CAULMERT LIMITED

Engineering, Environmental & Planning
Consultancy Services

Brookhill Landfill Site

Flintshire County Council Waste Management Services

Quarterly Monitoring Review

July – September 2015

Prepared by:

Caulmert Limited
InTec, Parc Menai, Bangor, Gwynedd, LL57 4FG
Tel: 01248 672666
Fax: 01248 672601
Email: jimmcclymont@caulmert.com
Web: www.caulmert.com

Doc ref: 2231.7.FCC.JDM.LS.A0

October 2015

Caulmert
Engineering, Environmental and Planning

APPROVAL RECORD

Site: **Brookhill Landfill Site**

Client: **Flintshire County Council Waste Management Services**

Document Title: **Quarterly Monitoring Review, July – September 2015**

Document Ref: **2231.7.FCC.SDB.JDM**

Report Status: **A0**

Project Director: **Mike Caulfield**

Project Manager: **Jim McClymont**

Caulmert Limited: **Intec, Parc Menai, Bangor, Gwynedd, LL57 4FG**

Tel: **01248 672666**

Author	Jim McClymont	**Date**	27.10.2015
Reviewer	Lisa Sumner	**Date**	27.10.2015
Approved	Jim McClymont	**Date**	30.10.2015

DISCLAIMER

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1902.EMP.01 – Environmental Monitoring Plan

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1.0 INTRODUCTION

1.1 Background

1.1.1 This report has been compiled in compliance with the Environmental Permit (EP) BV7273 – Variation Notice Number YP3835MJ for Brookhill Landfill Site, held by Flintshire County Council (FCC) Waste Management Services, which requires that the monitoring data collected at the site is reviewed quarterly. The data reviewed by this report was collected between the 1st of July and the 30th of September 2015.

1.1.2 This report records the monitoring data for landfill gas, leachate, groundwater, surface water and dust, and discusses this data in relation to emission limits set in the EP. This data will also be compiled into an Annual Monitoring Review in accordance with the EP, to be submitted by the 31st of January 2016.

1.2 Site Location and Surrounding Land-use

1.2.1 Brookhill Landfill Site is located approximately 1.5 km north of Buckley, Flintshire, North Wales at NGR SJ 278 656. The site is accessed via the Pinfold Industrial Estate, Pinfold Lane, which is located off the A494 Mold to Ewloe Road.

1.2.2 The site is bound to the east by a wooded, disused railway leading to open grassland. Agricultural land lies to the west of the site. The Pinfold Industrial Estate and a number of residential properties (on the outskirts of Buckley, approximately 400 m away) are situated to the south of the site. A restored refuse tip (Ewloe Barn Landfill) lies to the north of the site. It is currently rough grassland leading to open grazing land and some woodland.

1.2.3 The landfill site has been developed in a former quarry, which was worked for Buckley Fireclay and the siltstones and mudstones beneath the Fireclay (known as the Warrant) for use in the manufacturing of bricks and tiles.

1.2.4 In 1997, in preparation for the engineering for the landfill site, further Fireclay was removed together with a quantity of coal in the quarry base under agreement with the Coal Authority.

1.2.5 Brookhill Landfill Site started accepting waste in 1999. The wastes permitted at the site were stipulated within the site permit. The general waste streams which were permitted at the site through its history can be summarised as:

- Domestic food and organic wastes – approximately 60%
- Non-hazardous industrial wastes, (including plastic, paper, cardboard, wood, stone and sand, etc) – approximately 40%
- Most special wastes (allowed until June 2004).

1.2.6 The special wastes which were tipped at the site were accepted pre-June 2004 (under the WML for the site). Therefore they would have been deposited predominantly within Cell 1, and the lower parts of Cells 2, 3 and 4. It is unlikely that any of the waste tipped in Cells 5 and 6 contains any 'special waste' waste streams.

1.2.7 The site ceased accepting waste in late 2007. The final capping and restoration phases were completed in 2010.

2.0 LANDFILL GAS

2.1 Monitoring regime

2.1.1 Routine landfill gas monitoring is carried out on a weekly basis at perimeter locations BH1 to BH25 and monthly at 23 in-waste locations. Perimeter borehole locations are shown on Drawing 1902.EMP.01, enclosed. Methane, carbon dioxide, oxygen and atmospheric pressure are recorded on each visit.

2.1.2 Methane and carbon dioxide data from all perimeter boreholes are displayed in a summary table and time-series graphs in Appendix 1. The landfill gas data obtained during the review period was compared with the limits stipulated in the EP. Monitoring data gathered at in-waste gas monitoring locations is also listed in Appendix 1.

2.2 Perimeter Boreholes

Methane

2.2.1 None of the monitored perimeter gas boreholes were in breach of their respective methane EP limits during this review.

2.2.2 Similar to the previous quarter, no methane was detected at any time during the quarter in BH1, BH4, BH5, BH6, BH7, BH10, BH11, BH12, BH13, BH14, BH15, BH16, BH19, BH23, BH24 and BH25.

2.2.3 The highest methane concentrations were detected at BH8 (30.1 %) and BH9 (29.2 %) with average concentrations of 29.6 % and 28.5 % respectively. No increasing trends were observed, with consistent methane concentrations at both locations throughout this review period. These concentrations are compliant with the EP limits for these locations and are very similar to that of the previous quarter.

Carbon Dioxide

2.2.4 Carbon dioxide was recorded in all perimeter gas boreholes during the review period but remained below the relative EP limits throughout the review period in all locations.

2.2.5 The maximum recorded carbon dioxide concentration of 3.0 % in BH19 was lower than that recorded during the previous quarter, 3.3 % in BH20.

2.3 In-waste Boreholes

2.3.1 The gas field at Brookhill Landfill Site is monitored and balanced on a regular basis. In accordance with Condition 4.2.2 of the EP, landfill gas monitoring data for the in-waste boreholes for this review period is included in Appendix 1.

2.3.2 The average methane concentration in the GV wells was similar to that recorded in the previous quarter, 44.1 % while the average carbon dioxide concentration was 31.1 %.

2.3.3 The maximum H_2S concentration the GV wells was 216 ppm in well GVA.

3.0 GROUNDWATER

3.1 Introduction

3.1.1 Borehole locations are shown on Drawing 1902.EMP.01, enclosed. Groundwater levels were recorded on a monthly basis in monitoring boreholes GW1 – GW8.

3.1.2 Collected samples were analysed for the range of determinants listed below:

pH, electrical conductivity, ammoniacal nitrogen, chloride and dissolved oxygen.

3.1.3 All groundwater samples collected on the 30th of September were also analyzed for the following quarterly parameters:

Alkalinity - total as $CaCO_3$, biological oxygen demand (BOD), chemical oxygen demand (COD), sulphate, total oxidised nitrogen, total organic carbon, xylenes, toluene and metals – cadmium, calcium, chromium, copper, iron, lead, magnesium, manganese, nickel, potassium, sodium and zinc.

3.1.4 Table S4.4 in the EP requires that GW2A, GW3A and GW4 are controlled by individual limits for ammoniacal nitrogen, chloride, nickel, zinc, total xylenes and toluene. The EP limit for total xylenes has been set at 0.011 mg/l, as agreed in a meeting with NRW on the 16th of April 2013.

3.1.5 Revised EP limits for ammoniacal nitrogen and chloride were proposed in report reference 1629.9.FCC.JDM.ÅKS.A0[1], submitted to NRW on the 11th of July 2013 and is awaiting review.

3.1.6 Time-series graphs and a results summary of the laboratory analysis data are included in Appendix 2.

3.2 Groundwater Levels

3.2.1 Groundwater levels were recorded on the 29th of July, 28th of August and the 30th of September. Groundwater levels decreased over the review period as part of the seasonal trend of groundwater variation. Time series graphs of the groundwater levels are included in Appendix 2.

3.3 Groundwater Quality

3.3.1 Exceedances of the EP limit for ammoniacal nitrogen (1.7 mg/l) and chloride (60 mg/l) were observed in GW2A, GW3A and GW4 throughout the review period.

[1] Caulmert Ltd. July 2013. Groundwater Quality Compliance Level Review. 1629.9.FCC.JDM.ÅKS.A0.

3.3.2 Maximum concentrations of ammoniacal nitrogen in GW2A, GW3A and GW4 were 19.2 mg/l, 132.0 mg/l and 18.4 mg/l respectively. Maximum chloride concentrations at GW2A, GW3A and GW4 were 137 mg/l, 212 mg/l and 151 mg/l respectively, as compared to the maximums of 126 mg/l, 390 mg/l and 128 mg/l during the previous quarter.

3.3.3 Maximum ammoniacal nitrogen concentrations in the remaining locations ranged between 2.6 mg/l in GW6 and 46.3 mg/l in GW1.

3.3.4 Chloride concentrations in locations with no EP limits ranged between a minimum of 32 mg/l in GW6 and a maximum of 460 mg/l in GW1.

3.3.5 Electrical conductivity ranged between a minimum of 0.68 mS/cm in GW7 and a maximum of 3.10 mS/cm in GW1.

3.3.6 Dissolved oxygen concentrations were generally low and ranged between a minimum of <0.3 mg/l in several locations and a maximum of 3.38 mg/l in GW7.

3.3.7 The pH in the groundwater locations ranged between 6.1 in GW1.1 and 8.3 in GW8.

3.3.8 As in the previous quarter in the quarterly monitoring round, no toluene or xylenes were detected above the laboratory limit of detection in any of the groundwater locations in the September 2015 analysis. Nickel and zinc concentrations remained an order of magnitude below the respective EP limits at all locations.

4.0 LEACHATE

4.1 Introduction

4.1.1 Leachate levels at leachate chambers LC1B, LC2B, LC4B and LC6B and remote leachate monitoring points R1B, R2B, R3, R4B, R5 and R6B were recorded monthly. Well locations are shown on Drawing Number 1902.EMP.01, enclosed. No results for LC3 and LC5 are reported, as agreed with Natural Resources Wales on the 16th of April 2013.

4.1.2 The leachate treatment plant at the site accepts leachate from Brookhill Landfill Site and the nearby Standard Landfill Site. The treated effluent is discharged to public sewer and is therefore subject to a trade effluent agreement (Discharge Consent, DC).

4.1.3 Samples collected in September from the leachate chambers only were analyzed for the suite below:

Alkalinity, ammoniacal nitrogen, biological oxygen demand, calcium, chloride, chemical oxygen demand, magnesium, total organic carbon, pH, potassium, sodium, sulphate and total oxidised nitrogen.

4.1.4 The treated leachate discharge (Final Discharge, FD) was sampled and analysed for:

Alkalinity, ammoniacal nitrogen, chromium, chemical oxygen demand (COD), copper, lead, nickel, nitrate, nitrite, pH, suspended solids and zinc.

4.1.5 Data summaries of leachate and discharge quality can be found in Appendix 3.

4.2 Leachate Levels

4.2.1 Table S4.1 in the EP requires that leachate levels must not exceed 2m above the base of each cell. This trigger level was discussed in the Leachate Management Plan. Following an assessment of the lowest achievable leachate levels for each landfill cell, new EP limits were proposed for Cells 2, 3, 4 and 5. These levels, detailed in Table 2 below, were agreed in a meeting between Alison Soper of the Environment Agency and representatives from Flintshire County Council Waste Management Services (then AD Waste Ltd) and Caulmert on the 17th of September 2009.

Table 2: Leachate Level EP limits

Landfill Cell	Monitoring Points	Revised Limit (m)
Cell 1	LC1B & R1	2.0
Cell 2	LC2B & R2	3.0
Cell 3	R3	5.5
Cell 4	LC4B & R4	3.0
Cell 5	R5	3.0
Cell 6	LC6B & R6	2.0

4.2.2 Leachate levels recorded during this review period are summarised in Table 3 below.

Table 3: Leachate Head Data (exceedances highlighted in yellow)

Landfill Cell	Monitoring Point	Jul (m above base)	Aug (m above base)	Sep (m above base)	Trigger Limit
Cell 1	**BK LC 1B**	1.60	1.63	1.67	2.00
	BK R1 B	1.94	1.97	1.94	
Cell 2	**BK LC 2B**	0.83	0.73	0.62	3.00
	BK R2B	0.56	0.56	0.56	
Cell 3	**BK R3**	0.86	0.93	0.88	5.50
Cell 4	**BK LC 4B**	1.42	1.35	1.27	3.00
	BK R4B	2.37	2.44	2.35	
Cell 5	**BK R5**	4.09	4.05	4.08	3.00
Cell 6	**BK LC 6B**	0.83	0.85	0.91	2.00
	BK R6B	0.51	0.61	0.51	

4.2.3 The leachate level exceeded the EP limit in R5 throughout the review period, as observed in the previous review period. The leachate level at this well did not exceed the surrounding groundwater level.

4.2.4 Leachate levels at all other locations remained below their respective trigger limits throughout the review.

4.3 Leachate Quality

4.3.1 The concentrations of most parameters in LC1B, LC2B and LC4B remained similar to those recorded in the previous quarter.

4.3.2 Highest concentrations of key leachate parameters were recorded in LC5 and LC6 and had similar concentrations compared to the previous quarter. These results are consistent with strongest leachate being present in the most recently completed cells 5 and 6.

4.4 Final Discharge to Sewer

4.4.1 The pH and the concentrations of suspended solids and metals (chromium, copper, lead, nickel and zinc) remained compliant during this quarter (See Table 2 in Appendix 3).

4.4.2 The ammoniacal nitrogen limit of 50 mg/l was exceeded on one occasion, with a maximum of 78 mg/l detected on the 10th of July 2015.

4.4.3 The COD consent level of 1000 mg/l was exceeded throughout review period. The highest concentration, 1560 mg/l, was recorded on the 10th of July 2015.

5.0 SURFACE WATER

5.1 Introduction

5.1.1 Surface water samples are routinely taken from three locations, SW2, P2 and P4. Water flows in a northerly direction alongside the outside perimeter fence of the western boundary of the site and accumulates in a pond at SW2 before slowly seeping through a man made underground bypass drain which runs along the outside of the site towards the northern boundary. P2 is a pond to the west, which collects surface water run-off from the landfill. P4 is located in a field to the north west of the site, beyond landfill gas monitoring borehole BH10.

5.1.2 As agreed with NRW, water in P2 is only sampled when there is the likelihood of an overflow to the discharge point[2].

5.1.3 Collected samples were analysed for the range of determinants listed below:

Ammoniacal nitrogen, chloride, chemical oxygen demand (COD), pH and total suspended solids

5.1.4 In the EP, Table S4.3 requires that only location P2 be controlled by chemical quality limits. Monitoring locations are shown on Drawing 1902.EMP.01, enclosed. A summary of the laboratory analysis data is included in Appendix 4.

5.2 Surface Water Quality

5.2.1 Water quality at P4 was comparable to the long-term trends for water quality at this location.

5.2.2 No surface water samples were collected at locations SW2 or P2 during this review period.

[2] E-mail correspondence, 14.07.2014, Alison Soper (NRW) to Phil Mulhall (FCC).

6.0 DUST

6.1 Introduction

6.1.1 Dust monitoring was undertaken between the 01/09/2015 to the 02/10/2015 in this quarter as required by the EP.

6.1.2 Location 1 was located on bund by leachate storage tanks and opposite the transfer pad. Location 2 was on the site perimeter. Location 3 was in Oaks Farm.

6.2 Dust Results

6.2.1 Dust monitoring results are shown in Table 4 below:

Table 4: Results from dust monitoring at Brookhill

Monitoring Locations	Total Suspended Solids (mg/l)	Result (mg/m²/day)	Trigger Level (mg/m²/day)
Location 1	150	120	200
Location 2	18	14	200
Location 3	10	8	200

6.2.2 Deposited dust concentrations were below the EP trigger level at locations 1, 2 and 3 during this period.

7.0 CONCLUSIONS

7.1 Landfill Gas

7.1.1 Landfill gas concentration was monitored at locations around the site perimeter on a weekly basis. During this review period, none of the monitored perimeter gas boreholes were in breach of their respective methane or carbon dioxide EP limits.

7.1.2 During this review period methane concentrations remained below the instrumental detection limit of 0.1 % in many of the boreholes on site. The highest concentrations were, as expected, in BH8 and BH9 where average concentrations of 29.6 % and 28.5 % respectively were recorded. These boreholes therefore have individually set EP limits, which were not exceeded during this review period.

7.1.3 The maximum carbon dioxide concentration was 3.0 % recorded in BH19.

7.2 Groundwater

7.2.1 The results indicate that groundwater levels decreased around the site, reflecting the seasonal trend.

7.2.2 The EP limits for ammoniacal nitrogen and chloride were exceeded in GW2A, GW3A and GW4 throughout the review period.

7.2.3 Concentrations of the majority of parameters within the groundwater were highest in GW3A. The concentrations of most determinants were similar to those recorded in the previous quarter.

7.3 Leachate

7.3.1 Exceedances of the EP limit for leachate level was recorded in location R5 throughout the review period. Leachate levels at all other locations remained below their respective trigger limits throughout the review.

7.3.2 Highest concentrations of key leachate parameters were recorded in LC5 and LC6 and had similar concentrations compared to the previous quarter. These results are consistent with strongest leachate being present in the most recently completed cells 5 and 6.

7.3.3 Chemical analysis of the final discharge from the leachate treatment plant showed that two consent limits were exceeded during this review period, those for ammoniacal nitrogen and COD.

7.3.4 All chromium, copper, lead, nickel, pH, suspended solids and zinc concentrations in the final discharge remained below the respective consent limits.

7.4 Surface Water

7.4.1 Water quality at P4 was comparable to the long-term trends for water quality at this location.

7.4.2 No samples were collected from P2 as there was no likelihood of an overflow to the discharge point.

7.5 Dust

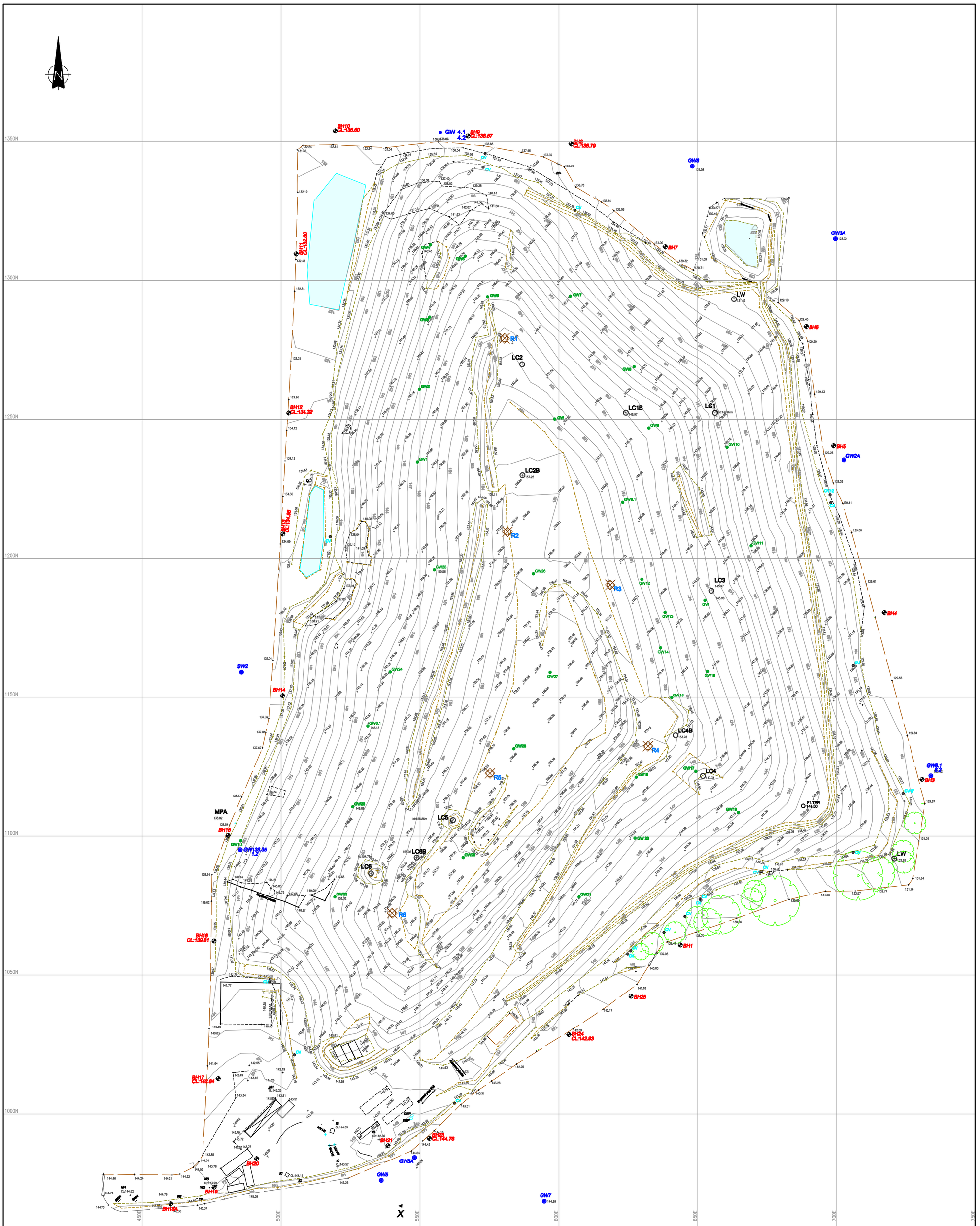
7.5.1 Deposited dust concentrations were below the EP limit at locations 1, 2 and 3 during this period.

NOTES

1. SURVEY INFORMATION PROVIDED BY SOUTH STAFFS SURVEYS, TITLE: UPDATE SURVEY, REF: 4839a.dwg. DATE: 08.02.2008.

LEGEND

BH14	GAS BOREHOLE
GW	GAS EXTRACTION WELL
GW5	GROUND WATER MONITORING BOREHOLE
LC5	LEACHATE WELL
SW2	SURFACE WATER MONITORING POINT
CV	COAL VENT
	LEACHATE MONITORING POINT



REV	MODIFICATIONS	BY	CH	AP	DATE

BROOKHILL LANDFILL SITE

ENVIRONMENTAL MONITORING PLAN

DRAWN BY: AS	DATE: 23.07.2010	
CHECKED BY: JM	SCALE @ A1: 1:750	
APPROVED BY: XX	ISSUE: Dr	REVISION: -

DRAWING NUMBER: 1140.EMP.01

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CAD FILE REF: M:\Cad Projects\1140 Brookhill\1140.EMP.01.dwg

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APPENDIX 1

APPENDIX 1 – LANDFILL GAS

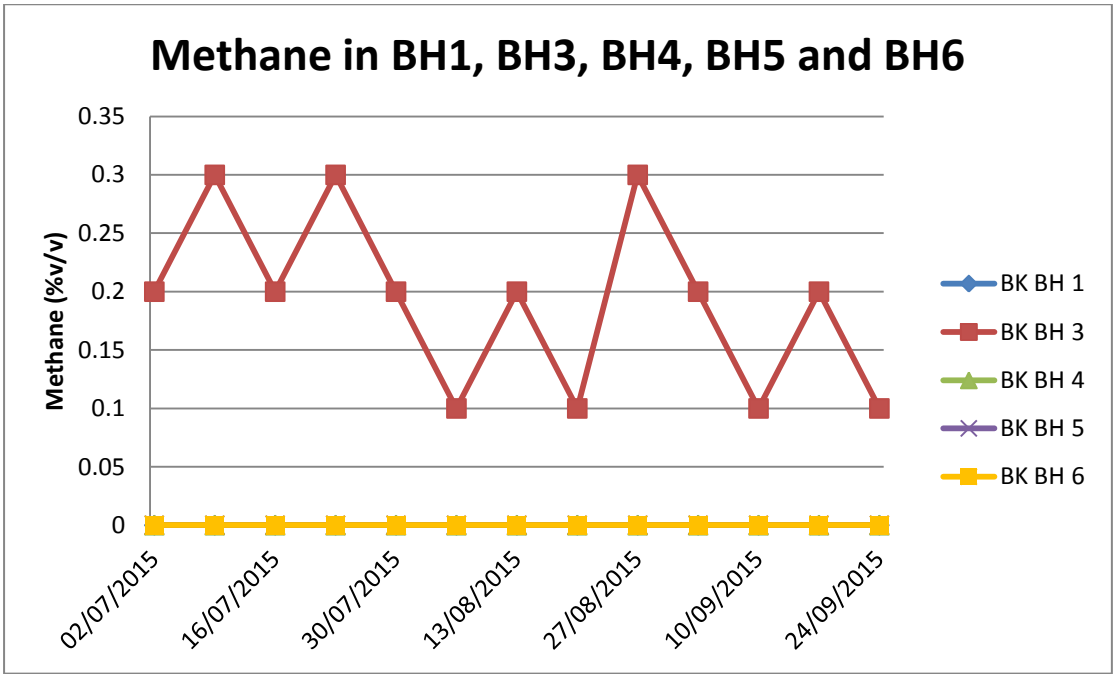
Table 1: Perimeter Landfill Gas Monitoring Data Summary

Location	Data	CH4	Trigger	CO2	Trigger
BK BH 1	Min	0.00	1	1.20	8.8
	Max	0.00		2.60	
	Average	0.00		2.01	
	Count	13		13	
BK BH 3	Min	0.10	1	1.00	3.1
	Max	0.30		1.40	
	Average	0.19		1.21	
	Count	13		13	
BK BH 4	Min	0.00	1	0.60	5.1
	Max	0.00		1.20	
	Average	0.00		0.89	
	Count	13		13	
BK BH 5	Min	0.00	1	0.50	1.5
	Max	0.00		1.20	
	Average	0.00		0.85	
	Count	13		13	
BK BH 6	Min	0.00	1	0.40	1.5
	Max	0.00		1.00	
	Average	0.00		0.65	
	Count	13		13	
BK BH 7	Min	0.00	1	1.10	10
	Max	0.00		1.60	
	Average	0.00		1.30	
	Count	13		13	
BK BH 8	Min	28.60	32.2	0.50	3.6
	Max	30.10		1.40	
	Average	29.60		0.76	
	Count	13		13	
BK BH 9	Min	27.80	29.6	0.90	10.4
	Max	29.20		1.30	
	Average	28.53		1.12	
	Count	13		13	
BK BH 10	Min	0.00	1	1.10	3.9
	Max	0.00		1.60	
	Average	0.00		1.35	
	Count	13		13	
BK BH 11	Min	0.00	1	0.50	6.5
	Max	0.00		1.50	
	Average	0.00		0.92	
	Count	13		13	
BK BH 12	Min	0.00	1	0.60	6.6
	Max	0.00		1.30	
	Average	0.00		1.04	
	Count	13		13	
BK BH 13	Min	0.00	1	1.00	9.4
	Max	0.00		1.80	
	Average	0.00		1.30	
	Count	13		13	

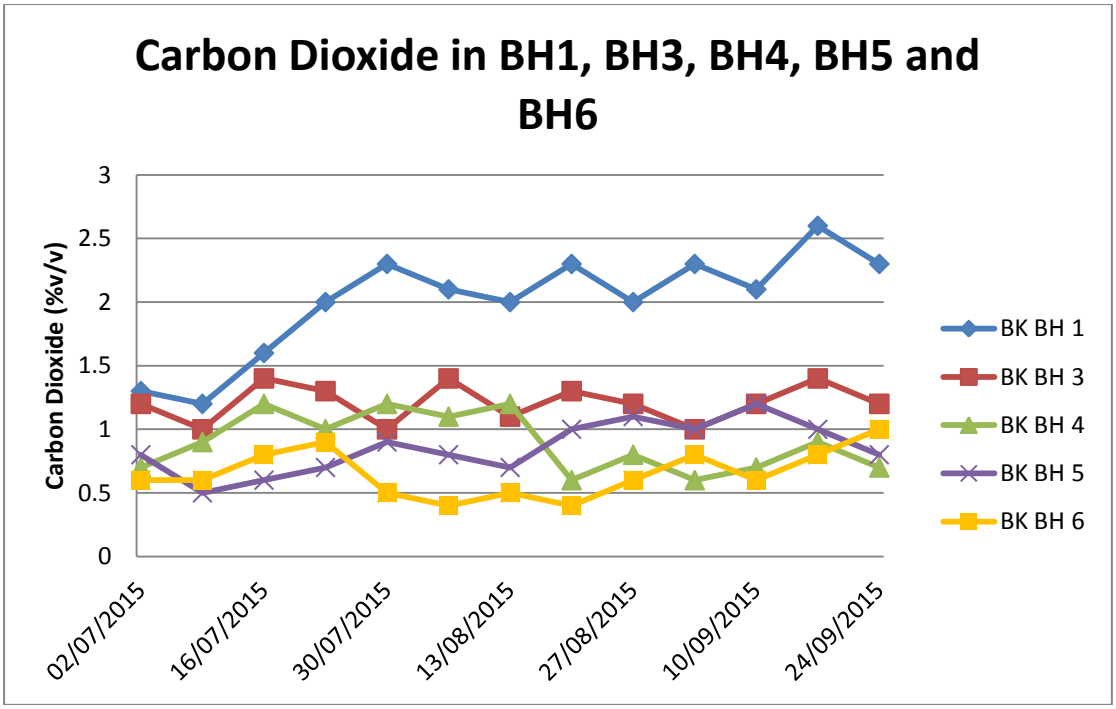
APPENDIX 1 – LANDFILL GAS

Location	Data	CH4	Trigger	CO2	Trigger
BK BH 14	Min	0.00	1	0.60	3.5
	Max	0.00		1.50	
	Average	0.00		0.84	
	Count	13		13	
BK BH 15	Min	0.00	1	1.00	17.6
	Max	0.00		1.50	
	Average	0.00		1.18	
	Count	13		13	
BK BH 16	Min	0.00	1	1.00	11.4
	Max	0.00		1.40	
	Average	0.00		1.18	
	Count	13		13	
BK BH 17	Min	0.30	1	1.00	12.9
	Max	0.60		1.90	
	Average	0.42		1.32	
	Count	13		13	
BK BH 18	Min	0.50	6.8	0.60	21.2
	Max	0.90		2.50	
	Average	0.68		1.48	
	Count	13		13	
BK BH 19	Min	0.00	1	1.60	11.2
	Max	0.00		3.00	
	Average	0.00		2.25	
	Count	13		13	
BK BH 20	Min	0.20	1	1.00	17.6
	Max	0.80		2.80	
	Average	0.42		1.96	
	Count	13		13	
BK BH 21	Min	0.20	1	0.80	11.4
	Max	0.70		2.30	
	Average	0.45		1.58	
	Count	13		13	
BK BH 23	Min	0.00	1	1.00	7.3
	Max	0.00		2.00	
	Average	0.00		1.45	
	Count	13		13	
BK BH 24	Min	0.00	1	0.50	1.5
	Max	0.00		0.90	
	Average	0.00		0.69	
	Count	13		13	
BK BH 25	Min	0.00	1	1.00	9.9
	Max	0.00		1.40	
	Average	0.00		1.16	
	Count	13		13	

APPENDIX 1 – LANDFILL GAS

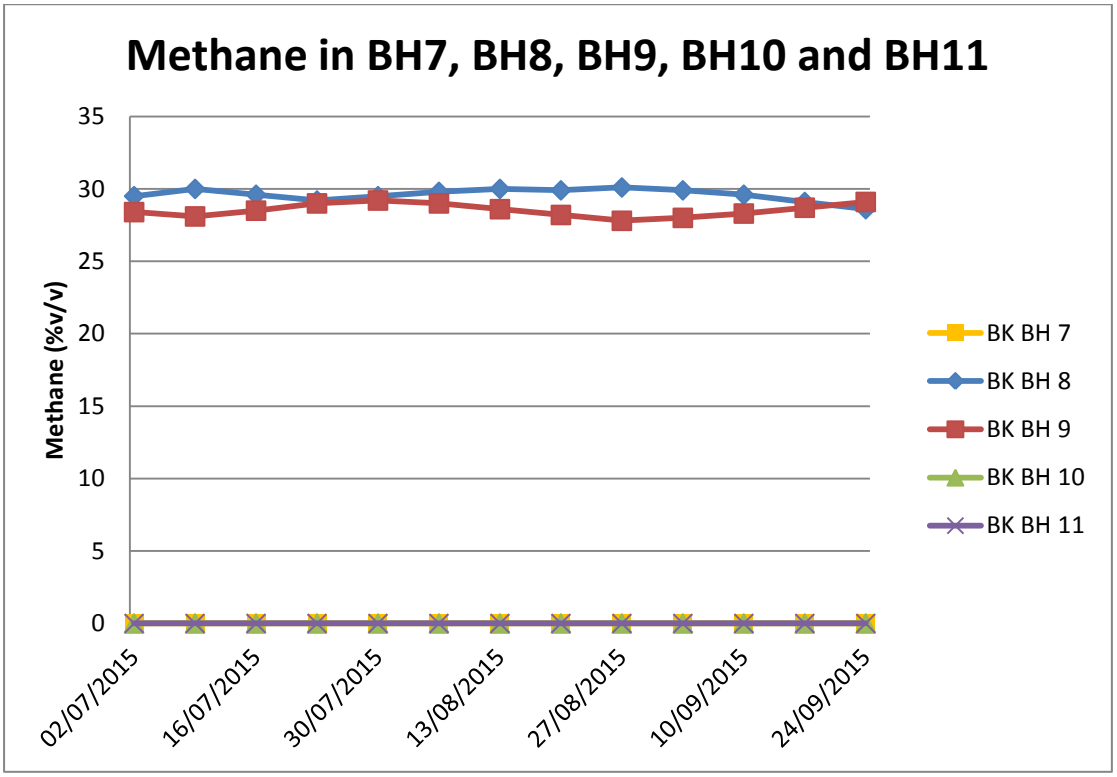


Graph 1: Methane in BH1, BH3, BH4, BH5 and BH6

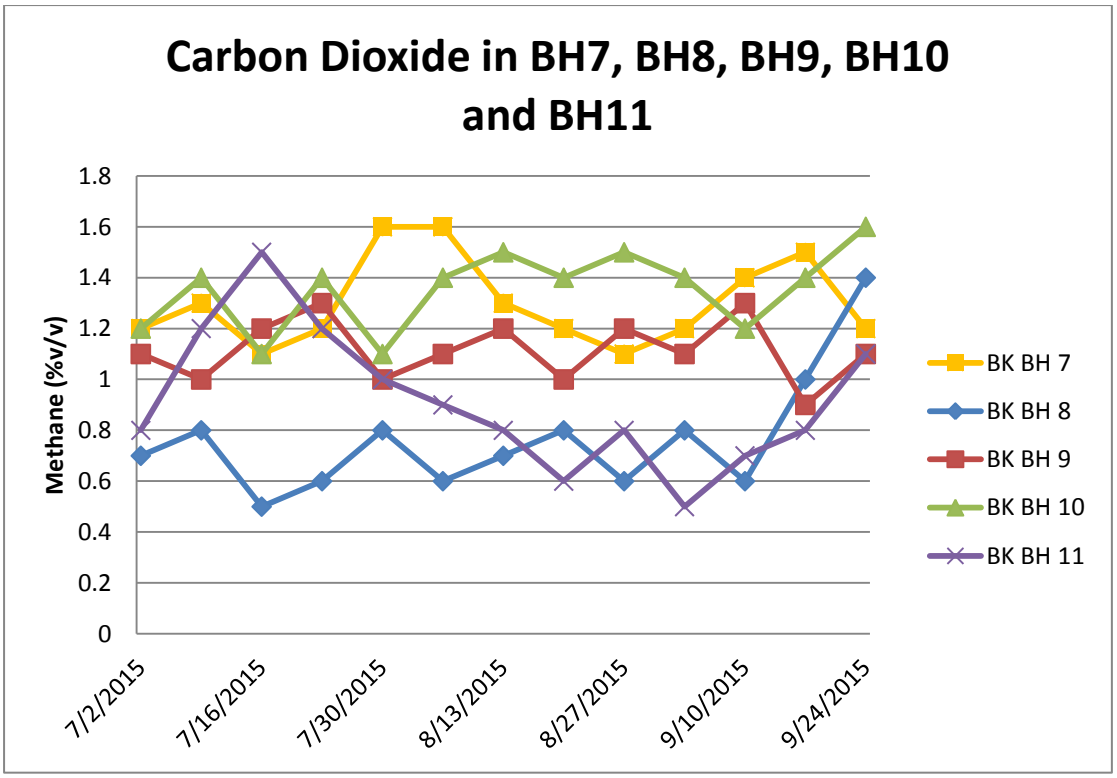


Graph 2: Gas: Carbon dioxide in BH1, BH3, BH4, BH5 and BH6

APPENDIX 1 – LANDFILL GAS

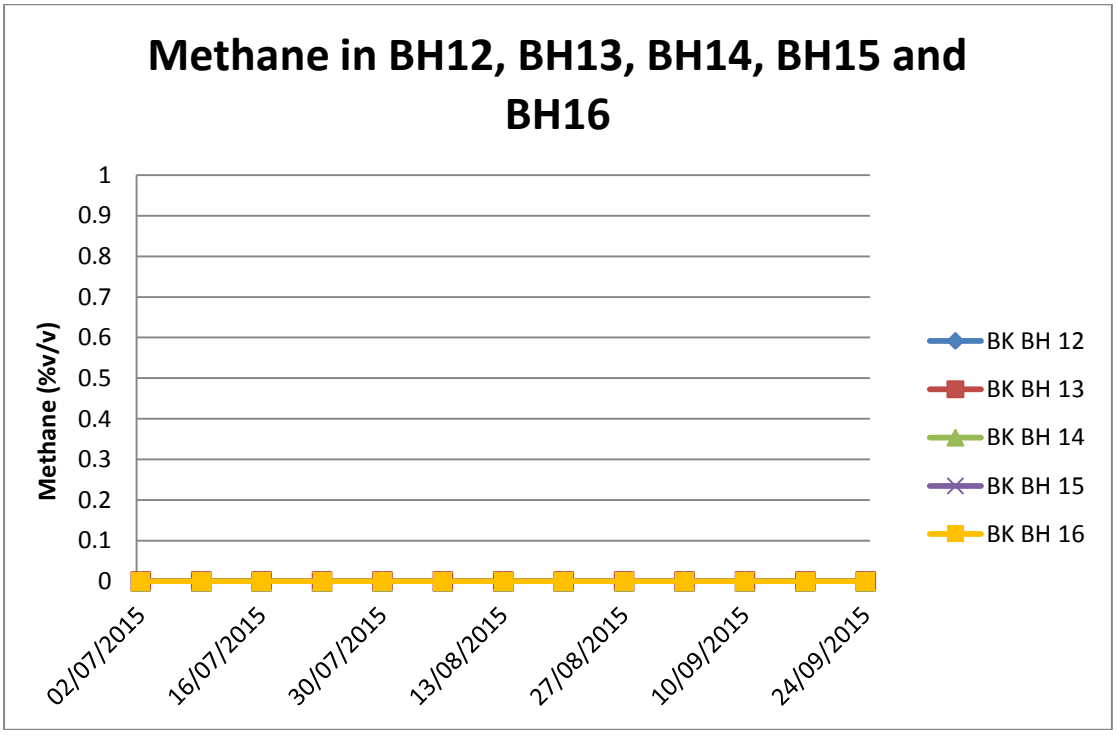


Graph 3: Methane in BH7, BH8, BH9, BH10 and BH11

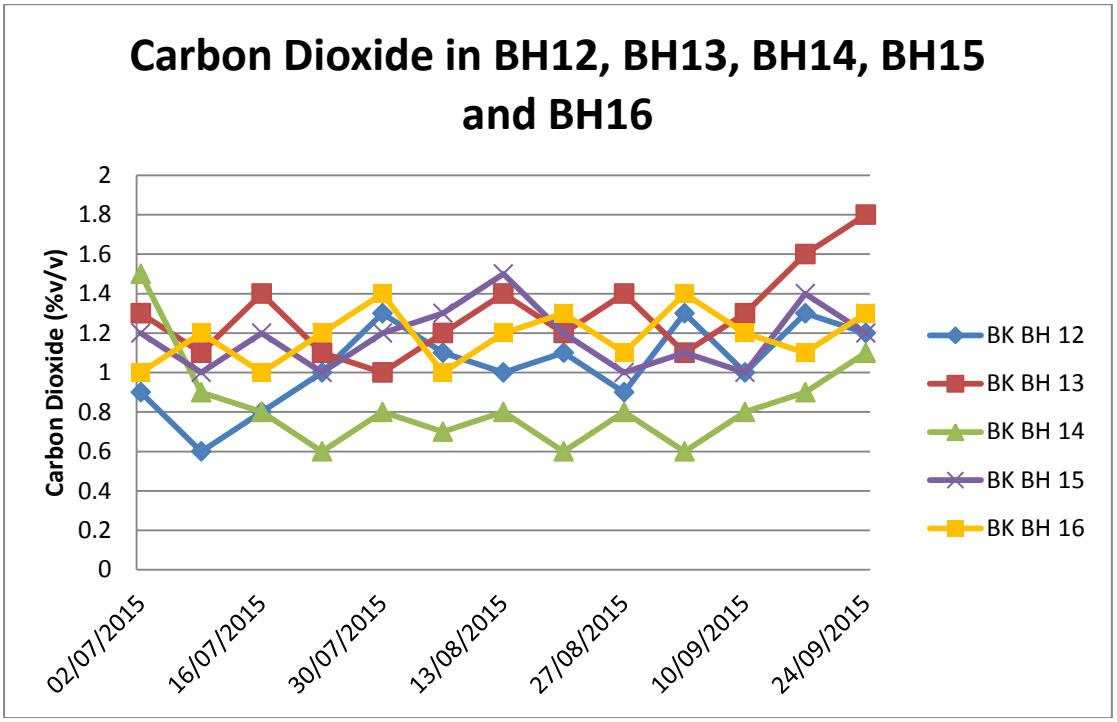


Graph 4: Carbon dioxide in BH7, BH8, BH9, BH10 and BH11

APPENDIX 1 – LANDFILL GAS

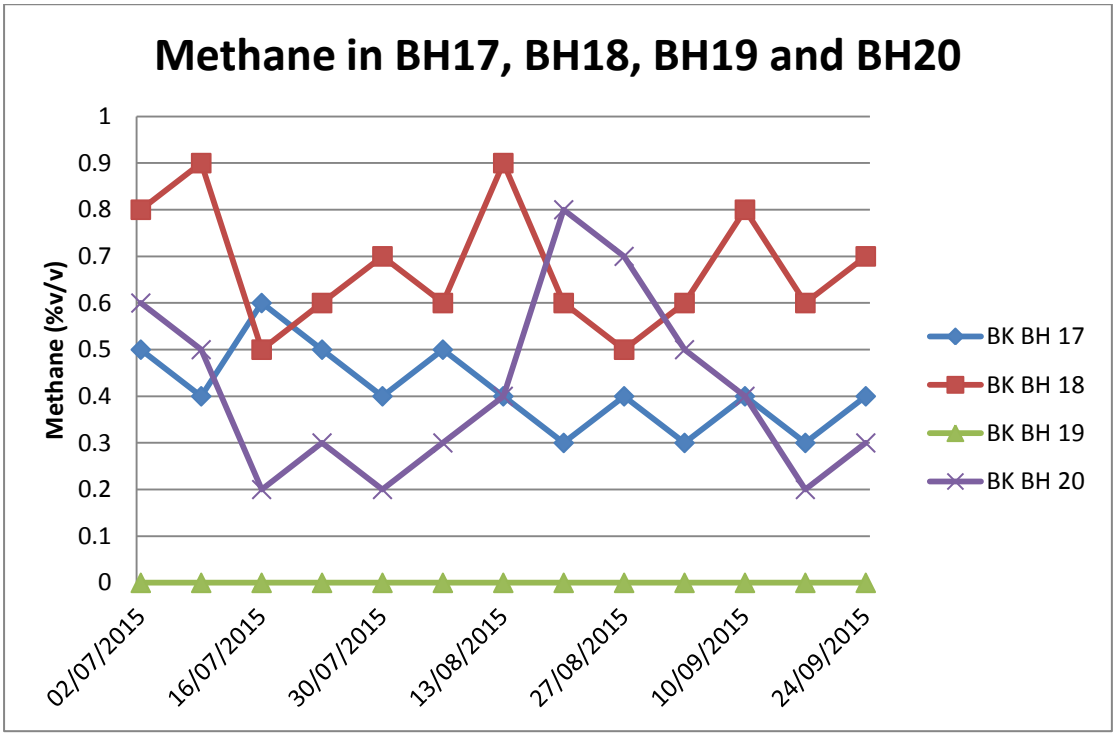


Graph 5: Methane in BH12, BH13, BH14, BH15 and BH16

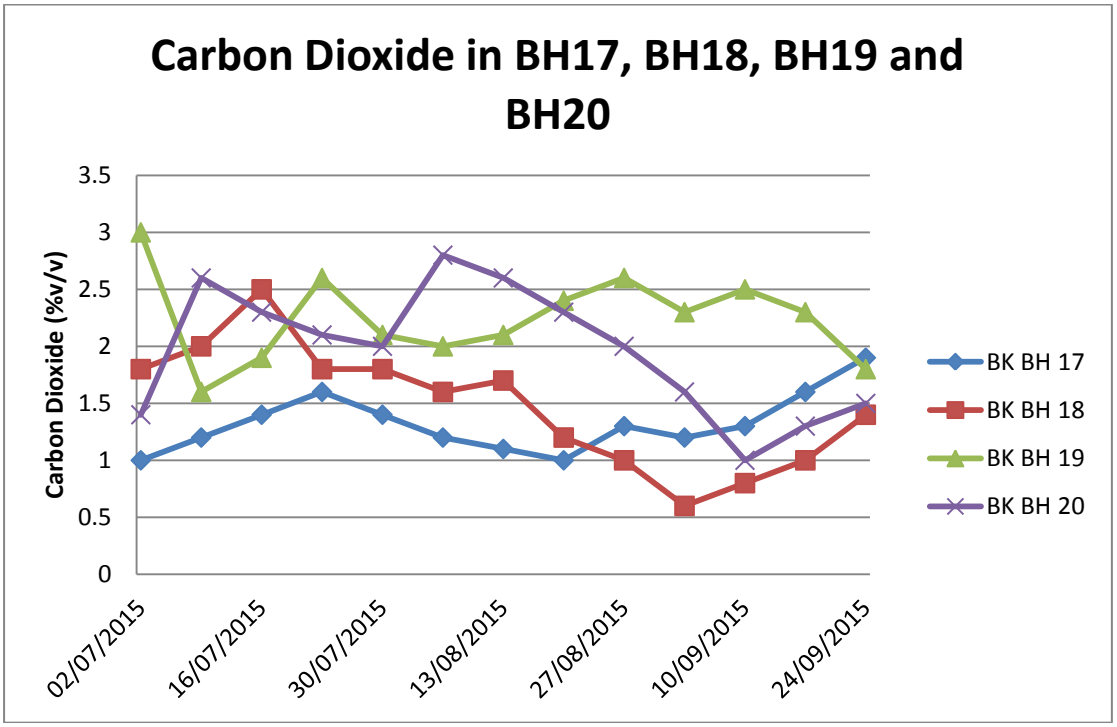


Graph 6: Carbon dioxide in BH12, BH13, BH14, BH15 and BH16

APPENDIX 1 – LANDFILL GAS

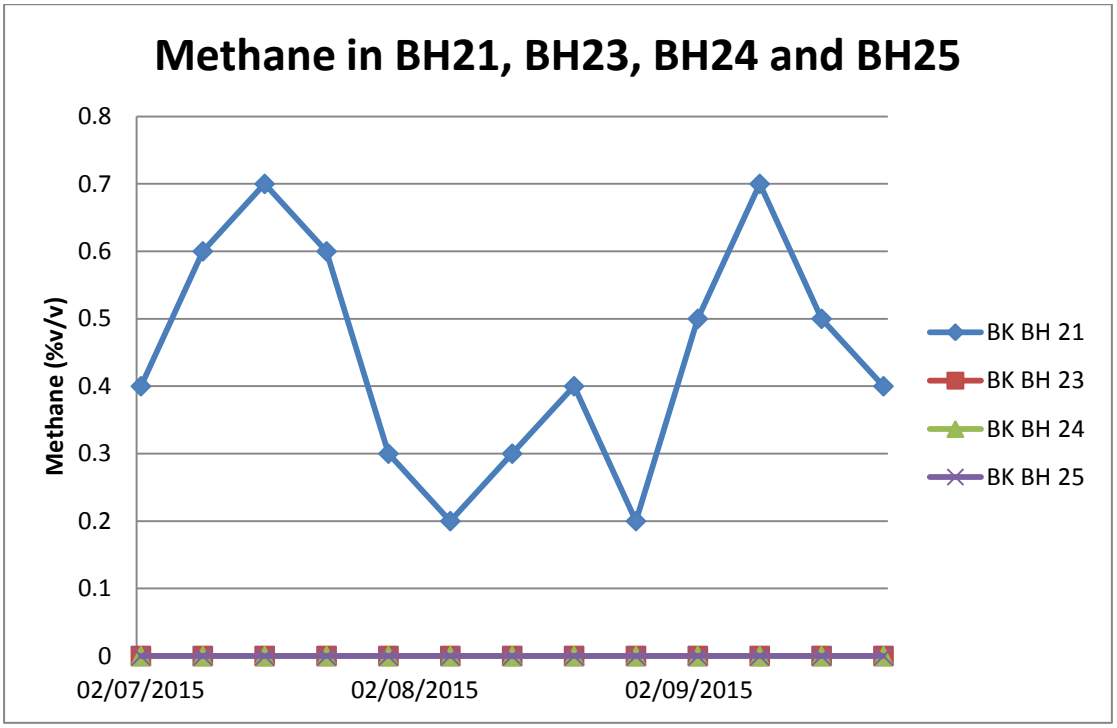


Graph 7: Methane in BH17, BH18, BH19 and BH20

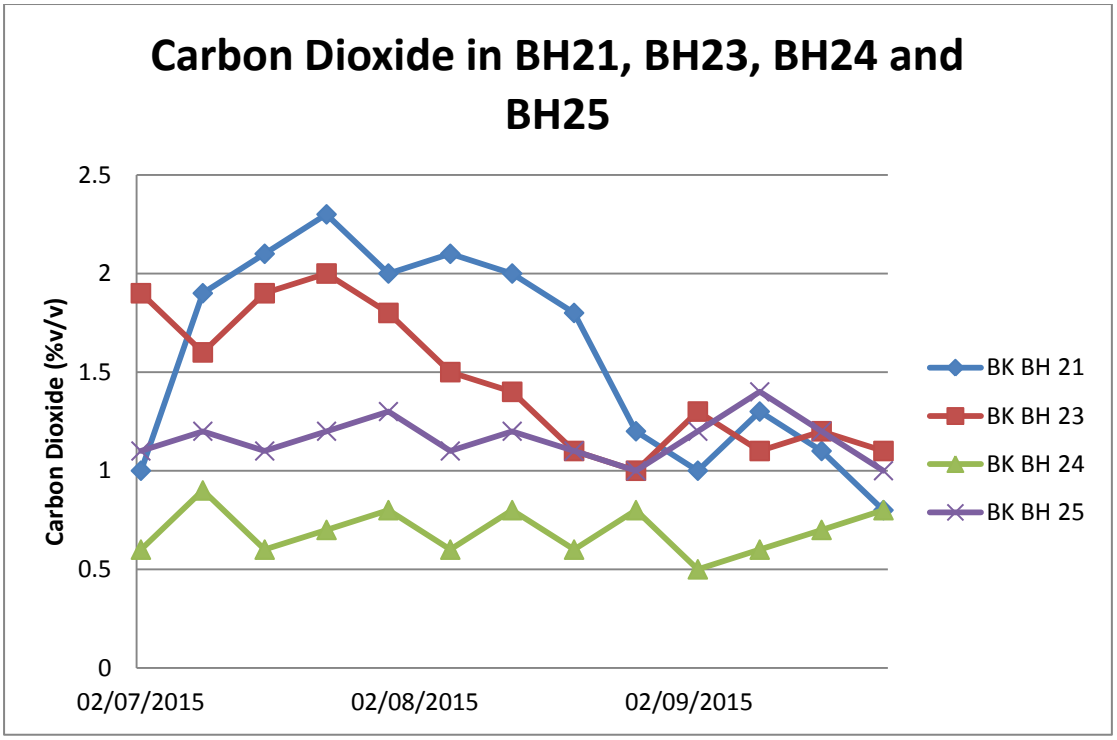


Graph 8: Carbon dioxide in BH17, BH18, BH19 and BH20

APPENDIX 1 – LANDFILL GAS



Graph 9: Methane in BH21, BH23, BH24 and BH25



Graph 10: Carbon dioxide in BH21, BH23, BH24 and BH25

APPENDIX 1 – LANDFILL GAS

Table 2: In waste landfill gas monitoring data summary

Monitoring Point	Date	CH4 (%)	CO2 (%)	O2 (%)	CO (ppm)	H2S (ppm)
B+C	07/07/2015	48.8	22.5	0.5	9	16
	11/08/2015	27.8	32.2	0.1	23	5
	04/09/2015	53.1	36.8	0.1	7	35
Flare	07/07/2015	43.2	23.6	2.0	8	7
	07/07/2015	46.2	29.9	1.0	3	3
	11/08/2015	40.2	21.3	1.5	0	0
	11/08/2015	46.2	21.8	0.4	0	0
	04/09/2015	55.6	38.3	0.2	6	47
	04/09/2015	55.6	38.2	0.0	7	47
GV / LC3.1 + LC3	07/07/2015	28.7	25.5	6.9	8	10
	11/08/2015	27.1	22.7	2.4	15	10
	04/09/2015	60.6	39.2	0.2	10	18
GV / LC3.1 + LC4	07/07/2015	50.2	31.2	0.8	7	5
	11/08/2015	49.3	38.2	1.1	23	66
	04/09/2015	59.9	40.1	0.0	14	3
GV 2.2+ LC2B	07/07/2015	30.2	26.7	7.2	14	3
	11/08/2015	35.1	31.0	2.5	25	19
	04/09/2015	54.1	40.2	1.6	6	0
GV 22	04/09/2015	65.8	34.1	0.1	4	19
	07/07/2015	0.0	2.3	18.4	0	0
	11/08/2015	35.3	34.4	0.5	25	77
GV 26	07/07/2015	50.0	32.8	1.1	7	27
GV 26 + 27	11/08/2015	40.1	35.8	0.2	30	60
GV 27+ 28	07/07/2015	51.2	30.9	0.3	8	32
GV 28+ 29	11/08/2015	34.8	35.0	0.2	22	32
GV B	04/09/2015	52.8	36.6	0.2	7	34
GV C	04/09/2015	57.4	42.1	0.5	11	167
GV1	07/07/2015	4.7	0.8	17.5	0	0
	11/08/2015	19.0	23.7	28.2	22	17
	04/09/2015	61.0	38.8	0.2	4	50
GV10	07/07/2015	45.6	22.8	1.1	19	0
	11/08/2015	10.7	19.5	2.2	13	0
	04/09/2015	65.0	34.8	0.2	9	6
GV11	07/07/2015	50.2	25.4	0.2	12	9
	11/08/2015	31.7	28.8	1.1	15	0
	04/09/2015	62.2	37.6	0.0	7	1
GV12+R3	07/07/2015	53.7	27.5	0.3	6	27
	11/08/2015	48.0	38.9	0.8	16	37
GV12+R3 Manifold	04/09/2015	57.8	40.1	0.5	9	64
GV13	07/07/2015	3.6	4.5	16.5	13	0
	11/08/2015	0.4	0.4	20.9	14	1
	04/09/2015	60.5	39.3	0.2	11	29
GV14	07/07/2015	49.9	32.5	1.0	7	25
	11/08/2015	25.3	30.1	0.1	16	42
	04/09/2015	58.4	41.5	0.1	11	146
GV15	07/07/2015	53.2	27.4	0.6	11	19
	11/08/2015	56.6	41.6	0.0	17	19
	04/09/2015	60.1	39.9	0.0	13	72
GV16	07/07/2015	39.8	25.6	2.2	8	7
	11/08/2015	19.7	30.1	0.6	15	9

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Monitoring Point	Date	CH4 (%)	CO2 (%)	O2 (%)	CO (ppm)	H2S (ppm)
	04/09/2015	52.4	37.8	2.4	7	0
GV17	04/09/2015	60.2	39.6	0.2	1	18
	07/07/2015	38.4	27.5	3.1	9	11
GV17+LC4 Manifold	04/09/2015	49.6	32.3	2.5	10	0
GV18	11/08/2015	45.6	38.4	0.1	15	102
	04/09/2015	60.1	39.9	0.0	13	27
	07/07/2015	52.3	31.0	0.4	13	25
GV19	07/07/2015	0.8	1.2	19.6	0	0
	11/08/2015	2.4	12.4	10.2	15	1
	04/09/2015	61.7	34.2	0.2	2	0
GV2	07/07/2015	47.5	26.8	1.2	9	22
	11/08/2015	24.3	24.4	0.2	24	17
	04/09/2015	60.0	39.8	0.2	5	16
GV20	07/07/2015	0.6	31.4	19.4	0	0
GV23	07/07/2015	52.2	26.3	0.4	0	0
	11/08/2015	52.9	40.8	0.2	22	99
	04/09/2015	59.4	40.6	0.0	6	54
GV24	07/07/2015	51.4	32.8	0.4	14	9
	11/08/2015	37.1	31.8	1.6	21	6
	04/09/2015	52.0	39.3	0.2	5	7
GV25	07/07/2015	48.8	39.9	1.0	6	11
	11/08/2015	23.6	28.7	0.3	21	19
	04/09/2015	59.0	40.9	0.1	6	216
GV26	04/09/2015	56.6	38.3	0.2	10	78
GV26 + 27 Manifold	04/09/2015	57.6	40.9	0.2	6	51
GV27	04/09/2015	57.3	41.2	0.3	7	45
GV28	04/09/2015	53.2	35.8	0.2	5	40
GV28+ 29 Manifold	04/09/2015	54.6	36.5	0.1	6	54
GV29	04/09/2015	57.3	38.2	0.2	6	63
GV29+D	07/07/2015	52.9	35.6	0.5	9	14
GV3	07/07/2015	52.6	30.2	0.3	12	15
	11/08/2015	62.5	35.4	0.2	23	3
	04/09/2015	63.0	36.8	0.2	4	7
GV30	07/07/2015	45.2	31.8	0.6	9	14
	11/08/2015	21.5	26.1	0.4	42	1
	04/09/2015	57.9	39.7	0.3	9	52
GV31	07/07/2015	42.2	29.9	0.6	14	14
	11/08/2015	37.2	34.7	0.5	26	0
	04/09/2015	58.5	39.0	0.5	5	25
GV32	07/07/2015	48.9	21.3	0.3	7	13
	11/08/2015	13.5	11.5	12.3	23	1
	04/09/2015	57.9	42.0	0.1	9	97
GV33	07/07/2015	48.5	29.8	1.3	13	16
	11/08/2015	21.2	27.4	0.8	17	2
	04/09/2015	58.7	41.2	0.1	9	93
GV34	07/07/2015	40.3	25.4	0.2	9	22
	11/08/2015	26.3	22.8	4.0	24	4
	04/09/2015	62.9	36.9	0.2	2	19
GV4	07/07/2015	48.9	27.4	1.1	14	6
	11/08/2015	23.8	28.4	0.0	23	56
	04/09/2015	62.8	37.1	0.1	3	39

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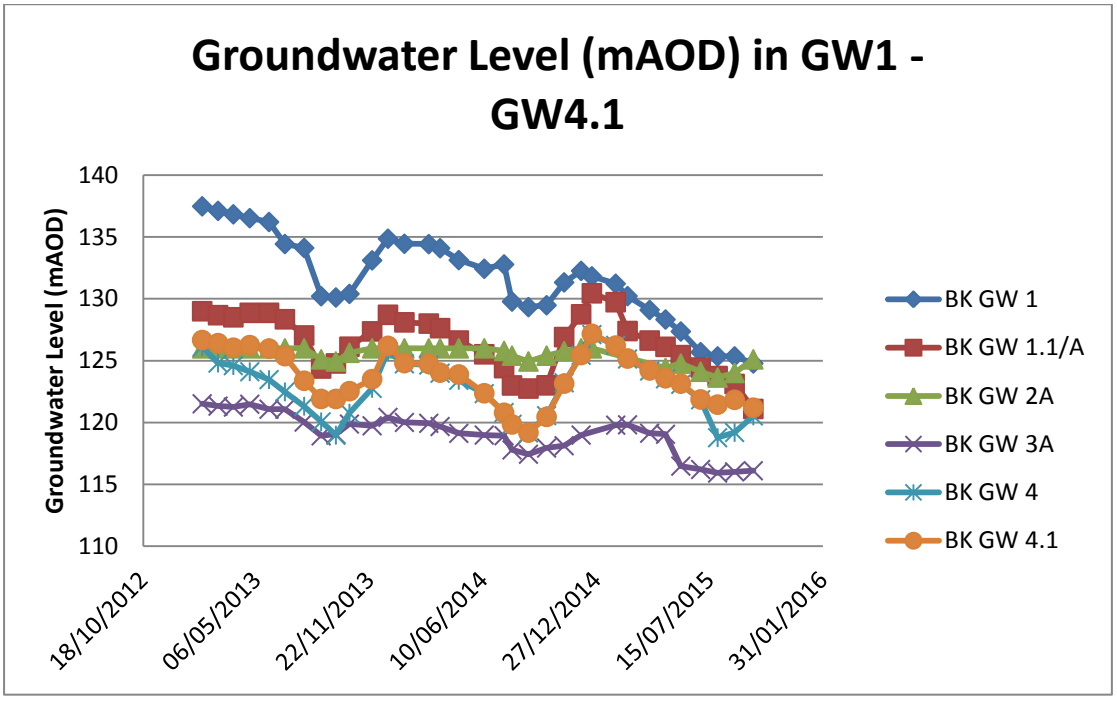
Monitoring Point	Date	CH4 (%)	CO2 (%)	O2 (%)	CO (ppm)	H2S (ppm)
GV5+R1	07/07/2015	29.9	27.5	3.2	10	9
GV6	07/07/2015	51.8	27.4	0.5	8	7
	11/08/2015	41.1	36.1	0.4	22	2
	04/09/2015	51.0	36.9	0.1	9	16
GV7	07/07/2015	52.3	28.5	0.1	6	11
	11/08/2015	25.1	28.7	1.5	15	3
	04/09/2015	63.8	36.0	0.2	6	9
GV8	07/07/2015	39.6	26.5	3.4	8	15
	04/09/2015	59.5	37.7	1.2	7	38
GV9	07/07/2015	51.2	29.5	0.2	14	12
	11/08/2015	43.0	35.7	0.2	15	1
	04/09/2015	59.7	39.9	0.1	11	29
GV9.1	07/07/2015	2.5	3.6	20.1	8	0
GVA	07/07/2015	49.8	31.7	0.6	9	25
	11/08/2015	24.1	21.5	7.8	24	5
	04/09/2015	58.9	40.9	0.2	17	216
LC1.1	07/07/2015	31.9	20.3	5.0	12	7
LC1B	07/07/2015	31.8	20.1	4.5	8	2
	11/08/2015	31.1	29.8	1.8	10	1
	04/09/2015	60.6	38.8	0.6	9	29
LC2R?	07/07/2015	45.6	25.5	0.9	11	9
	11/08/2015	30.7	32.5	0.0	18	6
	04/09/2015	50.7	36.2	0.1	7	6
LC3	04/09/2015	59.9	39.6	0.0	1	29
LC3.1	04/09/2015	60.6	39.2	0.2	10	18
LC4	04/09/2015	57.4	37.6	0.1	7	0
LC4B	07/07/2015	50.2	28.5	1.1	6	9
	11/08/2015	34.6	27.6	5.1	25	0
	04/09/2015	52.3	36.5	0.9	6	37
LC5	07/07/2015	43.5	22.9	3.5	10	0
	11/08/2015	46.5	20.0	4.6	8	10
	04/09/2015	59.8	40.2	0.0	7	110
LC6	07/07/2015	40.8	21.8	4.9	8	0
	11/08/2015	47.1	23.6	5.0	7	11
	04/09/2015	58.0	41.9	0.1	5	10
LC6B	04/09/2015	54.0	36.8	0.2	6	10
PW1	07/07/2015	0.6	1.8	16.9	16	0
	11/08/2015	0.3	1.2	17.2	0	0
	04/09/2015	0.2	0.0	21.5	2	0
PW2	07/07/2015	0.9	2.0	19.8	0	0
	11/08/2015	0.8	3.6	18.2	0	0
	04/09/2015	39.7	29.5	0.4	16	4
PW3	07/07/2015	1.5	2.5	16.8	6	0
	11/08/2015	1.2	3.0	17.3	0	2
	04/09/2015	18.9	16.5	8.6	3	0
PW4	07/07/2015	48.5	19.5	0.5	12	6
	11/08/2015	45.2	18.6	0.4	1	5
	04/09/2015	45.9	30.5	2.7	4	2
PW5	07/07/2015	30.2	19.8	6.5	7	9
	11/08/2015	25.1	18.4	5.2	3	1
	04/09/2015	60.8	39.0	0.2	5	0

APPENDIX 1 – LANDFILL GAS

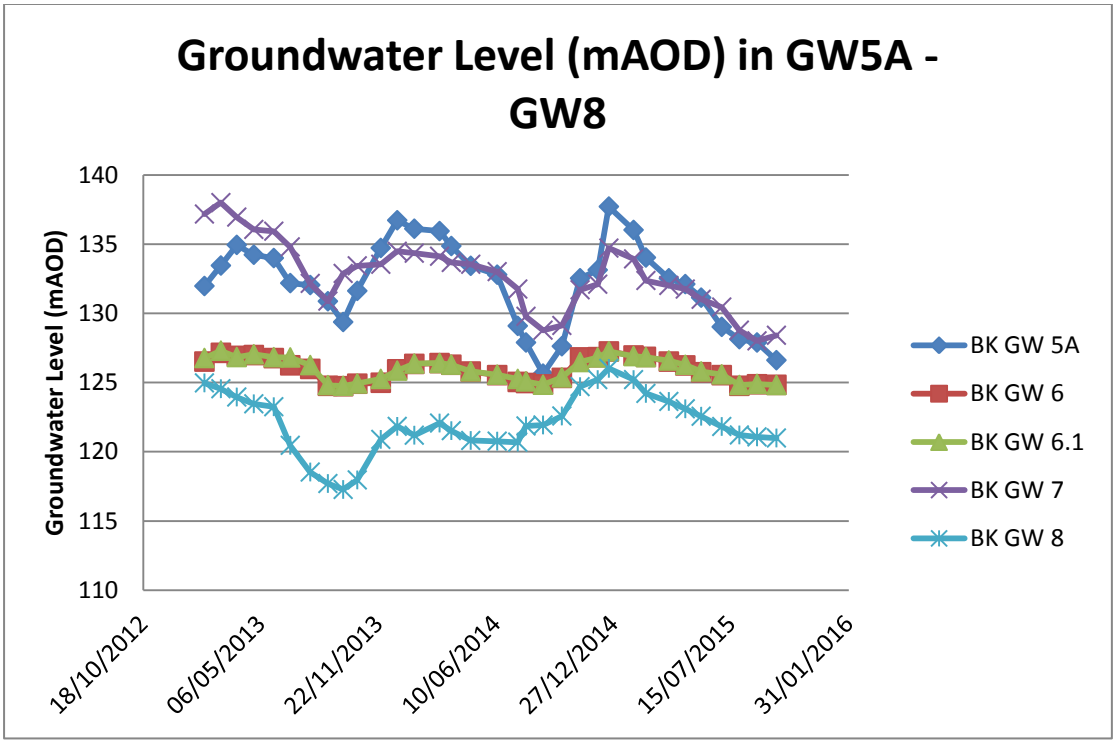
Monitoring Point	Date	CH4 (%)	CO2 (%)	O2 (%)	CO (ppm)	H2S (ppm)
PW6	07/07/2015	0.6	0.9	16.8	8	6
	11/08/2015	0.5	1.0	17.8	3	1
	04/09/2015	60.0	37.2	0.5	5	7
R1	04/09/2015	54.6	33.4	0.8	8	11
	11/08/2015	45.0	34.8	1.0	22	3
	04/09/2015	50.0	31.5	3.6	3	3
R1B	07/07/2015	42.1	25.5	0.9	10	8
	04/09/2015	52.6	36.9	0.1	6	9
R2 (not extracting)	04/09/2015	22.1	13.3	17.4	0	0
R2B	07/07/2015	42.3	25.7	0.9	7	5
	11/08/2015	45.2	33.2	0.2	6	9
	04/09/2015	54.0	37.2	0.0	6	19
R4 (not extracting)	04/09/2015	58.0	42.0	0.0	0	0
R4B	07/07/2015	48.2	20.3	1.2	13	0
	11/08/2015	33.7	30.1	3.3	23	2
	04/09/2015	53.5	37.8	0.2	4	0
R6 (not extracting)	04/09/2015	59.3	40.5	0.2	3	0
R6B	11/08/2015	42.2	37.8	0.2	27	85
	04/09/2015	56.7	38.9	1.1	6	8

APPENDIX 2

APPENDIX 2 - GROUNDWATER



Graph 1: Groundwater level as mAOD at locations GW1 – GW4.1



Graph 2: Groundwater level as mAOD at locations GW5 – GW8

APPENDIX 2 - GROUNDWATER

Table 1: Monthly monitoring data (exceedances highlighted)

Location	Parameter	Ammoniacal N	Chloride	Conductivity	Dissolved Oxygen	pH
	Units	mg/l as N	mg/l	mS/cm	mg/l	pH Units
GW1	31/07/2015	32.7	395	2.76	<0.3	6.85
	27/08/2015	46.3	460	3.10	<0.3	7.16
	30/09/2015	42.4	312	2.38	<0.3	6.81
GW1.1	31/07/2015	4.0	233	1.33	<0.3	6.10
	27/08/2015	3.5	223	1.44	<0.3	6.35
	30/09/2015	3.1	216	1.35	<0.3	6.15
GW2A	Trigger	1.7	60	N/A	N/A	N/A
	31/07/2015	12.1	128	1.53	<0.3	7.20
	27/08/2015	16.4	137	1.68	<0.3	7.20
	30/09/2015	19.2	132	1.59	<0.3	7.25
GW3A	Trigger	1.7	60	N/A	N/A	N/A
	31/07/2015	54.2	212	2.23	<0.3	6.97
	27/08/2015	49.1	195	2.12	<0.3	7.93
	30/09/2015	57.5	154	2.04	<0.3	7.24
GW4	Trigger	1.7	60	N/A	N/A	N/A
	31/07/2015	45.5	150	1.33	<0.3	7.14
	27/08/2015	46.0	151	1.30	<0.3	7.00
	30/09/2015	30.8	134	1.11	<0.3	7.35

Location	Parameter	Ammoniacal N	Chloride	Conductivity	Dissolved Oxygen	pH
	Units	mg/l as N	mg/l	mS/cm	mg/l	pH Units
GW5A	31/07/2015	2.8	100	0.96	0.53	6.73
	27/08/2015	4.1	101	0.99	<0.3	6.99
	30/09/2015	5.45	106	0.96	<0.3	7.35
GW6	31/07/2015	1.53	32	0.80	2.10	7.35
	27/08/2015	2.45	33	0.79	0.97	7.66
	30/09/2015	2.6	32	0.79	1.02	7.96
GW7	31/07/2015	3.0	124	0.72	3.38	7.66
	27/08/2015	2.8	125	0.68	2.19	7.96
	30/09/2015	2.3	122	0.70	1.74	7.77
GW8	31/07/2015	20.3	154	1.50	1.33	7.55
	27/08/2015	19.6	152	1.41	0.92	8.32
	30/09/2015	20.8	126	1.24	0.98	7.00

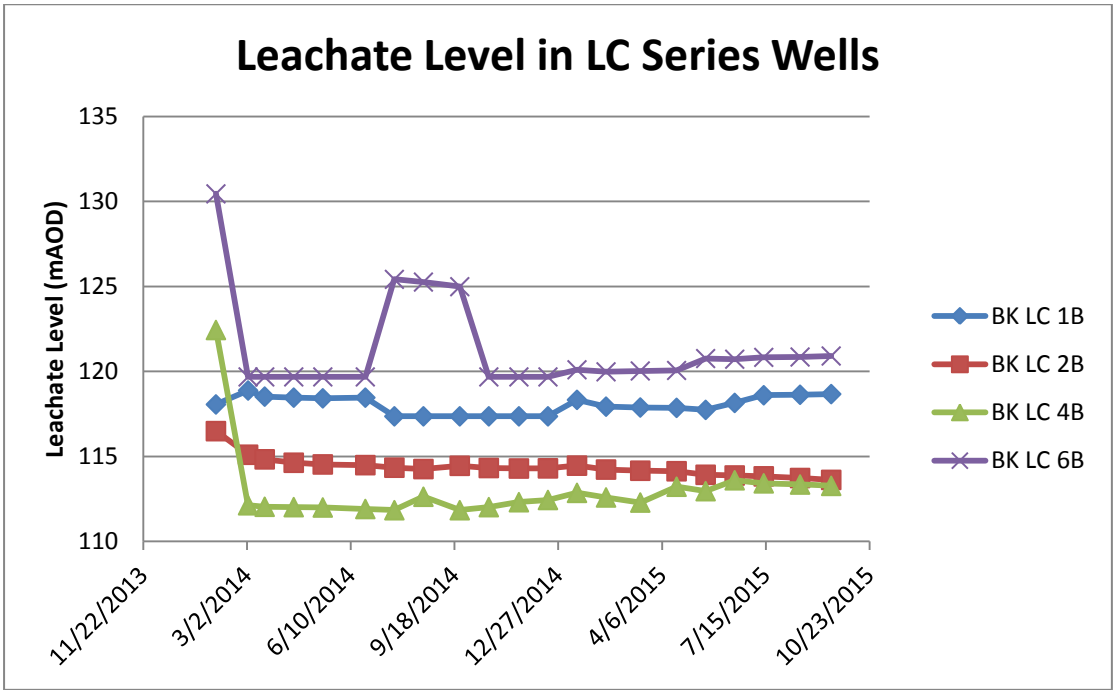
APPENDIX 2 - GROUNDWATER

Table 2: Quarterly monitoring data (exceedances highlighted)

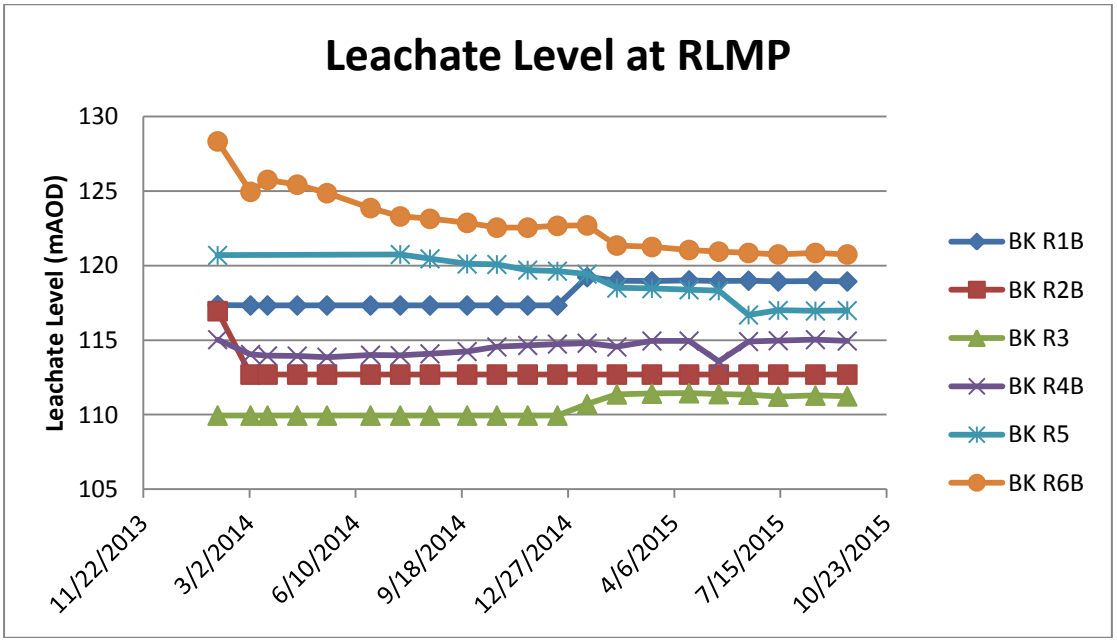
Sample Description		GW1	GW1.1	GW2A	GW3A	GW4	GW5A	GW6	GW7	GW8	Trigger Level
Date Sampled		30.09.2015	30.09.2015	30.09.2015	30.09.2015	30.09.2015	30.09.2015	30.09.2015	30.09.2015	30.09.2015	
Carbon											
Organic Carbon, Total	mg/l	12.9	38	12.4	38	18.9	6.02	5.19	5.17	12	
Inorganics											
Alkalinity, Total as CaCO3	mg/l	159	895	695	574	400	361	375	206	470	
Ammoniacal Nitrogen as N	mg/l	3.08	42.4	19.2	57.5	30.8	5.45	2.62	2.32	20.8	1.7
Chloride	mg/l	216	312	132	154	134	106	31.5	122	126	60
COD, unfiltered	mg/l	114	195	210	1390	164	26.2	78.1	53.9	51.1	
Conductivity @ 20 deg.C	mS/cm	1.350	2.380	1.590	2.040	1.110	0.956	0.786	0.697	1.240	
Oxygen, dissolved	mg/l	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	1.0	1.7	1.0	
pH	-	6.2	6.8	7.3	7.2	7.4	7.4	8.0	7.8	7.0	
Sulphate	mg/l	325	228	160	836	41	86	83	1	107	
Total Oxidised Nitrogen as N	mg/l	0.83	5.75	0.34	0.33	0.13	0.56	0.17	0.09	0.28	
Filtered (Dissolved) Metals											
Cadmium (diss.filt)	mg/l	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	
Calcium (diss.filt)	mg/l	110.0	248.0	197.0	190.0	77.3	102.0	99.8	21.0	84.9	
Chromium (diss.filt)	mg/l	0.0037	0.0153	0.0113	0.0084	0.0044	0.0064	0.0046	0.0031	0.0065	
Copper (diss.filt)	mg/l	<0.00085	0.00116	<0.00085	0.00167	<0.00085	<0.00085	<0.00085	<0.00085	<0.00085	
Iron (diss.filt)	mg/l	7.570	<0.19	1.740	7.680	1.200	<0.19	<0.019	<0.019	0.205	
Lead (diss.filt)	mg/l	<0.00002	0.00009	0.000064	0.000091	<0.00002	<0.00002	0.000031	0.000047	0.00004	
Magnesium (diss.filt)	mg/l	54.5	60.7	48.6	49.5	32.2	37.3	28.8	29.3	30.8	
Manganese (diss.filt)	mg/l	9.400	4.720	6.780	1.400	2.190	0.901	1.600	0.145	0.417	
Nickel (diss.filt)	mg/l	0.027	0.052	0.029	0.041	0.022	0.008	0.003	0.001	0.034	0.15
Potassium (diss.filt)	mg/l	15.1	61.4	34.5	56	29.1	18.7	19.8	22.2	31.2	
Sodium (diss.filt)	mg/l	77.4	172	78.9	123	66.1	59.7	20.3	65	106	
Zinc (diss.filt)	mg/l	<0.00041	0.019	0.002	0.002	<0.00041	0.005	0.001	<0.00041	0.005	0.254
TPH Criteria Working Group (TPH CWG)											
Sum of detected Xylenes	mg/l	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	0.011
Toluene	mg/l	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	0.004

APPENDIX 3

APPENDIX 3



Graph 1: Leachate Levels as mAOD at LC Series Wells (Jan 2014 – Sep 2015)



Graph 2: Leachate Levels as mAOD at Remote Leachate Monitoring Points (Jan 2014 – Sep 2015)

APPENDIX 3

Table 1: Quarterly monitoring data from leachate chambers

Parameters	Units	LC1B	LC2B	LC3	LC4B	LC5	LC6
Carbon							
Organic Carbon, Total	**mg/l**	822	1230	110	1540	5990	6200
Inorganics							
Alkalinity, Total as CaCO3	**mg/l**	8750	9800	2540	10200	13200	13100
Ammoniacal Nitrogen as N	**mg/l**	1590	2010	351	1960	3020	2930
BOD, unfiltered	**mg/l**	99.6	277	12.4	755	>5080	9750
Chloride	**mg/l**	2570	2430	559	3740	3460	3550
COD, unfiltered	**mg/l**	2640	3890	384	5280	18600	16600
pH	**pH Units**	8.08	8.05	7.69	8.07	8.13	8.28
Sulphate	**mg/l**	34.9	72.3	9.89	40.1	16.9	29
Total Oxidised Nitrogen as N	**mg/l**	<0.01	1.94	<0.01	<0.01	<0.01	4.02
Filtered (Dissolved) Metals							
Calcium (diss.filt)	**mg/l**	79.1	29.5	218	39.9	50.1	51.2
Magnesium (diss.filt)	**mg/l**	105	87.1	82.8	79.8	69.7	71
Potassium (diss.filt)	**mg/l**	855	961	176	856	958	974
Sodium (diss.filt)	**mg/l**	1850	1790	350	2390	3080	3080

APPENDIX 3

Table 2: Final Discharge (FD) monitoring data (exceedances highlighted)

Final Discharge	Alkalinity	Ammoniacal Nitrogen	Chromium	COD	Copper	Lead	Nickel	Nitrate as N	Nitrite as N	pH	Suspended solids, Total	Zinc
	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	-	mg/l	mg/l
Trigger	**-**	**50**	**2**	**1000**	**2**	**2**	**2**	**-**	**-**	**>5<10**	**500**	**2**
03.07.2015	850	18.8	0.0885	1290	0.0246	0.0182	0.242	1080	7.36	8.06	146	0.199
10.07.2015	1160	78	0.119	1560	0.0296	0.0197	0.235	1020	18.5	8.27	226	0.206
24.07.2015	710	1.39	0.115	1550	0.0331	0.0207	0.247	1060	<0.25	8.02	228	0.213
31.07.2015	570	1.61	-	1420	-	-	-	1080	<0.2	7.59	99	-
14.08.2015	218	0.975	0.112	1300	0.0317	0.00431	0.227	1110	<0.5	7.02	118	0.0572
18.09.2015	660	0.729	<0.22	1440	0.0389	0.00582	0.275	1280	<0.5	7.95	344	0.112
29.09.2015	260	1.48	0.0814	1400	0.0351	0.00523	0.252	-	<0.2	-	-	0.0746

APPENDIX 4

APPENDIX 4 – SURFACE WATER

Table 1: Monthly monitoring data

Location	Parameter	Ammoniacal N	Chloride	COD	pH	Suspended Solids
	Units	mg/l as N	mg/l	mg/l	pH Units	mg/l
P4	31/07/2015	0.5	93.5	639	7.5	687
	27/08/2015	0.2	94.2	174	7.9	105
	30/09/2015	1.2	88.9	280	7.8	434

APPENDIX 5

Flintshire County Council Deposited Dust Monitoring

Analysis of matter collected in atmospheric deposit gauge duing the period of:

From: 01/09/2015 To: 02/10/2015
No. of days 31

Collector: MW

Gauge Bowl No. Location 1 OES1
Location 2 OES2
Location 3 OES3

Factor (mg deposit to mg/m2) 24.7

Monitoring Location	Sample Volume (ml)	Total Suspended Solids (mg/l)	mg/m2/day
Location 1	150	150	120
Location 2	1300	18	14
Location 3	1300	10	8

Comments:

►Dust analysis carried out by SAL Laboratories, Manchester
►Algal growth noted in sample bottles, more prominent in Location 1 possibly due to greater exposure to sunlight?

Location 1: Site Operations - located on bund by leachate storage tanks and opposite new transfer pad
Location 2: Industrial Estate Boundary - located on perimeter near leachate treatment plant
Location 3: Oaks Farm

Caulmert
Engineering, Environmental and Planning

Registered Office:
InTec, Parc Menai, Bangor, Gwynedd, LL57 4FG
Tel: 01248 672671
Fax: 01248 672601
Email: contact@caulmert.com
Web: www.caulmert.com