horizontal Wells Procedure
KNKP 43	Reporting of Environmental Incidents

Waste Licence 146-02

04. PROCEDURE

4.1. *Training and Resources*

Adequate training and resources will be provided for the maintenance, monitoring and operation of landfill gas infrastructure. Training requirements for all site staff shall be identified in accordance with Training and Awareness Procedure KNKP 03.

One staff member will be dedicated full time to landfill gas management at Knockharley Landfill and 3<sup>rd</sup> party specialist contractors used for regular servicing and maintenance of plant and equipment.

4.2. *Acceptance and Management of odorous wastes*

The adoption of best practice is known to significantly reduce the release of odours to the atmosphere, particularly from the active disposal area. Odour nuisance is prevented by implementing the following measures:

- Pre-identification and booking of loads consisting of, or containing, malodorous wastes
- Any odorous waste received shall be tipped at the bottom of the working face and immediately covered with a layer of non-odorous waste or cover material
- Any waste arriving at the facility, which can be clearly identified as being malodorous, shall be rejected in accordance with the Waste Acceptance & Handling Procedure KNKP24

#### 4.3. Working face/active cell sizing and covering

In accordance with Waste Licence W0146-02, the following shall apply:

- Only one working face for the disposal of waste shall be open at any one time
- The working face shall be restricted to 25m length by 25m width (625m<sup>2</sup> surface area) and 2.5m in height after compaction
- Application to the working face of 150mm of daily cover of a suitable material, to prevent odour migration, at the end of each working day
- Application of 300mm of suitable intermediate capping to temporarily un-worked areas

It shall be ensured that the joint between vertical bunds and horizontal layers of daily cover material and temporary capping is not less than the required 150 mm and 300 mm respectively, as it is potentially a weak point which could provide a migration path for landfill gas in addition to waste odours.

Daily cover material shall be placed in accordance with Operation Start Up and Shut Down Procedure KNKP 14.

#### 4.4. Odour suppression methods

A misting system installed on permanent litter fencing will be used to pump sprays containing a natural odour neutralising/masking agent to prevent any potential odour nuisance arising off-site. Mobile misting units will be used at the working face or potentially odorous areas as necessary.

Contact neutraliser shall be sprayed directly on to odorous wastes on the working face using the water bowser, as required. The Supervisor will ensure the Banksman carefully monitors the working face for this requirement.

#### 4.5. Landfill gas collection and infrastructure

Long term odour control will be achieved via the active landfill gas extraction system, which collects landfill gas under negative pressure, reducing the potential for odours to be released in an uncontrolled manner. The gas extraction system will comprise the following:

##### 4.5.1. Vertical wells

Vertical landfill gas extraction wells shall be constructed, progressively with the development of the landfill, at 50 metre lateral and longitudinal centres. Additionally, vertical wells shall be drilled into the waste as required and determined by surveys of fugitive emissions, in order to minimise or eliminate landfill gas migration. The additional drilled wells shall be installed between the constructed main gas extraction wells, so as to reduce the distances between the individual wells and to increase the capture rate of landfill gas. Where appropriate, sacrificial vertical "pin" or "spike" wells will also be installed. It shall be ensured that the vertical gas wells are sealed at surface with bentonite as required in order to minimise the ingress of oxygen and the potential for migration of landfill gas.

##### 4.5.2. Horizontal wells

In order to further enhance gas extraction, horizontal gas wells consisting of slotted gas extraction pipes embedded in stone filled trenches shall be installed as appropriate. Horizontal trenches shall be installed in accordance with Installation of Horizontal Wells Procedure KNKP 42.

#### 4.5.3. Landfill gas collection network

All vertical and horizontal landfill gas extraction wells shall be connected to the gas collection pipe network which shall consist of a 355 mm ring main around the landfill footprint and 180 mm branches laid across the landfill surface. Each individual well as well as each individual branch shall, prior the point of connection into the next higher collection level (i.e. well-branch connections and branch-ring main connections) be equipped with shut-off valves, in order to enable flow restriction or isolation of individual wells or branches.

#### 4.5.4. Condensate removal

In order to continuously remove condensate from the landfill gas extraction network and therefore avoid uncontrolled flow restriction and pulsating, the ring main shall be connected to the gas flaring and utilisation plant via condensate knockout pots. The condensate accumulating in these pots shall be removed by pneumatic/electric pumps and piped back into the leachate riser pipes, from where it can drain to the cell base and be removed with the leachate.

#### 4.5.5. Field balancing and monitoring

Daily checks of the landfill gas field and combustion plant shall be undertaken to ensure optimum operation. Monitoring of internal and external landfill gas wells is carried out in accordance with Waste Licence 146-02 Schedule D.

#### 4.5.6. Landfill gas utilisation and flaring plant

The landfill gas collected in the landfill gas extraction and collection network shall, after passing through the condensate knockout pots, be flared off in an enclosed flare or utilised in gas combustion engines with electricity generation, as appropriate. Contingency arrangements shall be made to avoid gas venting in the case of plant failures.

Procedure KNKP 34 for the operation of landfill gas flares addresses the operational requirements to optimise the combustion rates and maintain compliance with emission limits and monitoring requirements. Any significant downtime of landfill gas flares or other utilisation equipment shall be logged on Form GS 037. Should significant downtime of landfill gas flares or other utilisation equipment occur and cause potential for environmental pollution, the Environmental Protection Agency shall be notified in accordance with procedure KNKP 43.

### 4.6. *Cover and capping*

Upon reaching the calculated filling heights, a settlement period is required prior to constructing an engineered cap. Premature capping could lead to problematic levels of differential settlement which would impact upon the integrity of the lining and gas extraction systems. When final levels are reached and sufficient settlement has occurred, the phased construction of the permanent, fully engineered capping system will act as a barrier to the migration of odours and increase the efficiency of the gas extraction system by removing oxygen ingress, hence improving gas quality.

Daily and intermediate cover shall be applied in accordance with Waste Licence Condition 5.7 and in accordance with Operation Start Up and Shut Down Procedure KNKP 14. The working face of the operational cell shall be covered with suitable material at the end of each working day to minimise nuisances from occurring.

Uncapped areas on non-operational parts of the site should be minimised to reduce the available area for uncontrolled landfill gas emissions. Areas with increased potential to allow

fugitive emissions shall be identified, for example, haul roads and side slopes, and additional mitigation measures applied.

#### 4.7. *Identification and monitoring of landfill emissions*

##### 4.7.1. *Odour Inspections*

In conjunction with existing daily (KNKP 23 Completion of Daily Site Condition Reports, Form GS 001) and weekly (KNKP 30 Weekly Inspection Procedure, Forms GS 002, GS 003) site condition reports which include a specific section for nuisance control, odour inspections will also be carried out on a daily basis by site staff and also in response to any odour complaints. Odour inspections shall be carried out in accordance with Nuisance Inspection Procedure KNKP 32 and recorded on Form GS 005 which will detail date, time, location, weather conditions, wind direction/speed and odour extent/intensity. The inspection will reference the complaint number and corrective action taken, as appropriate. Records of these inspections will be maintained on site.

Any odour inspections carried out following receipt of a complaint, shall have particular regard to the location to which the complaint relates and shall also have regard to any other observations or other activities in the area that could have contributed to complaints.

These odour inspections shall satisfy the requirement of Waste Licence Schedule D.10: Ambient Odour Monitoring.

##### 4.7.2. *VOC surface emissions monitoring*

Independent specialists will be commissioned to undertake Volatile Organic Compound (VOC) surface emission surveys on a biannual basis as required by Waste Licence Condition 6.10.2. The VOC survey is used to highlight areas where there may be potential for odour escape, by measuring VOC levels around the landfill area.


Additional VOC surface emission monitoring will be carried out by site staff to identify any fugitive sources of landfill gas emissions as necessary.

#### 4.8. *Monthly Review*

A monthly review of odour control measures in place at the facility shall be carried out. This review shall be recorded on Form GS 049 Odour Management Plan Report. Copies of the Odour Management Plan Reports shall be maintained on site.

#### 4.9. *Annual Review*

The OMP shall be reviewed annually and any updates/amendments submitted to the Agency as part of the Annual Environmental Report.

<b>Title</b>	Nuisance Inspection Procedure					
<b>Ref</b>	KNKP 32	<b>Rev</b>	1	<b>Date</b>	30/07/10	
<b>Issued.</b>	NM	<b>App.</b>	HM	<b>Pg</b>	71 /80	

01. Scope

This procedure documents the approach to be taken when carrying out nuisance inspections at the facility.

02. Responsibility

The FM will implement this procedure and site supervisor will ensure the procedure is correctly followed. All site staff will notify the FM or the SS about any observations and will take any other measures necessary to avoid any nuisances from arising outside the facility boundary. The Bird Control and Vermin Control Contractor and their staff will carry out all duties required under the conditions of their contracts and will notify the Facility Management of any other observations which might have the potential to give rise to nuisances outside the facility boundary.

03. References

Daily Site Condition Report GS 001

Weekly Inspection Sheet GS 003

Odour Inspection Record GS 005

Weekly Inspection Procedure KNKP 30

Completion of Daily Site Condition Reports KNKP 23

Waste Licence 146-02

Licence Condition 7.1: The licensee shall ensure that vermin, birds, flies, mud, dust, litter and odours do not give rise to nuisance at the facility or in the immediate area of the facility. Any method used by the licensee to control any such nuisance shall not cause environmental pollution

Licence Condition 8.13.1 Nuisance Monitoring: The licensee shall, at a minimum of one week intervals, inspect the facility and its immediate surrounds for nuisances caused by litter, vermin, birds, flies, mud, dust and odours unless otherwise agreed or instructed by the Agency.

04. PROCEDURE

4.1 *Litter*

Litter Inspections shall be carried out and recorded as part of the weekly inspection, which is outlined in the Weekly Inspection Procedure KNKP 30 and the Procedure for Completion of Site Condition Reports KNKP 23. It is of importance that the 5 individual areas, sections A to E as outlined in the Weekly Inspection Procedure and the Weekly Inspection Form (GS 003), are inspected at a frequency of one per day if practicable. The presence of litter shall be noted on the Inspection Form and removed immediately if practicable. Any litter noted at or outside the boundary fence, which appears to be illegally dumped, shall be inspected for any indications of identity if possible and reported to the Facility Manager.

4.2 *Vermin and Birds*

Inspections for vermin shall be carried out on a weekly basis for rodents etc. and on a daily basis for birds, in particular crows. The bird control operator, who carries out regular bird control duties on site, shall assist the Site Supervisor by notifying him of any unusual observations. He shall also record any observations in the daily bird control report. Any

observations made during inspections shall be recorded on the Daily Site Condition Report (GS 001) and the Weekly Inspection Form (GS 003).

#### 4.3 Flies

Particularly during the warmer months, attention shall be paid to observation of flies. Any observations shall be recorded on the Daily Site Condition Report (GS 001) and the Weekly Inspection Form (GS 003). The Facility Manager or the Site Supervisor shall be notified immediately in order to take measures to eliminate any fly populations from establishing. The areas around the surface water lagoon and the wetland, as well as the immediate vicinity of the working face, shall be inspected with particular intensity, as these are the most likely locations for fly populations to develop.

#### 4.4 Mud and Dust

The site roads shall be inspected on a daily basis for mud or dust and any observations recorded on the Daily Site Condition Report (GS 001) and the Weekly Inspection Form (GS 003). Special attention shall be paid to dust during the dry months and mud during the wet months and the Site Supervisor or the Facility Manager notified immediately in order to take measures to minimise or eliminate any potential nuisances arising from mud or dust accumulating on site roads.

#### 4.5 Odour

Odour Inspections shall be carried out in accordance with guidance notes on the Odour Inspection Record (GS 005) on a daily basis on and/or off site as required and any findings recorded on the Daily Site Condition Report (GS 001) and the Weekly Inspection Form (GS 003) as well as the Odour Inspection Record (GS 005). Any odour inspections carried out following receipt of a complaint shall have particular regard to the location to which the complaint relates and shall also have regard to any other observations or other activities in the area that could have contributed to complaints, e.g. spreading of slurry by farmers, etc.