

# ANNUAL ENVIRONMENTAL REPORT 2016 DUNGARVAN WASTE DISPOSAL SITE BALLYNAMUCK MIDDLE DUNGARVAN CO. WATERFORD Waste Licence Register No. W0032-3

Report Compiled by;

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#### Introduction

Waterford County Council was granted a Waste Licence (Ref 32-1) by the Environmental Protection Agency on the  $29^{\text{th}}$  November 2002 for the continued acceptance of municipal waste within the existing footprint of the Dungarvan Landfill Facility at Ballynamuck Middle, Dungarvan Co. Waterford. The landfill ceased to accept waste on the  $30^{\text{th}}$  June 2003. This licence was updated by Waste Licence (Ref 32-2) which included permission for a Transfer Station and Composting facilities. A further licence (W032 – 03) was granted by the Agency in October, 2014. This is the thirteenth Annual Environmental Report for the Facility and includes the monitoring period  $1^{\text{st}}$  January 2016 –  $31^{\text{st}}$  December 2016. The report has been prepared in accordance with Condition 11.7 and Schedule E of the Waste Licence.

#### 1. Reporting Period

This is the thirteenth Annual Environmental Report for the Dungarvan Waste Disposal Site, which covers the period 1<sup>st</sup> January 2016 to 31<sup>st</sup> December 2016.

#### 2. Waste Activities carried out at the Facility

Part 1 of the Waste Licence details the activities authorised by the licence:

in surface water retention (s) ponds

#### Waste Management Act 1996: Third Schedule

- Class 4. Surface impoundment, including placement of liquid or sludge discards in to pits, ponds or lagoons: This activity is limited to the storage of leachate generated within the facility in lined Integrated Constructed Wetland Ponds and the storage of surface water runoff
- 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 storage of rejected waste in the waste Inspection and Quarantine area and the Construction and Demolition Recovery Area prior to the removal of such waste off site for the disposal at an appropriate facility

#### Waste Management Act, 1996, Fourth Schedule

Class 2. Recycling or reclamation of organic substances, which are not used as solvents (including composting and other biological transformation processes): This activity is limited to recycling of organic waste including cardboard and paper at the civic waste facility only and the acceptance and storage of waste oils in appropriate containers at the civic waste facility prior to removal offsite.

Class 3. Recycling or reclamation of metals and metal compounds: This activity is limited to the acceptance of white goods within a designated Metal Recovery Area, the acceptance and storage of beverage cans in the appropriate containers at the civic waste facility prior to removal offsite.

## Class 4. Recycling or reclamation of other inorganic materials: This activity is limited to the acceptance and storage in appropriate containers of glass bottles, batteries and fluorescent tubes and the recovery of inert waste at the facility for use in site development and restoration works.

Class 9. Use of any waste principally as a fuel or other means to generate energy

## 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 suitable inert waste in site development and restoration works.

Class 13. Storage of waste intended for submission to any activity referred to in a preceding paragraph of this Schedule, other than the temporary storage, pending collection, on the premises where such waste is produced:

This activity is limited to the storage of wastes within designated areas and receptacles prior to recovery offsite and the storage of inert waste prior to restoration of the facility.

## **3.** Quantity and Composition of Waste received, disposed of and removed during the reporting period and each year previous

The quantity and composition of waste received, disposed of and removed for the reporting period  $1^{st}$  January 2016 –  $31^{st}$  December 2016 is attached in Appendix A.

#### 4. Methods of deposition of inert waste for restoration

All capping and restoration works have now been completed.

## 5.0 Environmental Monitoring

#### Introduction

Dungarvan landfill is located in County Waterford approximately 2km north west of Dungarvan off the N25 road on the southern edge of the Colligan River. The total area of the landfill site is approximately 6.5 hectares, and has been in operation since 1968. The landfill closed on 30<sup>th</sup> June 2003, but a transfer station, which accepts residual household waste remains operational on site.

Monitoring of surface waters, groundwater's and leachate and landfill gas was carried out in accordance with the waste licence W032-03. EPA and Waterford City and County Council staff carried out sampling and field measurements. Sampling was carried out by Jim McGarry, Brownstown, Kilkieran, Co. Kilkenny. Samples were analysed by ALcontrol Laboratories, Unit 7-8 Hawarden Business Park, Manor Road, Hawarden, Deeside, UK in each quarter of 2016.

Surface water stations	Groundwat er station	Leachate station	Gas monitoring station	Noise	Dust
Upstream/	<mark>GW1*</mark> ,	L1, L2a,	L1*, L2a, <mark>L3*,</mark>	Entrance	D1, D2,
Downstream	GW2a,	L3*, L4*	<mark>L4*</mark> , L5a, L6,		D2a
of Surface	RC3a,	L5a, <mark>L6*,</mark>	RC1*, RC3,		
Water	RC4*,	Leachate	RC4*, RC6,		
<b>Emission</b>	RC6a,	tank	RC7, RC8,		
Point to	RC7*,		<mark>GW1*</mark> , GW2a		
Colligan	RC8*				
River					
Wetlands					

Sampling sites are as set out in Table 1 and attached Drawing, DUN-EIS-003.

 Table 1: Monitoring locations, Dungarvan Landfill

\*Baseline results available for these sites

#### **Baseline Monitoring**

One of the purposes of compliance monitoring is to determine if there has been a release of contaminants to the environmental media, and to demonstrate compliance with landfill licence conditions. *Baseline monitoring* is monitoring which serves as a reference point to which later monitoring results are compared. While there is no data available preceding the landfill, for the purpose of this report, <u>water quality</u> results obtained during 2001 will be used as baseline monitoring data. Two new groundwater monitoring boreholes (RC7 and RC8) were installed since 2001, and results of tests carried out in 2002 at these sites are used as baseline. <u>Noise</u> measurements taken during the 1998 survey will also be used as comparison with the most recent study. For all new sampling sites referred to in the new licence the 2016 figures included in this report will be used as baseline figures going forward.

#### 5.1 SURFACE WATER.

#### 5.1.1 Introduction

The surface water sampling sites are SWE1, SWE2, SWE3, SWE4, SWE5, SWE6 and SWE7 which relate to storm water discharge points from the landfill and the outfall to the Colligan River (SWE6). River water quality upstream and downstream of the outfall pipe is also measured. Further surface water monitoring is carried out at the Constructed Wetland System at the outlets of Ponds 1a, 1b, 2,3,4 and 5. Sampling was carried out by Jim McGarry, Brownstown, Kilkieran, Co. Kilkenny. Samples were analysed by ALcontrol Laboratories, Unit 7-8 Hawarden Business Park, Manor Road, Hawarden, Deeside, UK in each quarter of 2016.

There are difficulties involved in monitoring surface water pollution from landfills adjacent to estuaries, as the salinity of the samples can interfere with many of the tests, (*ammonia, COD, arsenic, copper*). Additionally, many of the ions, which are considered indicators of leachate contamination, are also major components of sea/brackish water, (*chloride, sulphate, sodium, magnesium, calcium, boron*).

#### 5.1.2 Results – see table 5.1.1 to 5.1.4 below.

River and lagoon water quality was satisfactory.

#### Key Parameter – BOD

The BOD test is a measure of the amount of oxygen consumed by microorganisms in breaking down organic matter in water. Respiration by phytoplankton or their decay, can also lead to oxygen depletion during the BOD test resulting in a high BOD value. Surface waters supporting fish life should have a BOD value < 4 mg/l BOD as was the case throughout this reporting period.



### Discussion

BOD levels were low in the receiving waters throughout the year. All other water quality tests were satisfactory.

Dungarvan Landfill W0032-02 Qrt 1 2016								
Surface Water - Receiving Waters								
Parameters	Units							
LABORATORY NUMBER		2029	2030					
Sampling Location		U/S	D/S					
Date sampled	14/03/2016	14-Mar	14-Mar					
Sampled by	JMcGarry	JMcG	JMcG					
Time sampled		13:55	12:50					
			clear/					
Visual Inspection/Odou	r	clear	saline					
рН	units	7.55	8.7					
Cond	uS/cm	182	2690					
BOD	mg/l	<1	<1					
COD	mg/l	<7	15.3					
Sus Solids	mg/l	0.2	0.6					
Ammonia Total (as N)	mg/l	<0.2	<0.2					
Chloride	mg/l	15.2	768					
Dissolved Oxygen	% sat	107	106					
тос	mg/l	<3	<3					
Phosphate (ortho) as P	mg/l	<0.02	<0.02					
TN	mg/l	3.45	3.25					
FOG	mg/l	<1	<1					
Mineral Oils	mg/l	<1	<1					

## Table 5.1.1 Dungarvan landfill surface water monitoring Q1 2016

## Table 5.1.2 Surface water quality Dungarvan landfill Q2 2016

Dungarvan Landfill W0032-02 Annual 2016									
Surface Water									
LABORATORY NUMBER 2246 2247									
Sampling Location	/ /	U/S	D/S						
Date sampled	24/06/2016	24-Jun	24-Jun						
Sampled by	JMcGarry	JMcG	JMcG						
Time sampled		14:00	14:10						
Parameters Units									
/isual Inspection/Odou	r	clear	clear						
ЭΗ	units	7.8	7.5						
Cond	uS/cm	190	1128						
BOD	mg/l	<2	<2						
COD	mg/l	<7	12.3						
Sus Solids	mg/l	0.2	1						
Ammonia Total (as N)	mg/l	<0.2	<0.2						
Dissolved Oxygen	% sat	107	109						
ОС	mg/l	<3	<3						
hosphate (ortho) as P	mg/l	<0.02	<0.02						
'N	mg/l	3.51	3.76						
OG	mg/l	<1	<1						
∕lineral Oils	mg/l	<1	<1						

Table 5.1.3 Surface water quality Dungarvan landfill 🚺	)3 2016
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Surface Water - Receiving Waters								
Dungarvan Landfill W0032-02 Qrt 3 2016								
LABORATORY NUMBER		2384	2385					
Sampling Location		U/S	D/S					
Date sampled	19/09/2016 09-Jan	19-Sep	19-Sep					
Sampled by	JMcGarry	JMcG	JMcG					
Time sampled		15:20	15:40					
Parameters	Units							
Visual Inspection/Odou	r	clear	clear					
рН	units	7.4	7.2					
Cond	uS/cm	126	231					
BOD	mg/l	<2	<2					
COD	mg/l	9.4	12.2					
Sus Solids	mg/l	0.2	0.7					
Ammonia Total (as N)	mg/l	<0.2	0.388					
Dissolved Oxygen	% sat	103	108					
тос	mg/l	nm	nm					
Phosphate (ortho) as P	mg/l	<0.02	<0.02					
TN	mg/l	2.42	2.07					
FOG	mg/l	<1	<1					
Mineral Oils	mg/l	<1	<1					

## Table 5.1.4 Surface water quality Dungarvan landfill Q4 2016

Dungarvan Landfill W0032-02 Qrt 4 2016								
Surface Water - Receiving Waters								
Parameters	Units							
LABORATORY NUMBER		2423	2424					
Sampling Location		U/S	D/S					
Date sampled	26/10/2016	26-Oct	26-Oct					
Sampled by	JMcGarry	JMcG	JMcG					
Time sampled		13:55	14:15					
Visual Inspection/Odou	r	clear	clear					
Temperature	٥C	11.7	11.6					
Dissolved Oxygen	% Sat	106	107					
рН	units	7.7	7.9					
Cond	uS/cm	148	155					
BOD	mg/l	<1	<1					
COD	mg/l	8.45	<7					
Sus Solids	mg/l	<2	<2					
Ammonia Total (as N)	mg/l	<0.2	<0.2					
Dissolved Oxygen	% sat	106	108					
тос	mg/l	<3	<3					
Phosphate (ortho) as P	mg/l	<0.02	<0.02					
TN	mg/l	2.35	2.37					
FOG	mg/l	<1	<1					
Mineral Oils	mg/l	<1	<1					

Sampling Location		Ponds	Pond 1A	Pond 1B	Pond 2	Pond 3	Pond 4	Pond 5	Sample Date
Temperature	οC		11.7	10	8.3	8.6	9.2	8.9	29-Mar
рН	units		7.7	7.4	7.7	7.6	8.7	7.8	29-Mar
Cond	uS/cm		786	778	826	888	842	580	29-Mar
BOD	mg/l		26	9	4	3	6	15	29-Mar
COD	mg/l		99.6	60	29.5	35.8	36.4	46	29-Mar
Ammonia Total (as N)	mg/l		3.84	2.38	6.38	8.33	1.99	1.55	29-Mar
Dissolved Oxygen	% sat		129	59	87	91	148	98	29-Mar
Sampling Location		Ponds	Pond 1A	Pond 1B	Pond 2	Pond 3	Pond 4	Pond 5	Sample Date
Temperature	οC		nm	nm	nm	nm	nm	nm	18-Apr
рН	units		7.4	7.6	7.7	7.8	8.4	7.6	18-Apr
Cond	uS/cm		808	1144	708	659	558	616	18-Apr
BOD	mg/l		18	16	3	3	24	4	18-Apr
COD	mg/l		22	58.9	36.7	39.5	59.6	35.5	18-Apr
Ammonia Total (as N)	mg/l		7.55	16.1	2.04	0.235	0.589	<0.2	18-Apr
Dissolved Oxygen	% sat		nm	nm	nm	nm	nm	nm	18-Apr
	-								
Sampling Location		Ponds	Pond 1A	Pond 1B	Pond 2	Pond 3	Pond 4	Pond 5	Sample Date
Temperature	0 <b>C</b>		nm	nm	nm	nm	nm	nm	17-May
рН	units		7.4	7.1	7.6	7.7	7.3	7.5	17-May
Cond	uS/cm		1693	1073	951	843	713	657	17-May
BOD	mg/l		42	36	8	4	10	10	17-May
COD	mg/l		1180	994	50.4	36.7	52.6	65.9	17-May
Ammonia Total (as N)	mg/l		42.9	14.3	8.08	3.87	1.62	<0.2	17-May
Dissolved Oxygen	% sat		nm	nm	nm	nm	nm	nm	17-May

Table 5.1.5 Integrated Constructed Wetlands Surface Water Quality Dungarvan landfill 2016

Sampling Location		Ponds	Pond 1A	Pond 1B	Pond 2	Pond 3	Pond 4	Pond 5	Sample Date
Temperature	0 <b>C</b>		14.6	15.4	17.4	16.2	16.8	17.2	24-Jun
рН	units		7.2	7.3	7.3	7.4	7.5	7.2	24-Jun
Cond	uS/cm		820	834	803	785	700	784	24-Jun
BOD	mg/l		7	73	5	<5	30	4	24-Jun
COD	mg/l		29.5	4620	25.3	29.5	80	174	24-Jun
Ammonia Total (as N)	mg/l		7.25	5.47	3.98	2.43	0.703	2.14	24-Jun
Dissolved Oxygen	% sat		56	19	94	57	71	60	24-Jun
Sampling Location		Ponds	Pond 1A	Pond 1B	Pond 2	Pond 3	Pond 4	Pond 5	Sample Date
Temperature	0 <b>C</b>		17.4	13.9	15.6	17.7	17	18.4	14-Jul
рН	units		7.1	6.6	7.3	7.4	7.5	7.2	14-Jul
Cond	uS/cm		1515	864	916	837	656	694	14-Jul
BOD	mg/l		35	178	4	<5	17	6	14-Jul
COD	mg/l		614	72600	31.1	26	148	47.5	14-Jul
Ammonia Total (as N)	mg/l		33.7	1.68	5.8	2.86	<0.2	<0.2	14-Jul
Dissolved Oxygen	% sat		nm	nm	nm	nm	nm	nm	14-Jul
	-			-	-	_	_	-	
Sampling Location		Ponds	Pond 1A	Pond 1B	Pond 2	Pond 3	Pond 4	Pond 5	Sample Date
Temperature	0 <b>C</b>		17.4	14.3	15.5	16.2	14.8	15.5	19-Aug
рН	units		7.2	6.7	7.4	7.2	7.5	7	19-Aug
Cond	uS/cm		749	737	776	770	755	821	19-Aug
BOD	mg/l		6	481	<5	<5	7	11	19-Aug
COD	mg/l		14.3	34900	34.9	31.5	47.3	105	19-Aug
Ammonia Total (as N)	mg/l		3.66	1.09	1.88	1.94	2.19	2.34	19-Aug

75

nm

49

112

58

19-Aug

Dissolved Oxygen

% sat

121

Sampling Location		Ponds	Pond 1A	Pond 1B	Pond 2	Pond 3	Pond 4	Pond 5	Sample Date
Temperature	οC		13.6	12.2	12.3	12.5	12.7	12.5	26-Sep
рН	units		7.3	6.4	7.2	7.4	7.6	7.3	26-Sep
Cond	uS/cm		743	758	720	708	691	699	26-Sep
BOD	mg/l		48	29	3	<2	17	<2	26-Sep
COD	mg/l		89	36900	13.9	12.8	119	18.4	26-Sep
Ammonia Total (as N)	mg/l		5.09	0.355	2.14	1.24	1.69	0.672	26-Sep
Dissolved Oxygen	% sat		96	2	59	57	109	61	26-Sep
Sampling Location		Ponds	Pond 1A	Pond 1B	Pond 2	Pond 3	Pond 4	Pond 5	Sample Date
Temperature	οC		14.4	12.5	11.8	11.7	12.5	11.9	14-Oct
рН	units		7.7	6.7	7.6	7.5	7.9	7.4	14-Oct
Cond	uS/cm		612	751	692	691	682	690	14-Oct
BOD	mg/l		24	125	2	2	8	3	14-Oct
COD	mg/l		568	10400	20.8	23.4	60.8	24.6	14-Oct
Ammonia Total (as N)	mg/l		3.74	0.627	0.702	0.333	0.629	1.15	14-Oct
Dissolved Oxygen	% sat		123	2	67	64	104	83	14-Oct
				-				-	
Sampling Location		Ponds	Pond 1A	Pond 1B	Pond 2	Pond 3	Pond 4	Pond 5	Sample Date
Temperature	0 <b>C</b>		1.1	2.9	3.7	4.2	3.1	2.1	30-Nov
рН	units		7.5	7.1	7.8	8	7.9	8.1	30-Nov
Cond	uS/cm		1544	815	734	747	756	711	30-Nov
BOD	mg/l		1200	156	<5	<5	8	5	30-Nov
COD	mg/l		11400	33800	21.7	18.6	32.3	24.8	30-Nov
Ammonia Total (as N)	mg/l		27.5	0.837	1.62	1.89	3.5	0.688	30-Nov
Dissolved Oxygen	% sat		nm	nm	nm	nm	nm	nm	30-Nov

Sampling Location		Ponds	Pond 1A	Pond 1B	Pond 2	Pond 3	Pond 4	Pond 5	Sample Date
Temperature	οC		9.7	9.9	8.5	8.2	7.8	8.2	15-Dec
рН	units		7.7	7.2	7.9	7.8	8.4	7.5	15-Dec
Cond	uS/cm		687	632	617	607	571	632	15-Dec
BOD	mg/l		1200	156	<5	<5	8	5	15-Dec
COD	mg/l		11400	33800	21.7	18.6	32.3	24.8	15-Dec
Ammonia Total (as N)	mg/l		27.5	0.837	1.62	1.89	3.5	0.688	15-Dec
Dissolved Oxygen	% sat		73	39	72	72	83	60	15-Dec

#### 5.2 Groundwater

#### **5.2.1 INTRODUCTION**

Sites GW1, GW2a, RC3a, RC4, RC6a, RC7 and RC8 were sampled during 2016. RC1 is no longer in place.

RC4 (south west of site) and RC7 (east of site) are outside the waste deposit area.

All the other ground water stations are within the site boundary, either within or immediately adjacent to waste deposit areas. Ground-water flow through the site has previously been described as south to north.

#### 5.2.2 RESULTS

Results for 2016 are presented on tables 5.2.1 to 5.2.4 below, and appendices. High ammonia levels were detected at borewells RC3a, and RC6a, within the landfill site. Metals levels were generally low, although high iron levels were detected at GW1. Trace organics were not detected in groundwaters. High conductivity levels detected at site RC7, outside the landfill boundary, when tested in Q4, which indicates likely saline intrusion from the estuary.



#### Key Parameter – Ammonia

#### Key parameter - Iron



#### **5.2.3 DISCUSSION**

*Ammonia* was elevated at sites RC3a and RC6a. RC4 and RC7, outside the landfill area, had relatively low *ammonia*. Heavy metals and organics were not detected or else present in low concentrations.

The results of groundwater monitoring are in line with results from previous rounds of testing. The sites within and closely adjacent to the working area appear to be impacted by landfill leachate in terms of ammonia and iron concentration. Site RC4 at the south-western boundary had relatively good water quality. Site RC7, 200 metres east of the facility, and outside the landfill area, had generally satisfactory water quality though saline intrusion was evident.

## Table 5.2.1 Dungarvan landfill groundwater monitoring Q1 2016

						Groundwater		
						quality standards		Environmental
EntityName	Dungarvan	Dungarvan	Dungarvan	Dungarvan	Dungarvan	S.I. No. 9 of 2010	Comment	significance
StationName	GW1	RC3a	RC4	RC6a	RC7			
SampleDate	14/03/2016	14/03/2016	14/03/2016	14/03/2016	14/03/2016			
							Elevated levels at	
							GW1, RC3a and	
							RC6a, likely due to	None, given
Ammonia(N)	2.22	63.6	<0.2	14.1	<0.2	0.175	landfill leachate.	dilution available
							Elevated at RC3a,	
							RC6a and RC7.	None, given
							Likely due to	available dilution
							landfill material at	and estuarine
							RC3a and RC6a and	nature of
							brackish water	receiving
Chloride	15.6	101	28	75.9	1750	24	ingress at RC7.	environment.
Conductivity @ 25°C	962	1636	641	1042	6450	800	As for chloride	As for chloride
							Relatively low as	
Dissolved Oxygen % Saturation	72	19	56	16	24		to be expected	None
Faecal Coliforms	NT	NT	NT	NT	NT			
							Elevated at GW1	None, given
Iron	183	206	19	22.7	19	200	and RC3A	dilution available
pH	6.9	7	7.4	7.1	7.4			
Temperature	11.6	12	10.7	11.4	11			
							Slightly elevated	None, given
Total Oxidised Nitrogen	<0.1	<0.1	12.1	10.2	1.77	8.48	at RC4	dilution available

						Groundwater		
						quality standards		Environmental
EntityName	Dungarvan	Dungarvan	Dungarvan	Dungarvan	Dungarvan	S.I. No. 9 of 2010	Comment	significance
StationName	GW1	RC3a	RC4	RC6a	RC7			
SampleDate	24/06/2016	24/06/2016	24/06/2016	24/06/2016	24/06/2016			
							Elevated levels at	
							GW1, RC3a and	
							RC6a, likely due to	None, given
Ammonia(N)	3.23	65.8	<0.2	25.8	<0.2	0.175	landfill leachate.	dilution available
							Elevated at RC3a,	
							RC6a and RC7.	None, given
							Likely due to	available dilution
							landfill material at	and estuarine
							RC3a and RC6a and	nature of
							brackish water	receiving
Chloride	20.5	106	27.7	95.1	4820	24	ingress at RC7.	environment.
Conductivity @ 25°C	928	1690	650	1176	15030	800	As for chloride	As for chloride
, -							Relatively low as	
Dissolved Oxygen % Saturation	15	25	51	19	29		to be expected	None
Faecal Coliforms	NT	NT	NT	NT	NT			
						1	Elevated at	
							GW1,RC3A,RC6a	None, given
Iron	NT	NT	NT	NT	NT	200	and RC7	dilution available
pH	6.6	6.8	7.2	7.2	7.3			
Temperature	12.5	13.2	11.9	12.2	12.6	1	1	
							Slightly elevated	None, given
Total Oxidised Nitrogen	<0.1	<0.1	10.2	10.2	0.114	8.48	at RC4	dilution available

## Table 5.2.2. Groundwater quality Dungarvan landfill Q2 2016

Table 5.2.3.	Groundwater	quality D	ungarvan	landfill	<b>Q3</b>	2016
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						Groundwater		
						quality standards		Environmental
EntityName	Dungarvan	Dungarvan	Dungarvan	Dungarvan	Dungarvan	S.I. No. 9 of 2010	Comment	significance
StationName	GW1	RC3a	RC4	RC6a	RC7			
SampleDate	19/09/2016	19/09/2016	19/09/2016	19/09/2016	19/09/2016			
Ammonia(N)	2.22	62.9	<0.2	17.6	<0.2	0.175	Elevated levels at GW1, RC3a and RC6a, likely due to landfill leachate.	None, given dilution available
Chloride	15.6	112	27.4	112	5200	24	Elevated at RC3a, RC6a and RC7. Likely due to landfill material at RC3a and RC6a and brackish water ingress at RC7.	None, given available dilution and estuarine nature of receiving environment.
Conductivity @ 25°C	996	1638	655	1177	15800	800	As for chloride	As for chloride
Dissolved Oxygen % Saturation	41	17	52	16	52		Relatively low as to be expected	None
Faecal Coliforms	NT	NT	NT	NT	NT			
Iron	1830	580	190	190	190	200	Elevated at GW1,RC3A	None, given dilution available
рН	6.6	7	7.4	7	63.8			
Temperature	12.6	12.9	11.6	11.8	12.9			
Total Oxidised Nitrogen	BLD	0.143	9.64	8.88	<0.1	8.48	Slightly elevated at RC4, RC6a	None, given dilution available

## Table 5.2.4 Dungarvan landfill groundwater monitoring Q4 2016

						Groundwater		
						quality standards		Environmental
EntityName	Dungarvan	Dungarvan	Dungarvan	Dungarvan	Dungarvan	S.I. No. 9 of 2010	Comment	significance
StationName	GW1	RC3a	RC4	RC6a	RC7			
SampleDate	26/10/2016	26/10/2016	26/10/2016	26/10/2016	26/10/2016			
							Elevated levels at	
							GW1, RC3a and	
							RC6a, likely due to	None, given
Ammonia(N)	2.09	62.8	<0.2	18.8	<0.2	0.175	landfill leachate.	dilution available
							Elevated at RC3a,	
							RC6a and RC7.	None, given
							Likely due to	available dilution
							landfill material at	and estuarine
							RC3a and RC6a and	nature of
							brackish water	receiving
Chloride	18	110	27.1	109	3900	24	ingress at RC7.	environment.
Conductivity @ 25°C	1047	1713	657	1199	12460	800	As for chloride	As for chloride
							Relatively low as	
Dissolved Oxygen % Saturation	56	12	51	17	20		to be expected	None
Faecal Coliforms	NT	NT	NT	NT	NT			
							Elevated at	
							GW1,RC3A, RC6a	None, given
Iron	6410	1990	19	19	19	200	and RC7	dilution available
pН	6.5	7	7.1	7.1	7.8			
Temperature	12.9	12.6	11.6	11.8	12.4			
							Slightly elevated	None, given
Total Oxidised Nitrogen	BLD	0.244	10.1	8.16	0.177	8.48	at RC4	dilution available

#### **5.3 LEACHATE**

#### **5.3.1 INTRODUCTION**

In order to treat the leachate collected from the landfill an ICW consisting of five cells of varying size was constructed on top of the capped landfill. Each ICW cell was constructed by creating 1m x 3-4m wide perimeter bunds. Each cell was lined with HDPE to contain the leachate and each cell has a 500mm depth of subsoil to support the establishment of the wetland helophytic (emergent) vegetation. The wetlands have a total surface area of 18,000 m2. The ICW can be generally categorized as a surface flow wetland and strives to mimic natural wetlands of similar structure and vegetation. The dominant vegetation in the wetland consists of a range of helophytic genera (emergent plants) including amongst others Typha, Glyceria, Carex and Iris species. The sizing of the overall functional area of the ICW is based on an area loading of 0.2 litres of leachate per meter squared per day (0.2 l/m2/d). The leachate, after dilution, is pumped to the first ICW cell and thereafter flows by gravity sequentially from cell to cell where it is comprehensively treated prior to intermittent discharge to the on-site surface water lagoon. Currently leachate from the interceptor tank and leachate boreholes 2 and 6 are mixed with groundwater from RC8 and pumped to the ICW for treatment. Flow and contaminant loadings to the wetland are presented in table 5.3.1.

Table 5.3.1 Dungarvan	landfill integrated	constructed wetlan	d estimated loadings	s - present and	(future expe	cted).
					(	, .

Number of ponds	6
Total working wetland area m2	5158
Total working wetland volume m3	1032
HYDRAULIC FLOWS	
Influent Volume m3 per Day	26.9 (50)
Hydraulic loading l/m2/day	5.2 (12)
Ammoniacal Nitrogen loading (g/m2/day)	0.5
Total Phosphorous loading (g/m2/day)	0.003
COD loading (g/m2/day)	0.6
Metals mg/m2/day	<0.1

26









Figure 5.3.1: ICW inlet / outlet concentrations a) ammonium, b) chemical oxygen demand.

#### **Key Parameter – leachate COD**

The COD test measures the organic matter in a sample that is amenable to chemical oxidation. The COD test is usually applied to polluted waters and waste-waters.



Figure 5.3.2 Leachate COD Trends 2016

#### DISCUSSION

The strengths of leachate present in the holding/interceptor tank and at the ICW outlet were quite low, with an average COD value of 61 and 56 mg/l respectively. The interceptor tank receives leachate from a drain around the landfill and also from a waste transfer station. The contents of the interceptor tank and leachate boreholes 2 and 6 are treated in the on-site constructed wetland. Ammonium values at the ICW outlet ranged from 0.67 to 2.34 mg/l, with an average of 0.98 mg/l, and were below the proposed discharge licence limit of 5 mg/l. Similarly COD (mean 56 mg/l) values were low for the ICW outlet.

Dungarvan Landfill W0032-02 Qrt 1 2016							
	Leachates						
Parameters	Units						
LABORATORY NUMBER		2095					
		Lagoon					
Sampling Location		Marsh					
Date sampled	29/03/2016	29-Mar					
Sampled by	JMcGarry	JMcG					
Time sampled		10:10					
BOD	mg/l	<2					
COD	mg/l	24.9					

Dungarvan Landfill W0032-02 Annual 2016 Leachates						
LABORATORY NUMBER		2255 Lagoon	2256			
Sampling Location		Marsh	Interceptor			
Date sampled	24/06/2016	24-Jun	24-Jun			
Sampled by	JMcGarry	JMcG	JMcG			
Time sampled		14:40	14:45			
Parameters	Units					
BOD	mg/l	<2	<5			
COD, unfiltered	mg/l	45.2	40.6			
Ammonia Total (as N)	mg/l	0.225	<0.2			
Fluoride	mg/l	<0.5	<0.5			
Metals ***						
Sulphate	mg/l	<2	<2			
Chloride( asCl)	mg/l	69.5	92.2			
Cyanide	mg/l	<0.05	<0.05			
Phosphate(ortho)as P	mg/l	0.0392	<0.02			
Total Oxidised Nitrogen	mg/l	<0.1	<0.1			
Dissolved Oxygen	% sat	212	81			
VOC's @@@						
@@@ ****	See attached Ce See attached Ce	ertificate of Ana ertificate of Ana	alysis for Indiv alysis for Indiv	vidual compounds vidual metals		

## Table 5.3.4 Leachate Quality Dungarvan landfill, Q2 2016

Dungarvan Landfill W0032-02 Qrt 3 2016									
	Leachates								
LABORATORY NUMBER 2393 Lagoon									
Sampling Location	Sampling Location Marsh								
Date sampled	19/09/2016	19-Sep							
Sampled by	JMcGarry	JMcG							
Time sampled		15:50							
Parameters	Units								
BOD	mg/l	9							
COD	mg/I	67.9							

### Table 5.3.5 Leachate Quality Dungarvan landfill, Q3 2016

Dungarvan Landfill W0032-02 Qrt 4 2016								
	Leachates							
LABORATORY NUMBER		2432 Lagoon						
Sampling Location		Marsh						
Date sampled	26/10/2016	26-Oct						
Sampled by	JMcGarry	JMcG						
Time sampled		14:45						
Parameters	Units							
BOD	mg/l	3						
COD	mg/l	30.4						

## Table 5.3.6 Leachate Quality Dungarvan landfill, Q4 2016

#### 5.4. Groundwater and Leachate Levels

#### 5.4.1 Introduction

Groundwater and leachate levels are determined monthly, by dip meter, at boreholes GW1, RC3a, RC4, RC6a, RC7, RC8, L4, and L5a.

#### 5.4.2 Results

Results of monitoring are presented in table 4.1.

Date	Operator	GW1	GW2A	L1	L2	L4	L5	RC3A	RC4	RC6A	RC7	RC 8
05/01/2016	DR	7.50	10.20	13.10	10.40	9.30	10.20	9.30	7.40	3.60	1.70	3.60
04/02/2016	DR	7.70	10.10	12.90	10.30	9.40	10.20	9.30	7.40	3.70	1.60	3.40
04/03/2016	DR	7.60	10.20	12.20	10.10	9.40	10.10	9.30	7.40	3.60	1.60	3.40
05/04/2016	DR	7.60	10.10	11.80	9.90	9.20	10.10	9.40	7.40	3.60	1.50	3.70
04/05/2016	DR	7.60	10.10	11.80	9.90	9.20	10.10	9.40	7.40	3.60	1.50	3.70
03/06/2016	DR	7.70	10.10	11.60	9.90	9.20	10.10	9.30	7.40	3.60	1.50	3.60
05/07/2016	DR	7.60	10.10	11.40	9.90	9.20	10.10	9.10	7.40	3.60	1.60	3.70
05/08/2016	DR	7.70	10.20	11.30	9.90	9.40	10.10	8.90	7.40	3.60	1.50	3.60
06/09/2016	DR	7.70	10.10	11.10	9.90	9.30	10.10	9.10	7.40	3.60	1.50	3.60
03/10/2016	DR	7.60	10.20	10.20	D	9.40	10.10	9.10	7.40	3.60	1.50	3.80
19/12/2016	DR	7.80	10.20	10.90		9.40	10.10	3.50	7.40		1.70	3.40

#### Table 5.4.1 Dungarvan landfill leachate levels 2016

D=Damaged

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Note new wells drilled at L1A, L2B and L5B in August 2011

#### 5.4.3 Discussion

There was some fluctuation in levels in all boreholes. Some pumping of leachate to the on-site constructed wetlands was ongoing during this period and may have had an effect on leachate levels. Note new wells were drilled at L1A, L2B and L5B in August 2011.

#### **5.5 LANDFILL GASES**

#### **5.5.1 Introduction**

Gases (mainly methane -65% and carbon dioxide -35%) are given off by the biodegradation of organic matter within the landfill waste. The rate of gas generation is dependent on waste type, moisture content and age of waste. Gas is monitored weekly at the site building, and monthly at the groundwater and leachate boreholes. Results of gas monitoring are presented in figures 5.5.1 and 5.5.2 and tables 5.1 to 5.4 below. A full review of all leachate borewells will be undertaken during the next reporting period.

#### 5.5.2 Results

#### **KEY PARAMETER – METHANE**

Methane is a colourless, odourless gas generated by the biodegradation of organic matter. Landfill gas contains about 65% methane.



Figure 5.5.1 Methane temporal trends 2010 to 2016

No high levels of methane were detected throughout the year. No methane was detected in the site buildings or at monitoring points outside the landfill area.

Week No	Date	Operator	Gas	Site Hut	GW1	GW 2A	L1	L2	IA	L5	RC3A	RC4	RC6A	RC7	RC 8
		Sperator	СН	0.00	0.00	0.00	15 /0	2 10	0.00	8 10	1 70	0.00	0.00	0.00	2 10
1			CO,	0.00	0.00	0.00	9 20	2.10 4.20	0.00	6 90	1.70	0.00	0.00	0.00	1 90
	05/01/2016	DR	0,	20.90	20.00	20.90	6.40	4.20	20.90	11 10	18 10	20.00	20.90	20.90	17 70
			Air	1010	1010	1010	1010	1010	1010	1010	10.10	1010	1010	1010	1010
			Pressure	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016
			CH4	0.00											
2	14/01/2016		CO <sub>2</sub>	0.00											
	14/01/2010		02	20.90											
			Air	1023											
			CH <sub>4</sub>	0.00											
3			CO2	0.00											
	20/01/2016	-	<b>O</b> <sub>2</sub>	20.90											
			Air	1012											
			CH	0.00											
4	26/02/2016		CO <sub>2</sub>	0.00											
		-	02	20.90											
			Air	000											
			Pressure	330	0.00	0.00	1.00	4.55	0.00		0.00	0.00	0.00	0.00	0.00
5				0.00	0.00	0.00	1.90	1.60	0.00	2.20	0.00	0.00	0.00	0.00	0.00
	04/02/2016	-	0.	20.00	20.00	0.00	2.10	4.00	20.00	4.70	20.00	20.00	20.00	20.00	20.00
			Air	20.90	20.90	20.90	10.80	14.70	20.90	13.10	20.90	20.90	20.90	20.90	20.90
			Pressure	1023	1023	1023	1023	1023	1023	1023	1023	1023	1023	1023	1023
6			CH <sub>4</sub>	0.00											
	08/02/2016	-	0	0.00											
	00/02/2010		Air	20.90											
			Pressure	1021											
7	15/02/2016		CH <sub>4</sub>	0.00											
		_	CO <sub>2</sub>	0.00											
			O <sub>2</sub>	20.90											
			Pressure	1011											
	23/02/2016		CH <sub>4</sub>	0.00											
		_	CO2	0.00											
8			02	20.90											
			Air Pressure	1012											
	29/02/2016		CH <sub>4</sub>	0.00											
9			CO <sub>2</sub>	0.00											
			<b>O</b> <sub>2</sub>	20.90											
			Air	1021											
		1	CH <sub>4</sub>	0.00	0.00	0.00	2,10	2,90	0.00	1.90	0.00	0.00	0.00	0.00	2,10
10	04/03/2016		CO <sub>2</sub>	0.00	0.00	0.00	2.40	3.80	0.00	4.80	0.00	0.00	0.00	0.00	1.60
		-	O2	20.90	20.90	20.90	16.20	14.40	20.90	16.20	20.90	20.90	20.90	20.90	17.80
			Air	996	996	996	996	996	996	996	996	996	996	996	996
			CH4	0.00											
11			CO <sub>2</sub>	0.00											
	14/03/2016	-	O2	20.90											
			Air	1032											
			Pressure	1052											
12	22/03/2016		C0	0.00			1								
		-	02	20.00			1								
			Air	1010											
			Pressure	8101											
13	29/03/2016		CH4	0.00											
		-	0	20.00	-										
			Air	20.90			1								
		L	Pressure	997											
Week No	Date	Operator	Gas	Site Hut	GW1	GW 2A	L1	L2	L4	L5	RC3A	RC4	RC6A	RC7	RC 8

### Table 5.5.1: Dungarvan Landfill Gas monitoring Q1 2016
Week No	Date	Operator	Gas	Site Hut	GW1	GW 2A	L1	L2	L4	L5	RC3A	RC4	RC6A	RC 7	RC 8
			CH4	0.00	0.00	0.00	0.00	1.20	0.00	1.10	0.00	0.00	0.00	0.00	0.90
	05/04/2017	PB	CO <sub>2</sub>	0.00	0.00	0.00	0.00	2.90	0.00	2.10	0.00	0.00	0.00	0.00	1.20
14	05/04/2016	DK	O2	20.90	20.90	20.90	20.90	17.00	20.90	17.60	20.90	20.90	20.90	20.90	18.10
			Air Pressure	1006	1006	1006	1006	1006	1006	1006	1006	1006	1006	1006	1006
			CH <sub>4</sub>	0.00											
			CO	0.00											
15	12/04/2016	DR -	02	20.90											
			Air	1005											
			Pressure	1003											
			CO <sub>4</sub>	0.00											
16	18/04/2016	DR -	02	20.00											
			Air	1021											
			Pressure	1021											
			CH4	0.00											
17	27/04/2016	DR	0	0.00											
			Air	20.90											
			Pressure	1015											
			CH4	0.00	0.00	0.00	0.00	1.20	0.00	1.10	0.00	0.00	0.00	0.00	0.90
18	04/05/2016	DR -	CO <sub>2</sub>	0.00	0.00	0.00	0.00	2.90	0.00	2.10	0.00	0.00	0.00	0.00	1.20
			Air	20.90	20.90	20.90	20.90	17.00	20.90	17.60	20.90	20.90	20.90	20.90	18.10
			Pressure	1006	1006	1006	1006	1006	1006	1006	1006	1006	1006	1006	1006
			CH <sub>4</sub>	0.00											
19	10/05/2016	DR -	CO <sub>2</sub>	0.00											
			O <sub>2</sub> Air	20.90											
			Pressure	1005											
			CH <sub>4</sub>	0.00											
20	18/05/2016	DR -	CO <sub>2</sub>	0.00											
20	10/03/2010	DR		20.90											
			Pressure	1010											
			CH4	0.00											
21	23/05/2016	DP -	CO <sub>2</sub>	0.00											
21	25/05/2010	DK	O <sub>2</sub>	20.90											
			Pressure	1003											
			CH4	0.00											
22	20/05/2017		CO <sub>2</sub>	0.00											
22	30/05/2016	DK	O <sub>2</sub>	20.90											
			AIr Pressure	1014											
			CH4	0.00	0.00	0.00	0.00	0.80	0.00	0.40	0.00	0.00	0.00	0.00	0.00
	02/07/2017		CO <sub>2</sub>	0.00	0.00	0.00	0.00	2.20	0.00	0.50	0.00	0.00	0.00	0.00	0.00
23	03/06/2016	DR	O <sub>2</sub>	20.90	20.90	20.90	20.90	18.60	20.90	20.40	20.90	20.90	20.90	20.90	20.90
			Air Pressure	1024	1024	1024	1024	1024	1024	1024	1024	1024	1024	1024	1024
			CH4	0.00											
	140000000		CO <sub>2</sub>	0.00											
24	14/06/2016 D	DR	<b>O</b> <sub>2</sub>	20.90											
			Air Pressure	994											
			CH4	0.00	1	1		İ		İ					
		_	CO <sub>2</sub>	0.00											
25	22/06/2016	DR	02	20.90											
			Air	1014											
			CH4	0.00											
			CO <sub>2</sub>	0.00		1			1				1	1	
26	28/06/2016	DR	<b>O</b> <sub>2</sub>	20.90											
			Air	1015											
Week No	Date	Onerator	Gas	Site Hut	GW 1	GW 2A	11	12	14	15	RC34	RC4	RC64	RC 7	RC 8
1 *** CON 110	Date	operator	043	Lone Hut	U11 I	1 0 11 4/1	1.11	شي ا						1	

Table 5.5.2: Dungarvan	Landfill Gas	monitoring	<b>Q2</b>	2016
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Week No	Date	Operator	Gas	Site Hut	GW1	GW 2A	L1	L2	L4	L5	RC3A	RC4	RC6A	RC7	RC 8
			CH4	0.00	0.00	0.00	1.50	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	05/05/2017	DD	CO2	0.00	0.00	0.00	1.10	1.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	05/07/2016	DR	O2	20.90	20.90	20.90	19.40	19.10	20.90	20.90	20.90	20.90	20.90	20.90	20.90
			Air Pressure	1018	1018	1018	1018	1018	1018	1018	1018	1018	1018	1018	1018
			CH4	0.00											
			<u> </u>	0.00											
28	12/07/2016	DR -	02	20.90											<u> </u>
			Air	1001											<u> </u>
			Pressure	1001											
				0.00											
29	20/07/2016	DR	02	20.90											<u> </u>
			Air	1009											<u> </u>
			Pressure	1008											
			CO <sub>4</sub>	0.00											
30	25/07/2016	DR	0,	20.00											
			Air	1015											
			Pressure	1015					-						<u> </u>
			CH4 CO.	0.00			1								
31	29/07/2016	DR	0,	20.00											
			Air	1000											
			Pressure	1006											
			CH <sub>4</sub>	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32	05/08/2016	DR -	02	20.00	20.00	20.00	20.00	1.40	20.00	20.00	20.00	20.00	20.00	20.00	20.00
			Air	1002	1002	1002	20.30	10.30	1002	1002	1002	1002	1002	1002	1002
			Pressure	1002	1002	1002	1002	1002	1002	1002	1002	1002	1002	1002	1002
			CH4 CO:	0.00											
33	15/08/2016	DR	02	20.00											
			Air	20.90											<u> </u>
			Pressure	1019											
			CH4	0.00											
34	23/08/2016	DR	02	20.00											
			Air	20.90											1
			Pressure	1019											
			CH <sub>4</sub>	0.00					-						
35	30/08/2016	DR	0,	20.00											
			Air	1010					1		1		1		<u> </u>
			Pressure	1018	0.00	0.00	0.00	4 = 2	0.00	0.00	4.00	0.00	0.00	0.00	0.00
			CH4 CO2	0.00	0.00	0.00	0.00	1.50	0.00	0.00	1.20	0.00	0.00	0.00	0.90
36	06/09/2016	DR	02	20.90	20.00	20.90	20.00	19 10	20.90	20.90	18 70	20.00	20.90	20.90	17 90
			Air	1010	1010	1010	1010	1010	1010	1010	1010	1010	1010	1010	1010
			Pressure	1013	1013	1019	1013	1013	1019	1019	1019	1019	1019	1019	1013
				0.00											
37	12/09/2016	DR	02	20.90											
			Air	1000											
			Pressure	1000					-						<u> </u>
			CH4 CO1	0.00											
38	20/09/2016	DR	02	20.90											
			Air	1021											
			Pressure	1021					<u> </u>		<b> </b>		<b> </b>		<u> </u>
			CH4 CO:	0.00											
39	26/09/2016	DR	02	20.90											
			Air	1015			L								<u> </u>
		-	Pressure	1015											
Week No	Date	Operator	Gas	Site Hut	GW1	GW 2A	L1	L2	L4	L5	RC3A	RC4	I RC6A	IRC7	RC 8

# Table 5.5.3: Dungarvan Landfill Gas monitoring Q3 2016

Week No	Data	Operator	Cas	Site Unt	CW1	CW 2A	T 1	12	14	15	DC3A	PC4	DC6A	PC7	PC 8
WEEK NU	Date	Operator	Gas CH.		0.00	0.00	0.00	0.00	0.00	1.5	1 70	0.00	0.00	<b>KC</b> /	2 10
				0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.70	0.00	0.00	0.00	2.10
40	03/10/2016	DR	02	20.00	20.00	20.00	20.00	20.00	20.00	20.00	18 10	20.00	20.00	20.00	17.70
			Air	1027	1007	1027	1027	1027	1027	1027	10.10	1027	1027	1027	1027
			Pressure	1027	1027	1027	1027	1027	1027	1027	1027	1027	1027	1027	1027
			CH4	0.00											
41	11/10/2016	DR -	0	0.00											
				20.90											
			Pressure	1023											
			CH <sub>4</sub>	0.00											
42	17/10/2016	DB -	CO <sub>2</sub>	0.00											
42	17/10/2010	DK	0 <sub>2</sub>	20.90											
			Pressure	1012											
			CH <sub>4</sub>	0.00											
		_	CO2	0.00											
43	24/10/2016	DR	<b>O</b> <sub>2</sub>	20.90											
			Air	1010											
			CH <sub>4</sub>												
			CO <sub>2</sub>												
44	31/10/2016	-	O2												
			Air												
			CH4												
			CO <sub>2</sub>												
45	07/11/2016	-	<b>O</b> <sub>2</sub>												
			Air												
			Pressure												
46	14/11/2016	-	02												
			Air												
			Pressure												
47	21/11/2016	-	02												
			Air												
			Pressure												
48	28/11/2016	-	02												
			Air												
			Pressure												
			CH4												
49	05/12/2016		0.												
			Air												
			Pressure												
			CH4												
50	12/12/2016	-	CO <sub>2</sub>												
			Air												
			Pressure												
			CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	3.20
51	19/12/2016	-	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	1.10
51	1.7.1.2010		O <sub>2</sub> Air	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00		20.00	17.10
			Pressure	1010	1010	1010	1010	1010	1010	1010	1010	1010		1010	1010
			CH4												
52	26/12/2016		CO <sub>2</sub>			ļ									
32	20/12/2010		O <sub>2</sub>												
			Pressure												
Week No	Date	Operator	Gas	Site Hut	GW 1	GW 2A	L1	L2	IA	L5	RC3A	RC4	RC6A	RC7	RC8

# Table 5.5.4: Dungarvan Landfill Gas monitoring Q4 2016

## **5.6 NOISE**

## 5.6.1 Introduction

Noise levels were not recorded during the reporting period as due to cessation of our kerbside collection noise levels on site have lessened considerably. There were no significant changes to on site practices that would lead to an increase in noise levels. 2014 results are included here.

Daytime noise levels were recorded on 11/6/14 at the site entrance. There are limits of 55 dB Leq(30) daytime, and 45 dB Leq(30) night-time imposed as a condition of the licence. Night-time measurements were not considered necessary as the landfill does not operate at night.

A Cirrus 800A Sound Level Meter was used. The meter was calibrated and checked with a 94 dB calibrator before and after each measurement. Broadband and Frequency Band analysis measurements were conducted at each location. A summary of results is presented in the table below. Octave band analysis is presented in figures 5.6 below.

# 5.6.2 Noise levels

1998 "Baseline" noise levels							
Site	Date of	L(A)eq[30mins]					
	Monitoring	dB					
	_						
Site entrance	11/6/14	55.7					
	Baseline 1998	<mark>54</mark>					

Table 5.6.1 - 2012 Noise levels

## 5.6.3 Discussion

Noise level recorded in June 2014 was 55.7, which was slightly in excess of the noise emission requirement of 55 dB(A) LAeq (30 mins) and was higher than the baseline level of 54 dB recorded in 1998. No unusual vehicle or other noise sources were reported by the operator. The octave analysis followed the usual pattern for this site, with no tonal extremes at either end of the frequency spectrum.



Fig 5.6 Dungarvan landfill noise monitoring 11/6/14, site entrance, octave band analysis, A weighting

# **5.7 DUST**

# 5.7.1 Introduction / Methodology

Dust levels were not recorded during the reporting period as due to the cessation of our kerbside collection dust levels on site have lessened considerably. There were no significant changes to on site practices that would have resulted in an increase in dust levels.2014 results are included here.

Dust deposition rates were measured over 28 days in 2014 at three locations (D1, D2 and D2A) at Dungarvan Landfill. The measurement method was the Bergerhoff deposition method. Two of the sample sites at D2 and D3 were damaged and could not be reported.

5.7.2 Results

Date started Date finished Dust deposition mg/m2/day 1/10/14 29/10/14 160

 Table 5.7.1 - Dust Deposition at Dungarvan Landfill 2014

# 5.7.3 Discussion

Dust deposition rates was below the limit expected to give rise to nuisance (350 mg/m2/day).

# **5.8 MACROINVERTEBRATE SURVEY**

# **INTRODUCTION**

Sampling of macroinvertebrates was carried out at River Colligan sites SW1 and SW2 adjacent to Dungarvan Landfill on 12/12/12. Sampling was conducted on this date to take advantage of suitable river levels which could change on rainfall and prevent sampling on other dates. Sample procedure each time was two minute kick sampling in the riffle zones, plus 2 minute stone washing, with capture in biota net. The catch was returned to Adamstown Laboratory and kept aerated overnight in river water. Identification and counting of biota, using various freshwater macroinvertebrate identification keys, was carried out. The EPA Q-rating scheme was applied to the results in order to get a Q value for each site. However, it should be noted that both stations are subject to tidal influences and may at times be brackish, depending on flow of freshwater and extent of tide.

#### <u>RESULTS –</u>

	Sample location	SW1 River Colligan	SW2 River Colligan
	Date sampled	12/12/2012	12/12/2012
GROUP	species	Count	Count
	Mayflies EPHEMEROPTERA		
В	Baetis	2	
A1	Ephemera	2	
A1	Ecdyonurus	3	3
	Stoneflies PLECOPTERA		
A1	Perla	1	
	Caddis TRICOPTERA		
В	Hydropsyche	1	
В	Rhyacophila	1	
В	Polycentropus	1	2
A2	Anabolia		1
A2	Stenophylax	1	
A2	Sericostoma	1	2
	Other		
В	Limnius		1
	Other Snails		1
В	Gammarus	125	200
	Water mites		1
-	TAXON RICHNESS	10	8

Table 5.8.1. Macroinvertebrate counts 12/12/12

	SW1	SW2
A1	Small Numbers	Small Numbers
A2	Small Numbers	Small Numberw
В	Numerous/Dominant	Numerous/Dominant
С	Absent	Absent
D	Absent	Absent
Assigned		
Q Rating	3/4	3⁄4

Table 5.8.2 Nominal Q-Ratings 12/12/12.

Table 5. Species list of macroinvertebrates 2009 survey (Limosa 2009).

Onter	Family	Tolerance	SW2	SWI	SW4 Pond
Ephemerophera (Maylies)	Heplagenidae	A	1	1968.00P	CONCORTER ON
	Baeticae	¢		0.0	
Trichoptera (Cased caddis)	Seracestomalidae	8	2	- 24	
1. 242 CHARLEN (1992)	Gumaler				
Trichoptera (Lincased caddis)	Linephildae	9	5		
	Polycentropodidae	C			4
Colecters (Beetles)	Emiciae	C	7	3	
Crustacea (Crustaceans)	Gammaridae	c	60	120	
Drivents (Daevaillies)	Constationidae	14		223	
Diptera (Files)	Chitonomidae	6	1		
	Ceratopogonidae	c			- 31
	Chactoraise	C			2
Gastropoda (Snaits)	Lywnaeidae	0	2		69
	litydrobidae	c	30	11	
Fish	Plearonextribe	÷	3	4	
	Considae	44 - L			11
Frestwater Warms	Oligochaeta				
Ciadocera (Water Fiea)	Disphnicker	1			+500
Taxon Richness		10 1	10.	10	1

# DISCUSSION

Both stations SW1 and SW2 are subject to tidal influences and may at times be brackish, depending on river flow and tidal range.

Nominal Q-scores are assigned for this survey (table 5.8.2) in order to comply with licence requirements, aid interpretation of the species count and to allow trends to be tracked. However, as the Q index system is designed for freshwaters, standard interpretation of the Q score is not possible for these tidal and possibly brackish stations.

Comparison with previous surveys and between stations is possible. Taxon richness was higher in the December 2012 survey compared to the Oct 2009 survey at SW1 ( $10_{2012}$  vs 5  $_{2009}$ ) and slightly lower for SW2 (8  $_{2012}$  vs 11  $_{2009}$ ). In the December 2012 survey here was a slight increase in taxon richness between the upstream station SW2 (8) and the downstream station SW1 (10).

Taxon richness and species present at both stations indicate good water quality.

A detailed Ecological Report is included in APPENDIX L

# **5.11 CONCLUSIONS**

Water quality, at the River Colligan surface water sites, in the vicinity of the landfill was satisfactory throughout 2015.

The results of groundwater monitoring are in line with results from previous rounds of testing carried out since 1999. As indicated in previous reports, some of the boreholes within the current working area appear to be impacted by leachate from the landfill in terms of ammonia and iron, however groundwater outside the landfill site was generally satisfactory.

Leachate quality was as expected for a landfill accepting mainly domestic and inert waste. Metal and trace organics concentrations were low. Based on leachate management, treatment in the on-site constructed wetlands, attenuation and dilution, no environmental effect from landfill leachate is expected.

Taxon richness and species present at both river stations' macroinvertebrate surveys indicated good water quality, in line with previous biological surveys.

Overall, water and ecological quality in the vicinity of the landfill were satisfactory and there was no indication that the landfill was having a detrimental impact on the surrounding environment.

# 5.12 Meteorological Data.

Monthly meteorological data is attached in Appendix G

# 6. Sequence and timescale for development and restoration of the facility

## a) Landfill Capping and Restoration

A Restoration and Aftercare Plan has been approved by the EPA. Capping was completed in 2008.

# b) Landfill Gas & Leachate Management Tank and pipeline testing and inspection report

As part of the leachate and gas systems required under the licence, 1549m of leachate pipework (315mm, 225mm, 160mm, 90mm, 63mm), 3334m of gas pipework (250mm, 90mm), and 3 No. gas manifolds, were installed in 2009. All pipework was pressure tested in accordance with the contract and passed.

Two No. 25m3 Glass lined steel leachate storage tanks were erected onsite in 2009, however works onsite were suspended before final testing and commissioning. In May 2010, one of these tanks was brought into use as a leachate storage tank, and was (water) tested prior to usage. The tank on the western side of the site is now fully operational and forms part of the leachate abstraction system.

# Report on progress made and proposals being developed to minimise generation of leachate for disposal

As per the information in the waste licence review submission (Dec-08), capping works were completed in mid 2008. The final capping system generally comprises of a gas collection layer, LLDPE liner, drainage layer, subsoil layer and topsoil layer as follows:

- 150-300mm layer of topsoil; underlain by
- Subsoil such that thickness of topsoil and subsoil is at least 1m thick; underlain by
- A surface water geocomposite layer; underlain by
- 1mm LLDPE liner (a low permeability geomembrane material).
- Geocomposite gas collection layer.

The capping layers provide protection from the ingress of rain into the site and thus minimise leachate generation.

Wetland ponds were constructed in 2008 for the purpose of treating leachate. Leachate extraction wells are located strategically across the site in order to maximise collection

efficiency. Furthermore, rainwater will assist in the dilution of leachate within the constructed wetlands.

The leachate and gas collection pipework and ancillary items was completed in 2009.

# Development / Infrastructural works summary (completed in previous year or prepared for current year)

In 2009, as part of the leachate and gas systems required under the licence, 1549m of leachate pipework (315mm, 225mm, 160mm, 90mm, 63mm), 3334m of gas pipework (250mm, 90mm), and 3 No. gas manifolds, were installed. Two No. 25m3 Glass lined steel leachate storage tanks were erected.

A flare trial was carried out in 2009 to confirm the size of permanent flare required. A closed permanent flare of 100 m3/hr capacity was assessed as required, and was installed.

Following the tender and recommendations in the Gas Flare Tender Assessment Report (May 2008), AFS was awarded the tender for the flare and associated works. The gas collection system was completed in June 2009, but the project was then put on hold due to funding issues. The permanent flare was installed and commissioned by AFS in July 2010.

The telemetry system associated with the flare is fully operational and monitoring data referred to in Schedule C.1.2 of the licence can be furnished to the Agency as required. The licensee will agree a period for residence time also in accordance with Schedule C.1.2. The 2016 EPA Landfill Gas survey is included in Appendix H

In 2014 a 12kW thirty metre high micro wind turbine was erected at Dungarvan Civic Amenity site, in order to contribute towards attaining the 2020 targets for local authorities of reducing CO2 emissions by 33% and the gross electrical consumption from renewable sources target of 40% as set out in government policy.

The wind turbine generated 13,000KWh in 2015, which equates to an annual saving of  $\notin 2,600$  in electricity supply costs at the facility.

# 7. Topographical survey

No significant topographical changes have occurred on site since the previous survey was carried out. The previous survey has not been attached as it is cannot be accommodated with an acceptable level of detail in this document.

# 8. Schedule of Environmental Objectives and Targets for the forthcoming year

**Objective 1** – To maintain site infrastructure to the standards outlined in Condition 3 of the Waste Licence

**Target 1.1** - Any defect to the existing infrastructure will be repaired / replaced as quickly as possible on an ongoing basis.

**Objective 2** – That no specified emissions from the facility, shall exceed the limit values, set out in Condition 6 and Schedule C of the Waste Licence and that all measures referred to in Condition 6 of the licence are adhered to

**Objective 3** – To maintain the Monitoring Programme as outlined in Condition 8 and Schedule D of the Waste Licence.

**Target 3.1** – To carry out the monitoring programme as outlined in Condition 6 and Schedule C of the Waste Licence.

**Target 3.2** – To submit Annual Environmental Report to the Agency within the timescale as outlined in Schedule E of the Waste Licence.

**Objective 4** – To establish good record keeping and that all records are held at the facility office to comply with Condition 11 of the Waste Licence.

**Objective 5** – That no emergency situation occurs on the site.

**Target 5.1** – Ensure the contingency arrangements as outlined in Condition 9 of the Waste Licence are implemented throughout the year. A document entitled 'Emergency Response Procedures' forms the nucleus of the contingency arrangements and is currently with the Agency.

**Objective 6** – To restore the landfill on an ongoing basis in such a way that final works have a minimal impact on the surrounding environment.

**Objective 7** – To carry out regular maintenance of the Gas Management System including gas field balancing, telemetry maintenance and temperature control.

Objective 8 – To maintain Leachate Management System

**Objective 9** – To maintain Landscaping of Landfill Cap

**Objective 10** – To maintain SCADA system

# 9. Full title and a written summary of any procedures continued during the reporting period

The European Council Directive 90/313/EEC on the *Freedom of Access to Information on the Environment* recognises the significance of the public's access to information relating to the environment. At present, copies of all documents and correspondence relating to Waste Licence 32-2 are on display at the Civic Offices, Dungarvan.

A communications programme will be put in place as required under condition 2.4.1 of the Waste Licence to ensure that members of the public can obtain information concerning the environmental performance of Ballynamuck Landfill. This in turn will address any local community concerns and allow the public the opportunity to provide feedback on the facility.

The Facility Manager will be responsible for the implementation of this programme, which shall form part of the routine operation and management of the facility. Further support will be provided from the Environment Section of Waterford County Council if required.

# Programme

# Information to be provided at the Facility

1. The following information will be available for inspection at the Site Office, and will be maintained by the Facility Manager.

- Map of the Facility showing all environmental monitoring points
- Current Waste Licence for the Facility
- All records relating to the Facility
- Civic Waste Records
- Nuisance Inspection
- Integrity Tests of Bunds
- Complaints Register
- Incidents Register
- Environmental Monitoring Records (Groundwater, Surface water, Leachate, Landfill Gas, Noise and Meteorological Data).
- Emergency Response Procedure
- Programme for the control and Eradication of Vermin and Flies
- The current EMS for the Facility
- Annual Environmental Report
- Visitors Book

2.		The Waste Acceptance hours under condition 1.7.1.2 of the
		Waste Licence are
	Monday – Friday	9.00am – 1.00pm and 1.30pm – 5.00pm,
	Saturday's	9.00am – 1.00pm.

- **3.** All visitors are required to sign a Visitors Book at the site office outlining their reason for visiting. Unauthorised personnel are not allowed access to the site.
- 4. Members of the public may arrange a site visit by contacting the Facility Manager prior to their visit. For Health and Safety reasons all visitors must have appropriate clothing (High Vis-jacket, Walking boots/Wellingtons). The Facility Manager or Caretaker shall accompany all visitors on site visits. A number of school visits to the facility took place during the reporting period
- 5. If information is requested that is not available at the site, the interested party will be directed to the Environment Section of Waterford County Council at the Civic Offices in Dungarvan.

Written Requests for Information All requests concerning the environmental performance of the facility should be made in writing to: David Regan Facility Manager Ballynamuck Waste Disposal Site Dungarvan, Co. Waterford.

7.

6.

The Facility Manager shall copy all requests to:

Raymond Moloney Senior Executive Officer Environment Section Waterford City and County Council Civic Offices Dungarvan Co. Waterford

- 8. Each request should indicate the name, address and contact telephone number of the concerned party, an outline of the required information and the manner in which they require the information i.e. copy of record, e-mail etc.
- **9.** Waterford City and County Council shall make replies in writing within twenty working days of receiving the written request.
- **10.** The information required shall be issued in paper format unless otherwise requested by the concerned party. Requests that require information in digital format may require more time than the twenty working days as outlined previously.
- **11.** If requested Waterford City and County Council will provide a clear explanation of the information provided.
- **12.** If the concerned party requests the examination of a particular report/document relating to the facility, then it will be made available for viewing at the Landfill site office.

## Media Requests

The Director of Services within the Environment Section of Waterford City and County Council shall nominate a liaison person to respond to requests made by the media for information relating to the environmental performance of the facility.

# Feedback from the public

The Facility Manager will record any comments or suggestions made by the public during their visits and the opportunity will also be available to submit a written comment to the landfill site office. Copies of such minutes or submissions will be kept in a register by the Facility Manager and will also be copied to the Environment Section, for the attention of the Senior Engineer. If requested a reply will be provided by the Council within twenty working days.

# **Emergency Response Procedures**

# Scope

The Emergency Response Procedures apply but is not limited to the following incidents occurring:

- Fire / Explosions
- Spillages
- Migration of Landfill Gas
- Environmental Pollution
- Injury or serious accident to persons
- Any other incident, which may pose a significant threat to persons or the environment.

# Responsibility

- 1. The Facility Manager is responsible for the implementation of the Emergency Response Procedure and for the training of all landfill personnel and contractors in effective emergency response procedures.
- **2.** In the event of a major fire or an explosion the Senior Rostered Fire Officer will be notified immediately via the Regional Fire
- **3.** In the event of a serious accident or injury to a person the Ambulance service should be contacted

#### 13.

14.

**4.** In the event of other incidents e.g. spillages or environmental pollution the Senior Environment Engineer will be notified and will assume responsibility along with the Facility Manager.

# Procedure

In the event of an accident occurring the following procedure will be adopted:

- Evacuate the immediate area within the site if necessary
- Inform other site users
- Remain upwind of any hazard area
- Contact site office and advise in detail of the emergency
- Ensure entrance/exit gate is not obstructed
- Contact fire Brigade, Ambulance, Gardaí, and / or Senior Engineer, Waterford County Council as required by dialing 999 or 112
- If incident occurs outside office hours an emergency telephone contact number will be provided on the site notice board
- Personnel shall report to the designated assembly point at the site office
- All areas affected by the incident shall remain closed until given the all-clear by an authorised person

In the event of landfill gas being detected in the site office the following procedure will be followed:

- Raise the alarm
- Evacuate the site office
- Notify relevant senior personnel in Waterford County Council or emergency services if necessary
- Immediately conduct gas survey to identify source
- Remedy cause of problem
- Document incident properly

In the event of a spillage, the Facility Manager shall apply a suitable absorbent material to contain and absorb any spillage at the facility. Once contained the Facility Manager shall have regard to the Corrective Action Procedure.

In the event of a serious threat to the environment, the Facility Manager shall take all necessary short-term action to minimise any further impact and allow the Corrective Action Procedure.

## Records

Details of any incident will be recorded in a written register, which will be maintained at the site office

# Waste Characterisation & Acceptance Procedures for the Acceptance, Storage and Segregation of Waste

The Civic Waste Facility at Dungarvan Landfill accepts waste from Domestic Householders only. The following items are accepted:

**Waste Electronic and Electrical Equipment** – Cages are provided for the collection and storage of small electrical goods. Members of the public are instructed to place all items into these cages by Waterford City and County Council Employees.

**Paint** – A 20ft container allows for the collection and storage of paint cans. Members of the public are instructed to place all items on the floor of the container where they are later packed in to steel drums by Waterford City and County Council Employees.

White Goods (Cookers, washing machines, driers, fridges, freezers) - A 20 ft container allows for the collection and storage of all White goods. Members of the public are instructed to leave all items near the door of the container where they are later double stacked by Waterford City and County Council Employees.

**Glass** – Bottle banks are in place to facilitate the disposal of green, brown and clear glass bottles. There is also a small skip in place for the collection of flat glass where it is removed off site for recovery at a later stage.

Hazardous Materials (These are collected and stored in a 40ft container)

Cooking Oil – Waterford City and County Council employees place all cooking oil in steel drums.

**Car oil** – Members of the public are instructed to leave all cans beside the oil collection unit where it

is later emptied in to the unit by Waterford City and County Council employees.

Fluorescent tubes – Are collected and stored in a specifically made timber container.

**Domestic Batteries** – These are collected and stored in plastic barrels.

Car Batteries – These are collected are stored in specifically designed battery receptacles.

**Obsolete medicines** - These are collected and stored in plastic barrels.

- Aerosols These are collected and stored in plastic barrels (all aerosols are separated in to flammable, non – flammable, toxic prior to packing. The aerosols are stacked in layers and covered with vermiculite which is a fire proofing material)
- **Pesticides** These are collected and stored in plastic barrels.
- Scrap metal Members of the public are instructed to place all metal items in to an open skip where it is later removed off site for recovery
- **Bulky Items** (Beds, Carpets, Mattresses, etc) Members of the public dispose of these items in to a 20ft container where they are later disposed of to the tip head.
- Household Waste Members of the Public place domestic waste in to a closed skip where it is later disposed of to the Transfer Station.
- **Rubble** Members of the Public place rubble waste in to an open skip. It is transported offsite for recovery
- Clay & Top soil Members of the Public place clay & topsoil in to an open skip. It is transported offsite for recovery

Household Dry Recyclables – Members of the public dispose of recycling material in to a closed skip where it is later removed off site for recovery.

**Timber** - Members of the Public place timber products in to an open skip where it is later removed off site for recovery.

# **10.** Reported Incidents and Complaints

There were no reported incidents or complaints for the reported period.

# 11. Management and Staffing of the Facility

Management and staffing of the facility is attached in Appendix J

# **12.** Programme for Public Information

All files are held at the site office and at the Civic Offices Dungarvan Co. Waterford

# **13.** Report on training of staff

Both the Facility Manager and Deputy Manager have attended the Fás Waste Management Training Course. Site personnel have attended the Fás Safe Pass program, Waste Facility Operative Course and site operatives attended a course in the handling, storage and removal of Waste from the Civic Amenity Site. All staff have received manual handling training, Waste Facility Operative Course, Fire Fighting and fire extinguisher training and a refresher First Aid Course.

# 14. Statement on the costs of Landfill

The project budget as submitted to the Department of the Environment and Local Government has not changed since the last reporting period.

# 15. Reports on Financial Charges and Provisions

Waterford County Council is responsible for providing annual fees to the Agency for monitoring and inspection of the site. The annual fee for 2015 for monitoring was €46,000.00 and €22704 for licences.

# Aftercare Phase (30yrs)

The original estimates for long term liabilities were contained in the CRAMP and detail  $\notin$ 80,000,  $\notin$ 70,000, and  $\notin$ 20,000 for general management, leachate, and gas systems, respectively (as per extracted Table 7.3 below).

Costs of aftercare management proposals
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Environmental Liability	Description	Cost Estimate
General Management and maintenance of site during aftercare phase (30 yrs – includes for 20 years of aftercare).	€ 80,000 per annum– monitoring contract with Laboratory, small maintenance works.	€ 2,400,000
Management and maintenance of Leachate Abstraction & Treatment Process and pumping system during aftercare phase (30 yrs – includes for 20 years of aftercare)	€ 70,000 per annum- maintain Leachate Abstraction & treatment Process and SCADA system and replace pumps, lines etc. where required; Power supply; Testing	€ 2,100,000
Management and maintenance of Gas Management System during aftercare phase (30 yrs – includes for 20 years of	€ 20,000 per annum – Maintain & operate landfill gas extraction system	€ 600,000

aftercare)		
	Total for 30 year period	€ 5,100,000
	Contingency set at 15% for increased scope on last three items.	€ 765,000
	Total for 30 years with contingency	€ 5,865,000

#### **Dungarvan landfill Maintenance costs**

Item	Description	Details	Cost
1	Flare maintenance	As per contract	€3,400
2	Flare maintenance	Allow for 4 days callouts at contract rate	€3,000
3	Flare maintenance	Allow for parts replacement	€3,000
4	Leachate system maintenance	Current contract (to Oct-11, new contract needed thereafter)	€3,600
5	Leachate system maintenance	Allow for 4 days callouts at contract rate	€3,000
6	Leachate system maintenance	Allow for parts replacement	€1,500
7	Subtotal		€17,500
8	Contingencies at 15%		€2,625
9	Subtotal		€20,125
10	VAT		€2,717
11	Total		€22,842

# 16. Slope Stability Assessment

No significant slope slippage has occurred since the previous assessment was carried out in 2010. As a consequence a revised Slope Stabilty Assessment has not been included in the report.

# APPENDIX A

Quantity & Composition of Waste Received, Disposed of & Recovered during the reporting period.

Waste Disposed	Туре	EWC Code	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16	Dec-16	Total
Domestic	Bulky - Areas	20 03 01	51.62	6.84	19.94	18.12	14.70	13.10	45.25	15.70	53.06	23.54	0.00	0.00	261.87
	Bulky - Greenstar Skip	20 03 01	2.82	2.80	6.34	2.04	3.14	8.86	8.46	8.10	5.22	7.10	0.00	0.00	54.88
	Civic Skip (Black Bag CA)	20 03 99	10.76	9.42	10.70	10.98	10.48	8.62	9.92	9.27	8.70	9.02	0.00	0.00	97.87
	Clean Ups (See notes)	20 03 99	0.00	0.00	9.14	5.20	1.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.86
Litter	Irish Water	20 03 99	0.70	0.00	0.00	0.06	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.82
	Litterbins	20 03 99	28.94	28.00	37.80	34.56	35.90	31.56	34.46	35.54	35.42	25.40	0.00	0.00	327.58
	Mattresses	20 03 03	0.00	0.00	2.96	2.74	2.36	0.00	3.14	6.22	0.00	1.32	0.00	0.00	18.74
	Public Trailers	20 03 01	81.48	64.00	68.40	37.20	71.20	77.20	71.20	65.60	62.00	75.60	0.00	0.00	673.88
	Roadsweeper	20 03 99	32.22	55.78	67.78	53.76	59.92	42.54	29.36	45.40	47.84	47.52	0.00	0.00	482.12
	WCCC Housing	20 03 99	0.08	0.26	0.18	0.24	0.00	3.82	1.74	1.76	7.10	7.52	0.00	0.00	22.70
Total for Disposal			208.62	167.10	223.24	164.90	199.28	185.70	203.53	187.59	219.34	197.02	0.00	0.00	1956.32

Total Waste received for Disposal at Dungarvan Civic Amenity Site and Transfer Station between January 1<sup>st</sup> and December 31<sup>st</sup> 2015

# Total Waste received for Recovery at Dungarvan Civic Amenity Site and Transfer Station between January 1<sup>st</sup> and December 31<sup>st</sup> 2015

Recycling	Dry Material	15 01 01	15.44	15.12	18.10	11.76	0.00	12.12	0.00	11.22	9.38	12.98	0.00	0.00	106.12
	Large Household	16 02 13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Small Household (WEEE)	16 02 13	16.16	12.86	14.14	14.58	27.94	18.94	0.00	16.44	21.48	12.36	0.00	0.00	154.90
	Textiles	04 02 22	0.48	0.14	0.00	0.58	0.36	0.14	0.44	0.58	0.00	0.22	0.00	0.00	2.94
Recovery	Clay	17 05 04	0.00	0.00	0.00	13.12	0.00	0.00	0.00	8.54	0.00	0.00	0.00	0.00	21.66
	Cooking Oil	02 02 99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Film Farm Plastics	02 01 04	0.00	0.00	0.00	0.00	0.00	0.00	19.34	0.00	0.00	0.00	0.00	0.00	19.34
	Flat Glass	17 02 02	0.00	0.00	0.00	3.92	0.00	3.10	2.42	2.94	0.00	3.44	0.00	0.00	15.82
	Garden Council	02 01 07	1.26	8.00	56.38	28.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	93.94
	Garden Private (CA site)	02 01 07	0.00	0.00	0.00	0.00	0.00	30.52	25.62	26.16	28.90	26.90	0.00	0.00	138.10
	Rubble	17 01 07	0.00	13.14	0.00	5.26	0.00	0.00	10.96	12.36	0.00	0.00	0.00	0.00	0.00
	Scrap metal	17 04 07	2.64	0.94	1.72	4.00	2.08	3.60	1.38	1.78	1.30	4.04	0.00	0.00	23.48
	Timber	17 02 01	9.30	11.20	11.18	14.52	19.02	16.34	37.80	11.46	10.44	7.94	0.00	0.00	149.20
Hazardous	Aerosols	16 05 04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Batteries (Car)	16 06 01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Batteries (Small)	16 06 02	0.00	0.00	0.22	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42
	Car Filters	16 01 07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Engine Oil	13 02 06	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.40	0.00	0.00	2.40
	Flourescent Lamps	16 02 11	0.00	0.00	0.00	0.00	0.00	0.14	0.40	0.00	0.22	0.00	0.00	0.00	0.76
	Medicines	18 01 08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Paint	08 01 21	0.90	0.00	0.34	0.00	0.88	0.80	0.62	0.62	0.64	0.48	0.00	0.00	5.28
Total for Recovery			47.18	61.40	102.08	96.04	50.48	85.70	98.98	92.10	72.36	69.76	0.00	0.00	776.08



Monitoring Locations



Appendix C

Surface Water Results – Receiving Waters

# Dungarvan Landfill W0032-02 Qrt 1 2016

# Surface Water - Receiving Waters

Parameters	Units		
LABORATORY NUMBER		2029	2030
Sampling Location		U/S	D/S
Date sampled	14/03/2016	14-Mar	14-Mar
Sampled by	JMcGarry	JMcG	JMcG
Time sampled		13:55	12:50
			. ,
			clear/
Visual Inspection/Odour		clear	saline
рН	units	7.55	8.7
Cond	uS/cm	182	2690
BOD	mg/l	<1	<1
COD	mg/l	<7	15.3
Sus Solids	mg/l	0.2	0.6
Ammonia Total (as N)	mg/l	<0.2	<0.2
Chloride	mg/l	15.2	768
Dissolved Oxygen	% sat	107	106
тос	mg/l	<3	<3
Phosphate (ortho) as P	mg/l	<0.02	<0.02
TN	mg/l	3.45	3.25
FOG	mg/l	<1	<1
Mineral Oils	mg/l	<1	<1

Dungarvan Landfill W0032-02 Quarter 2 incorporating Annual Requirements Surface Water Receiving Waters						
Parameters	Units					
LABORATORY NUMBER		2246	2247			
Sampling Location		U/S	D/S			
Date sampled	24/06/2016	24-Jun	24-Jun			
Sampled by	JMcGarry	JMcG	JMcG			
Time sampled		14:00	14:10			
Visual Inspection/Odou	r	clear	clear			
рН	units	7.8	7.5			
Cond	uS/cm	190	1128			
BOD	mg/l	<2	<2			
COD	mg/l	<7	12.3			
Sus Solids	mg/l	0.2	1			
Ammonia Total (as N)	mg/l	<0.2	<0.2			
Dissolved Oxygen	% sat	107	109			
тос	mg/l	<3	<3			
Phosphate (ortho) as P	mg/l	<0.02	<0.02			
TN	mg/l	3.51	3.76			
FOG	mg/l	<1	<1			
Mineral Oils	mg/l	<1	<1			

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# Dungarvan Landfill W0032-02 Qrt 3 2016

# Surface Water - Receiving Waters

Parameters	Units			
LABORATORY NUMBER		2384	2385	
Sampling Location		U/S	D/S	
Date sampled	19/09/2016 09-	Jan 19-Sep	19-Sep	
Sampled by	JMcGarry	JMcG	JMcG	
Time sampled		15:20	15:40	
Visual Inspection/Odour		clear	clear	
рН	units	7.4	7.2	
Cond	uS/cm	126	231	
BOD	mg/l	<2	<2	
COD	mg/l	9.4	12.2	
Sus Solids	mg/l	0.2	0.7	
Ammonia Total (as N)	mg/l	<0.2	0.388	
Dissolved Oxygen	% sat	103	108	
тос	mg/l	nm	nm	
Phosphate (ortho) as P	mg/l	<0.02	<0.02	
TN	mg/l	2.42	2.07	
FOG	mg/l	<1	<1	
Mineral Oils	mg/l	<1	<1	

# Dungarvan Landfill W0032-02 Qrt 4 2016

# Surface Water - Receiving Waters

Parameters	Units			
LABORATORY NUMBER		2423	2424	
Sampling Location		U/S	D/S	
Date sampled	26/10/2016	26-Oct	26-Oct	
Sampled by	JMcGarry	JMcG	JMcG	
Time sampled		13:55	14:15	
Visual Inspection/Odour		clear	clear	
Temperature	0 <b>C</b>	11.7	11.6	
Dissolved Oxygen	% Sat	106	107	
рН	units	7.7	7.9	
Cond	uS/cm	148	155	
BOD	mg/l	<1	<1	
COD	mg/l	8.45	<7	
Sus Solids	mg/l	<2	<2	
Ammonia Total (as N)	mg/l	<0.2	<0.2	
Dissolved Oxygen	% sat	106	108	
тос	mg/l	<3	<3	
Phosphate (ortho) as P	mg/l	<0.02	< 0.02	
TN	mg/l	2.35	2.37	
FOG	mg/l	<1	<1	
Mineral Oils	mg/l	<1	<1	



Monitoring of Constructed Wetland System - Monthly Monitoring Results

# Monthly Wetland Analysis

# Ponds - March 2016

LABORATORY NUMBER			2097	2098	2099	2100	2101	2102
Sampling Location		Ponds	1A	1B	2	3	4	5
Date sampled	29/03/2016		29-Mar	29-Mar	29-Mar	29-Mar	29-Mar	29-Mar
Sampled by	JMcGarry		JMcG	JMcG	JMcG	JMcG	JMcG	JMcG
Time sampled			13:20	13:40	13:50	14:05	14:45	14:55
Parameters	Units							
Temperature	0 <b>C</b>		11.7	10	8.3	8.6	9.2	8.9
рН	units		7.7	7.4	7.7	7.6	8.7	7.8
Cond	uS/cm		786	778	826	888	842	580
BOD	mg/l		26	9	4	3	6	15
COD	mg/l		99.6	60	29.5	35.8	36.4	46
Ammonia Total (as N)	mg/l		3.84	2.38	6.38	8.33	1.99	1.55
Dissolved Oxygen	% sat		129	59	87	91	148	98
Metals **								
**	Individ	lual met	als are in	the Cert	ificate of	f Analysis	s, enclos	ed

Monthly Wetland Analysis									
Ponds - March 2016 - Effluent									
LABORATORY NUMBER		2096	2095 Lagoon						
Sampling Location		Interceptor	Marsh						
Date sampled	29/03/2016	29-Mar	29-Mar						
Sampled by	JMcGarry	JMcG	JMcG						
Time sampled		12:30	12:15						
Parameters	Units								
BOD	mg/l	3	2						
COD	mg/l	24	24.9						
Ammoniacal Nitrogen as N	mg/l	<0.2							
Metals ****									
****	Individual metal	ls are contained in Certifica	ate of Ana	lysis, enclosed.					

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<b>Client Reference:</b>	1940/03/07/05/07/04/07	Attention:	Jim McGarry	Superseded Report:	

### Sample Descriptions

rain Sizos								
very fixe 📔 🔐	Celeve Cere	0.265 mm - 0 3mm-	motom	i Seen 🕴 ea	ine Iter 10	1/1	ent - 200	
Leb Semple No(s)	Curtomar Semple	Ref. Depth (m)	Colean	Ospeription	Graia size	Inclusions	Inskutare 2	
15179413	2-2000		Dark Brown	N/S -	2.00-80.00mm	Stones	Vegetation	
13179414	\$-2161	-	Dark Brown	Send	0.065-2.00mm	Sprea	Nane	
13179418	4-2112		Gark Brown	165	0.083 - 2.00 mm	Spres	Vegetator	
151759417	19910		Dark Brown	N/4	200-50.00mm	Storag	Vegetation	
15179410	1963/286		Light Brown	N/5	200-50.00mm	Storag	Vagetation	
10170411	30.2236		Dario Brown	565	2.00 - 50.00 mm	Stores	Vegetation	

These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample metrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to NCERTS for send, day and ream/topsoll, or any of these materials - whether these are derived from naturally ocurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.

Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

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#### CERTIFICATE OF ANALYSIS

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Copper Idiss.RC	-0.86 0 1	F Th/162	0	66.03	0	->2,86	:0.85	-
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Nickel (dies filt)	<0.16 µ	pt 70,952		3.00		2.38	18.6	
Das (disc 🐨)	-10-11 st	TIM52		0.052		15.0	17	
Secury (site #8)	-0.01 pg	K TNHAS		•0.01		40.D1	+0.01	1
Chronium (tot uinilit)	319	Tk/101		6.1		4.82	4.78	1
Coloises: relice film	<0.012	Th/228		65.6		50.2	(9.5	-
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Potassium (dins filit)	<1 mp	78,1233		.144		19.7	20.2	
han (diss.fit)	+0.019	TK/2235		0.247		0.233	0.24	-
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Malkaine Context Ratio (5 of as reactive? sample)	8	P54024	96		22			10
Arsen ::	-0.6	TRAN	11.5		201			17.5
Cadenium	<0.02	TKITST	1.22		108			144
Chronicum	- mg/sg - 40,0	TMITIST	10.2		107			23.6
Copper	nging Al A	TMIAL	13.7	-	7.6			15
	ngist	1975	1000		18			100
Lued	npkg	INTIAL	143		128			18.3
Me in any	<0.14	TRHAT	- bi-10-	1 C 1				49.14
likkel	40.2	TMHAT	16.7		10.5			31.5
Celertur.	11 121	E TRAVAL	2.52		×3			3.04
200		Thereas	200		4			24.5
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Auminium (diss filt:	42.9 p)	1 Tk/162		<20		5.92	878	-
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Doron-(diss Bit)	44.4 (6	A TMHS2		53		461	742	
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Codjurt (dista III)	-uure	11/12286		51		34.5	A11	
Magnasium (das.10)	-10.058	TIN1228	-	754		13.6	141	
Potassium (dies filt)	- mgal - string	78,1233	-	140		5.03	0.00	
han (diss./11)	-0.015	TIMESA	-	6.455		C-0384	4	-
Charlen and	ingal cet Succ	a Ta 9000		*		p 	*	-
ewer (assint	- Ala Pi	n muse		1.00		26.6	318.	
Maistaine Content Ratio (5 of as reactive? sample)		P54024	8		60			¥0
Arsen iz	-0.6 nigka	TRANA	16.5		111			11.5
Cadmium	<0.62 mg/ca	TK1181	1.84		1.5			148
Chronium	-0.9	TR/181	26.3		21.3			24.0
Copper-	PLA.	TMIAL	20.6	-	17.7			22
Level	30.7	TRUM	21.7	-	22.5			26.9
Neway	rigikg (c), th	TKHAL		-	-40.14			40.14
lickel	102	TIMAL	27.1	-	31.4			30.8
a both of	nigks	TEMAL	1.01	-	22			(2.63
Text.		Teleco	002		21.5			07.0
	ngég	10181	80.9		-52A			87.8
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Annihim (diss filt:	42.9	P31 Tkm62	<20 	9			
Attenic (diss \$10	40.12	agé 76/862	1.08				
Boron-(diss 83)	(6.4)	Pat DVHS2	32.3				
Cadmium (das fill)	- 50(1)	ugi IM162	640.1				
Copper triss/fit:	-0.85	9.94 Th/1162	<1.85				
Lead (clas. 18)	-0.02	upi TM152	0.268	2			
Mangericae (classifii)	-0.04	uge 1M152	415				
Nickel (diss filt;	20.15	spt 70/052	2.42				
Zins (disc 🛣)	रत ल	age TMHS2	34	4			
Mensury (site (1)	-0.01	upi TMHAD	*C 01				
Chronium (tot un'it)	31	91 Tkit01	43				
Caloium (site fil)	-0.0	12 DA228	70.4				
Codium (diss III)	-110	ne 11/1228	50.3				
Magnasaan (daa.Hi)	-0.0	98 TM1228	3.42				
Potessium (dies filt)	410	ipi TR/220	9.04				
inan (diss.411)	-0.0	IS TRAZZAS	0.182	3			
Silver (diss filt	-15	pg1 Th1288	বাই				
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09.15.45.07/04/2018
		ĆĒ	RTIFICA	TE OF A	ALYSIS	191 	100000		10	
SDG: 190531-107 Job: D_MCGARRY_KL- Client Reference:	6	Location: Customer: Attention:	Dangarwa Jiw MoGo Jiw McCa	ו זע זע		Onde Reps Supe	r Kumbar: et Humber: rseded Reco	36904 d)	1	
		Tes	t Com	pletio	n Date	s	0.0000000000000000000000000000000000000	-011		
Lab Sample Nois)	12170413	13179416	13179414	12170428	13179410	13179427	12170417	13179425	13179421	12122410
Customer Sample Ref.	5000	PCM.	NC III	NIRE	-00	-77	5181	960	16852	MORE!
AGS Ref. Depth	-				11		_	_	_	
Type	801.0	110010	SOLD	CQUD	SOUD	LIQUID	8010	LIGUID	LIQUID	SOLD
Annorschitunger	-	and an article		12-60-309		25-621-0170		and an other	23-649-91/10	
COC Unfibered	-	(PAR-ARE)		12-44-304		37.54+0108	2	Charlenne.	12-Per-12H	
Dissolved Vistal stoj (CPVVS		07-Apr-3016		CS-4pe-2015		35-Ap+30-6		25-Apr-2016	TT-44+30-6	
Branked W. Maran O to CP MS	2	01/02-10/40D	-	00-Apr-3010		30-A\$1-55-0		3643-2016	394446010	
Wexay Displayed		04-307-2016		C4 Apr 2015		34 /er 2016	1	04.5 m-2016	34 /21 2016	
Versie by ICep-CES Divestved (Wr		05-Apr-2016	-	05-Apr-2016		28-441-20 6		05-Apr-2016	35-441-20 6	
Mercula or and discussion by CB-30	Device 304		Ge#4+01/H		-8-Aac-2010		Linker 204			14406-819
See pic interplay Total View by ICP-445	U -for 2019	2-44-3010	TI Aprillia	15-Apr-2015	dl Am 2016	154462010	U 400 2019	2545ar-2010	15 Aprophi	17 Apr 2019
Lab Sample No(s)	19179420	13179411	15170423	121/2425	I					
Customer Sample Ref.	IRAC.	1176	1.	I I I	3					
AGS Ref. Depth										
Туре	LOUD.	SCUD	LIDUID	LOUD	12					
Annorisati history	12 /09 2015		22-641-2016		7					
COD Briteriet	10-Apr-2019		2544+9010	12-Apr-2014						
Dissolved Visial also ICP/VS	12-404-3014	-	dir far oli'll							
Dissolved W. No and Zriby CT-MS	05-Apt-2015		35-44+20 6							
Meesing Resident	04-4pe-30%	Ú.	3%4\$*6016							
Mexis by Kan CES Dissolved (V) Mexis, it existing year by OF's	18 /or 2016	05-Apr-2016	08 (g) 2018							
The Contract of the last	10.000 200	SUPPORT NUMBER	20.00.000	-						
Statistical applicatives	conde ans	5	19.41.20.6							

Ponds - April 2016								
LABORATORY NUMBER		2103	2104	2105	2106	2107	2108	
Sampling Location	Ponds	1A	1B	2	3	4	5	
Date sampled	18/04/2016	18-Apr	18-Apr	18-Apr	18-Apr	18-Apr	18-Apr	
Sampled by	JMcGarry	JMcG	JMcG	JMcG	JMcG	JMcG	JMcG	
Time sampled		13:15	13:30	13:50	13:00	14:40	14:05	
Parameters	Units							
Temperature	oC	nm	nm	nm	nm	nm	nm	
рН	units	7.4	7.6	7.7	7.8	8.4	7.6	
Cond	uS/cm	808	1144	708	659	558	616	
BOD	mg/l	18	16	3	3	24	4	
COD	mg/l	22	58.9	36.7	39.5	59.6	35.5	
Ammonia Total (as N)	mg/l	7.55	16.1	2.04	0.235	0.589	<0.2	
Dissolved Oxygen	% sat	nm	nm	nm	nm	nm	nm	
Metals **								
**	Individual met	als are in	the Cert	ificate of	Analysis	s, enclos	ed	

# Ponds - April 2016 - Effluent

LABORATORY NUMBER		2109
		Pond 5
Sampling Location		Outlet
Date sampled	18/04/2016	18-Apr
Sampled by	JMcGarry	JMcG
Time sampled		14:35
Parameters	Units	
Temperature	0C	nm
рН	units	7.6
Cond	uS/cm	586
BOD	mg/l	4
COD	mg/l	39.2
Ammonia Total (as N)	mg/l	nm
Chloride	mg/l	74.3
Total Oxidised Nitrogen	mg/l	<0.1
Total Organic Carbon	mg/l	11.1
Phenols+++	mg/l	<0.025
Dissolved Oxygen	% sat	nm
Metals **		
Volatile Organic Compour	nd: ug/l	%%%
**	Individual m	etals are in the Certificate of Analysis, enclosed
+++	Individual Pl	nenols are in the Certificate of Analysis, enclosed
%%%	Individual Co	ompounds are in the Certificate of Analysis, enclosed

ALcontrol Laboratories

#### CERTIFICATE OF ANALYSIS

Validated

SDG: 1 Job: 1	190421-14 1_MCGARRY	KL-A	Location: Customer:	DA .N	ngar-an v MoGorty				Onder Hum Report Hum	ber: iber:	353534		
Client Kerenetter:			Animon:		a mereated				suscisedor	1 POADS			
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Conference	LOGAN	IN NHERE		_				_		_			_
Organiz Carbon, Telle	- COR	Ce TAXISHI			1								
Ammoniacal Nitrogen as N	*D.2m	(g) TIV(0582	2.04		0.035		0.559		+0.2			7.55	20
COD. un#lered	40	gii 71/1107	30.7		89.6	-	69.6		86.5		89.2	22	- 12
Aluminium (dies filt)	-251	91 D.862	6.24				21.3		4.03	-		371.	1
Alseoit (diss:11)	<0.42	ADI TANGP	1.15	1	0.009		124		0.642			0.007	
Boron (disa.61)	×8.44	491 IN1162	100		108	-	118			-		195	24
Codmium (855 Fill)	-0.11	ng1 Th/1162	-90.1		. 40.1		-:0.1	-	<0.1				
Copper (class/ill)	-0.65	api TMI52	<0.45		•0.05	*	-0.65		-0.85	4		0.520	
Load (clas.18)	-0.02	agi 11/11/12	0 394	2	0.204	A	0.459	P	0 287	2		0.427	<u>्</u> ष्ट्
Manganese (dks filt)	(0.04	10f 70/052	316	1	10	*	052	2	256	7		.417	. E
Nicawi (dias 78)	×0.15	NHS2	2.75		2.50	*	201		2.44	2		261	t,
Das (clas #)	-0-1	api TM152	9.45	4	10.9	*	157	4	6.74	-		12.7	
Mercury trics (III)		ugit Thinsa	+1.01	2	<0.01	*	40.01	8	<0.01	0		40.01	4
Chindsie	<2n	of Diffet		-				4		"	743		
John Occlosed Nilrogen a	a -10.1m	HSIMI (g)		-		-		-				-	-
N Chroman (tatamit)	190	at IN1191	<3	2	8.58		~3		4		*	-5	-316
Calcium (clas (B)	×0.01	2 10,1220	56.0		53.1	*	26.7	4				719	2
Spalure (dies III)	194) -0.07	16 TK/0230	57.6		465	*	42.5	21	47.7			40.9	
Magnesium (diss filt)	- mg/ - 40.02	6 Th/1228	11.2	2	11.1	*	12.5	-	11	2		12.4	2
Potessium (dies filt)	(10) <10	or. 10.1230	12.5		12	*	17.4	7	13.4	2		12.1	ť
Inan (diss fit)	<0.01	8 70/220	0.121	*	0.12	+	0.025		0.372			0.00054	*
	ngt		12827	4	1/5/6	*	1000	a	1.22233			30031	¥
Carrier Carrier		K2 11/12/00									*		
Vileosta	194	50 In 1200		_		_				_	4		_
Ayarda	100	A4 15,0254									4		
2,3,5-Trimedigiphenol	100	AS 11/1259									*0.005		
serabado elo perra	en na mai	TRUNK									-01006		
Phenois, Total Delected 5 Mediated	a a a ngi	S TN258									40.005		
Silver (dins fil)	-(1.5)	ANT THUS	ेल इ		<15		1.5		*1.5			014	
-					8								_
12	1		8		G.	-							_

Dock         DOC 2011 (LACCARRY (LAC))         DOC 2011 (LAC) Reference         DOC 2011 (LAC) Reference </th <th></th>	
International Substructure         Calibre of Market         Description           International Substructure         Substructure         Substructure         Substructure           Substructure         Substructure         Substructure         Substructure         Substructure           Substructure         Substructure         Substructure         Substructure         Substructure           Substructure         Substructure         Substructure         Substructure         Substructure           Substructure         Substructure         Substructure         Substructure         Substructure           Substructure         Substructure         Substructure         Substructure         Substructure           Substructure         Substructure         Substructure         Substructure         Substructure<	
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Description         Description <thdescription< th=""> <thdescription< th=""></thdescription<></thdescription<>	
COL unlined $27  rgl$ Tullit       Sole $g$ Image of the state	
Automatic (des.10:         <2 × p.)         The THE         2 < 6         2           Answer (des.10:         <1 × p.p.)	
Alterna (Alkolin)         Closep         Think         Line           Description         (24.16)         (24.16)         Think         (42.26)         (42.27) <t< td=""><td></td></t<>	
Decent (see B)         -2-4 (s)3         TUTC2         1925         a         1 <th1< th=""> <th1< th="">         1&lt;</th1<></th1<>	
Continue (duality)         Chi (ba)         Ibiti (2)         Chi (2) </td <td></td>	
Copper (165:0/8)         Cl. 85 (p)         Th/162         -1, 85 (p)         p	
Land (stantifi)         -0.05 upt         Th/152         C.7         p           Marganesa (stantifi)         -0.04 upt         Th/152         404         p         1 </td <td></td>	
Marganese (statistic)         -RUE-up)         TM1152         434         a           Nake (statistic)         -O.16.up)         TM102         -S7         - </td <td></td>	
Maximum (structure)         An (figure)         Text (figure)         A (figure)         Text (figure)         A (figure)         Text (figure)         A (figure)         Text (figure)         A (figure)         Text (figure)         A (figure)         Text (figure)         A (figure)         Text (figure)         A (figure)         Text (figure)         A (figure)         Text (figure)         A (figure)         Text (figure)         A (figure)         Text (figure)         A (figure)         Text (figure)         A (figure)         Text (figure)         A (figure)         Text (figure) <thtext (figure)<="" td=""><td></td></thtext>	
Intersted Wr.       >40 of uppi       Th/162       0.51       0	
Matrix (contral)         Matrix         <	
Arron un conurre, Cakkam jake filt;         -31 (p) (n)         IN100 (n)         0.14 (n)         0.14 (n)	
Second processing         Staticity	
Scourt (data int)         Nume         Num	
Nagradient (data filt)         NUC00 mg3         IN220 10.4 (data filt)         NUC00 (data filt)         IN220 (data filt)         IN2200 (data filt)	
Constant (conset)         C (1)         M (220)         C (0)         Ø <thø< th=""> <thø< th=""> <thø< td=""><td></td></thø<></thø<></thø<>	
Non (data fit)         NO19 mq3         TV220 d         C.101 d         d	

		LER	E.1			
SDG: 15 Job: D. Client Reference:	0421-14 _MCGARRY_K	L-A	Location: Customer: Attention:	Dangarkan Jiw MoGarry Jiw McGarry	Order Humber: 36353 Report Humber: 36353 Superseded Report;	•
OC MS (W)		on the second second second second second second second second second second second second second second second	a service she	acto variante	Construction of the second second second second second second second second second second second second second	10
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Tokuma diffi		7917910	151			_
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< Bramafluarabanzane**	*	TM1208	08.7			
Disblored Buoromethane	31.101	Tk/208				
Chlommelhane	in sinal	0,000	- 41	. ······		
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1,1-Collomethene	55 P01	TANDOR	्स			-
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(MLBE) Irans-1 2-Diabloraetheae	109.75	TM208	at	-		-
1.1-Dichloroathana	XI and	11/2/08	-1	*		1.0
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2,2-3 chioroprocene	4(10)	TINCTIA	त			
Bromochipromiethane	(64.14	TINGSIS	-1			
Chlorodom	er 191	70/208	100			
1, 1, 5-Tash locaethane	(d) (40 <sup>±</sup>	75,000	-41			-
1, 1-Dichiompropene	ALL AND	70.000	-1			
Carbontehachloride	1001	16/208	~1	*		
12 Determetry	er 100	Turne		*		-
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1,2-Dictionpropage	<1 pg/	761202	- 41			
Obranianistrate		TNI200	- 41			
Bromodichlovensiltana		TIMERON	•1			
66-1.8-Oithiorogropena	1.00	Tiv1208	-11	-		
Takene	101.15	70.1202		1		
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namen, 2-professioneproperat	(199)	IN 208	-1	7		1
1.1.2-Trideloroethane	- S1 191	10/208	- 11			-

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SDG: Job: Diste Reference:	BDG: 19421-14 Job: D_MCGARRY_KL-0 Dist: Reference:		Locution: Customer: Attention:	Dangarwan Jim MoGarry Jim McGarry	Order Humber: Report Humber: 369534 Superseded Report;	
OC MS (W)			esson transfer L	and the set		
BETHER speeched     CONTReconstruct     Construct Texastruct     Constend Texastruct     Construct Texastruct     Co	n Ar Saardani () Arreit al. Far conversi Bile Conversi Bile Conversi Bile	Excension Excepts 8 Comple System Sergia System Sergia Telle Celle Records (CO Set) Line Records (S)	EPTORO REALERA SERVICEA SERVIC	8		
Hirld Lends Arm et trens	LOBAN	A00 Extension Mothed	a constant			
1,3-Dichioropropuna	\$1.45	A1 TN 208	~1			
Tokaohiolulehoke	51.89	M TM208	41			
Obramachlarameirtene	41.40	TING203	-1	·		
1,2-3 bromostrans	s? #9	AT TANDAR	9			
Chlarobinziane	×1.45	A) 11/12/08	-1			
1,1,12-Teirachiorceinan	a si pe	TN:200	- 11			
Ethyloensene	- AC 40	TK1200	-11			
u t-Xiloue	<1.18	M TM1208	-91			
o-Xylene	< H	p1 TI/208				
Cignaria	1 ×1 +5	AT 11/203	41			
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lagsigsylsenalene	AC 40	N TRUEDO	e.			
1, 1, 2 2-Teirach broeinan	* <u>X120</u>	Threads		- <u>}</u>	5 N	
1,2,3-Trichibropropene	X1-ug	BUETAT IN	4			
Rionoleszere	85.90	p 73,000	1			
Fitaybergene	55.46	pi 174200	<u>et</u> ,			
2 Chlordolaana	ST 49	A 11/1208	- 31	0		-
1.3.9 Tonetybenzene	<1.00	AT TA1208	-1			-
4-Chlordpluene	51.65	TINIZALA	8			
iet-Bulybenzene	11.48	e 11/208	-11			
1.2,4 Transingly and any	89	a1 10/208				
esc-faits between	5° FB	1 78.1300	d			
Alex-Prosylia Lene	1 45 AS	TINIZGE	<u>et</u>	0		
1.3 OroHorobenzene	51 AS	P TM208	্ৰা			
1.4-3. Glomberstere	5 H	P 10,000				
Butylsendene	5 <sup>11</sup> +5	AT TIMIZOS	-1			
1,2-Dichloroberszene	\$1.45	al TINI208	<1	•		
1,3-Ci branis-3-chiaragne arw	P 51 40	TACON I	-11			
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hspachiorobuladana	×1 49	AT TAYEOUS	3			
ist-Anyl rustyl etter (TAME)	< H	PI TRIDOR		·		
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	A CURRENT		CER	CIFICATE OF A	MALTSIS	( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( )	
SDG: 190 Job: D_) Client Reference:	H21-14 HCGARRY_	KL A	Location: Customer: Attention:	Dangarkan Jim McGorry Jim McGarry	Onder Humb Report Hum Superseded	an: ber: 369534 Roport:	
C MS (W)			Next Contraction	addigae and		Section Sectio	
Concentration     Concent	alari et al.Fre innis constry	Exclamate Sample 8 Destination Complet System Sample Title Date Received Side Received Side Received Side Received Side Received Side Received Side Received Side Received Si	EFF3-00 Malegul/ESV/ Istables Strates Sectors Sectors Sectors	6			
ang templatic et ar a contra de	LODAN	AGO Forbrace	2				
2.3-Techtorobenzene	\$1.49	1 TM208	<1				
3.5 Technologicane	< 19	A TN/208	41	-			
		1-					
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		1					
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ALcontrol L	aboratories		CE	RTIFICA	TE OF A	ALYSIS			-	Validated
SDG: Job: Client Reference:	190421-14 D_MCGARRY_KL-0	ŝ.	Location: Customer: Attention:	Dungurka Jin MoGo Jin McGa	r TV TV		Orde Reps Supe	r Humber: et Humber: rsodod Ropert:	869534	
			Tes	t Com	pletion	n Date:	S	instruction		
Le	h Sample No(s)	12223556	13290897	132513506	12223800	13290901	13282504	12223595		
Custor	ner Sample Ref.	39385	3693	-2.8.	20.88	11428	10.00	1942.04		

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23-Apr-2010 23-Apr-2010 23-Apr-2016 23-Apr-2016 23-Apr-2016 23-Apr-2010 22-Apr-2010

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22-40-5020 22-600-3040

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26 April 2016 - 26 April 2016 22 April 2016 - 22 April 2016 22 April 21 April 2016 22 April 21 April 2016

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26-Apr-2016

AGS Ref. Depthy Type

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Mesony Directived Meson by more CFR Mesoner (FV) Phonois he FPLC (W)

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Anionality Kona (ut COC Unfibered Developed Visitation (CPVVS)

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27-Apr-2016 37-Apr-2016 37-Apr-2016 37-Apr-2016

11.20.00 27/04/2018	

	Monthly Wetland Analysis								
Ponds - May 2016									
LABORATORY NUMBER			2147	2148	2149	2150	2151	2152	
Sampling Location		Ponds	1A	1B	2	3	4	5	
Date sampled	17/05/2016		17-May	17-May	17-May	17-May	17-May	17-May	
Sampled by	JMcGarry		JMcG	JMcG	JMcG	JMcG	JMcG	JMcG	
Time sampled			16:15	16:20	16:30	16:10	16:40	16:50	
Parameters	Units								
Temperature	0 <b>C</b>		nm	nm	nm	nm	nm	nm	
рН	units		7.4	7.1	7.6	7.7	7.3	7.5	
Cond	uS/cm		1693	1073	951	843	713	657	
BOD	mg/l		42	36	8	4	10	10	
COD	mg/l		1180	994	50.4	36.7	52.6	65.9	
Ammonia Total (as N)	mg/l		42.9	14.3	8.08	3.87	1.62	<0.2	
Dissolved Oxygen	% sat		nm	nm	nm	nm	nm	nm	
Metals **									
**	Individ	lual met	als are in	the Cert	ificate of	Analysis	s, enclos	ed	

Monthly Wetland Analysis									
Ponds - May 2016 - Effluent									
LABORATORY NUMBER		2153							
Sampling Location		Interceptor							
Date sampled	17/05/2016	17-May							
Sampled by	JMcGarry	JMcG							
Time sampled		17:00							
Parameters	Units								
Temperature	0C	nm							
рН	units	7.8							
Cond	uS/cm	635							
BOD	mg/l	6							
COD	mg/l	40.5							
Ammonia Total (as N)	mg/l	nm							
Chloride	mg/l	77.2							
Total Oxidised Nitrogen	mg/l	0.24							
Total Organic Carbon	mg/l	11.4							
Phenols+++	mg/l	<0.025							
Dissolved Oxygen	% sat	nm							
Volatiles (VOC's)***									
+++	Individual Phenols ar	e in the Certificate of Analysis, enclosed							
***	Individual Filenois are in the Certificate of Analysis, enclosed           Individual Compounds are in the Certificate of Analysis, enclosed								

C	Service of the servic	č.	CER	TIFICAT	EOFA	NALYSIS	-</th <th></th> <th></th> <th></th> <th></th> <th>-</th>					-
606: Job: Client Reference:	190615-116 D_MCGARRY	_KLA	Location: Customer: Attention:	Dangarkan Jin MoGorry Jin McGarry				Order Hum Report Hur Supersede	bar: nber: d Rop	362732 arli		
Peol a . re	- 4	Conterner seman e	71/16-2	216	61	2021-4		76.56		747-14	21-8-16	
<ul> <li>Marcola Collect size</li> <li>Marcola Collect State</li> <li>Marc</li></ul>	ala. ngla. 16	Dapakan) Danjak Sjer Date Danjani Saaran Dan	Alder (* ARTA) 1778-214	804.97 1-34	ANCON NOCON	Value 700090 100000150	8	Wide photo Wide photo	ŝ	864-19 <sup>2</sup> /0920) 178-2810	Value, 70000 178-0021	*
Mark na anoshiya a mata di katalaka a vala di katalaka na katalaka katalaka na katalaka katalaka na katalaka	tradication the experiment difference of the tradication of the tradication of the tradication of the tradication of the tradication	Enter Brand José 2008 Gel Lota Georgia Marja 2018 Karlanaman	16/26/210 1635 5 - 5 12/80 204	165 165 168	usis 9/HS usic	186.60710 0.819-115 1942/78		18/36/29/ 96319-10 13/80120	8	1603-2818 0003-9440 05400294	1.4650/3 10(29)-44 136/30/39	
Companient Americania cal Nitrogan	as <0.27	no nemesa ngi mulas	0.01		υ <del>ν</del>	167	- 3	<d.2< td=""><td></td><td>439</td><td>14.3</td><td>100</td></d.2<>		439	14.3	100
COD unlitered	-78	pi TMIGT	50.4	30	<del>.</del>	\$2.6	8	65.9	1	Tat	3214	1
Anninium (diss filt:-	(2.9)	01 Th 1162		47	-6	4.6	6	4,83	2	3.12	42.0	<u>е</u>
Assenic (diss 110	40.12	sgi Tk/862	1.75	2	* H	2,43	5	242	7	2.17	143	2
Doron-(dise tit)	(8.4)	at DAIS?	11.7	10	4	122-1	-	115	-	303	105	<u>_</u>
Cadmian (das 60	\$0.14	ual IM162	-90.1	<mark>و</mark> وې	4			\$0.1	-			<u>.</u>
Concertaine (Rt	-0.86	D.1162	01.25	1	*	20.55	0			0.014	10.55	e
copper tusses.		55 minor	14,45		*	4.00				1914		- 12
Land (COR. 18)	-0.02	AD IN122	6.257	2	4	0.162	0	0.176	2	1.20	E 0.215	ę
Hargenicas (classifii)	-0.04	ugi 1M152	(230	2	N	45-40		401		539	1270	đ
Nikkel (dies filt;	20.15	apt TMB52	3.99		8	281		5.38		7.67	3.87	r.
Das (disc 🐨)	10.05	NDF TMH52	1.92		2	285		1.44	-	47	325	
Secury (site fil)	-0.01	upi Thilas	(0,0)	•0	a1	-D D1		40 D.5	1	+0.01	-D.DI	
Chronium (tot un'it)	40	91 Tk1101	<48		3	3		-3	-	02.8	92.0	
Caloium (size filt)	<0.0	12 TM228	a1	6 67	<b>6</b>	59.4		501	-	67.2	.35.1	
Codium (data III)	-100 -100	16 11/12285	84.7	1 72	*	56.7	*	54.5	-	144	ds.7	
Marrayan Atus Ma	79) 30 (P	1 88 T0/7208	18.5	2	*	12.0	2	18.1	2	245	1 197	ť
The second second	тқа			1				100			r	2
Popeoutr (dies sin)	10	pr Hyscar	80			101		E.u.		110		
iran (diss.fit)	*0.0 mp	IS TRUZAS	D.62	a 11	w	172		4.97	0	G 291	0.034	
Silver (diss filt	-41.51	001 TN/288	ৰ ট		6	-15				416	\$1.ā	
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ALcontrol Laboratories

and the second second second	121850-0		LEI	CIFICATE OF	ANALISIS	10000	121			
SDG: 1905 Job: D_M Client Reference:	915-116 ICSARRY_KI	ĿŔ	Location: Customer: Attention:	Dungarwan Jim McGarry Jim McGarry		Onder Humber: Report Humber: Superseded Report:	302732			
Productory of the second		tite oor vaaraate F Daaate ooj Daaagte Tyjer Date Daaagte Santte Timo Date Casel oor Santte Timo Date Casel oor Santte PC (200 Ke Instance	Alter (* APK) Alter (* APK) Volka EM Parka EM Parka EM							
rganiz Carbon, Tola	<3 mpi	79,1090	- 11.4	8	· · · · ·					
00 utilitered	+7 mpi	TMHOT	40.5							
Norise	<2 rigi	Tk/184	77.2	4			24			
dal Oxidked Kittigen as	so ingi	Tkilled	0.24							
tecol	20002	TI/12528	10.002							
iveeb	-0.000 mal	TN:299	<0.206							
aluniola.	-0.008 Ten	76/260	<0.006				10			
2,5-Trimethylphensi	200.0-	TINCHIS	+8.005	2	1					
-beopropisipitanici	-0.006 T(a)	10/2559	×0.008							
Secols, Total Detected S secolat	<0.075 mg/	70,4338	×0.025	-						
				•						

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	ALD INSTAN		LER	12 C		
SDG: 190 Job: D_J Client Reference:	X615-116 MCGARRY_KL	·0	Location: Customer: Attention:	362732		
OC MS (W)		Number of Street of Street		/h	Construction of Sound	101
Part of a construction     In the Construction     Security Construction     Security Construction     Part of the Construction     Part of the Construction     Security Constructin     Security Construction     Security Constructin     Security C	ndentio contra contra contenty A	Engels (a) Engels (a) Engels Type Engels Engels Samte Engels Engels Engels Store (a) Store (a) S	Alary 7.0700 Alary 7.0700 Without N Hotel Eng Hotel Eng Hotel Eng Hotel Eng	4		
Comparison Difference of second all second	LOGUNES	NHEROS TR/200	476			
Tokene-d6**	50	TIVIZAD	96.1			
< Branafluarabanzane**	15	71/1208	101	1		2
Dicklored Buoromethane	<1.10)	76.1208				
Chlommelhane	feq is	TMODA				
Virgi drietske	-Stage	10/208	-1	-		
Bronomethane	100.78	Tk1208		*		
Chiarosthere	al in	Thursday		-		
	100000	10.000		2		30
Incident services at any	(et is	11/208	a.	2		
1,1-Distionethene	51.601	70,1002	्त			
Carbon cikulpit de	104.58	נמכואד	स			
Dictionar elfans	1015	TAURA	12			
Marhyl Rotiary bulyl ether MTRES	(61.15)	Tk1208	्या			
inne-12-Diablomethese	109.75	D/208	्वर			
1,1-Dichloroelfiane	11 25	11/203				
es-12-3deposition	Shept	TA1208	<1	2		
2,3-Outlionprogene	1.00	TR/1202	स			
Bronochiston alterna	stunt	TAXAN	.1	-		
Chicadam		Thereas		3		
Cherolom	c. 19	10/208	1.41	2		
1, 1, 1-Trub Woethane	51 HØ2	D.1000	-41			
1,1-Dichiompropene	104 in	78,1203	स	4		
Carbontelrachieride	1484 12	TM208	<1			
1.2 Dictionoethane	feu 12	TM:208	-41			
Dencere	141	TINIZADA	-11			
Trichéprostheme	ter is	11/2018	9	-		17.00
1,2-Dictionpropage	(pg)	TK1202		*		
Oborrionalizata	1 dine	75/201				
		The second		4		
Biomodic fibrarteitere	4.19	TIVERE	1	2		
66.1.8-3idvlorogropena	<1101	71/208				
Trkens	\$1.102	0.1202	et			
iners-1,3-Dichloroproperse	. Vi. 491	11/208	41			
1.1.2-Tridriorodhane	light (>	TM208			- 10	
				21		

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BDS:     19051 5-115     Location::     Darphines:     0.       Job:     D_HIGSARRY_KLA     Castomer:     Joh NoGorry     R       Clast Reference:     Viet Noticery     R       VOC INS (W)     Exclassing:     SCHITCSCITTO     R       Image: Status     SCHITCSCITTO     R     SCHITCSCITTO       Image: Status     SCHITCSCITTO     SCHITCSCITTO     SCHITCSCITTO       Image: Status     SCHITCSCITTO     SCHITCSCITTO     SCHITCSCITTO       Image: SCHITCSCITTO     SCHITCSCITTO <th>ider Kunden: Ispart Number: 302732 Uperseded Razant;</th>	ider Kunden: Ispart Number: 302732 Uperseded Razant;
CDC MS (W)     Excision - Exc	1
Construction         Construction	
International Control Control Control     Marine Marine Control Control       1,3-Orthoroproven     <1 yg1	
1.2-Checkeroproprise     <1 pg/l	
Tutachiouschere <i 208="" <i="" tr="" y<br="" ygi="">Disconschionmeinene <i 208="" <i="" tr="" y<br="" ygi="">1,2 Citerencelmane <i 208="" <i="" tr="" y<br="" ygi="">1,1 Citerencelmane <i 208="" <i="" tr="" y<br="" ygi="">1,1 Citerencelmane <i 208="" <i="" tr="" y<br="" ygi="">1,1 Citerencelmane <i 208="" <i="" tr="" y<br="" ygi="">Citerencelmane <i 208<="" td="" tr="" ygi=""><td></td></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i></i>	
Discrementation         <1 µg1         TN/2001         <1         #           1,2-Discrete/intre         <1 µg1	
1,1,20 Environmentaria     <1 agi	
Childromenceme     <1 yg1	
1,1,12     Tetrachiscoelnane     <1,01	
Ethylaensens <i +1="" p<br="" pg1="" tn200="">mp Sylone <i <1="" p<br="" pg1="" tn208="">o-Xylone <i <1="" p<br="" pg1="" tn208="">o-Xylone <i <1="" p<br="" pg1="" tn208="">Ethylaense <i <1="" p<br="" pg1="" tn208="">Ethylaense <i <1="" p<br="" pg1="" tn208="">Ethylaensens <i <1="" p<br="" pg1="" tn208="">Ethylaensens <i <1="" p<br="" pg1="" tn200="">(1,1,2 &gt;Teimchorsetans <i <1="" p<="" pg1="" td="" tn200=""><td></td></i></i></i></i></i></i></i></i></i>	
n.p.3ylone <ir>          n.p.3ylone         <i th="" yg1<="">         TM208         <i th="" yg1<=""> <!--</td--><td></td></i></i></ir>	
o-Xylene <i 008="" <1<br="" pg1="" tv="">Sgrane <i 008="" <1<br="" pg1="" tv="">Bionextern <i 008="" <1<br="" pg1="" tv="">Bionextern <i 008="" <1<br="" pg1="" tv="">Bionextern <i 008="" <1<br="" pg1="" tv="">(1,1,2 &gt;Teinch-proclame <i 000="" <1<="" pg1="" td="" tv=""><td></td></i></i></i></i></i></i>	
Egnane (1 µg) TV203 (1 µg) Exception (1 µg) TV203 (1 µg) Isopropylandene (1 µg) TV203 (1 µg) (1,1,2 > Teinchorceltane (1 µg) TV203 (1 µg)	
Biomotorn         <1 µgi         TM208         <1         #           Isophty/servere         >1 µgi         TM200         <1	
Isoporpy/Denzene Allugi TMC00 41 (1,1,2 2-Telmohorpelhane Allugi TMC003 41	
1,3,2.2-Telrachiorpelnane Kirygi TW200 +1	
1,2,3-Trichterspropene X1 ug/ 11/208 41 g	
Romanezere <i 70,000="" <1<="" td="" yg)=""><td></td></i>	
Fragsbergene si 191 TA1200 st 2	
2 Chloridolisens <1 cg/ TM208 <1	
1.3.6 Tenetylbenzine <1 µg1 7h/308 <1	
+Chlordolasme (1 yg) TM233 (1	
let-Bulgberzene Vilugi 11/203 41	
1.2,4 TenneliyBeneariy <1,991 Th1208 <1	
sec-fady between site of a second sec	
Alex-Process Lene (1.9) TV000 (1	
1,3 O o turro benzeno en 1 ggi 17/208 en 1	
1.4-Distionabesteete <1 µg1 Di300 <1	
n-Butyteeneene Vilugel 10/1203 V1	
1,2-O chiardenaena <1 agi 11/208 <1	
1,3-Clibnonic-3-chiloroping vill ugi TM200 vill etw	
1,2,4-Trichiprobenzone (1,2,9) TV233 (1,2)	
Hexachicrobusedians <1 µg1 11/288 <1 d	
let-Anglinetyletter stipgt 10000 st p	
Kaphihalene styp 10000 st	

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<ul> <li>Fulcomici Lab</li> </ul>	Gradues		CER	TIFICATE OF	ANALYSIS		CHESSEE		
SDIG: 16 Job: Dj Client Reference:	0615-116 MCGARRY	.KL-0	Location: Dangarwan Cantomer: Jin MoGony Attention: Jin McGany			Order Humber: Report Humber: Superseded Repo	362732 di		
OC MS (W)			0.00000.0000	adhara an an an an an an an an an an an an an	36 3		201X ~		
IDE VED exceeded     ACVED exceeded	enter o cut for cut for cut for cut for	Excentre - Earspie B Destination Comple System Starge Hare Other Bace rate (COD Set List Engine Hare) Schemerson	A STANTESOUT AND A STANTESOUT 2005/04 ADD 2005 ADD 2005 A	10					
CERCIPE	LOBUN	In Notred	2	-	-				
2.3-Fedriorobaneone	\$1.45	A1 11/208	-1						
3.5 Tridriorobeneene	<1.8	V TN1208	বা						
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600: Job: Client Reference:	190615-116 D_MCGARRY_KL-6	È.	Location: Customer: Atlention:	Dangurwa Jiw MoGo Jiw McGa	ו זע זע		Ond Rep Sup	er Kumber: ort Humber: orseded Report;	362792	
			Tes	t Com	pletion	n Date:	S			
	ab Sample No(s)	13455006	13458037	13453038	13455059	13458034	13458035	13455041		
Custo	mer Sample Ref.	2464	8.54	224	1.5	19449	5478	a restriction of		

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25-May 27.6 25-May 2015 25-May 27.6 25-May 27.6 25-May 2015 25-May 27.6 25-May 2016 25-May 27.6 25-May

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2244ag-22-6 2747ag-2010 2747ag-2016 2244ag-22-6 2747ag-2010 2747ag-2016 2244ag-22-6 2244ag-22-6 2747ag-2010 2747ag-2010 2244ag-22-6 2047ag-2010 2747ag-2010

LIQUID LIQUID LIQUID

LIQUID

21-May 2128

25 No 276

23-May 27-0 23-May 25-6

Depth Type

American souther to get An long by Kong (va COC Unfiltered December 11/2 data by ICP/VIS

Versary Directived Mercury manufact University V/I Phones has HPLC (W)

Tablify and edg 109-445 Tablify and 2014 Programs Carbon VCC M5 (V)

Dissolved A. No are 20 by CT NS

LIQUID LIQUID LIQUID

		Ctiana	Anarys	515			
	Ponds	June 2	2016				
LABORATORY NUMBER		2257	2258	2259	2260	2261	2262
Sampling Location	Ponds	1A	1B	2	3	4	5
Date sampled	24/06/2016	24-Jun	24-Jun	24-Jun	24-Jun	24-Jun	24-Jun
Sampled by	JMcGarry	JMcG	JMcG	JMcG	JMcG	JMcG	JMcG
Time sampled		15:40	15:55	16:05	15:35	16:25	16:15
Parameters	Units						
Temperature	0 <b>C</b>	14.6	15.4	17.4	16.2	16.8	17.2
рН	units	7.2	7.3	7.3	7.4	7.5	7.2
Cond	uS/cm	820	834	803	785	700	784
BOD	mg/l	7	73	5	<5	30	4
COD	mg/l	29.5	4620	25.3	29.5	80	174
Ammonia Total (as N)	mg/l	7.25	5.47	3.98	2.43	0.703	2.14
Dissolved Oxygen	% sat	56	19	94	57	71	60
Metals **							
**	Individual met	als are in	the Cert	ificate of	f Analysi:	s, enclos	ed

#### Ponds - June 2016 - Effluent

LABORATORY NUMBER		2263
		Pond 5
Sampling Location		Outlet
Date sampled	24/06/2016	24-Jun
Sampled by	JMcGarry	JMcG
Time sampled		16:30
Parameters	Units	
Temperature	0C	19.3
рН	units	7.5
Cond	uS/cm	765
BOD	mg/l	<5
COD	mg/l	38.2
Ammonia Total (as N)	mg/l	0.31
Chloride	mg/l	93.7
Total Oxidised Nitrogen	mg/l	<0.1
Total Organic Carbon	mg/l	13.8
Sulphate	mg/l	<2
Phosphate(ortho) as P	mg/l	<0.02
Metals\$\$\$		
Phenols+++	mg/l	<0.025
Dissolved Oxygen	% sat	46
Volatiles (VOC's)***		
+++	Individual Phenols are	e in the Certificate of Analysis, enclosed
***	Individual Compound	s are in the Certificate of Analysis, enclosed
\$\$\$	Individual Metals are	in the Certificate of Analysis, enclosed

C	ALcontrol Laboratories
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#### CERTIFICATE OF ANALYSIS

Validated

500: Job: Client Reference:	150825-27 D_MCGARRY	<u>(</u> 61.0	Custom: Customer: Attention:	Jor N Jim N	lativan JoGorty JoGarty				Order Kumber: Report Humber Superseded Re	369057 sailt	
Read or or a factor consider a factor consider a factor consider toold factor of the set	ed sh	Contract Version F	75.83		238-4		2281-4	28	28/26	325-54,	226-10
<ul> <li>Structure in most sample Laterative motion Laterative motion Table and the sample masks of instructure and masks of instructure and masks of instructure masks of instructure Market and masks of instructure Market and Market and</li></ul>	n. Ny faritr'o analasi'ny amin'ny  Entre Breigheit Sampler Haro- Entre Breist auf 3000 Gef Lain Greigheithe (of GBB Rechergen)	3036.217 3036.217 15025-22 3460315		SACRATE 18 SACRATE 18 ISOSE 37 INFOR 29		3 46-86-74 5 86-96-74 100623-27 3948-07		3006230 3006230 3006230 300232 390223	SUBJECT S	3 HBL/5/78 3 HBL/5/78 -0053537 1360078	
Sampanent Ammoniacai Nitrogen	as 40.27	mgi TMIRR	2.43	2	2.40		B.700		2.14	7 25	147
COD utilities	-7 8	TMIGT	25.3		295		10	1	174	215	4650
Auninim (des filt:	42.9	1 Thillie	6-	2	<2.0	*	6.16	6	8.12	<2.0	7.04
Assenic (diss fili)	40.12	100 Tk/162	-11	3	1.25	*	2.23	5	1.77	* 0.099	0.335
Doron-(diss Bit)		Hat DAIGS	90.5		-105	*	- 141	-	145	4 57 P	75.5
Cadmium (das 61)	\$0.1	Pg1 1M162	-90.1	-	- 42.1	+	~0.1	-	\$0.1		94.1 (s1.1
Copper (riss.filt)	-01.85	uol Dutte2	-01.85	1	30.35	*	30.65	1	e) 89	*	ef -00.85
Lasid (class 40)	10.02	ADE TRAINS	0.254		0.105	*	0.154	8	0.090	4	0.325
Manager and John 191				2	2.0	*		¢	4	4	ę
Hatgenese (classe);	50.04	uge initiaz	214		. 491		13.5		/060 #	*	140
Nickel (diss filt;	20.15	100 TM 52	8.77		3.45		161		43. g	319.	0.85 #
Dat (disc 🛣)	-0.41	ser TMS2	0 073		0.774		203		0.905	6.59	160
Mercury (size fill)	-0.01	upi Thilda	+C 01		+0.01		+D D1		40 D )	D.CS46	-D.DI
Chronium (tot un'it)	31	g1 Tk1101	<48		23		3		(9)	8 29	93.0
Calolium (siles fill)	-0.0	12 TM238	61.5		72.0		45.5		56.7	85.0	A7 8
Ecolum (data III)	-0.0	16 1N/228	-44		45.1		52.7		87	313	42.9
Wegnesien (das.Hi)		58 TM228	14.3	7	148		15.8	0	15.3	121	13,6
Potassium (dine filit)	- 164 	0 105 TR/1230	6.51		6.25	*	495	5	2.03	6.43 <b>*</b>	7.29
Inan (daes/fit)	-0.0	IS TNIZAS	0.305		0.265	*	B.751	2	0 216	* 0.0222	0.05.02
Shorides (II)	- mg	1 (0.1 Th/283	ता	2	e16.	- 4	-15	4	2 (1.5	416	41.5

	- 6 IStee Varate F Explore( Bande Spr	Customer: Attention: 200-WH	Jin McGany Jin McGany	Report Humber: Superseded Report.	303057		
alaurio ni ra ni alau	ikt op Varigte F Depikent Storgde Type Sate	20.00	1				
	Sargin Time Entre Entre Jan 300 Gri a Grapha Marja 200 Reference	Alacije 187.07 197.08.214 197.08.214 197.025-27 197.025-27					
<3 mpi	TN:090	12.8				-	
-D 2mg	TIVICESE	0.21	11			-	
<1 mgs	76/1107	88.2	2				
25443	Tk/162	<2 B	2			-	
(0.12.00)	TRACE	4.75	-			-	
Carlester.	Thereit		4				
~254 µg1	IM162	135					
40.1 µg1	TK1162	-40.1				111	
-0.65 spi	TM152	+0.45	2				
~0.02 upt	101152	0.111					
<0.04bgt	71/11/52	292					
×0.15 apr	TM:152	8.04					
-B-H upt	TM152	3.92	-				
10.01 ugi	Tk/188	+2.01	2		-	-	
<2 mg/	Thilad	42	-			-	
S2 mg4	10034	95.7	*		1	-	
10.00	DV184	\$2.02				-	
rigit	TRAMA					-	
-wing.	0,101	199	1		_		
(G+D)	TMIST	.,	0		_		
<0.012 Tg1	Th/1228	60.5					
40.076 100 <sup>1</sup>	TK-1230	68.1			_		
1000	76.220	15.5					
<1 mgs	TK1228	4,52					
-0.010	TK1228	1214				-	
*0.002	TINCESS	*D.002				-	
fign sucur-	11/259	-0.006	2				
767 40.000	76/1228	10 006				-	
1611 10000	78/2250	(0.000				-	
091	11.55.0		4				
-0.006 mg/l	TIVCES	-0.006	2				
-0.026 1991	71/1260	<0.125					
1012 IS	76/033	त इ					
1		-	· · · · · ·			-	
	-0.2mg) -2.mg) -2.mg) -2.mg) -0.12up -0.12u	-0.2mgi         TV028           -27mgi         TV052           -2122mgi         TV152           -2012mgi         TV152           -2012mgi         TV152           -2012mgi         TV152           -2014mgi         TV152           -201	-0.2mgi         TV029         0.21           -77 mgi         TV029         0.21           -77 mgi         TV009         0.21           -77 mgi         TV009         0.21           -72 mgi         TV009         0.21           -72 mgi         TV009         0.21           -72 mgi         TV009         0.25           -72 mgi         TV009         0.25           -70 mgi         TV009         0.25           -70 mgi         TV009         0.25           -70 mgi         TV009         0.25           -70 mgi         TV009         0.25           -70 mgi         TV009         0.25           -70 mgi         TV009         0.25           -70 mgi         TV009         0.25           -70 mgi         TV009         0.25           -70 mgi         TV009         0.25           -70 mgi         TV009         -70           -70 mgi         TV009         -70	-0.2 mgi         Th028         0.21         p           -37 mgi         Th0107         56.2         p           -2.5 mgi         Th0107         56.2         p           -0.12 mgi         Th0107         56.2         p           -0.12 mgi         Th0107         56.2         p           -0.12 mgi         Th0107         1.25         p           -0.12 mgi         Th0102         -2.9         p           -0.12 mgi         Th0102         -0.13         p           -0.12 mgi         Th0152         -0.15         p           -0.02 mgi         Th0152         -0.14         p           -0.02 mgi         Th0152         -0.14         p           -0.02 mgi         Th0152         -0.14         p           -0.01 mgi         Th0152         -0.25         p           -0.01 mgi         Th0152         -0.25         p           -0.02         Th0164         -52         p           -0.02         Th0164         -52         p           -0.02         Th0164         -52         p           -0.01         Th0164         -52         p           -0.01         Th0164	-92  straple       Th (1007) $86.2$ $g$ $-27  roys$ Th (1007) $86.2$ $g$ $-28  straple$ Th (1007) $86.2$ $g$ $-28  straple$ Th (1007) $86.2$ $g$ $-40.42  straple$ Th (1007) $46.2$ $g$ $-80.44  straple$ Th (1027) $40.11$ $g$ $-80.44  straple$ Th (1027) $40.11$ $g$ $-40.45  straple$ Th (1027) $40.11$ $g$ $-40.45  straple$ Th (1027) $26.2$ $g$ $-40.41  straple$ Th (1027) $26.2$ $g$ $-40.41  straple$ Th (1027) $26.2$ $g$ $-40.41  straple$ Th (1027) $26.27$ $g$ $-40.41  straple$ Th (1028) $40.24$ $g$ $-20.41  straple$ Th (1048) $40.24$ $g$ $-21.426$ Th (1048) $40.44$ $g$ $g$ $-21.426$ Th (1048) $40.44$ $g$ $g$ $g$ $-21.426$ Th (1048)		-D Smp3         TH0282         D.21         J

			CER	UNIVERIE OF ANAL				
SDG: 15 Job: D. Cliefe Reference:	MCGARRY_K	L-A	Custom: Attention:	Jim McGarry Jim McGarry	Order Humber: Report Humber: 303057 Superseded Report.			
OC MS (W)		Maria Company	AND STOP	and the second second	Constant Constant	12		
Product a constraint     Product a constr	Sandhard So dince Francisco Francisc	Engels of Genetic P Engels (m) Bangde Syne Dele Bangde Syne Santte Hand Santte Hand and BOB Gel Lak Gengte Ma (k) (2015 Sector and	20 (2-40-14 Addes )7 /07 //A 30 (36:21 // 102(26-22) 103(26-22)					
Company of Longran elitate <sup>11</sup>	LOGUNES S	MMINST TAUXOD	104			-		
Tokene-d6**		TIV(200	99.5			1		
< Branafluarabanzane**		71/208	08.7			2		
Disblored illuorenethane		76/202	st					
Chlommelhane	(eq. is	TM200	- e1			-		
Virgi christide	lige IS.	TN:208	~1	*		2		
Bronomethane		71/208	-91.	*				
Chlorostheme	feets -	Threads	a d	*				
Inchlorofucionalitane	Ni Light	18/5808	9	2		1		
1.1-Disitionethere	151 P01	70,4202	्त	*				
Carbon disalpit de	<141	TIVERO	स	*				
Dichloromethane	1016	TINUZIDA	12	*				
Mathyl Rotiony bullyl ether	(119)	71/1208	্বা	2				
MTBE) Irans-1 2-Diabloroetheae	<5.601	Th/208	at	-		-		
1,1-Dichloroelfaarw	XT 291	11/203	51	-				
os-12-äddoroethere	<1,pg	TI/1208	<1					
2,3-3 chioropropante	<(10)	79,1200	đ	e				
Bromodiforomethane	(e4 )*	TINISIA	-1					
Chloroform	et 19	70/208	(at					
1, 1, 9-Trub Wooethane	61 HQ2	75,1202	<t< td=""><td>2</td><td></td><td></td></t<>	2				
1,1-3 chiompropene	41.101	TAUSON	स					
Carbontelrachloride	<b>e</b> t i>	Th/208	<1			-		
1.2 O etioroethane	(0,19	Tk/1208	-41					
Dancara	<1 19 <sup>1</sup>	79,12834	-1					
Trichéoroethene	(1 pg)	18/2008	9					
1,2-3 citiompropane	41 pg/	76/202	-1					
Discriminate	41 HQ1	TIMODO	स					
Dismoschipromeihere	41 FB1	TINCASS	-1					
66 1.8 Oldiorogropena	<110	Th/1208	ব			2		
Trkens	<1.101	0.002	- et					
ham-1,3-Dichloropropune	ige IV.	16/2808	-1			-		
				21				

10.000			CER	TITICALE OF ANA	Eroid .	
603: Job: Client Reference:	190825-27 D_MCGARRY,	<u>.</u> KL-0	Location: Customer: Attention:	Dangarwan Jim MoGorry Jim McGarry	Onter Humber: Report Humber: 303057 Superseded Ruport;	
OC MS (W)	_		1 Station Contraction	and the second		-
BOARD speeched     CONTRespective     Control of the speeched     Control of the	n Ar Guardiael (1) Arristi aut. Fra Arristi aut. Fra Arri	Excension Excepts 8 Comple System Songle System Songle Talle Data Response Colo Set Los Responses (s)	STRAKEY MAREFUNCTION SUMMOREN SUMMOREN HERER ZF	8		
1946 Tenh Aris et terns Component	LOBUN	AGO Extension In Notice	0			
1,3-Dichloropropuna	\$1.45	AT TN:208	<1			
Totrachie u obierie	51.65	V TM1208	41			
Obramachiana meinane	41.45	N TAXAB	-1			
1,2-3 bronceltere	s: #5	AT TANDAS	-9			
Chlerobanzane	47 HS	A) TIM208	-1			
1, 1, 12-Teirachiorceinan	a sipp	TN:200	41			
Etyloanoana	AC 46	TK1200	- 11	1		
u t-Xioue	<1.16	vi TM1208	-\$1			
o-Xylene	< H	p) 70,1208				
State	×1.45	A1 TIN203	41			
Branjokarn	1. S. M.	AT TIVE208	- 41			
Isopropylaenaene	Ma	(CCLINT 14	a			
1, 1, 2 2-Teirach broeinan	· · · · · · · · · · · · · · · · · · ·	TIN 200	- 9			
1,2,3-Trichioropropane	X7.45	N TATEOR	<u>e</u> 1			
Rionoberzere	4.90	10 TA208	्त			
Frosbergene .	ৰ ম	1 TA 200	¢1			
2 Chloridoluene	51 HS	A 11/1208	. 91			
1.3.9 Tonetybenzone	<1.15	AT TA1208	- A			
4-Chlordpluene	51.65	TINIZALA	1			
let-Bulybanzana	11.45	ai 11/12/38	-1			
1.2,4 Transfiglisencers	80	a1 10/208	1			
nec-fut/sitements	21 H	P1 TR1200	d			
Alex-Prosylia Lene	et es	TINIZGE	- 11	2		
1.3 Or of longborgence	51 M	<sup>4</sup> Ti/208	ৰ			
1.1-Dictionaberstere	S.H.	P TATON	4			
-Butylkendene	N) 45	FT THE208	*1			
1,2-Dichloroberszene	×1 +5	AT TRIZOS	<1			
1,3-0 bronio-3-chilorogin erw	e si er	TACENT N	-11	·		0
1,3,4T1chloroberusene	*1.45	1 11/203	- q			
havachicrobuladisms	×7.45	al TINIZUSI	-1			
ist-Amyl rustoji ether (TAME)	et pr	pi Tutone	-81	·		
Kaphihalene	41 H	TV:200	- 41			

			CEF	RTIFICATE OF	ANALYSIS	-book to come	1	
SDG: 1: Job: D. Client Reference:	90825-27 _MCGARRY_	.KL-0	Location: Customer: Attention:	Dangarwan Jim MoGorry Jim McGarry		Order Humber: Report Humber: Superseded Report	303057 1	
OC MS (W)			NOAT LANDA	a contract of the second	00	a second a second	510	
B (C) (C) exceeded     C (C) exceeded     C (C) exceeded     C (C) exceeded     C (C) (C) (C) (C)     C (C) (C) (C)     C (C) (C) (C) (C)     C (C) (C) (C) (C)     C (C) (C) (C) (C)     C (C) (C) (C) (C)     C (C) (C) (C) (C)     C (C) (C) (C) (C)     C (C) (C) (C) (C)     C (C) (C) (C) (C)     C (C) (C) (C) (C)     C (C) (C) (C) (C)     C (C) (C) (C) (C)     C (C) (C) (C) (C)     C (C) (C) (C) (C)     C (C) (C) (C) (C)     C (C) (C) (C)     C (C) (C) (C)     C (C) (C) (C)     C (C) (C) (C)     C (C) (C) (C)     C (C) (C) (C)     C (C) (C) (C)     C (C) (C) (C)     C (C) (C) (C)     C (C) (C) (C)     C (C) (C) (C)     C (C) (C) (C)     C (C)     C (C) (C)     C (C)     C (C) (C)     C (C)     C (C) (C)     C (	saelat n atal. Par nastalar atal. Say	Excision Fample 3 Events for the Comple System Sample The East Reserved COS Part Los Respiratory	STRANETY MINISTRATION STRATEGY STRATEGY STRATEGY	8				
CERCINE.	LOBAN	Ro Notrad	2					
,2.3-Techtorobenzene	\$1.45	A1 11/1208	-1					
3.5 Tildhiorobenzene	<1.95	y Th/208	বা	-				
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SDG: Job:	190825-27 D_MCGARRY_KL-0	Customer:	Dangarkan Jim MoGarty	Order Kumber: Report Humber:	303057
Client Reference:		Attention:	Jim McGarry	Superseded Report:	

Lab Sample No(s)	13000919	135665620	13663122	1 3000923	13562917	12663215	130005029
Customer Sample Ref.	2.M	10001	2214	800	2017/041	81918	STON OF
AGS Ref. Depth	-	-		-	1		_
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6mmonsattenspe	28-28-2018	28540-2010	10-14-02784	Lo Alenta	10-34-5110	30.4.0029	29-24-2018
Ar long by Kong (up	-						25.9455118
COC Urfibered	33-Jun-2011	30-Jun-0016	04-11-2010	33-Jun-2010	: 05-Jun-30   0	33 A.B-2016	33-Jun-2010
Descrived Patriating ICP/VIS	av.a.c.ata	010044-6110	07-04-08996	39-A-F2012	01004.070	07-14-0096	27-3.6-201a
Dissolved A. No are 20 by CT MS	75 A4 2012	1544-2216	05-11-2015	25 A4 2015	0544.0216	05 cit 2015	35 A4 2015
Versury Directived	25-A-1-2012	05-14-20 6	06-14-2015	05-A4-2015	05-14-22-6	05-141-2010	25-A4-2012
Mercula by science(CFM University VI)	20.442404	18-1401216	BEST CITH	31.4.1.2119	18-14-017-11	INVESTIGATION .	00.812.011
Phonois hair-PLC (W)	10000000		1000100000	90.00		1999	33 Aur 2018
Tabilitatil 656 ICP-645	31-A-5012	11449310	01-01-0015	UI-RESING	2414-0210	11-12-2010	31-AF2012
intel digaracand insigan a cartain	The state of the second	CHESTRA DEL		10000			31.8.1.2.115
VCC MS WA		1					01-34-2015

## Ponds - July 2016

LABORATORY NUMBER			1000	1001	1002	1003	1004	1005
Sampling Location		Ponds	1A	1B	2	3	4	5
			14-		14-	14-	14-	14-
Date sampled	14/07/2016		Jul	14-Jul	Jul	Jul	Jul	Jul
Sampled by	JMcGarry		JMcG	JMcG	JMcG	JMcG	JMcG	JMcG
Time sampled			10:40	10:50	11:00	11:25	11:40	11:45
Parameters	Units							
Temperature	oC		17.4	13.9	15.6	17.7	17	18.4
рН	units		7.1	6.6	7.3	7.4	7.5	7.2
Cond	uS/cm		1515	864	916	837	656	694
BOD	mg/l		35	178	4	<5	17	6
COD	mg/l		614	72600	31.1	26	148	47.5
Ammonia Total (as N)	mg/l		33.7	1.68	5.8	2.86	<0.2	<0.2
Dissolved Oxygen	% sat		nm	nm	nm	nm	nm	nm
Metals **								

\*\*

Individual metals are in the Certificate of Analysis, enclosed

# Ponds - July 2016 - Effluent

LABORATORY NUMBER		1006
		Pond 5
Sampling Location		Outlet
Date sampled	14/07/2016	14-Jul
Sampled by	JMcGarry	JMcG
Time sampled		11:50
Parameters	Units	
Temperature	OC	nm
рН	units	nm
Cond	uS/cm	nm
BOD	mg/l	<5
COD	mg/l	37.1
Ammonia Total (as N)	mg/l	nm
Chloride	mg/l	84.1
Total Oxidised Nitrogen	mg/l	<0.1
Total Organic Carbon	mg/l	13.1
Phenols+++	mg/l	<0.025
Dissolved Oxygen	% sat	nm
Volatiles (VOC's)***		
+++	Individual Pheno	ls are in the Certificate of Analysis, enclosed
***	Individual Comp	ounds are in the Certificate of Analysis, enclosed

SDG: Job: Client Reference:	190718-34 D_MCGARRY	(KLA	Location: Customer: Attention:	Du Ju	ngari-an r MoGorry r McGarry		Onder Humber: Report Humber: Superseded Rep	871243 arti	
Part Lorent Control Constraint Control Constraint Control Constraint Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control br>Control Control Control Control Control Con	des updes species a function of the	Casto de Garate F Doptioni Bonde Spr Dele Bongad Sorgin Tiro	1937) Man (7 1977) 1937 20		1-00-1 (0.000-1	NET-F Valley 7004764 THE - GUT V	View View Yoursto	NULLY AND	081-96 081-500000 196,5078
enaity of installation on our discussion of some pignore and some comparison of the some	nipasini, e din di ha isa masay di masaha	Enter Brand Jack 2008 Gel Lote Groupin Mar (K 2008 Kalawa mar	15216-34 13230-36		90794-08-18 150796-04 192798-178	106-6075 100753A 1990101	10/2010 10/216 34 10/2010	1000/0010 1000/0034 0020002	196-5278 1970/36 1970/36
Ammoniacai Nitrogen	as <0.20	mail Thilling	50	-	2.66	×0.3	×D.2	217	163
N COD unlitered	-7.0	TMINT	31.1		25	145	47.5	514	72900
An available to Mare Mare		al 70.99(2)	0.15	2	4	43-12 13-12	4	4	6
attanti assis	521	<b>9</b> 1 161102	6.92	÷	*	10.2	40 p	*	310
Assenic (diss filt)	30.81	90° Tkt162	3.73		1.14	2.03	171	6.839	31
Doron-(diss Bit)		01 D/HS2	114		105	102	125	250	108
Cadmian (das Ell)	-0.08	uge IM162	80.05	-	\$0.08	-0.06	80.02	\$0.0>	-0.06
Concer (diss/@t)	-0.85	Di162	-01.85	1	¥ :0.35	et 100	1 (1) (6)	*	149
copper tearings.		all allow			4		1	*	
Lead (close fill)	191	pg1 TM152	G 123	-2	401	620 ¢	×0.1 #	***	104
Marganicae (classifi)	-12.78	ugi 1M152	1020		2/9	57.8		435	1500
Nickel (diss (b)	ch (4	901 TM852	254		2.72	20	2.91	6.71	29
Dins (diss. 181)	(1.2	Hat TMISE	71	9 1	<10	41	4.5	* - 24 %	e 0.07
Silver (dan tit)	100	g1 TM152	а	-	9	291			.000
Mercury triss fills	-0.01	ugi Tkinaa	÷1.01		<0.01	40.01	<0.01	<0.01	
Chronium (trituinfilt)	(4);	g1 D.1181	1.4%		43	-	4	316	274
Calcium (clash#)	~u.0	12 11/2285	80.2	-	76.9	42.2	56.0	82.4	91.2
Socium (dras All)	-0.0	76 TM1228	69.5	-	52.8	52		137	59.1
Magnesium (disc filt)	100 × 00	0 TM220	16.5		162	15.2	15.9	251	17.1
	19	1	0.44				1	*	
Poppedum (dina /18)	110	ige TM220	9.57	2	7.55 4	232 p	B.05 p	232	12.2
han (diss 11)	40.0 TG	10 TN1228 A	0.409		4.157	0.307. P	0.640 #	0.0012	1.89
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CERTIFICATE OF ANALYSIS

Validated

11.10.57 50/07/2018

ALcontrol Laboratories

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600: Job: Client Reference:	190718-34 D_MCGARRY	.KLA	Location: Customer: Attention:	Dungarkan Jin MoGorry Jin McGarry		Onter Humber: Report Humber: Superseded Report;	871249	
		FREME AN CONTRACTOR	TRUE TO LEASE	-			<u> </u>	
In rel 4 accepted     Section 2 accepted     Section 2 accepted     Section 2 accepted     Section 2 accepted     Section 2 accepted accepted accepted     Section 2 accepted accepted accepted     Section 2 accepted accepted accepted     Section 2 accepted accepted accepted     Section 2 accepted accepted accepted     Section 2 accepted accepted     Section 2 accepted accepted     Section 2 accepted accepted     Section 2 accepted accepted     Section 2 accepted accepted     Section 2 a	s a handard to and to the mark of side No of the strength	Engels og Bongde Type Ende Engeland Sonrete Hero- Ende Engelse der 3000 Get	ALANYATER ALANYATER YOLKER SERVICE SERVICE					
CONTRACTOR CONTRACTOR	LOQU	ABLE Material						
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theide	- Arn	The The Street	- 27.1					
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avsolu	-0.0	08 TM259	<0.206		2			
laturiota :	-0.0	08 11/290	<0.006		2		2	-
3,5-Trimethylphenol	-0.0	IS TAUSER	+8.005					
bacanap slatian d	-00	06 11/1259	×0.008	P				
in an also Tagest Producers &	TH		10.205	2	4			
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SDG: Job: Client Reference:	ISUVISION D_MCGARRY_KL	-0	Customer: Attention:	Jangarwan Jan McGarry Jan McGarry	Order Humber: Report Humber: 3712 Superseded Report	19
OC MS (W)	-	uncon recy	p)211 en en	activities and	Construction and Arrive	10
Constraints     Constrain	control pro- metro pro- metro pro- metro pro- metro pro- tero pro-	Denne Verfalle F Denneke (sjor Det Bengens) Songte Hine Det Bengenske (sjor Songte Hine Det Bengenske (sjor Offic Historymen)	ALANY AND A			
Comparison Difference functions et also et al	LOQUMS %	MMINST TRADO	114	-		_
Tokene-d6"	- 10	TM2800	90.5			
< Brandfuarabanzane**		70/1208	00.7			
Distional duoron ethane	51 µg4	78/202				
Chlommelhane	feq is	TM200				
Virgi chronde	St up	TN:208	- 1	*		3
Bronomethane	1017	71/208	-91	8		~
Chicrosteine	feets.	Threads	a	*		
Inducronations	Nugi	18/12/06	- 1	2		
1.1-Cictionethere	51.601	70/1002	et	2		
Carbon citulpit de	104 PM	TAUCOLO	et			
Dictionar ethane	1040	TINIZIDA	12	*		-
We full to the youty of the	(QLIP)	Tk/1208	्य			
inn BE) Inns-1 2-Diablametheas	< 101	D/208	st			
1,1-Dichlorodharw	10.29	11/208	-1			
es-12-3 ditoroethere	S149	TIN1208	S1			
2,3-3 chicropropane	4(1 <b>9</b> )	19,1200	e	*		
Bromochipromiethane	(e4.).	TAXABL				
Chloroform	er 19 <sup>1</sup>	71/208	(191)			
1,1,5-TashWooethane	51 H9 <sup>2</sup>	79,1200	-4		_	
1,1-Dictiompropene	41 FB1	TRUCK	-1			
Carbontehachloride	<b>18</b> 4 (2	TK/208	<1			_
1.2 Orenoroethane	(04 IP)	TK1208	- 41	-		-
Dencere	×1 +91	TINCZOA	-1			
Trichéoroathana	101	11/12/08	9			
1,2-3 ctionpropage	41 <b>FB</b> 1	761202	- 41			
Obranianelitate		TIMODA				
Bromodichlorantelhane	- A1 697	TINCAGA	-1	3		
66 1.8 Oldriorogropena	<1.101	71/208	্য			- 2-
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o-Xylere	< €	p1 TI,1208	<1			
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soproy/servere	- M #	COCUNT 14	a			
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Monthly Wetland Analysis Ponds - August 2016								
LABORATORY NUMBER			2371	2372	2373	2374	2375	2376
Sampling Location		Ponds	1A	1B	2	3	4	5
Date sampled	19/09/2016		19-Sep	19-Sep	19-Sep	19-Sep	19-Sep	19-Sep
Sampled by	JMcGarry		JMcG	JMcG	JMcG	JMcG	JMcG	JMcG
Time sampled			13:35	13:50	14:00	13:20	13:10	12:20
Parameters	Units							
Temperature	0 <b>C</b>		17.4	14.3	15.5	16.2	14.8	15.5
рН	units		7.2	6.7	7.4	7.2	7.5	7
Cond	uS/cm		749	737	776	770	755	821
BOD	mg/l		6	481	<5	<5	7	11
COD	mg/l		14.3	34900	34.9	31.5	47.3	105
Ammonia Total (as N)	mg/l		3.66	1.09	1.88	1.94	2.19	2.34
Dissolved Oxygen	% sat		121	nm	75	49	112	58
Metals **								
** Individual metals are in the Certificate of Analysis, enclosed								

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# Ponds - August 2016 - Effluent

LABORATORY NUMBER		2377		
		Pond 5		
Sampling Location		Outlet		
Date sampled	19/09/2016	19-Sep		
Sampled by	JMcGarry	JMcG		
Time sampled		12:50		
Parameters	Units			
Temperature	OC	15.4		
рН	units	7.2		
Cond	uS/cm	788		
BOD	mg/l	<5		
COD	mg/l	38.4		
Ammonia Total (as N)	mg/l	nm		
Chloride	mg/l	105		
Total Oxidised Nitrogen	mg/l	<0.1		
Total Organic Carbon	mg/l	12.3		
Phenols+++	mg/l	<0.025		
Dissolved Oxygen	% sat	38		
Volatiles (VOC's)***				
+++	Individual Phenols are in the Certificate of Analysis, enclosed			
***	Individual Compounds are in the Certificate of Analysis, enclosed			

## Ponds - September 2016

LABORATORY NUMBER		2433	2434	2435	2436	2437	2438
Sampling Location	Ponds	1A	1B	2	3	4	5
Date sampled	26/10/2016	26-Oct	26-Oct	26-Oct	26-Oct	26-Oct	26-Oct
Sampled by	JMcGarry	JMcG	JMcG	JMcG	JMcG	JMcG	JMcG
Time sampled		15:20	15:35	15:40	15:50	16:05	16:15
Parameters	Units						
Temperature	0 <b>C</b>	13.6	12.2	12.3	12.5	12.7	12.5
рН	units	7.3	6.4	7.2	7.4	7.6	7.3
Cond	uS/cm	743	758	720	708	691	699
BOD	mg/l	48	29	3	<2	17	<2
COD	mg/l	89	36900	13.9	12.8	119	18.4
Ammonia Total (as N)	mg/l	5.09	0.355	2.14	1.24	1.69	0.672
Dissolved Oxygen	% sat	96	2	59	57	109	61
Metals **							
**	Individual me	tals are in	the Cert	ificate of	<sup>:</sup> Analysis	s, enclose	ed
		Copious		from	from		
		Algae		pipe	pipe	algae	
		present	Muddy	clear	clear	present	
# Ponds - September 2016 - Effluent

LABORATORY NUMBER		2439
Sampling Location		Interceptor
Date sampled	26/10/2016	26-Oct
Sampled by	JMcGarry	JMcG
Time sampled		16:30
Parameters	Units	
Temperature	0C	12.6
рН	units	8
Cond	uS/cm	704
BOD	mg/l	<5
COD	mg/l	26.9
Chloride	mg/l	70.4
Total Oxidised Nitrogen	mg/l	0.171
Total Organic Carbon	mg/l	11.7
Metals\$\$\$		
Phenols+++	mg/l	<0.025
Volatiles (VOC's)***		
+++	Individual Phenols ar	e in the Certificate of Analysis, enclosed
***	Individual Compound	ds are in the Certificate of Analysis, enclosed
\$\$\$	Individual Metals are	in the Certificate of Analysis, enclosed

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### Ponds - October 2016

LABORATORY NUMBER Sampling Location	Ponds	2567 1A	2568 1B	2569 2	2570 3	2571 4	2572 5
Date sampled	14/11/2016	14-Nov	14-Nov	14-Nov	14-Nov	14-Nov	14-Nov
Sampled by	JMcGarry	JMcG	JMcG	JMcG	JMcG	JMcG	JMcG
Time sampled		15:35	15:50	16:00	15:25	15:15	15:00
Parameters	Units						
Temperature	0 <b>C</b>	14.4	12.5	11.8	11.7	12.5	11.9
рН	units	7.7	6.7	7.6	7.5	7.9	7.4
Cond	uS/cm	612	751	692	691	682	690
BOD	mg/l	24	125	2	2	8	3
COD	mg/l	568	10400	20.8	23.4	60.8	24.6
Ammonia Total (as N)	mg/l	3.74	0.627	0.702	0.333	0.629	1.15
Dissolved Oxygen	% sat	123	2	67	64	104	83
Metals **							
**	Individual me	tals are in	the Cert	ificate of	Analysis	s, enclose	ed
		Copious		from	from	over	
		Algae		pipe	pipe	pipe	
		present	Muddy	clear	clear	clear	clear

### Ponds - October 2016 - Effluent

#### LABORATORY NUMBER

2573

Sampling Location		Interceptor
Date sampled	14/11/2016	14-Nov
Sampled by	JMcGarry	JMcG
Time sampled		14:50
Parameters	Units	
Temperature	0C	11.1
рН	units	7.1
Cond	uS/cm	733
BOD	mg/l	3
COD	mg/l	32.1
Chloride	mg/l	64.8
Total Oxidised Nitrogen	mg/l	0.225
Total Organic Carbon	mg/l	6.53
Metals\$\$\$		\$\$\$
Phenols+++	mg/l	<0.025
Volatiles (VOC's)***		***
+++	Individual Phenols a	re in the Certificate of Analysis, enclosed
***	Individual Compound	ds are in the Certificate of Analysis, enclosed
\$\$\$	Individual Metals are	in the Certificate of Analysis, enclosed

ebre.	10110-00		Instant	Dec				_	Clube Manda		_		_
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Anar a (dan 110	\$25 µg	- INIS	3,963	-	143		1.32		- 11 - 2	137		36	
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Codmian (dissifit	*208µg	CHMT .			-2.08		-13		623	-2.08		/3.08	
Of concer (disc 10)	<12pp	TMIS	412	-	<12		412		412	<12		412	
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Now Sector	434448	THIS	16		135		30		3.31	\$32		2.25	
En plants	at 3ppt	TMIS	1.82		*13		<u>90</u>	a	17 6	480		212	
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Calcian (Sisoff)	<3.012.heg	THE N	W.S.		187	. 4	75.6		79.5 J	(1)	4	30	
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istal Cigaric and Inergeals Carbon								22464-22-5 72464-42-5		

### Ponds - November 2016

LABORATORY NUMBER		2619	2620	2621	2622	2623	2624
Sampling Location	Ponds	1A	1B	2	3	4	5
Date sampled	30/11/2016	30-Nov	30-Nov	30-Nov	30-Nov	30-Nov	30-Nov
Sampled by	JMcGarry	JMcG	JMcG	JMcG	JMcG	JMcG	JMcG
Time sampled		12:25	12:50	13:00	13:10	13:20	13:30
Parameters	Units						
Temperature	0 <b>C</b>	1.1	2.9	3.7	4.2	3.1	2.1
рН	units	7.5	7.1	7.8	8	7.9	8.1
Cond	uS/cm	1544	815	734	747	756	711
BOD	mg/l	1200	156	<5	<5	8	5
COD	mg/l	11400	33800	21.7	18.6	32.3	24.8
Ammonia Total (as N)	mg/l	27.5	0.837	1.62	1.89	3.5	0.688
Dissolved Oxygen	% sat	nm	nm	nm	nm	nm	nm
Metals **							
**	Individual me	tals are in	the Cert	ficate of	Analysis	, enclose	d
		Frozen					
		low level		from	from	over	
		at		pipe	pipe	pipe	
		manifold	Muddy	clear	clear	clear	clear

#### Ponds - November 2016 - Effluent

LABORATORY NUMBER		2625
Sampling Location		Interceptor
Date sampled	30/11/2017	30-Nov
Sampled by	JMcGarry	JMcG
Time sampled		13:50
Parameters	Units	
Temperature	0C	3
рН	units	8.3
Cond	uS/cm	712
BOD	mg/l	4
COD	mg/l	23.9
Chloride	mg/l	64.5
Total Oxidised Nitrogen	mg/l	<0.1
Total Organic Carbon	mg/l	7.9
Metals\$\$\$		\$\$\$
Phenols+++	mg/l	<0.025
Volatiles (VOC's)***		***
+++	Individual Phenols ar	e in the Certificate of Analysis, enclosed
***	Individual Compound	ds are in the Certificate of Analysis, enclosed
\$\$\$	Individual Metals are	in the Certificate of Analysis, enclosed

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14.57.45 12/12/2018

ALS	SDG: Local

#### CERTIFICATE OF ANALYSIS Giant Relevence:

Validated

Control (Control)         Description         Description         Description                • • • • • • • • • • • • •	SDC:	<u>a - 1</u>	151202-66 Ducearcae	Client Bake Only: Burnh	vnes:	Report Number : Superveded Report:	389/051
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			CER	CERTIFICATE OF ANALYSIS				
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feld Copierie and Intergrate Carbon	2						49 Den 2/18		
ACCENTER (MICHAELE)						1	08 Dem 2018		

### Ponds - December 2016

LABORATORY NUMBER		2648	2649	2650	2651	2652	2653
Sampling Location	Ponds	1A	1B	2	3	4	5
Date sampled	15/12/2016	15-Dec	15-Dec	15-Dec	15-Dec	15-Dec	15-Dec
Sampled by	JMcGarry	JMcG	JMcG	JMcG	JMcG	JMcG	JMcG
Time sampled		14:05	14:00	13:20	13:10	12:50	13:00
Parameters	Units						
Temperature	0 <b>C</b>	9.7	9.9	8.5	8.2	7.8	8.2
рН	units	7.7	7.2	7.9	7.8	8.4	7.5
Cond	uS/cm	687	632	617	607	571	632
BOD	mg/l	1200	156	<5	<5	8	5
COD	mg/l	11400	33800	21.7	18.6	32.3	24.8
Ammonia Total (as N)	mg/l	27.5	0.837	1.62	1.89	3.5	0.688
Dissolved Oxygen	% sat	73	39	72	72	83	60
Metals **							
**	Individual met	als are in	the Certi	ficate of	Analysis	, enclose	d
				from	from	over	
				pipe	pipe	pipe	
			Muddy	clear	clear	clear	clear

#### Ponds - December 2016 - Effluent

LABORATORY NUMBER		2654
Sampling Location		Interceptor
Date sampled	15/12/2016	15-Dec
Sampled by	JMcGarry	JMcG
Time sampled		13:35
Parameters	Units	
Temperature	0C	8.4
рН	units	7.9
Cond	uS/cm	610
BOD	mg/l	<5
COD	mg/l	19.5
Chloride	mg/l	52.9
Total Oxidised Nitrogen	mg/l	0.273
Total Organic Carbon	mg/l	9.26
Metals\$\$\$		\$\$\$
Phenols+++	mg/l	<0.025
Volatiles (VOC's)***		***
+++	Individual Phenols ar	e in the Certificate of Analysis, enclosed
***	Individual Compound	ds are in the Certificate of Analysis, enclosed
\$\$\$	Individual Metals are	in the Certificate of Analysis, enclosed

		100000	CERT	IFICATE O	FAI	ALYSIS			
ALS Location:		151217-28 DUNGARWAN	City Ord	nt Relevance: ler Humber:	32.0	2 M12	Report Numb Superseded R	a: 992541 leport:	
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Examides Mil	Sug	INIS	64.8	48.5	-		¥ 81.4	4 55.7	51
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#### CERTIFICATE OF ANALYSIS Client Rolevence: 32/02/H12

Validated

(ALS) MAL	11	UNGARWAK	Orde	r Humber:	32/02/01/2	Superveded Report	27(254)
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SDG:         151217-28         Cleant Reference:         32-02 M12         Report Number:         992541           Location:         DLNGARWA         Order Number:         Superveded Report:         Superveded Report:

Lab Sample No(s)	14735155	14125 152	14(2519)	14736130	14122 8	14(251)2	14735103	14725 87	14(251/3
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Renning Energie			-310-d0h		384 1010			3106-208	
000 Un/Nenel	23.Dex 2018	28 Dec 28 8	22 Gen 20 H	19 Den 2018	21 Dec 2018	20;128	33.0ex.3018	Construction of the local sector	
Discustrational Contract	200 00 2.15	20 Jac 20 6	A DESCRIPTION OF A DESC	10000-018	The last and	2HINGS N	(HOme-2/16		
Versury Discoved	10036-018	2010/07/8		UHSec121	2010/02/07/01	26G14-2616	060m2/078		
Weiks by 10 ap-005 Discolved (M)	29-Dec-2215	280wo 28 K		29-Dec-22-8	25-Dec 2816	250 in 208	29-Dec-20-5		and the second
News Dir Chriff Search (M)						1000000			2506-200
Promb to HPLE (%)	2	-	22.0 (* 20.8					22 Oct 28 8	
Same and									250 an 25 M
(d) M463/13-0X	AREAS AND	71060.78%		Others 11	210au-2018	Billio (B.B.	CHOICE CO.		
Total Crystic and Integrate Carbon	0		0.03 date:101910						
ACCORDENCE.			3604-200			1		28-040-2816	

Appendix E

Groundwater Results

### Dungarvan Landfill W0032-02 Qrt 1 2016

LABORATORY NUMBER Sampling Location		2031 GW 1	2032 GW 2A	2033 RC 3A	2034 RC 4	2035 RC 6A	2036 RC 7	2037 RC 8
Date sampled	14/03/2016	14-Mar	14-Mar	14-Mar	14-Mar	14-Mar	14-Mar	14-Mar
Sampled by	JMcGarry	JMcG	JMcG	JMcG	JMcG	JMcG	JMcG	JMcG
Time sampled		14:50	13:25	14:35	13:50	13:20	12:30	12:40
Parameters	Units							
		muddy				sl	muddy	no
Visual Inspection/Odour		brown	dry	clear	clear	muddy	/saline	tubing
Taste								
Groundwater Level	m	3.2	2	12.9	16.1	7.7	11.1	nm
Temp	oC	11.6		12	10.7	11.4	11	nm
рН	units	6.9		7	7.4	7.1	7.4	nm
Cond	uS/cm	962		1636	641	1042	6450	nm
Salinity	0/000	nm		nm	nm	nm	3.4	nm
Ammonia Total (as N)	mg/l	2.22		63.6	<0.2	14.1	<0.2	nm
Chloride( asCl)	mg/l	15.6		101	28	75.9	1750	nm
Total Oxidised Nitrogen	mg/l	<0.1		<0.1	12.1	10.2	1.77	nm
Dissolved Oxygen	% sat	72		19	56	16	24	nm
Iron	mg/l	1.83		2.06	<0.019	0.227	<0.19	nm

# Dungarvan Landfill W0032-02 Annual 2016

		2248	2249	2250	2251	2252	2253	2254
Sampling Location	24/05/2045	GW 1	GW 2A	RC 3A	RC 4	RC 6A	RC /	RC 8
Date sampled	24/06/2016	24-Jun	24-Jun	24-Jun	24-Jun	24-Jun	24-Jun	24-Jun
Sampled by	JMcGarry	JMcG	JMcG	JMcG	JMcG	JMcG	JMcG	JMcG
lime sampled		13:15	15:30	12:55	13:45	15:20	16:40	14:25
Parameters	Units							
		muddy				light	muddy	no
Visual Inspection/Odour Taste		brown	dry	cloudy	clear	brown	/saline	tubing
Groundwater Level	m	2.1	1.7	10.5	15.7	7.8	5.6	11.9
Temp	оС	12.5		13.2	11.9	12.2	12.6	nm
рН	units	6.6		6.8	7.2	7.2	7.3	nm
Cond	uS/cm	928		1690	650	1176	15030	nm
Salinity	0/000	nm		nm	nm	nm	8.6	nm
Alkalinity	mg/l	440		685	240	385	200	nm
Ammonia Total (as N)	mg/l	3.23		65.8	<0.2	25.8	<0.2	nm
Fluoride	mg/l	<0.5		<0.5	<0.5	<0.5	<0.5	nm
COD, unfiltered	mg/l	587		33.4	<7	33.8	200	nm
Metals ***								nm
Sulphate	mg/l	<2		28	23	30.2	681	nm
Chloride( asCl)	mg/l	20.5		106	27.7	95.1	4820	nm
Nitrate as N	mg/l	<0.0677		<0.0677	10.2	10.2	0.103	nm
Phosphate(ortho)as P	mg/l	<0.02		<0.02	<0.02	0.0206	<0.02	nm
Total Oxidised Nitrogen	mg/l	<0.1		<0.1	10.2	10.2	0.114	nm
Nitrogen,total	mg/l	3.56		76.8	12.8	40.3	3.57	nm
Dissolved Oxygen	% sat	15		25	51	19	29	nm
Phenols,total	mg/l	<0.025		<0.025	<0.025	<0.025	<0.025	nm
VOC's @@@								
@@@	See att	ached Ce	ertificate	of Analy	sis for In	dividual	compou	nds
****	See attac	ched Cer	tificate o	of Analysi	s for Indi	ividual m	netals	

# Dungarvan Landfill W0032-02 Qrt 3 2016

LABORATORY NUMBER		2386 GW 1	2387 GW 2A	2388 RC 3A	2389 RC 4	2390 RC 6A	2391 RC 7	2392 RC 8
Date sampled	19/09/2016	19-Sep	19-Sep	19-Sep	19-Sep	19-Sep	19-Sep	19-Sep
Sampled by	JMcGarry	JMcG	JMcG	JMcG	JMcG	JMcG	JMcG	JMcG
Time sampled		14:50	14:15	14:35	15:10	16:10	16:45	15:50
Parameters	Units							
		browni		browni				no
Visual Inspection/Odour		sh	dry	sh	clear	cloudy	brown	tubing
Groundwater Level	m	3	2	11	14	7.8	10.7	nm
Temp	оС	12.6		12.9	11.6	11.8	12.9	nm
рН	units	6.6		7	7.4	7	63.8	nm
Cond	uS/cm	996		1638	655	1177	15800	nm
Salinity	0/000	nm		nm	nm	nm	9.2	nm
Ammonia Total (as N)	mg/l	2.22		62.9	<0.2	17.6	<0.2	nm
Chloride( asCl)	mg/l	15.6		112	27.4	112	5200	nm
Total Oxidised Nitrogen	mg/l	<0.1		0.143	9.64	8.88	<0.1	nm
Dissolved Oxygen	% sat	41		17	52	16	52	nm
Iron	mg/l	1.83		0.58	<0.019	<0.019	<0.19	nm

# Dungarvan Landfill W0032-02 Qrt 4 2016

LABORATORY NUMBER		2425	2426	2427	2428	2429	2430	2431
Sampling Location		GW 1	GW 2A	RC 3A	RC 4	RC 6A	RC 7	RC 8
Date sampled	26/10/2016	26-Oct	26-Oct	26-Oct	26-Oct	26-Oct	26-Oct	26-Oct
Sampled by	JMcGarry	JMcG						
Time sampled		12:15	12:40	12:45	13:35	14:30	17:00	14:15
Parameters	Units							
							cloudy	
							light	no
Visual Inspection/Odour		muddy	dry	clear	clear	grey	brown	tubing
Groundwater Level	m	3.6	0.5	12.9	15.9	7.2	10.5	nm
Temp	oC	12.9		12.6	11.6	11.8	12.4	nm
рН	units	6.5		7	7.1	7.1	7.8	nm
Cond	uS/cm	1047		1713	657	1199	12460	nm
Salinity	0/000	nm		nm	nm	nm	7	nm
Ammonia Total (as N)	mg/l	2.09		62.8	<0.2	18.8	<0.2	nm
Chloride( asCl)	mg/l	18		110	27.1	109	3900	nm
Total Oxidised Nitrogen	mg/l	<0.1		0.244	10.1	8.16	0.177	nm
Dissolved Oxygen	% sat	56		12	51	17	20	nm
Iron	mg/l	6.41		0.199	<0.019	<0.019	<0.19	nm
## Appendix **F**

Leachate Results

Dungarvan Landfill W0032-02 Qrt 1 2016														
Leachates														
Parameters	Units													
LABORATORY NUMBER		2095												
		Lagoon												
Sampling Location		Marsh												
Date sampled	29/03/2016	29-Mar												
Sampled by	JMcGarry	JMcG												
Time sampled		10:10												
BOD	mg/l	<2												
COD	mg/l	24.9												

	L	.eachates		
LABORATORY NUMBER		2255 Lagoon	2256	
Sampling Location		Marsh	Interceptor	
Date sampled	24/06/2016	24-Jun	24-Jun	
Sampled by	JMcGarry	JMcG	JMcG	
Time sampled		14:40	14:45	
Parameters	Units			
BOD	mg/l	<2	<5	
COD, unfiltered	mg/l	45.2	40.6	
Ammonia Total (as N)	mg/l	0.225	<0.2	
Fluoride	mg/l	<0.5	<0.5	
Metals ***				
Sulphate	mg/l	<2	<2	
Chloride( asCl)	mg/l	69.5	92.2	
Cyanide	mg/l	<0.05	<0.05	
Phosphate(ortho)as P	mg/l	0.0392	<0.02	
Total Oxidised Nitrogen	mg/l	<0.1	<0.1	
Dissolved Oxygen	% sat	212	81	
VOC's @@@				
@@@	See attached Cer	rtificate of An	alysis for Indivi	dual compound
****	See attached Cer	rtificate of An	alysis for Indivi	dual metals

Dur	ngarvan Lan	dfill W0032-02 Qrt 3 2016													
	Leachates														
LABORATORY NUMBER		2393 Lagoon													
Sampling Location		Marsh													
Date sampled	19/09/2016	19-Sep													
Sampled by	JMcGarry	JMcG													
Time sampled		15:50													
Parameters	Units														
BOD	mg/l	9													
COD	mg/l	67.9													

Dur	Dungarvan Landfill W0032-02 Qrt 4 2016													
Leachates														
LABORATORY NUMBER		2432 Lagoon												
Sampling Location		Marsh												
Date sampled	26/10/2016	26-Oct												
Sampled by	JMcGarry	JMcG												
Time sampled		14:45												
Parameters	Units													
BOD	mg/l	3												
COD	mg/l	30.4												

# Appendix G Meteorological Data

date: - 00 to 00 utc rain: - Precipitation Amount (mm) maxtp: - Maximum Air Temperature (C) mintp: - Minimum Air Temperature (C) gmin: - 09utc Grass Minimum Temperature (C) soil: - Mean 10cm soil temperature (C) cbl: - Mean CBL Pressure (hpa) wdsp: - Mean Wind Speed (kt) hm: - Highest ten minute mean wind speed (kt)

date	maxtp	mintp	gmin	rain	cbl	wdsp	hm	ddhm	hg	soil	ре	evap	smd_wd	smd_md	smd_pd	glorad
01-Jan-16	9.6	1.8	-4.2	10.7	996.2	15	25	130	39	5.931	0.6	0.8	0	-10	-10	45
02-Jan-16	10.1	4.3	5.9	1.7	988.2	8	17	110	26	8.432	0.3	0.4	0	-1.4	-10	124
03-Jan-16	10.1	4.3	1.6	9.8	979.9	10.8	24	140	35	7.783	0.1	0.2	0	-9.7	-10	304
04-Jan-16	9.4	5.6	4.8	1.2	969	6.2	11	220	16	7.272	0.2	0.3	0	-1	-10	239
05-Jan-16	8.2	5.3	2.5	1.2	978.4	10.6	17	300	24	6.862	0.4	0.5	0	-0.8	-10	267
06-Jan-16	10.1	2.5	-1.1	11.5	979	11.6	28	140	39	5.87	0.3	0.4	0	-10	-10	188
07-Jan-16	9.9	2.8	1.2	5.5	978.5	11.3	24	290	35	5.739	0.1	0.1	0	-5.4	-10	388
08-Jan-16	7.8	3.6	1.4	20.1	984.8	7.3	17	200	29	5.686	0.3	0.3	0	-10	-10	260
09-Jan-16	7.1	2.2	-0.7	14.3	975.3	5.6	12	300	18	5.203	0.3	0.5	0	-10	-10	83
10-Jan-16	5.6	1.9	-0.1	1.4	972.3	7.1	12	220	18	4.008	0.3	0.4	0	-1.1	-10	269
11-Jan-16	6.4	0.2	-4.1	0.2	979.7	8.6	19	300	30	3.559	0.2	0.3	0	0	-9.5	299
12-Jan-16	6	-0.2	-0.1	0	998.6	15.6	29	290	42	3.003	0.6	0.8	0.7	0.7	-8.4	413
13-Jan-16	6.1	0.3	-2.9	1.4	1003.2	8.3	13	250	19	2.57	0.5	0.6	0	-0.3	-8.9	137
14-Jan-16	5.3	-1.4	-4.4	0.2	1006	11	19	290	29	2.099	0.5	0.6	0.3	0.3	-8.2	401
15-Jan-16	5.4	0.8	-0.6	0	1018.2	11.7	21	290	28	1.921	0.7	0.8	0.9	0.9	-7.1	451
16-Jan-16	6.9	-0.3	-5.4	0	1021	4.7	10	300	13	2.514	0.3	0.4	1.2	1.2	-6.5	289
17-Jan-16	9.1	4.2	-1	4.9	1009.9	7.8	19	140	27	4.755	0.5	0.6	0	-3.3	-10	135
18-Jan-16	8.2	5.9	3	5.6	1002.1	7.9	18	150	28	6.287	0.4	0.5	0	-5.2	-10	84
19-Jan-16	9.1	3.1	2.1	0	1007.6	3.4	8	150	12	5.88	0.4	0.6	0.4	0.4	-9.1	265
20-Jan-16	7.4	2.1	-5.5	0.1	1007.9	7.6	16	140	23	3.377	0.6	0.7	0.9	0.9	-8.2	282
21-Jan-16	10.9	7.4	-1.8	10.4	1002.5	16.4	22	150	29	7.426	0.5	0.7	0	-9.1	-10	49
22-Jan-16	11.2	8.4	9.1	12.8	1004.5	13.4	18	170	29	8.872	0.3	0.5	0	-10	-10	409
23-Jan-16	11.3	8.6	6.8	6	1013.1	12.1	23	160	36	8.315	0.4	0.6	0	-5.6	-10	88
24-Jan-16	11.7	10.8	8.5	0.6	1009.2	14.5	18	190	29	10.07	0.4	0.6	0	-0.2	-9.7	100
25-Jan-16	11.7	6.1	10.3	0.5	1004.9	14.1	21	170	35	9.345	0.6	0.8	0.1	0.1	-9.2	277
26-Jan-16	11.3	9.2	3.1	13	999.3	20.3	26	210	45	9.185	0.6	1	0	-10	-10	60
27-Jan-16	11.4	2.1	9.9	2.8	999.1	14.9	23	200	37	8.724	0.4	0.6	0	-2.4	-10	329
28-Jan-16	10.7	2.4	0.2	0.6	1009.5	15.1	23	220	39	5.977	0.6	0.8	0	0	-9.5	141
29-Jan-16	10.6	6.8	6.5	0.5	1003.6	16.1	27	220	46	8.698	0.7	0.9	0.2	0.2	-8.9	399
30-Jan-16	7	2.5	0.5	0.1	1002.2	10.4	18	260	28	4.944	0.7	0.9	0.7	0.7	-7.9	419
31-Jan-16	13.2	4.2	2.2	5	998.9	13	19	250	30	7.753	0.7	0.9	0	-3.6	-10	264

date: - 00 to 00 utc

rain: - Precipitation Amount (mm)
maxtp: - Maximum Air Temperature (C)
mintp: - Minimum Air Temperature (C)
gmin: - 09utc Grass Minimum Temperature (C)
soil: - Mean 10cm soil temperature (C)
cbl: - Mean CBL Pressure (hpa)
wdsp: - Mean Wind Speed (kt)
hm: - Highest ten minute mean wind speed (kt)

date	maxtp	mintp	gmin	rain	cbl	wdsp	hm	ddhm	hg	soil	pe	evap	smd_wd	smd_md	smd_pd	glorad
01-Feb-16	11.6	6.6	9	0.4	1003.2	17.9	26	230	39	8.548	1.1	1.4	0.7	0.7	-8.8	536
02-Feb-16	7.7	1.2					18	230	30							l .
03-Feb-16	8.8	1.3					18		27							l .
04-Feb-16	12.5	8.2		0.1	1016.7	10.1	15	250	24	8.239	0.6	0.8	0.5	0.5	0.5	353
05-Feb-16	9.9	3	7.4	8.9	1004.6	13.2	20	200	36	7.588	0.5	0.7	0	-7.9	-7.9	104
06-Feb-16	9.5	3.9	-0.2	9	983.4	12.6	22	180	33	6.269	0.6	0.9	0	-8.4	-10	272
07-Feb-16	9.9	3.1	1.5	6.9	976.2	14.5	24	250	41	4.9	0.5	0.8	0	-6.4	-10	427
08-Feb-16	8.7	3.4	3.6	4.4	975.2	18.9	29	270	47	5.537	1	1.5	0	-3.4	-10	694
09-Feb-16	5.1	0.9	-0.7	2.1	983	13	21	290	34	3.324	0.6	0.9	0	-1.5	-10	528
10-Feb-16	7.9	1.6	-0.1	0.1	991.6	6.9	18	270	29	4.317	0.5	0.8	0.4	0.4	-9.1	1322
11-Feb-16	7.3	1.1	-3.8	1.5	991.3	2.4	8	350	13	4.056	0.3	0.6	0	-0.8	-9.8	855
12-Feb-16	7.5	2.7	-0.7	4.1	982.5	7.3	17	120	31	5.304	0.4	0.6	0	-3.7	-10	444
13-Feb-16	6.9	5	4.5	9.4	978	9.3	15	140	25	5.819	0.6	0.9	0	-8.8	-10	272
14-Feb-16	6.9	1.3	3.4	0.7	996.6	10.2	17	50	24	4.736	0.9	1.3	0.2	0.2	-9.3	727
15-Feb-16	6.7	-0.2	-1.8	0	1019.8	6.3	11	330	19	3.199	0.8	1.2	1	1	-8	1562
16-Feb-16	8.7	3	-3.2	19.5	1016.1	14.9	21	200	35	4.957	0.7	1.1	0	-10	-10	263
17-Feb-16	8.9	0.7	3.5	12.5	1005.3	7.2	20	190	32	6.095	0.5	0.8	0	-10	-10	949
18-Feb-16	7.9	0	-2.5	0.1	1007.3	7.1	11	250	17	3.589	0.9	1.3	0.8	0.8	-8.7	1485
19-Feb-16	9.8	1.9	-0.2	1	1003.9	10.3	16	200	26	5.767	0.6	0.9	0.3	0.3	-8.7	624
20-Feb-16	12	7.1	5.3	0.9	1000.7	12	18	240	28	7.55	0.8	1.2	0.3	0.3	-8.3	350
21-Feb-16	11.4	7	8.9	0.7	1000.3	15.9	25	240	38	9.42	0.7	1.1	0.3	0.3	-7.9	645
22-Feb-16	8	2.4	3.7	0	1004.5	6.3	12	290	18	6.911	0.9	1.3	1.2	1.2	-6.6	1385
23-Feb-16	7.8	1.2	-2.1	0.1	1011	7.1	11	50	17	4.989	1	1.6	2.1	2.1	-5.4	1848
24-Feb-16	7.9	-0.3	-2.4	0	1012.3	6.3	9	340	13	4.213	1.1	1.5	3.1	3.1	-4	1039
25-Feb-16	7.3	-0.8	-4	0.9	1007.5	4.6	7	320	11	3.65	0.7	1	2.9	2.9	-4	548
26-Feb-16	6.9	3.1	1.2	11.7	998.7	8.8	14	100	23	4.765	0.7	0.9	0	-8.1	-10	186
27-Feb-16	7	3.8	2.5	0.5	1004.5	8.4	12	40	21	5.008	1.2	1.6	0.7	0.7	-8.8	764
28-Feb-16	7.6	0.8	-0.8	0	1015.9	5.3	10	80	16	4.913	1	1.5	1.7	1.7	-7.3	1170
29-Feb-16	9.5	1.7	-4.5	8.4	1013.3	10	18	220	30	4.905	0.6	0.9	0	-6	-10	164

date: - 00 to 00 utc rain: - Precipitation Amount (mm) maxtp: - Maximum Air Temperature (C) mintp: - Minimum Air Temperature (C) gmin: - 09utc Grass Minimum Temperature (C) soil: - Mean 10cm soil temperature (C) cbl: - Mean CBL Pressure (hpa) wdsp: - Mean Wind Speed (kt) hm: - Highest ten minute mean wind speed (kt)

<sup>ddhm: - Wind Direction at max 10 min mean (deg)
hg: - Highest Gust (kt)
pe: - Potential Evapotranspiration (mm)
evap: - Evaporation (mm)
smd\_wd:- Soil Moisture Deficits(mm) well drained
smd\_md:- Soil Moisture Deficits(mm) moderately drained
smd\_pd:- Soil Moisture Deficits(mm) poorly drained
glorad:- Global Radiation (J/cm sq.)
ind: - Indicator (i)</sup> 

date	maxtp	mintp	gmin	rain	cbl	wdsp	hm	ddhm	hg	soil	pe	evap	smd_wd	smd_md	smd_pd	glorad
01-Mar-16	12.4	4 2.8	, 4.2	7.3	1001.9	15.5	, 22	260	35	8.354	1	1.6	0	-6.3	-10	847
02-Mar-16	9.4	1.5	, 0.7	8.2	996.8	3 19	29	250	44	5.256	1.4	2.3	0	-6.8	-10	999
03-Mar-16	8.6	0.8 ز	, 3.4	+ 3.5	996	10.3 ز	21	280	31	5.588	0.6	1	0	-2.9	-10	536
04-Mar-16	6.3	-0.1	1.3	1.3	989.2	12.2	20	350	31	3.549	0.8	1.2	0	-0.5	-10	544
05-Mar-16	8.4	4 1.8	, 1.4	+ 0	1000	10.6 ر	16	320	26	4.681	1.5	2.1	1.5	1.5	-8	, 1199
06-Mar-16	5.5	-1.5	, -4.9	0.8	1001.6	5.6 ز	10	270	13	3.708	0.7	1	1.4	1.4	-7.7	651
07-Mar-16	9.4	1.2	0.4	. 0.1	1005.7	/ 8.2	. 15	290	24	4.73	1.1	1.6	2.4	2.4	-6.3	904
08-Mar-16	9.8	3.8	, 2.6	8.7	998.9	7.2	. 14	290	21	6.632	1	1.4	0	-5.3	-10	830
09-Mar-16	9.9	3.7	2.3	0.8	999.4	15.1	. 23	320	38	5.964	1.7	2.7	0.9	0.9	-8.6	1319
10-Mar-16	10.9	2.9	-0.7	<u> </u>	1014	4 5.8	12	320	18	6.425	1.2	1.7	2.1	2.1	-6.9	1174
11-Mar-16	10.3	7.3	-0.5	0.5	1018.6	6.5 ز	, 10	200	15	7.927	0.8	1.1	2.4	2.4	-6.3	443
12-Mar-16	12	8.5	, 8.3	0.1	1021.1	5.1	. 9	210	14	9.172	0.8	1.1	3.1	3.1	-5.3	525
13-Mar-16	10.9	6.6	, 7.3	0	1025.7	/ 3.8	9	40	14	9.538	0.9	1.2	3.9	3.9	-4.2	. 756
14-Mar-16	8.8	5.4	1.6	0.2	1024.2	2 7.9	14	50	19	8.035	1.3	2	5	5	-2.9	1485
15-Mar-16	9.7	, 4.3	, 2.1	. 0	1023.6	8.2 ز	. 12	50	18	7.301	1.5	2.1	6.4	6.4	-1.2	. 1232
16-Mar-16	9.4	4 5.5	, 2.9	0.1	1023.7	, 8.9	17	40	24	7.665	0.9	1.3	7.1	. 7.1	-0.4	656
17-Mar-16	8.1	1.4	1.2	<u> </u>	1023.5	5.7	10	100	17	7.113	1.2	1.7	8.2	8.2	0.8	, 1251
18-Mar-16	7.9	1	1.5	<u> </u>	1021	8.8	15	20	24	6.736	1.1	1.9	9.2	9.2	1.9	1481
19-Mar-16	7.1	5.4	4.3	<u>ہ</u>	1020.7	/ 9.4	14	30	21	7.138	1	1.4	10.2	10.2	2.9	333
20-Mar-16	7.7	, 2	. 4.7	0	1019.9	4.9 ر	9	40	15	7.111	0.8	1.1	10.9	10.9	3.7	492
21-Mar-16	8.1	1.7	-1.9	<u>ہ</u>	1016.9	4.7	7	320	11	6.261	0.9	1.2	11.7	11.7	4.6	643
22-Mar-16	8	4.5	1.7	· 0	1012	2.9	5	330	7	7.089	0.8	1.1	12.4	12.4	5.4	361
23-Mar-16	10.6	5 ز	4	+ 0.1	1008.6	5.5 ز	12	210	19	8.185	1.3	1.9	13.5	13.5	6.6	1000
24-Mar-16	11	5.6	4.2	3.1	1003.1	10.5	18	210	29	8.111	0.8	1.2	11.1	. 11.1	4.4	348
25-Mar-16	10.7	/4	.0.5	<u>ہ</u>	1000.8	3 12.2	21	200	35	7.758	1.4	2.3	12.4	12.4	5.8	1316
26-Mar-16	9.7	, 5.4	+ 7.7	11.6	986.6	16 ز	24	210	36	8.315	0.8	1.4	1.5	1.5	-5	477
27-Mar-16	9.5	3.5	2.4	4.5	979.7	/ 12.9	23	220	40	7.066	1.4	2.3	0	-1.6	-7.8	1110
28-Mar-16	9.9	2.2	0.2	<u> </u>	981.7	/ 9.3	16	280	22	6.823	1.6	2.4	1.6	1.6	-5.8	1317
29-Mar-16	7.9	2.2	0.9	3.8	991.4	4 8.5	17	220	26	6.015	1.2	1.8	0	-1	-8.1	. 930
30-Mar-16	11.1	. 1.8	-1.5	, 0	1000.5	7.4 د	14	220	20	5.962	1.7	2.4	1.7	1.7	, -6	1321
31-Mar-16	11.1	2.4	-0.1	0	1008.9	7.2	13	230	20	6.903	2	2.8	3.6	3.6	-3.8	1616

date: - 00 to 00 utc

rain: - Precipitation Amount (mm)

maxtp: - Maximum Air Temperature (C)

mintp: - Minimum Air Temperature (C)

gmin: - 09utc Grass Minimum Temperature (C)

soil: - Mean 10cm soil temperature (C)

cbl: - Mean CBL Pressure (hpa)

wdsp: - Mean Wind Speed (kt)

hm: - Highest ten minute mean wind speed (kt)

date	maxtp	mintp	gmin	rain	cbl	wdsp	hm	ddhm	hg	soil	ре	evap	smd_wd	smd_md	smd_pd	glorad
01-Apr-16	9.1	6.7	0.8	12.4	1003.9	14.8	23	170	35	7.544	0.8	1.3	0	-8	-10	260
02-Apr-16	9.1	6.3	7.4	21.9	998.2	9.4	19	160	29	8.303	0.6	1	. 0	-10	-10	306
03-Apr-16	10.7	6.4	5.7	9	993.9	10	18	160	25	8.063	0.8	1.3	0	-8.2	-10	450
04-Apr-16	11.7	6.3	4.1	7.2	994.6	4.3	11	250	18	9.62	1.4	2	0	-5.8	-10	1187
05-Apr-16	11.5	3.2	0.2	0.6	1000.1	8.3	14	230	22	8.925	1.7	2.6	1.1	1.1	-8.4	1575
06-Apr-16	9.3	3.8	4	2.4	1000.1	14.4	24	310	38	8.355	1.4	2.6	0.1	0.1	-9	1636
07-Apr-16	12.3	3.6	2.5	0.1	1005.6	11.7	19	310	28	7.547	2	3.1	1.9	1.9	-6.7	1593
08-Apr-16	8.6	2.9	1	7.5	1002.7	8.7	17	300	25	7.117	0.8	1.3	0	-4.8	-10	579
09-Apr-16	7.9	1	-0.8	0	994.2	6.1	11	180	17	7.288	2	3	2	2	-7.5	2040
10-Apr-16	10.1	2.5	-3.5	6.5	993.3	13.2	21	100	37	6.434	1.3	1.9	0	-3.2	-10	425
11-Apr-16	9.9	5.9	5.3	0.8	997.4	6.4	12	90	19	8.413	0.9	1.2	0.1	0.1	-9.4	547
12-Apr-16	12	3	-1.7	0.1	998.5	4.8	11	190	14	9.789	2	3	2	2	-7	2014
13-Apr-16	12.1	2.7	0.8	3.4	1000.3	5.1	8	130	13	10.177	1.5	2.2	0.1	0.1	-8.5	1389
14-Apr-16	10.9	7.5	7	3.4	1000.1	9.5	16	40	24	10.658	1.7	2.7	0	-1.6	-9.8	1537
15-Apr-16	11.5	2.6	5.8	1.8	996.4	7.8	13	310	20	9.417	1.6	2.2	0	-0.2	-9.5	846
16-Apr-16	9.8	1.4	-0.4	0	1002.1	7.8	15	340	25	8.213	2.2	3.2	2.2	2.2	-6.9	1856
17-Apr-16	9.2	1.1	-1.5	0	1010.2	6.4	12	220	18	7.657	1.6	2.3	3.7	3.7	-5	1225
18-Apr-16	11.6	6.8	6	0	1015.9	8.2	15	230	22	8.94	1.8	2.5	5.4	5.4	-3	1006
19-Apr-16	11.3	5.2	1.3	0	1020.6	6.5	11	50	16	10.434	2.3	3.4	7.6	7.6	-0.5	2094
20-Apr-16	12.2	4.1	1.3	0	1020	9.3	17	40	26	10.809	2.4	3.8	9.8	9.8	1.9	2261
21-Apr-16	11.5	7.7	5.9	0	1015.9	9.9	14	50	20	9.917	1.9	2.7	11.6	11.6	3.8	938
22-Apr-16	9.9	5.7	7.8	0	1014.3	8.5	13	40	20	9.773	1.4	1.9	12.8	12.8	5.2	740
23-Apr-16	11.1	3.4	1.8	0	1016.2	5.4	10	350	17	9.696	2	2.9	14.6	14.6	7.2	1631
24-Apr-16	11.8	3.8	-0.6	0	1015.2	7.8	11	330	18	10.172	2	2.9	16.3	16.3	9.2	1442
25-Apr-16	13.9	3.7	5.1	0.1	1009.1	9.6	15	300	23	11.055	2.7	3.8	18.5	18.5	11.8	1558
26-Apr-16	10.1	2	-0.9	0.3	1008.2	10.5	19	320	32	9.692	2.8	4.3	20.5	20.5	14.2	2279
27-Apr-16	10	0.8	-1.6	0.2	1008.5	7.7	16	310	27	9.366	2.3	3.4	22.2	22.2	16.2	1908
28-Apr-16	12.2	1.6	-2.1	1.1	1005.1	12	22	250	31	8.182	2.1	3.1	22.7	22.7	17.1	1271
29-Apr-16	10.6	1.3	-0.6	0.2	1006.8	10.4	19	290	28	8.333	2.4	3.7	24.4	24.4	19.1	1812
30-Apr-16	11	2.1	-0.9	0	1014.4	8.4	15	210	23	8.482	1.8	2.6	25.8	25.8	20.7	1297

date: - 00 to 00 utc rain: - Precipitation Amount (mm) maxtp: - Maximum Air Temperature (C) mintp: - Minimum Air Temperature (C) gmin: - 09utc Grass Minimum Temperature (C) soil: - Mean 10cm soil temperature (C) cbl: - Mean CBL Pressure (hpa) wdsp: - Mean Wind Speed (kt) hm: - Highest ten minute mean wind speed (kt)

date	maxtp	mintp	gmin	rain	cbl	wdsp	hm	ddhm	hg	soil	ре	evap	smd_wd	smd_md	smd_pd	glorad
01-May-16	12.1	8.3	5.8	4	1013.7	11.6	16	220	24	10.183	1.1	1.7	22.6	22.6	17.7	677
02-May-16	13.2	5.1	8.5	3.9	1010.9	12.6	22	260	35	11.298	2.3	3.9	20.6	20.6	15.9	2026
03-May-16	12.1	4.4	2.1	0	1017.5	8.4	15	240	21	9.972	2.1	3.2	22.3	22.3	17.9	1568
04-May-16	11.9	7.5	3.4	0	1014.8	10.6	17	190	26	10.805	1.8	2.9	23.8	23.8	19.6	1387
05-May-16	14.3	7	6.1	1.8	1010.1	5.4	9	150	13	12.765	2.4	3.3	23.8	23.8	19.9	1782
06-May-16	14.5	7.2	3.3	0	1004.2	10.1	15	40	23	12.952	3.1	4.5	26.2	26.2	22.7	2111
07-May-16	12.8	8.3	7.9	8.3	998.1	8	13	50	20	11.78	1.4	1.9	19	19	15.6	684
08-May-16	16.9	10.2	10.4	0	996.6	6	12	50	18	14.052	2.5	3.5	21.1	21.1	. 18	1704
09-May-16	14.4	12.1	9.5	15.9	999.2	6.4	10	50	18	12.948	1.4	1.8	6.3	6.3	3.3	518
10-May-16	13.4	11.6	11.8	7.7	999.1	5.3	11	50	17	13.12	0.8	1.1	0	-0.7	-3.5	396
11-May-16	15.6	11.4	11.5	0.3	997.3	6.8	11	30	18	13.575	1.4	2	1.1	1.1	-2.3	785
12-May-16	18.2	11.5	10.8	0.9	999.1	10	15	40	23	15.12	3.1	4.6	3.3	3.3	0.1	2168
13-May-16	16.4	9.5	8.6	0	1005.8	9.1	13	50	21	15.665	3.4	5.1	6.6	6.6	3.5	2613
14-May-16	11	4.5	6.7	0	1013.4	7.8	14	50	20	15.138	2.6	4.2	9.1	9.1	6.1	2603
15-May-16	14.1	4.4	-0.8	0	1016.2	5	8	270	13	14.627	2.4	3.4	11.3	11.3	8.5	1796
16-May-16	14.9	9.1	9.5	0	1013.8	5.8	13	220	18	16.597	2.9	4.2	13.9	13.9	11.4	2365
17-May-16	13.1	9.8	7.8	1.4		10	17	210	26	14.003	1.1	1.8	13.5	13.5	11.1	787
18-May-16	15.6	8.1	6.5	3.2	998.3	7.1	15	320	22	14.057	2.8	4	12.7	12.7	10.7	1885
19-May-16	14.5	7.6	5.5	5.9	1001.7	9.4	15	230	25	12.72	1.5	2.3	8.1	8.1	6.3	1016
20-May-16	13.3	9.9	8.1	8.8	1000.4	10.5	17	200	27	12.653	1.4	2.2	0.6	0.6	-1.1	898
21-May-16	14.2	9	10.5	0.5	995.1	11.6	17	210	26	13.955	2.5	4.3	2.6	2.6	0.9	2313
22-May-16	14.7	6.7	1.6	6.2	1003.1	6.9	12	290	17	13.073	2.5	3.7	0	-1.1	-2.8	1912
23-May-16	13.9	6	3.7	0	1012.7	5.7	11	300	17	12.983	2.7	3.9	2.7	2.7	0.1	2063
24-May-16	14.1	5.7	0.9	0	1013.9	8.6	14	50	21	14.132	3.1	4.8	5.7	5.7	3.1	2779
25-May-16	11.7	8.4	5.9	0	1012.1	9.6	14	40	22	14.285	2.7	4.1	8.2	8.2	5.8	2085
26-May-16	13	7.3	7.5	0	1009.7	4.5	6	50	10	14.505	2.1	2.9	10.1	10.1	7.9	1448
27-May-16	13.9	7.2	3.3	1.3	1009.3	6.1	9	50	14	13.545	1.7	2.4	10.3	10.3	8.2	1169
28-May-16	16.8	8.5	5.8	0	1008.1	4.7	7	50	11	16.42	3.2	4.4	13.2	13.2	11.4	2398
29-May-16	17	9.6	6.2	0.2	1009.2	6	11	40	16	17.788	3.5	5	16.1	16.1	14.6	2653
30-May-16	17.9	10.3	7.2	0	1014.1	7	13	50	18	17.985	3.7	5.3	19.2	19.2	18.1	2629
31-May-16	18.8	11.3	7.8	0	1017.7	5.9	10	320	15	19.335	4.1	5.7	22.6	22.6	21.9	2863

date: - 00 to 00 utc

rain: - Precipitation Amount (mm) maxtp: - Maximum Air Temperature (C) mintp: - Minimum Air Temperature (C) gmin: - 09utc Grass Minimum Temperature (C) soil: - Mean 10cm soil temperature (C)

cbl: - Mean CBL Pressure (hpa)

wdsp: - Mean Wind Speed (kt)

hm: - Highest ten minute mean wind speed (kt)

ddhm: - Wind Direction at max 10 min mean (deg) hg: - Highest Gust (kt) pe: - Potential Evapotranspiration (mm) evap: - Evaporation (mm) smd\_wd:- Soil Moisture Deficits(mm) well drained smd\_md:- Soil Moisture Deficits(mm) moderately drained smd\_pd:- Soil Moisture Deficits(mm) poorly drained glorad:- Global Radiation (J/cm sq.) ind: - Indicator (i)

date	maxtp	mintp	gmin	rain	cbl	wdsp	hm	ddhm	hg	soil	ре	evap	smd_wd	smd_md	smd_pd	glorad
01-Jun-16	17.1	10.9	8.9	0	1019.4	10.4	17	50	27	19.158	3.7	5.8	25.5	25.5	25.1	2962
02-Jun-16	14.8	9.5	9.1	0	1015.8	9.5	15	50	22	18.368	3.8	5.9	28.5	28.5	28.4	3035
03-Jun-16	16.9	7.7	5.3	0	1011.4	4.8	8	0	11	18.79	3.6	5.1	31.2	31.2	31.4	2764
04-Jun-16	18.1	9.9	5.8	0	1011.4	5.6	9	50	14	19.818	3.8	5.2	33.9	33.9	34.3	2662
05-Jun-16	19.1	12.9	12.8	0	1012.7	3.5	7	70	11	20.7	3.1	4.1	36	36	36.7	1974
06-Jun-16	18.5	13	9.8	9.3	1013.2	4	10	150	13	19.105	2.1	2.8	28.1	28.1	28.9	1273
07-Jun-16	20.2	14.2	14	0.1	1015.8	6.4	11	220	16	19.275	3.5	4.8	30.6	30.6	31.6	2230
08-Jun-16	20.3	11.4	11.1	0	1017	4.1	9	250	13	20.673	3.4	4.6	33	33	34.3	2358
09-Jun-16	18	11.7	12.8	0.1	1012.3	3.5	7	180	11	20.01	2.3	3.1	34.6	34.6	35.9	1494
10-Jun-16	17.6	13.6	12.6	0.7	1005.9	3.3	10	0	21	19.003	1.9	2.5	35.2	35.2	36.7	1096
11-Jun-16	19	13.2	12.5	5.8	1001.1	6.1	14	200	21	19.545	2.8	3.8	31.3	31.3	32.9	1733
12-Jun-16	19	13	13.1	7.2	998.1	7.5	15	240	23	18.433	2.5	3.5	25.9	25.9	27.6	1490
13-Jun-16	18.8	11.8	11.6	4.8	994.9	6.8	13	220	19	17.52	2.3	3.2	22.8	22.8	24.7	1390
14-Jun-16	17.3	12.5	11.8	9.2	989.2	8.4	14	290	22	16.755	2.1	2.9	15.3	15.3	17.3	1108
15-Jun-16	17.5	11	11.7	3	990.8	4.6	10	0	15	17.632	2.7	3.8	14.6	14.6	16.8	1896
16-Jun-16	16.3	10.6	7.5	0.2	997.2	8.5	14	320	21	16.29	2.4	3.4	16.5	16.5	18.8	1511
17-Jun-16	16.3	10	8.3	0	1005.5	9.2	15	340	25	15.682	3	4.2	19	19	21.5	1789
18-Jun-16	16.4	9.9	7.6	0.8	1013.4	6.6	13	240	19	16.36	2.5	3.5	20.2	20.2	22.9	1700
19-Jun-16	15.7	13.1	12.9	8.3	1010	11.7	18	200	30	16.153	0.9	1.5	12.6	12.6	15.4	544
20-Jun-16	19.3	13.2	13.2	1.6	1004.7	7.8	15	290	26	17.68	3.4	4.8	14	14	17	2143
21-Jun-16	17.2	12.2	10.3	0	1007.5	8.2	15	210	24	17.485	2.9	4.3	16.6	16.6	19.7	1983
22-Jun-16	17.9	11.6	8.9	0.1	1008.7	8.4	14	190	20	18.15	3.3	5	19.3	19.3	22.6	2496
23-Jun-16	17.4	9.7	5.7	0	1009	8.9	15	230	24	18.202	3.2	4.9	21.9	21.9	25.4	2444
24-Jun-16	17.1	11.6	9.6	5.6	1009.4	8.5	15	240	24	16.81	2.5	3.7	18.4	18.4	21.9	1638
25-Jun-16	17.1	11.8	10.3	0.1	1012.5	9.4	15	290	26	15.89	2.5	3.5	20.3	20.3	24	1415
26-Jun-16	19.1	11.7	10	1.2	1011	8.3	17	290	25	16.167	2	2.7	20.8	20.8	24.5	998
27-Jun-16	17.1	11.4	9.7	0	1011.9	7.5	14	220	22	17.22	3.1	4.4	23.3	23.3	27.2	1944
28-Jun-16	16.3	10.5	7.8	19.8	1006	5.6	11	170	18	15.083	1.9	2.5	5	5	8.9	929
29-Jun-16	19.1	10.2	9.4	13.2	997.7	10.3	16	200	26	15.682	2.8	4.1	0	-5.6	-1.5	1673
30-Jun-16	13.9	9.2	7.3	2.4	999.1	7.9	14	230	24	14.14	1.2	1.8	0	-1.2	-2.6	736

date: - 00 to 00 utc rain: - Precipitation Amount (mm) maxtp: - Maximum Air Temperature (C) mintp: - Minimum Air Temperature (C) gmin: - 09utc Grass Minimum Temperature (C) soil: - Mean 10cm soil temperature (C) cbl: - Mean CBL Pressure (hpa) wdsp: - Mean Wind Speed (kt) hm: - Highest ten minute mean wind speed (kt)

date	maxtp	mintp	gmin	rain	cbl	wdsp	hm	ddhm	hg	soil	pe	evap	smd_wd	smd_md	smd_pd	glorad
01-Jul-16	15.8	9.1	8.6	3	1000.4	9.3	17	240	27	15.35	2.9	4.4	0	-0.1	-2.5	2180
02-Jul-16	16.6	8.7	6.5	0.4	1005.2	9.2	16	250	25	15.19	3.1	4.7	2.7	2.7	0.3	2275
03-Jul-16	16.9	9.9	6.2	0	1010.1	7.6	12	220	18	16.938	3.6	5.2	6.2	6.2	3.9	2575
04-Jul-16	16.2	10.7	7.2	0.5	1007.8	9.8	20	220	31	16.25	2	3.2	7.6	7.6	5.4	1550
05-Jul-16	16.4	9.3	5.6	0	1012.5	6.7	11	320	18	16.595	2.5	3.5	9.9	9.9	7.9	1601
06-Jul-16	15.4	11.8	10.3	0.5	1012.9	7.9	12	200	20	16.505	1.3	2	10.6	10.6	8.7	862
07-Jul-16	17.6	13.9	13.8	4.3	1008.1	9.3	15	220	24	17.698	2	3.1	8.2	8.2	6.5	1448
08-Jul-16	19.3	13.4	13	0.7	1007.1	10.1	14	220	24	17.812	2.4	3.6	9.7	9.7	8.2	1481
09-Jul-16	16.3	14.4	14.6	12.9	1003.9	12.4	17	200	30	16.98	0.9	1.4	0	-2.4	-3.9	536
10-Jul-16	16.2	13.4	13.3	0.7	995.7	13.1	18	220	32	16.425	1.5	2.4	0.8	0.8	-2.9	926
11-Jul-16	17.4	12.5	12.6	0	999.2	9.6	14	250	23	16.228	2.4	3.3	3.1	3.1	-0.4	1252
12-Jul-16	16.7	10.1	7.8	0.9	1007.6	7	14	230	20	16.003	2.5	3.5	4.7	4.7	1.3	1553
13-Jul-16	17.8	9.7	7.5	0	1014.1	8.7	15	300	21	16.622	3	4.3	7.6	7.6	4.3	1826
14-Jul-16	17.1	8.6	4.4	0.8	1018.5	7.2	13	300	19	17.47	2.9	4.2	9.5	9.5	6.4	2060
15-Jul-16	16.2	12.1	10.8	3.7	1016.9	12.1	16	220	24	16.988	1.4	2.3	7.1	7.1	4.1	1031
16-Jul-16	18.5	14.1	14.1	0	1016	7.4	14	230	21	17.943	2	2.8	8.9	8.9	6.1	1304
17-Jul-16	21.3	14.4	13.1	0	1015.1	5.7	11	220	15	20.263	2.9	4	11.6	11.6	, 9	1884
18-Jul-16	21.4	13.2	11.5	0	1013.1	4.6	8	160	13	22.147	3.9	5.4	15.1	15.1	12.9	2758
19-Jul-16	22.4	14.3	11	0.1	1006.4	5.8	10	210	15	23.057	3.8	5.3	18.3	18.3	16.5	2563
20-Jul-16	20.8	14.8	14.7	0.3	1003.5	7.9	12	240	18	21.833	2.9	3.9	20.3	20.3	18.9	1627
21-Jul-16	19.3	14.8	13	2.5	1007.4	8.9	14	190	23	20.89	2.5	3.6	19.8	19.8	18.6	1549
22-Jul-16	20	15.1	15.3	3.4	1010.6	5.6	10	170	16	20.693	3	4	18.9	18.9	17.9	1793
23-Jul-16	17.5	13.8	12.2	0.6	1012.3	5.7	11	220	18	19.142	1.7	2.3	19.7	19.7	18.8	1017
24-Jul-16	19.4	12.8	10.5	2.4	1009.5	6.6	16	220	23	18.998	2.5	3.5	19.3	19.3	18.7	1598
25-Jul-16	17.8	11	7.5	0	1012.2	5.7	11	230	16	18.005	2	2.8	21	21	20.6	1188
26-Jul-16	17.1	13.8	11	1.1	1010.3	9.4	14	210	24	18.36	1.6	2.4	21.2	21.2	20.9	943
27-Jul-16	18.5	13.7	13.6	0.7	1008.8	6.7	12	320	17	18.958	2.4	3.3	22.4	22.4	22.3	1417
28-Jul-16	20.2	14.5	13.5	1.4	1005.5	8.8	14	230	22	20.052	2.9	4.3	23.3	23.3	23.5	1960
29-Jul-16	16.5	13	12.7	3.2	1005.1	5.1	11	270	16	18.345	1.2	1.7	21.1	21.1	21.4	651
30-Jul-16	18.3	12.5	11.2	0	1008.7	5	9	300	13	18.025	2.3	3	23	23	23.4	1243
31-Jul-16	17.4	11.6	9	0	1011.3	6.1	12	280	18	18.465	2.6	3.6	25	25	25.6	1644

date: - 00 to 00 utc rain: - Precipitation Amount (mm) maxtp: - Maximum Air Temperature (C) mintp: - Minimum Air Temperature (C) gmin: - 09utc Grass Minimum Temperature (C) soil: - Mean 10cm soil temperature (C)

cbl: - Mean CBL Pressure (hpa)

wdsp: - Mean Wind Speed (kt)

hm: - Highest ten minute mean wind speed (kt)

ddhm: - Wind Direction at max 10 min mean (deg) hg: - Highest Gust (kt) pe: - Potential Evapotranspiration (mm) evap: - Evaporation (mm) smd\_wd:- Soil Moisture Deficits(mm) well drained smd\_md:- Soil Moisture Deficits(mm) moderately drained smd\_pd:- Soil Moisture Deficits(mm) poorly drained glorad:- Global Radiation (J/cm sq.) ind: - Indicator (i)

date	maxtp	mintp	gmin	rain	cbl	wdsp	hm	ddhm	hg	soil	ре	evap	smd_wd	smd_md	smd_pd	glorad
01-Aug-16	16.4	12.4	11.2	12.6	1006	5.5	12	150	17	17.478	1	1.3	13.2	13.2	13.9	418
02-Aug-16	19.6	14.9	15	0.4	999.2	8.3	16	220	23	18.88	2.1	3.1	14.6	14.6	15.5	1420
03-Aug-16	18.4	13.7	12.6	0.1	996.6	13.3	20	210	34	18.095	2.5	4	16.7	16.7	17.8	1824
04-Aug-16	19.3	13.6	12.2	0.3	1003.8	9.2	14	250	20	18.142	2.5	3.5	18.5	18.5	19.8	1431
05-Aug-16	18.4	13.3	12	0	1013	7.9	15	230	22	19.505	3	4.4	21.1	21.1	22.5	2198
06-Aug-16	18.5	11.7	7.4	0.7	1016.5	9.3	15	220	27	19.013	1.9	2.9	21.9	21.9	23.4	1457
07-Aug-16	18.5	12.1	12	0.1	1013.9	11.7	20	230	31	19.475	3	4.7	24.2	24.2	26	2286
08-Aug-16	18.8	10.9	8.3	0	1017.6	7.7	13	320	21	17.685	3.2	4.4	26.7	26.7	28.6	1893
09-Aug-16	17.5	9.3	3.2	0	1022	7.7	14	320	19	16.845	2.7	3.7	28.7	28.7	30.8	1508
10-Aug-16	16.8	10.9	8	0	1019.8	8	16	270	24	16.388	1.8	2.4	30	30	32.3	860
11-Aug-16	22.9	11.5	8.5	0	1017	8.3	18	270	24	17.812	3.4	4.6	32.5	32.5	34.9	1995
12-Aug-16	18.1	10.6	6.1	0	1015	11.1	20	220	33	17.177	1.8	2.7	33.7	33.7	36.2	1156
13-Aug-16	18	11.7	8.6	0	1015.7	6.8	14	240	21	17.538	1.9	2.6	35	35	37.6	1155
14-Aug-16	17.5	11.2	12	0	1018.8	3.6	8	300	12	17.638	1.8	2.4	36.3	36.3	38.9	1021
15-Aug-16	21.3	10.6	5.5	0.1	1015	6.1	13	150	17	18.093	3.2	4.5	38.3	38.3	41.1	2339
16-Aug-16	20.6	12.8	7.1	0.2	1009.1	6	13	140	18	18.833	3	4.2	40.1	40.1	43	2099
17-Aug-16	17.3	15	11	2.4	1005.1	4.7	9	120	15	17.728	1.3	1.7	38.5	38.5	41.4	578
18-Aug-16	19.6	14	13.8	0.4	1001.3	4.5	8	160	13	18.443	2.4	3.2	39.6	39.6	42.7	1487
19-Aug-16	19	13.2	12.7	20	992.3	14.2	21	140	30	17.54	1.8	3	20.8	20.8	23.9	1395
20-Aug-16	18.1	14.3	13.7	4.7	993.7	15.3	21	220	37	16.442	1.9	3	17.7	17.7	20.8	1108
21-Aug-16	16.1	12.7	10.5	2	1005.8	12.1	18	220	30	15.562	1.1	1.7	16.6	16.6	19.8	540
22-Aug-16	20	13.9	15.2	11.3	1011	9	18	220	26	17.44	2	3	7.1	7.1	10.4	1437
23-Aug-16	18.5	13.8	13.7	1.1	1012.8	5	10	180	15	17.465	1.5	2	7.3	7.3	10.8	843
24-Aug-16	19.2	10.4	5.1	0	1013.3	3.7	7	110	12	17.562	2.9	3.9	10	10	13.6	2175
25-Aug-16	18.5	10.7	7.6	0	1009.6	5	9	240	14	16.968	2.1	2.8	11.9	11.9	15.7	1280
26-Aug-16	18.3	11.4	8	0.2	1009.8	7.9	14	220	22	16.53	2.3	3.4	13.8	13.8	17.7	1801
27-Aug-16	17.4	11.9	7.3	0.2	1007	5.9	11	40	18	16.948	1.9	2.7	15.3	15.3	19.2	1448
28-Aug-16	19.6	13.6	11.5	0	1007.6	4.6	9	350	15	17.675	2.1	2.8	17.1	17.1	21.1	1305
29-Aug-16	19.4	10.9	6.5	0	1014.8	6.6	13	210	19	17.568	2.5	3.5	19.1	19.1	23.3	1927
30-Aug-16	18.6	15.2	13.6	0	1013.2	9.3	15	190	22	17.722	1.8	2.4	20.6	20.6	24.8	935
31-Aug-16	18.4	11.5	9	5.1	1012.3	7	11	190	19	17.13	1.8	2.6	17	17	21.3	1228

date: - 00 to 00 utc

rain: - Precipitation Amount (mm)

maxtp: - Maximum Air Temperature (C)

mintp: - Minimum Air Temperature (C)

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ddhm: - Wind Direction at max 10 min mean (deg) hg: - Highest Gust (kt) pe: - Potential Evapotranspiration (mm) evap: - Evaporation (mm) smd\_wd:- Soil Moisture Deficits(mm) well drained smd\_md:- Soil Moisture Deficits(mm) moderately drained smd\_pd:- Soil Moisture Deficits(mm) poorly drained glorad:- Global Radiation (J/cm sq.) ind: - Indicator (i)

date	maxtp	mintp	gmin	rain	cbl	wdsp	hm	ddhm	hg	soil	ре	evap	smd_wd	smd_md	smd_pd	glorad
01-Sep-16	16.6	9.1	5.7	3.6	1012.7	9.4	16	190	26	15.51	1.3	2.1	14.5	14.5	18.8	1037
02-Sep-16	18.2	13.3	12.7	0.1	1009.1	7.4	14	210	23	16.5	1.9	2.7	16	16	20.4	1337
03-Sep-16	17.2	13.7	11.2	30.9	1002.9	11.2	19	230	31	15.743	0.8	1.2	0	-10	-9.8	382
04-Sep-16	17.4	13.1	12.3	5.2	1003.5	8.1	15	150	22	15.907	1.5	2.1	0	-3.7	-10	844
05-Sep-16	18.1	14.4	13	0.9	1007.8	10.6	17	220	25	16.905	1.1	1.8	0.2	0.2	-9.3	842
06-Sep-16	19.6	16	16	0.6	1013.2	6.9	12	180	19	17.472	1.1	1.6	0.7	0.7	-8.3	634
07-Sep-16	20.2	15.1	15.7	1.6	1005.7	7.7	15	140	21	17.903	1.5	2.1	0.6	0.6	-8	905
08-Sep-16	16.9	13.7	12.9	4.4	999.8	11.3	16	180	28	16.695	1.5	2.3	0	-2.3	-10	1066
09-Sep-16	16.9	11.3	12.3	15.6	998.4	11.6	21	190	34	15.855	0.8	1.2	0	-10	-10	367
10-Sep-16	16.9	10.3	9.4	0	1004.8	5.8	11	220	19	15.257	1.9	2.6	1.9	1.9	-7.6	1318
11-Sep-16	17.4	11.8	9.4	1.6	1001.9	13.3	21	180	35	15.262	1.7	2.8	2	2	-7.1	1457
12-Sep-16	17.9	15.4	14.7	10.2	997.2	12.3	20	170	32	16.455	0.6	0.9	0	-7.6	-10	314
13-Sep-16	16.4	12.2	11.9	2.2	1003.3	7.3	12	340	18	16.108	1.1	1.5	0	-1.1	-10	600
14-Sep-16	20.7	13.1	12.8	0.4	1003.9	8	14	50	23	16.64	2.2	3.1	1.8	1.8	-7.7	1504
15-Sep-16	18.2	12.5	10.6	0.1	1005.5	5.9	14	290	19	16.875	1.7	2.3	3.4	3.4	-5.7	1250
16-Sep-16	17.4	10.3	9.1	0	1012	8.5	14	290	22	15.575	2	2.7	5.3	5.3	-3.5	1266
17-Sep-16	16.9	10	9.3	0	1016.8	4.7	11	290	16	15.425	1.6	2.2	6.8	6.8	-1.7	1125
18-Sep-16	15.7	10.2	8.2	2.5	1014.2	6.3	12	210	21	15.075	0.7	1	5	5 5	-3.4	432
19-Sep-16	15.2	9.9	9.9	0.1	1017.2	6.5	12	350	19	14.783	1.5	2.1	6.3	6.3	-1.8	975
20-Sep-16	16	10.5	9.3	0	1013.2	3.4	7	120	12	14.845	1.6	2.2	7.8	7.8	-0.1	940
21-Sep-16	16.1	9.4	5.9	11.7	1007.3	8.2	15	190	23	14.195	1.2	1.7	0	-2.7	-10	636
22-Sep-16	15.9	6.4	1.9	0.1	1010.5	7.5	14	200	22	13.1	1.6	2.3	1.5	1.5	-8	1263
23-Sep-16	16.6	8.5	3.3	0.2	1009	11.5	20	200	33	13.347	1.2	2	2.5	2.5	-6.6	1146
24-Sep-16	16.5	13	12.2	6.8	1000.3	14.6	20	180	32	14.797	0.9	1.2	0	-3.4	-10	160
25-Sep-16	15.1	9.8	7	0	1003	9.5	18	230	29	13.483	1.8	2.6	1.8	1.8	-7.7	1479
26-Sep-16	15.3	11.2	8.6	10.1	1007.7	6.8	16	140	24	14.02	1	1.4	0	-7.4	-10	729
27-Sep-16	18.9	12.8	13.7	0.6	1010.8	9.4	14	260	22	15.257	1.7	2.5	1.1	1.1	-8.4	1299
28-Sep-16	16.2	12.6	11.2	0.9	1011.3	14.3	20	220	33	15.062	0.7	1.2	1	. 1	-8.1	400
29-Sep-16	16.2	9.1	10	0.1	1005.8	9.4	17	270	24	14.212	1.3	2	2.1	. 2.1	-6.5	1255
30-Sep-16	14.3	8.7	5.6	1.1	1001.1	6	11	230	17	12.845	1.4	1.9	2.4	2.4	-5.9	1091

date: - 00 to 00 utc

- rain: Precipitation Amount (mm)
- maxtp: Maximum Air Temperature (C)
- mintp: Minimum Air Temperature (C)
- gmin: 09utc Grass Minimum Temperature (C)
- soil: Mean 10cm soil temperature (C)
- cbl: Mean CBL Pressure (hpa)
- wdsp: Mean Wind Speed (kt)
- hm: Highest ten minute mean wind speed (kt)

ddhm: - Wind Direction at max 10 min mean (deg) hg: - Highest Gust (kt) pe: - Potential Evapotranspiration (mm) evap: - Evaporation (mm) smd\_wd:- Soil Moisture Deficits(mm) well drained smd\_md:- Soil Moisture Deficits(mm) moderately drained smd\_pd:- Soil Moisture Deficits(mm) poorly drained glorad:- Global Radiation (J/cm sq.) ind: - Indicator (i)

date	maxtp	mintp	gmin	rain	cbl	wdsp	hm	ddhm	hg	soil	ре	evap	smd_wd	smd_md	smd_pd	glorad
01-Oct-16	13.9	8.5	4.8	9.3	1001.3	7.9	15	320	24	12.903	1.4	2	0	-5.5	-10	1030
02-Oct-16	15.4	6.5	3.5	0.1	1010.2	6.7	11	160	18	12.505	1.4	2	1.3	1.3	-8.2	1271
03-Oct-16	16.8	13.4	8.8	0	1015.3	14.3	22	150	31	13.548	1.9	2.6	3.2	3.2	-5.9	1092
04-Oct-16	16.1	13.1	11	0	1018.1	. 10.1	16	140	22	13.745	1.2	1.6	4.4	4.4	-4.3	554
05-Oct-16	15.9	11.6	10.4	0	1019	8.7	14	110	21	13.682	1.5	2	5.9	5.9	-2.6	827
06-Oct-16	13.5	10.7	6.2	0	1016.7	9.4	15	110	24	12.55	1.7	2.3	7.5	7.5	-0.7	1071
07-Oct-16	13.3	9.5	5.4	5.2	1015.2	6.4	11	110	18	12.25	0.8	1.1	3.1	3.1	-5	310
08-Oct-16	15.9	11.4	10.3	0.1	1020.1	. 2.7	5	70	8	13.493	0.9	1.2	3.9	3.9	-4	712
09-Oct-16	15	8.7	9.9	0	1022.7	4.8	9	60	12	13.73	1	1.4	4.9	4.9	-2.8	868
10-Oct-16	14.1	7.9	3.9	0	1019.9	5.2	9	60	14	12.863	1.1	1.6	5.9	5.9	-1.5	939
11-Oct-16	12.4	10.2	4.5	0	1015.5	7.8	13	90	19	11.898	1.2	1.6	7.1	7.1	-0.2	741
12-Oct-16	14.1	10.3	6.6	0	1013.5	7.8	11	60	18	12.22	1.1	1.4	8.1	8.1	0.9	619
13-Oct-16	12.9	7.2	7	1.5	1006.3	5.4	11	50	17	11.94	0.9	1.2	7.4	7.4	0.3	515
14-Oct-16	13.4	6.9	0.9	22.7	996.9	6.6	14	120	24	11.22	0.9	1.2	0	-10	-10	716
15-Oct-16	13.5	7.8	3.9	20	993.8	5.4	17	140	25	11.307	0.8	1.1	0	-10	-10	643
16-Oct-16	14.3	10	5.9	11	995.1	. 13.9	23	140	33	11.608	1.3	1.8	0	-9.7	-10	790
17-Oct-16	14.6	8.9	5.6	0.2	1005.1	. 9.3	15	220	25	11.493	1.1	1.5	0.9	0.9	-8.6	861
18-Oct-16	13.1	6	4.7	0	1014.2	8.5	15	270	23	10.753	1	1.4	1.9	1.9	-7.2	804
19-Oct-16	12.6	6.5	2.2	0	1018.6	7.5	11	280	17	10.25	1	1.4	2.9	2.9	-5.8	838
20-Oct-16	13.7	7	4.9	0.1	1017.2	5.8	8	340	13	10.56	0.9	1.2	3.6	3.6	-4.7	898
21-Oct-16	13.3	5.6	1.8	0.2	1013.6	3.3	7	320	8	10.323	0.6	0.9	4	4	-4.1	575
22-Oct-16	12.4	8.6	1.9	0	1009	6.1	11	90	18	10.507	0.8	1.2	4.8	4.8	-3	776
23-Oct-16	11.8	9.4	6.8	0	1004.4	11.1	15	60	26	10.247	1.3	1.6	6.1	6.1	-1.6	625
24-Oct-16	11.4	10.2	8.3	1.6	1006.6	9.9	15	50	23	10.227	1	1.2	5.4	5.4	-2.1	192
25-Oct-16	14.2	10.2	9.2	0.3	1013	4.8	9	170	13	11.24	0.6	0.7	5.7	5.7	-1.7	243
26-Oct-16	15.1	10.8	8.7	0	1018.9	6.4	10	210	16	12.09	0.7	1	6.3	6.3	-1	677
27-Oct-16	14.8	11.2	7.2	0.1	1021.7	11	18	220	30	12.208	0.9	1.1	7	7	-0.1	473
28-Oct-16	16.2	12.1	9.8	0	1025.2	6.4	10	250	16	12.51	0.8	1	7.8	7.8	0.7	457
29-Oct-16	12.5	11.1	8.6	0	1025.1	5.1	8	180	13	12.13	0.7	0.9	8.5	8.5	1.4	171
30-Oct-16	13.2	11	9.8	0	1021.1	. 3	7	200	11	12.023	0.6	0.7	9	9	2	145
31-Oct-16	14	10.4	4.9	0.2	1018.4	6.8	11	50	17	11.948	0.5	0.7	9.3	9.3	2.3	454

date: - 00 to 00 utc

rain: - Precipitation Amount (mm)

maxtp: - Maximum Air Temperature (C)

mintp: - Minimum Air Temperature (C)

gmin: - 09utc Grass Minimum Temperature (C)

soil: - Mean 10cm soil temperature (C) cbl: - Mean CBL Pressure (hpa)

wdsp: - Mean Wind Speed (kt)

hm: - Highest ten minute mean wind speed (kt)

date	maxtp	mintp	gmin	rain	cbl	wdsp	hm	ddhm	hg	soil	ре	evap	smd_wd	smd_md	smd_pd	glorad
01-Nov-16	12	5.3	7.2	0	1019.3	10.6	16	20	26	10.86	0.8	1	9.9	9.9	3	405
02-Nov-16	10.5	3.5	0.8	0	1019.1	5.5	9	330	15	8.865	0.6	0.9	10.5	10.5	3.7	662
03-Nov-16	10.8	4.4	-1.5	0	1012	4.4	11	250	16	8.827	0.6	0.8	11.1	11.1	4.2	344
04-Nov-16	10.5	4.6	1	0.1	1003.7	6.3	10	270	15	8.562	0.6	0.8	11.5	11.5	4.7	544
05-Nov-16	8.5	3.9	-0.9	0	1004.3	10.1	15	340	23	7.712	0.8	1	12.2	12.2	5.5	719
06-Nov-16	8.4	3	0	0	1007.8	11.5	17	330	28	6.639	1	1.2	13.1	13.1	6.5	698
07-Nov-16	8.3	2.1	-0.1	0	1011	9	13	320	21	6.151	0.7	0.9	13.7	13.7	7.2	699
08-Nov-16	11.1	4.7	0	16.9	999.3	8.9	20	320	32	7.181	0.7	0.9	0	-2.6	-9	95
09-Nov-16	10.2	4.2	1.8	0.9	996.2	9.3	16	270	25	7.29	0.6	0.8	0	-0.3	-8.8	513
10-Nov-16	10.3	3.4	2.3	0.4	1005.4	8.5	15	300	21	7.574	0.5	0.7	0.1	0.1	-8.2	386
11-Nov-16	12.2	2	-3	9.3	1006.9	9.1	19	180	30	6.98	0.4	0.5	0	-8.8	-10	189
12-Nov-16	13.1	6.8	4.6	3.6	1009	6.7	14	190	23	9.672	0.2	0.4	0	-3.4	-10	478
13-Nov-16	11.7	6.6	1.3	0	1020	6.1	13	300	18	8.825	0.4	0.6	0.4	0.4	-9.1	192
14-Nov-16	13.1	11	8.4	0.1	1020.7	9.1	13	230	20	10.565	0.3	0.5	0.7	0.7	-8.4	223
15-Nov-16	14.3	7.6	11.1	0.1	1016	6.2	12	230	18	11.37	0.3	0.5	0.9	0.9	-7.7	237
16-Nov-16	11.3	5.9	1.9	0.2	1007.1	10	17	270	30	9.427	0.7	0.8	1.4	1.4	-6.9	371
17-Nov-16	9.9	2.3	1.6	2.4	992.8	12.2	22	250	33	7.459	0.7	0.9	0	-0.4	-8.3	387
18-Nov-16	5.1	0.6	-1.8	0	988.7	10.8	17	250	24	5.302	0.5	0.7	0.5	0.5	-7.3	334
19-Nov-16	5.8	2.1	-1.4	2.3	987.4	6.9	15	270	21	5.116	0.5	0.6	0	-1.3	-8.8	266
20-Nov-16	5.8	1.2	-0.8	0	983.6	8.7	13	320	19	5.1	0.5	0.6	0.5	0.5	-7.9	508
21-Nov-16	7.4	1.2	-1.1	7.6	985	14.1	24	40	39	4.809	0.9	1.2	0	-6.3	-10	53
22-Nov-16	7.8	3.1	2.6	0.1	996.7	13.5	19	330	32	5.22	0.9	1.1	0.8	0.8	-8.7	424
23-Nov-16	9	1.8	-0.1	0	1012	9.7	14	40	22	5.007	0.5	0.7	1.4	1.4	-7.7	225
24-Nov-16	8.8	6.6	1.6	0	1017.5	12.1	16	60	24	6.41	0.7	0.8	2.1	2.1	-6.6	413
25-Nov-16	8.4	5.5	2.7	0	1017.1	10.1	15	40	23	6.396	0.5	0.6	2.6	2.6	-5.7	340
26-Nov-16	8.9	3.7	1.1	0.2	1014.5	8	12	40	19	5.913	0.3	0.4	2.7	2.7	-5.3	349
27-Nov-16	9.5	4.2	0.5	0.1	1017.7	6.9	11	100	20	6.291	0.5	0.7	3.1	3.1	-4.6	154
28-Nov-16	8.1	5.5	4.9	0	1022.2	6.2	10	100	17	6.622	0.9	1.1	4	4	-3.5	153
29-Nov-16	7.7	-0.3	-5.7	0	1025.9	4.1	7	330	9	5.082	0.2	0.3	4.1	4.1	-3.2	454
30-Nov-16	9.9	0.8	-4.1	0	1027.4	5.2	9	320	11	4.134	0.3	0.4	4.5	4.5	-2.7	440

date: - 00 to 00 utc rain: - Precipitation Amount (mm) maxtp: - Maximum Air Temperature (C) mintp: - Minimum Air Temperature (C) gmin: - 09utc Grass Minimum Temperature (C) soil: - Mean 10cm soil temperature (C) cbl: - Mean CBL Pressure (hpa)

wdsp: - Mean Wind Speed (kt)

hm: - Highest ten minute mean wind speed (kt)

date	maxtp	mintp	gmin	rain	cbl	wdsp	hm	ddhm	hg	soil	ре	evap	smd_wd	smd_md	smd_pd	glorad
01-Dec-16	9	0.9	-4.2	0	1024.2	3.8	8	320	10	4.143	0	0.1	4.5	4.5	-2.5	438
02-Dec-16	8.1	3.7	-0.8	0	1019.6	4.9	9	110	14	5.376	0.5	0.7	5	5	-1.8	35
03-Dec-16	8.2	6	4.8	0	1016	6.8	11	100	18	6.135	0.8	0.9	5.8	5.8	-1	122
04-Dec-16	6.9	4.7	0.9	0	1013.6	7.9	13	120	21	5.326	0.9	1	6.6	6.6	0	195
05-Dec-16	10	5.4	-0.5	0.7	1013.5	5.7	9	100	13	6.066	0.5	0.6	6.3	6.3	-0.3	70
06-Dec-16	12.2	9.7	6.1	0.6	1013	10.1	16	180	28	8.043	0.4	0.6	6.1	6.1	-0.4	51
07-Dec-16	12.6	11.5	10.3	7.4	1011	13	17	210	29	9.802	0.3	0.5	0	-0.9	-7.5	38
08-Dec-16	12.2	10.3	8.6	14.8	1011.8	7	14	180	22	10.217	0.1	0.1	0	-10	-10	263
09-Dec-16	12.2	10.9	10.3	5.4	1010.7	11.1	16	200	27	10.592	0.3	0.4	0	-5.1	-10	97
10-Dec-16	11.2	6	6.5	0.1	1013.7	6.2	12	220	18	9.783	0.4	0.5	0.3	0.3	-9.2	99
11-Dec-16	11	5.4	0.6	0.3	1015.9	5.6	12	250	16	7.99	0	0	0	0	-9.1	423
12-Dec-16	11.2	6.4	-1.4	7.6	1010.8	6.7	12	220	18	8.447	0.2	0.3	0	-7.4	-10	148
13-Dec-16	12	8.8	7.9	14.8	1005.1	10	17	170	28	9.807	0.3	0.4	0	-10	-10	127
14-Dec-16	12.5	5.9	7.9	25.4	1004.9	10.6	20	170	31	9.887	0.5	0.7	0	-10	-10	30
15-Dec-16	11.1	5.2	0.1	5.6	1004.2	9.3	17	140	27	8.925	0.1	0.1	0	-5.5	-10	293
16-Dec-16	10.7	4.3	6.7	18.6	1014.8	8.7	15	150	24	8.935	0.3	0.4	0	-10	-10	114
17-Dec-16	8.5	1.8	-3.9	0.1	1028.3	4.2	8	320	12	6.727	0.1	0.2	0	0	-9.5	282
18-Dec-16	9.2	7.6	-0.2	0	1026.7	7	12	210	19	7.351	0.6	0.7	0.6	0.6	-8.4	163
19-Dec-16	10.3	4.7	3.1	0	1020.1	5.8	11	340	18	7.964	0.3	0.4	1	1	-7.7	148
20-Dec-16	9.4	3.8	-0.7	5.6	1009.5	7.9	14	200	26	7.298	0.2	0.3	0	-4.4	-10	204
21-Dec-16	9.8	3.7	-0.5	1.1	1009.1	6.9	15	240	25	7.189	0.4	0.4	0	-0.7	-10	251
22-Dec-16	8.9	5.5	-3.4	0	1016.9	7.7	12	210	18	6.236	0.4	0.4	0.4	0.4	-9.1	309
23-Dec-16	11.6	5.1	0.3	5.8	1010.8	15	24	210	40	7.255	0.6	0.8	0	-4.9	-10	93
24-Dec-16	11	5.4	1.1	0	1015.3	14.6	22	220	33	6.833	0.6	0.8	0.6	0.6	-8.9	209
25-Dec-16	12.1	6.4	5.3	1.6	1012.3	15.2	23	220	34	9	0.6	0.9	0	-0.3	-9.4	106
26-Dec-16	7.9	2.2	-0.8	0	1024.4	7.3	15	240	22	6.576	0.4	0.4	0.4	0.4	-8.5	373
27-Dec-16	8.8	2.1	-4.2	0.1	1033.3	5.1	11	160	15	5.889	0.5	0.6	0.7	0.7	-7.7	116
28-Dec-16	9.9	6.7	2.5	0	1030.1	5.6	9	160	15	6.705	0.4	0.5	1.2	1.2	-6.9	215
29-Dec-16	10.2	5.1	-2.4	0	1026.5	5	10	210	16	7.138	0.4	0.5	1.6	1.6	-6.2	69
30-Dec-16	11	9.7	3.5	0	1025.8	7.7	13	230	19	8.448	0.4	0.5	1.9	1.9	-5.5	106
31-Dec-16	10.4	8.6	5.9	0.4	1018	8.9	14	240	24	8.82	0.2	0.3	1.7	1.7	-5.4	227

<mark>Appendix</mark> H

Flare Servicing Records and Landfill Gas Survey

SERVIC SHEE Page No 2	CE F	JOB NO Dungarvan		A	U,		5	Autor Unit 8, E Coventry United K Tel: +44 Fax: +44 www.afs	matic Flare Systems Ltd           Ensign Business Centre           / CV4 8JA           / ingdom           (0)24 7647 4877           - (0)24 7647 4834           -group.co.uk						
SITE: Dungarvan Landfil	l site, Co Wat	erford						DAT	E: 12-10-2010	6					
HEALTH AND SAFETY N	OTICE														
WEAR A HEAD HAT ANI	O REFLECTIVI	E VEST OR JAC	KET ON OPERA	TIVE SITES											
WEAR A PROTECTIVE F	ACE MASK W	HEN WORKING	IN AN AREA V	HERE THERE	IS ANY P	OSSIE	BILITY OF BI	REATHIN	G IN CERAMIC	C INSULAIN	G DUST				
TO BE COMPLETED FC	R ALL HIRE	INSTALLATIO	N, SERVICE A	ND REPAIR V	ISITS				FLAR	RE AUTO TIME	ER SETTINGS				
<ol> <li>RECORD AL</li> <li>RECORD AL</li> </ol>	L INSTRUME L CHANGES	NT READINGS AND REPAIRS	AND VALVE	SETTINGS ON	ARRIVA	4L			DAY	STAI	RT STOP				
3. RECORD AL	L PARTS, MA	TERIALS & CO	OMPONENTS I	FITTED OR US	ED				SUNDAY	11:0	0 17:00				
<ol> <li>CHECK THA</li> <li>RECORD AL</li> </ol>	T PRESSURE L INSTRUME	AND VACUUN NT READINGS	A GAUGES AR	E ZEROED SETTINGS ON	I DEPAR	ГURE	Ξ		MONDAY	11:0	0 17:00				
6. LEAVE SITE 7 NOTE FUTU	CLEAN AND	TIDY	EDED AND SE	Γ ΤΗΛΤ ΙΤ IS (	ADDIEL		г		I UESDA Y	11:0 V 11:0	0 17:00				
		2 no non nel				501	-		THURSDAY	11:0	0 17:00				
									FRIDAY	11:0	0 17:00				
									SATURDAY	11:0	0 17:00				
FNGINEERS NAME	Steve	Hindle					Flare type	HT100							
ARRIVAL: FLARE RUNNING on Auto Timer															
<u></u>				r			т								
HOURS RUN	BOOSTER 1	20518	CH4	51.7		%	CO2		26.7		%				
	BOOSTER 2	N/A	02	0.8		%	PRESSUR	Е	15.4		mbar				
INLET VALVE SETTING	G % OPEN														
NO 1 100%	NO 2	N/A	NO 3	N/A	NO 4		N/A	NO 5	N/A	NO 6	N/A				
MAIN CONTROL VALV	E SETTING 9	6 OPEN			1			100%							
INLET VACUUM GAUG	E READINGS	S STARING SIE	E NEAREST K	NOCKOUT PC	)T					(mbarg)					
NO 1 -2 0		N/A	NO 3	N/A		Γ	N/A	NO 5	N/A	NO 6	N/A				
-2.0	110 2		10.5	N/A	1104		N/A	105	IV/A	100	11/74				
INLETTEMP		20	°C	INLET VA FILTER	CUUM F	RIOF	С 10 KO PO	Ľ	-2.0		MBAI				
VACUUM AFTER KO P	OT FILTER	-3.0	MBAI	R VACUUM ARRESTE	I AFTER I	NLE	T FLAME		N/A		MBAR				
OUTLET PRESSURE AF BOOSTER	TER GAS	15.4	MBAI	R OUTLET	GAS TEM	IP			22		٥(				
PRESSURE AFTER SLA	M SHUT	13	MBAI	R PRESSUR ARRESTE	E AFTER R	OUT	TLET FLAMI	Ξ	N/A						
TOTAL FLOW		1564231	m	<sup>3</sup> BLOWER	SPEED				38 %						
DAMPER POSTION		21.0 %		1											
FLOW RATE	m³/h	r MEASURI	ING INST	RUM	IENT		OPFM								
FLAME TEMP		1016	°C	MOTOR T	EMP (dri	ve bea	aring)		21		°C				
FLAME QUALITY		ОК		AMBIENT	TEMP				14.0		٥(				
MANOMETER LIQUID	LEVEL WITH	RIG SHUT DO	WN	AMBIENT	PRESSU	RE			1021		MBAR				
TYPE OF LIQUID: PERF	FLOW			1					L						
RED SG - 0.8	Γ		EMISSIONS	ANALYSER C	20	18		EMISSI CELL	ONS ANALYS	SER NOX	N/A				

Job No

Dungarvan

Automatic Flare Systems Ltd Unit 8, Ensign Business Centre Coventry CV4 8JA United Kingdom

SERVICE							1	Fel: +44 (0)24 7647 Fax: +44 (0)24 7647	7 4877 7 4834		
SHEET					A	2.2					
Page No 2											
CHECK FOR LEAKS WIT	'H GAS DETI	ECTOR			None						
CONDENSATE DRAIN SY	YSTEM CHE	СК			Yes						
DRAINS CORRECTLY		Yes			KNOCKOUT PO	T FILTER CL	EAN		N/A		
COMMENTS											
BOOSTER MODEL AND	SERIAL NO	В	G 30 / 34-3	ЗX							
MOTOR & FAN SEAL GR	REASED	Yes			BOOSTER CORF	RECT ROTAT	TON		Yes		
NOTE: USE SHELL ALVA	USE SHELL ALVANIA 3, GREASE EVERY SERVICE IMPORTANT DO NOT OVERGREASE										
BOOSTER OIL CHANGEI	D (EVERY 50	000 HOUR	RS, USE 20V	V50 EN	GINE OIL IN DON	KIN V50			N/A		
BOOSTER FLEXIBLE CO	NNECTORS	OK	MO	JNTIN	GS	ОК	BEARIN	IG NOISE		OK	
BOLTS TIGHT	Yes		SLAMSH	IUT SP	RING	ОК	GAUGE	S ZEROED		Yes	
FLAME ARRESTER INLE	ET OK		OUTLET			ОК	PILOT			ОК	
PILOT LIGHT FUNCTION	N Cleane	ed & set	UV SEN	SOR FL	JNCTION	Cleaned	CONDI	TION OF THERMO	COUPLER	OK	
DAMPER OPERATION	ОК		CONDIT	ION OI	F BURNER CUPS	ОК	CONDI	FION OF FLARE LI	NING	ОК	
LOUVERS CONDITION	ОК		INTERIC	RLIG	HT	N/A	EXTER	OR LIGHT		N/A	
ALL INDICATOR BULBS	FUNCTION		Yes	EL	ECTRICAL CONNI	ECTIONS CH	ECKED F	OR TIGHTNESS		Yes	
HINGES & VALVES LUB	RICATED		Yes								
PRESSURE SWITCH FUN	ICTION			•							
SUCTION N	/A	SETT	ING		N/A	VENT		N/A	SETTING		N/A
BOOSTER Y	es	SETT	ING		1.0 mbar	OTHER (sp	ecify)	N/A	SETTING		N/A
BURNER N	/A	SETT	ING		N/A				SETTING		
COMMENTS								•			

### Job No

SHEET

SERVICE

Page No 3

Dungarvan



Automatic Flare Systems Ltd Unit 8, Ensign Business Centre Coventry CV4 8JA United Kingdom Tel: +44 (0)24 7647 4877 Fax: +44 (0)24 7647 4834

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GAS ANALYSER C.	ALIBRATION R	REPORT:			
GAS USED: 1954 Co	ompressed Gas.	Methane (CH4)	50 % concentration	Carbon Dioxide	e: Remaining Balance
Before Calibration:	CH4	N/A %	CO2	N/A %	
After Calibration:	CH4	N/A %	CO2	N/A %	
Comments:	None				
GAS USED: 1954 Co	ompressed Gas.	Oxygen (O <sub>2</sub> )	20.9% Concentration	Nitrogen: Rem	naining Balance
Before Calibration:	O <sub>2</sub>	N/A %			
After Calibration:	O <sub>2</sub>	N/A %			
Comments:	None				

SERVICE SHEET Page No 4	Job No Dungarv	an		A	F	5	Automa Unit 8, Ensig Coventry CV United King Tel: +44 (0) Fax: +44 (0)	tic Fla gn Busine V4 8JA dom 24 7647 4 24 7647 4	are System ss Centre 877 4834	s Ltd
REPORT ANY FURTHER REPAIRS	I OR ACTIC	N NEEDED	:							
The 10mm air line supplying to KOP 1	has blown	a hole in it ca	ausing the	e compressor	to run con	stantly, dis	splacing all the	oil and se	eizing. Requires 1	new
compressor and a new 10mm supply lin	ie.									
DEPARTURE REPORT:										
HOURS RUN: 20521	R	UN RIG FOI	R 30 MIN	UTES BEF	ORE TAKI	NG READ	DINGS			
CH4 51.7	% C	02	26.7	%	O2	0.6	% CO		123.3	
INLET VALVE SETTING % OPEN										
NO 1 100% NO 2	N/A	NO 3	N/	A N	NO 4	N/A	NO 5	N/A	NO 6	N/A
MAIN CONTROL VALVE SETTING	% OPEN						100%			
INLET VACUUM GAUGE READING	S START	ING SIDE N	EAREST	KNOCKOU	JT POT				(mbarg)	
NO 1 - 2.5 NO 2	N/A	NO 3	N/	A N	NO4	N/A	NO 5	N/A	NO 6	N/A
INLET TEMP		20	°C	INLET V	ACUUM F	RIOR TO	KO POT FILT	ΓER	-2.5	MBAR
VACUUM AFTER KO POT FILTER		-3.0	MBAR	VACUUN	AFTER	NLET FL	AME ARRES	TER	N/A	MBAR
OUTLET PRESSURE AFTER GAS B	OOSTER	15.4	MBAR	OUTLET	GAS TEM	IP			22	°C
PRESSURE AFTER SLAM SHUT		12.0	MBAR	PRESSU	RE AFTER	OUTLET	FLAME ARF	RESTER	N/A	
OTHER				BLOWER	R SPEED %	6		38		%
DAMPER POSITION		43.3	%	MANOM	ETER REA	ADING		75		m <sup>3</sup> hr
FLOW RATE		78.4	m <sup>3</sup> hr	FLAME (	QUALITY			OK		
FLAME TEMP		1024	°C	HAS RIG CLEAN	& COMP	OUND BE	EN LEFT	Yes		
NAMES OF ALL AFS & SUB CONTR	RACTOR	STAFF CAR	RYING C	OUT WORK						
Steve Hindle										
REPORT WRITER	Steve H	lindle								
SIGNATURE										
DATE	12-10-2	016								

a

			JOB NO			-		_	-	Autom	natic	Flar	e Syste	ems I	_td	
I	REPAII SHEET Page No 5	2	Dungarvan l	Landfill	site	A	<b>V</b> ;	2	5	Unit 8, En Coventry 9 United Kin Tel: +44 ( Fax: +44 ( www.auto	sign B CV4 8J ngdom 0)24 76 0)24 76 maticfl	usiness JA 647 487 647 483 laresyst	Centre 7 34 .ems.co.uk			
SITE : Dung	garvan Landfill	site, Co Wat	terford							DATE	E 27/	tic Flare Systems Ltte n Business Centre 4 8JA loom 4 7647 4877 24 7647 4877 24 7647 4834 titicflaresystems.co.uk 27/10/2016 HING IN CERAMIC INSULATIN BJ10 WPY BJ10 WPY BJ10 WPY BJ10 WPY MO 6 (mbarg) NO 6 /A /A /A /A /A /A /A /A /A /A				
HEALTH A WEAR A H WEAR A PI	ND SAFETY N ARD HAT AN ROTECTIVE F DUST	NOTICE D REFLECT ACE MASK	IVE VEST OR J WHEN WORK	ACKE ING IN	Γ ON OP AN ARI	ERATIVE SIT	ES IERE IS A	ANY POS	SSIBILIT	Y OF BRE	ATHIN	G IN CI	ERAMIC IN	ISULA	ГING	
TO BE COM 1. 2. 3. 4. 5. 6. 7.	MPLETED FOF RECORD ALL RECORD ALL RECORD ALL CHECK THAT RECORD ALL LEAVE SITE ( NOTE FUTUR	ALL HIRE INSTRUME CHANGES PARTS, MA PRESSURE INSTRUME CLEAN AND E REMEDIA	INSTALLATIO ENT READINGS AND REPAIRS ATERIALS & CO AND VACUUM INT READINGS D TIDY AL ACTION NEI	N, SER AND MADE OMPON M GAU S AND EDED A	VICE AI VALVE ( NENTS F GES AR VALVE ( AND SEF	ND REPAIR VI SETTINGS ON ITTED OR USE E ZEROED SETTINGS ON E THAT IT IS C	ISITS   ARRIVA ED   DEPAR   CARRIED	IL TURE OUT								
ENGINEER	S NAME	Steve	e Hindle						VEHICLI	E NO		BJ10	WPY			
MILEAGE TO SITE MILEAGE FROM SITE																
ARRIVAL I	RECORD Flare	e running									0					
HOURS RU	IN	BOOSTER 1	20614		CH4	0			CO2		0					
		BOOSTER 2	2		O2	0			PRES	SSURE	0					
INLET VAI	LVE SETTING	(CLICKS FF	ROM CLOSED)	START	TING SIE	E NEAREST F	KNOCKO	UT POT								
NO 1	0	NO 2		NO 3	3		NO 4			NO 5	0 NO 6					
MAIN CON	TROL VALVE	E SETTING (	CLICKS FROM	CLOSI	ED)		1			50%						
INLET VAC	CUUM GAUGI	E READING	S STARING SIE	DE NEA	REST K	NOCKOUT PC	т						(mbarg)			
NO 1	N/A	NO 2	N/A	NO 3	3		NO4			NO 5			NO 6			
INLET TEM	1P	I	N/A			INLET VA FILTER	CUUM P	RIOR TO	) KO PO	Г	N/A					
VACUUM	AFTER KO PO	T FILTER	N/A			VACUUM ARRESTE	AFTER I R	NLET F	LAME		NA					
OUTLET PI BOOSTER	RESSURE AFI	TER GAS	N/A			OUTLET (	GAS TEM	Р							°C	
PRESSURE	AFTER SLAN	I SHUT	N/A			PRESSUR ARRESTE	E AFTER R	OUTLE	T FLAMI	3	NA					
TOTAL FLO	WC		1493476			DAMPER					%					
FLOW RAT	ТE					MEASURI	NG INST	RUMEN	Т							
FLAME TE	MP			0	Ċ	MOTOR T	EMP				OK					
FLAME QUALITY AMBIENT TEMP N/A									°C							
MANOMET	TER LIQUID L	EVEL WITH	I RIG SHUT DO	WN		0										
TYPE OF L	IQUID: PERFI	.OW		-						-				_		
RED SG - 0	.8			EMI: CEL	SSIONS L	ANALYSER C	0	N/A		EMISSIC CELL	ONS AN	NALYSI	ER NOX			

C	ALL OUT SHEET Page No 2	Job No Dungarvan Landfill site	A	FS	Automatic Flar Unit 8, Ensign Business Coventry CV4 8JA United Kingdom Tel: +44 (0)24 7647 487 Fax: +44 (0)24 7647 483	e Systems Ltd Centre 7 34
REPORT	ALL & ANY REPAIRS	I				
REPORT A	ALL & ANY PARTS REPLA BE INVOICED	ACED OR NEW PARTS FITT	ED INCLUDING	PART NOS & SUF	FICIENT DETAIL FOR	
	FAULTS FOUND OR SH	UT DOWNS ACKNOWLEDO	JED	REPAIRS OR NI	EW PARTS FITTED	
	Disconnected dan from compound. Install new comp Replace 10mm Ko	naged compressor an ressor. op supply pipe.	d removed	1 x Compre 20m x 10m	essor 50L-2HP (af m plastic pipe. (af	s supplied) s supplied)
	Report Condensate pump constantly pumpin Suspect fault with Compressor is sw repaired. On site 8:45 to 9:4	9 in KOP nearest flar ng. 1 pump requires inves 1 itched off until pump 45	e is stigating. 5 is			

			JOB NO			-				Auton	natic I	Flare Syste	ms Ltd
	ALL OU SHEET Page No 2	UT T	Dungarvan l	andfill	site	A	0;	15	5	Unit 8, En Coventry United K Tel: +44 Fax: +44 www.aute	nsign Bus CV4 8JA ingdom (0)24 764 (0)24 764 omaticflat	siness Centre A 47 4877 47 4834 resystems.co.uk	
SITE: Dung	arvan Landfill s	site, Co Wat	terford							DAT	E: 08-11	-2016	
HEALTH A WEAR A H WEAR A PI	ND SAFETY N ARD HAT AN ROTECTIVE F DUST	NOTICE D REFLECT ACE MASK	TIVE VEST OR J K WHEN WORK	ACKE ING IN	Γ ON OP AN ARI	ERATIVE SITI EA WHERE TH	ES IERE IS A	ANY POS	SSIBILIT	Y OF BRE	ATHING	IN CERAMIC IN	SULATING
TO BE CON           1.         1           2.         1           3.         1           4.         6           5.         1           6.         1           7.         1	MPLETED FOR RECORD ALL RECORD ALL RECORD ALL CHECK THAT RECORD ALL LEAVE SITE ( NOTE FUTUR	R ALL HIRE INSTRUM CHANGES PARTS, M. PRESSURF INSTRUM CLEAN ANI E REMEDIA	E INSTALLATIO ENT READINGS AND REPAIRS ATERIALS & CO E AND VACUUM ENT READINGS D TIDY AL ACTION NEI	N, SER AND V MADE OMPON A GAU AND V EDED A	VICE AN VALVE S IENTS F GES ARI VALVE S AND SEE	ND REPAIR VI SETTINGS ON ITTED OR USI E ZEROED SETTINGS ON THAT IT IS C	SITS ARRIVA ED DEPAR CARRIED	URE OUT					
ENGINEER	S NAME	Stev	ve Hindle						VEHICLI	ENO	1	BJ10 WPY	
MILEAGE TO SITE MILEAGE FROM SITE													
ARRIVAL I	ARRIVAL RECORD												
HOURS RU	N	BOOSTER	1 20630		CH4				CO2				
		BOOSTER	2		02				PRES	SURE			
INLET VAI	.VE SETTING	(CLICKS F	ROM CLOSED)	START	'ING SID	E NEAREST K	NOCKO	UT POT	·				
NO 1	F/O	NO 2		NO 3	;		NO 4			NO 5		NO 6	
MAIN CON	I TROL VALVE	E SETTING	(CLICKS FROM	CLOSI	ED)								
INLET VAC	CUUM GAUGE	E READING	S STARING SIE	E NEA	REST K	NOCKOUT PO	Т					(mbarg)	
NO 1	N/A	NO 2	N/A	NO 3	;		NO4			NO 5		NO 6	
INLET TEM	ſP		N/A			INLET VA FILTER	CUUM P	RIOR TO	O KO PO	Г	N/A	I	
VACUUM	AFTER KO PO	T FILTER	N/A			VACUUM ARRESTE	AFTER I R	NLET F	LAME		NA		
OUTLET PH BOOSTER	RESSURE AFT	TER GAS	N/A			OUTLET C	GAS TEM	Р			N/A		°C
PRESSURE	AFTER SLAM	I SHUT	N/A			PRESSURI ARRESTE	E AFTER R	OUTLE	T FLAMI	Ξ	NA		
TOTAL FLO	WC		15733230										
FLOW RAT	Έ		N/A			MEASURI	NG INST	RUMEN	T				
FLAME TE	MP		N/A			MOTOR T	EMP				ОК		
FLAME QU	ALITY		OK			AMBIENT	TEMP				N/A		°C
MANOMET	TER LIQUID L	EVEL WITH	H RIG SHUT DO	WN		0					•		
TYPE OF L	IQUID: PERFL	.OW											
RED SG - 0	.8			EMIS CELI	SSIONS L	ANALYSER C	0	N/A		EMISSI CELL	ONS ANA	ALYSER NOX	
				]									

# CALL OUT SHEET

Job No Dungarvan Landfill site



Automatic Flare Systems Ltd Unit 8, Ensign Business Centre Coventry CV4 8JA United Kingdom Tel: +44 (0)24 7647 4877 Fax: +44 (0)24 7647 4834

Page No 2

REPORT A	ALL & ANY REPAIRS		
REPORT A THEM TO			
	FAULTS FOUND OR SHUT DOWNS ACKNOWLEDGED	REPAIRS OR NEW PARTS FITTE	ED
	08-11-16		
	Called out: - Gas lifting Cap membrane on gas field & High Condensate Alarm.		
	Investigated Gas lifting Cap membrane on gas field and found that the Horses on site had crumpled a small section of Lagoon lining, rising above the water level. (see. Picture below)		
	Investigate High Condensate Alarm and found that the gas collection system near the Flare was flooded with pressurised water. The flare was isolated from the GCS to prevent further damage and the flare drain points opened to drain. The KOP pump in pot was not working correctly.		
	To determine how and where the source of the water that had entered the GCS needs extensive investigation. EPS was contacted and arrange to meet on site on the 10-11-16 to aid with the investigation,		
	Time arrived on site:15:00Time leaving site:17:00		
	10-11-16		
	The Leachate / Condensate systems were investigate with EPS to determine where the water was coming from. It was found that the outlet end of both discharge pipes from Condensate pumps 1 & 2 were submerged in the lagoon. Both outlet pipes were raised above the lagoon water level.		
	The faulty condensate pump in KOP 2 chamber was removed and it was found that the pump was detached from the 63mm discharge line, allowing the lagoon water to enter the GCS.		
	The water in the GCS at KOP1 was pumped out and did not recharge with lagoon water.		
	Time arrived on site:09:00Time leaving site:16:30		



			JOB NO	JOB NO Automatic Flare Systems L									Ltd			
	Dungarvan	Dungarvan Landfill site Unit 8, Ensign Business Centre Coventry CV4 8JA United Kingdom Tel: +44 (0)24 7647 4877 Fax: +44 (0)24 7647 4834 www.automaticflaresystems.co.uk														
SITE : Dung	garvan Landfill	site, Co Wa	terford				DATE 18/11/2016									
HEALTH AND SAFETY NOTICE WEAR A HARD HAT AND REFLECTIVE VEST OR JACKET ON OPERATIVE SITES WEAR A PROTECTIVE FACE MASK WHEN WORKING IN AN AREA WHERE THERE IS ANY POSSIBILITY OF BREATHING IN CERAMIC INSULATING DUST											ATING					
TO BE COMPLETED FOR ALL HIRE INSTALLATION, SERVICE AND REPAIR VISITS1.RECORD ALL INSTRUMENT READINGS AND VALVE SETTINGS ON ARRIVAL2.RECORD ALL CHANGES AND REPAIRS MADE3.RECORD ALL PARTS, MATERIALS & COMPONENTS FITTED OR USED4.CHECK THAT PRESSURE AND VACUUM GAUGES ARE ZEROED5.RECORD ALL INSTRUMENT READINGS AND VALVE SETTINGS ON DEPARTURE6.LEAVE SITE CLEAN AND TIDY7.NOTE FUTURE REMEDIAL ACTION NEEDED AND SEE THAT IT IS CARRIED OUT																
ENGINEER	S NAME	Stev	ve Hindle, John B	rown					VEHICLI	E NO		BJ10	) WPY,			
MILEAGE	TO SITE				M	ILEAGE FROM	A SITE									
ARRIVAL	RECORD Flar	e off														
HOURS RU	IN	BOOSTER	1 20630	CH4		0	0		CO2		0	0				
		BOOSTER	2	O2			0 PF			ESSURE 0						
INLET VAI	LVE SETTING	(CLICKS FI	ROM CLOSED)	START	ING SID	E NEAREST KNOCKOUT POT										
NO 1	0	NO 2		NO 3			NO 4			NO 5	5		NO 6			
MAIN CON	TROL VALVE	ESETTING	(CLICKS FROM	CLOS	ED)					50%	)%					
INLET VAC	CUUM GAUGI	E READING	S STARING SII	DE NEA	REST KN	IOCKOUT PO	OCKOUT POT					(mbarg)				
NO 1	N/A	NO 2	N/A	NO 3	3		NO4			NO 5			NO 6			
INLET TEN	1P	1	N/A	1		INLET VA FILTER	INLET VACUUM PRIOR TO KO POT N/A FILTER									
VACUUM	AFTER KO PC	T FILTER	N/A			VACUUM ARRESTE	-	NA								
OUTLET PI BOOSTER	RESSURE AFI	TER GAS	N/A			OUTLET GAS TEMP					°c					
PRESSURE	AFTER SLAM	I SHUT	N/A			PRESSURE AFTER OUTLET FLAME ARRESTER					NA					
TOTAL FLO	WC		15733230			DAMPER					%					
FLOW RAT	ТЕ					MEASURI	MEASURING INSTRUMENT									
FLAME TE	MP			C	С	MOTOR TEMP					ОК					
FLAME QUALITY						AMBIENT	TEMP				N/A				°C	
MANOMET	TER LIQUID L	EVEL WITH	H RIG SHUT DO	WN		0										
TYPE OF L	IQUID: PERFI	LOW														
RED SG - 0	.8			EMI CEL	SSIONS A	ANALYSER C	0	N/A	EMISSIONS ANALYSER NOX CELL							

CALL OUT SHEET Page No 2	Job No Dungarvan Landfill site	A	FS	Automatic Flare Systems Ltd Unit 8, Ensign Business Centre Coventry CV4 8JA United Kingdom Tel: +44 (0)24 7647 4877 Fax: +44 (0)24 7647 4834
REPORT ALL & ANY REPAIRS				
REPORT ALL & ANY PARTS REPL THEM TO BE INVOICED	ACED OR NEW PARTS FITTED	INCLUDING	PART NOS & SUF	FICIENT DETAIL FOR
FAULTS FOUND OR SI	HUT DOWNS ACKNOWLEDGED		REPAIRS OR NE	EW PARTS FITTED
Condensates pur modifications. The old 63mm diducted for the ne head pressure on pushed into the 6 approx. 110m the great to push the pipe had not reace discharge pipe. T the 32mm pipe we end, but was at the landfill. A 63mm – 32mm to seal the old 63 new 32mm disch A new 63mm – 3 used to seal the of	mp & Discharge system ischarge pipe was used a w 32mm pipe to reduce the pump. The 32mm p 53mm discharge pipe, aft e weight and resistance w pipe any further. The 32 ched the outlet end of the The Distance was measure vas approx. 10m short from the close to the top of the m compression coupler w form discharge pipe with large pipe.			
chamber lid with The condensate p KOP and a new 3 Flare water dan Drained water fro Drained water fro	the new 32mm discharg oump was reinstated into 32mm compression elbo nage repairs. om Flares Condensate K om Blower housing.	ge pipe. o the w. COP.		
Drained water fro down steam of or Drained water fro pipes	om main gas line includi rifice plate, om Poddy-meter display	ing <sup>7</sup> and		
Drained water from	om feed and return gas s	ample		

pipes to LGA.	
Fit new headline filter.	
Removed & Drained water from all LGA feed and return tubes.	
Fit new input green filter.	
Replaced damaged CH4 card.	
Replaced damaged CO2 card.	
Started flare and found the flow surging. To drain the main gas line the Condensate pump 2 was switched on. Time arrived on site: 09:00 Time leaving site: 15:00	

Hare No. 1																	
	Flare type	?				AFS HT150			If "other" e	enter flare de	scription here						
	Is the flare	e an open or e	enclosed fla	are ?		Enclosed	•	Rated flare of	capacity ?	150	•	m3/hr					
	Month /yea	ar comissione	d?	•		July	2010										
	Month decomissioned if decomissioned in 2016 ?																
	What is the function of the flare ?						m uncapped area	•	lf "other" en	ter flare func	tion here						
Monthly	Method	Runtime	Runtime	Downtime	Total runtime	Average Inlet	Average Inlet Temp	Average Flow	Average CH₄	Average CO <sub>2</sub>	Average O <sub>2</sub>	Combustion	Total CH <sub>4</sub>	Total CH₄			
	M/C/E	days/month	hrs/day	hrs	hrs/month	Pressure (mbg)	∘ C	Rate (m <sup>3</sup> /hr)	%v/v	%v/v	%v/v	efficiency (%)	m³	kgs			
January	С	30	10.0	24.0	276	-21	10	90	35.50	22.00	3.50	98.0	8,642	5,843			
February	С	27	10.0	24.0	246	-21	10	90	35.50	22.00	3.50	98.0	7,703	5,208			
March	С	30	10.0	24.0	276	-21	10	90	35.50	22.00	3.50	98.0	8,642	5,843			
April	С	29	10.0	24.0	266	-21	10	90	35.50	22.00	3.50	98.0	8,329	5,631			
May	С	30	10.0	24.0	276	-21	10	90	35.50	22.00	3.50	98.0	8,642	5,843			
June	С	29	10.0	24.0	266	-21	10	90	35.50	22.00	3.50	98.0	8,329	5,631			
July	С	30	10.0	24.0	276	-21	10	90	35.50	22.00	3.50	98.0	8,642	5,843			
August	С	30	10.0	24.0	276	-21	10	90	35.50	22.00	3.50	98.0	8,642	5,843			
September	С	29	10.0	24.0	266	-21	10	90	35.50	22.00	3.50	98.0	8,329	5,631			
October	С	30	10.0	24.0	276	-21	10	90	35.50	22.00	3.50	98.0	8,642	5,843			
November	С	29	10.0	24.0	266	-21	10	90	35.50	22.00	3.50	98.0	8,329	5,631			
December	С	30	10.0	24.0	276	-21	10	90	35.50	22.00	3.50	98.0	8,642	5,843			
Total					3,242								101,510	68,635			

to be filled in by licensee calculated by spreadsheet

Please note: Only fill the "Yearly	y" table if data is not availabe or cannot be calculated nor estimated on a monthly basis
------------------------------------	---

							Average							
Yearly	Method	Runtime	Runtime	Downtime	Total runtime	Average Inlet	Inlet Temp	Average Flow	Average CH <sub>4</sub>	Average CO <sub>2</sub>	Average O <sub>2</sub>	Combustion	Total CH <sub>4</sub>	Total CH <sub>4</sub>
	M/C/E	days/year	hrs/day	hrs	hrs/year	Pressure (mbg)	∘ C	Rate m <sup>3</sup> /hr	%v/v	%v/v	%v/v	efficiency (%)	m <sup>3</sup>	kgs
2016					0		10					98.0	0	0



Management Structure

### Management Structure of Waterford City and County Council

CEO Mr Michael Walsh



**Director of Services** 

Environment, Roads & Water Services Mr. Fergus Galvin

 $\bigcup_{i=1}^{n}$ 

Senior Executive Officer Mr. Raymond Moloney

Senior Executive Engineer Niall Kane



**Executive Scientific Officer** 

**Executive Engineer** 

Assistant Engineer

Mr. Paul Carroll

John McKeown

Ted Cunningham



Landfill and Civic Amenity Manager

Mr. David Regan

**Caretakers** Mr. Bill O Keeffe, Pat Earley

## <mark>Appendix</mark> K

Pollutant Release Transfer Register


| PRTR# : W0032 | Facility Name : Dungarvan Waste Disposal Site | Filename : W0032\_2016 Dungarvan PRTR.xlsm | Return Year : 2016 |

#### Guidance to completing the PRTR workbook

# PRTR Returns Workbook

REFERENCE YEAR 2016

#### **1. FACILITY IDENTIFICATION**

Parent Company Name	Waterford City & County Council
Facility Name	Dungarvan Waste Disposal Site
PRTR Identification Number	W0032
Licence Number	W0032-03

Classes of Activity	
No.	class_name
-	Refer to PRTR class activities below

Address 1	Ballynamuck Middle
Address 2	Dungarvan
Address 3	
Address 4	
	Waterford
Country	Ireland
Coordinates of Location	-7.64444 52.104
River Basin District	IESE
NACE Code	3821
Main Economic Activity	Treatment and disposal of non-hazardous waste
AER Returns Contact Name	David Regan
AER Returns Contact Email Address	dregan@waterfordcouncil.ie
AER Returns Contact Position	Executive Technician
AER Returns Contact Telephone Number	058 22112
AER Returns Contact Mobile Phone Number	086 8307065
AER Returns Contact Fax Number	058 45606
Production Volume	0.0
Production Volume Units	
Number of Installations	1
Number of Operating Hours in Year	2184
Number of Employees	3
User Feedback/Comments	
Web Address	lwww.waterfordcouncil.ie

#### 2. PRTR CLASS ACTIVITIES

Activity Number	Ŧ	Activity Name	-
50.1		General	
50.1		General	

#### 4.1 RELEASES TO AIR

Link to previous years emissions data

10/11/2017 12:27

SECTION A : SECTOR SPECIFIC PRTR POLLUTANTS

	RELEASES TO AIR		Please enter all quantities in this section in KGs							
	POLLUTANT	METHOD			ADD EMISSION POINT	QUANTITY				
			Method Used							
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year		
					0.0		0.0 0.0	0.0		

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

SECTION B : REMAINING PRTR POLLUTANTS

		RELEASES TO AIR	Please enter all quantities in this section in KGs									
		POLLUTANT			METHOD	ADD EMISSION POINT		QUANTITY				
				Method Used								
No.	. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year			
					Estimated from Flare data							
01		Methane (CH4)	E	OTH	and Landgem Model	93571.0	93571.0	0.0	0.0			
					Estimated from Flare data							
03		Carbon dioxide (CO2)	E	OTH	and Landgem Model	1440000.0	1440000.0	0.0	0.0			
					Estimated from Flare data							
07		Non-methane volatile organic compounds (NMVOC)	E	OTH	and Landgem Model	17000.0	17000.0	0.0	0.0			
		* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button										
ADD NEW ROW	DELETE ROW *											
	EMI	SSIONS (As required in your Licence)										

	RELEASES TO AIR	Please enter all quantities in this section in KGs							
	POLLUTANT	METHOD			ADD EMISSION POINT	QUANTITY			
				Method Used		1			
Pollutant No.	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG	Year F (Fugitive) KG/Year	
					0.0	)	0.0	0.0 0.0	

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

#### Additional Data Requested from Landfill operators

For the purposes of the National Inventory on Greenhouse Gases, landfill operators are requested to provide summary data on landfill gas (Methane) flared or utilised on their facilities to accompany the figures for total methane generated. Operators should only report their Net methane (CHA) emission to the environment under T(total) KGyr for Section A: Sector specific PRTR pollutants above. Please complete the table below :										
Please enter summary data on the	Dungarvan Waste Disposal one									
guantities of methane flared and / or										
utilised			Met	hod Used						
				Designation or	Facility Total Capacity					
	T (Total) kg/Year	M/C/E	Method Code	Description	m3 per hour					
Total estimated methane generation (as per										
site model)	420750.0	E	ОТН	Landgem	N/A					
Methane flared	380000.0	E	OTH	Landgem	250.0	(Total Flaring Capacity)				
Methane utilised in engine/s	0.0				0.0	(Total Utilising Capacity)				
Net methane emission (as reported in										
Section A above)	93571.0	E	OTH	Landgem	N/A					

#### 4.2 RELEASES TO WATERS Link to previo

Link to previous years emissions data

#### | PRTR# : W0032 | Facility Name : Dungarvan Waste Disposal Site | Filename : W0032\_2016 Dungarvan PRTR.xlsm | Return Year : 2016 |

10/11/2017 12:27

SECTION A : SECTOR SPECIFIC PRTR POL	LUTANTS	Data on ambient monitoring of storm/surface water or groundwater, conducted as part of your licence requirements, should NOT be submitted under AER / PRTF								
	RELEASES TO WATERS	Please enter all quantities in this section in KGs								
				ADD EMISSION POINT	QUANTITY					
				Method Used						
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year		
			•		0.0	0.0	0.0	0.0		
					0.0	0.0	0.0	0.0		

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

SECTION B : REMAINING PRTR POLLUTANTS

		RELEASES TO WATERS		Please enter all quantities in this section in KGs							
		POLLUTANT				ADD EMISSION POINT		QUANTITY			
					Method Used			1			
No	. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year		
79		Chlorides (as Cl)	E	ESTIMATE		0.0	0.0	i 0.0	0.0		
71		Phenols (as total C)	E	ESTIMATE		0.0	0.0	i 0.0	0.0		
						0.0	0.0	, 0.0	0.0		
		* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button									

ADD NEW ROW DELETE ROW \*

EMISSIONS (as required in your Licence)

	RELEASES TO WATERS			Please enter all quantitie	s in this section in KG	s		
	POLLUTANT				ADD EMISSION POINT		QUANTITY	
			Method Used					
Pollutant No.	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
372	Nitrite (as N)	E	ESTIMATE		8.0	8.0	0.0	0.0
351	Total Organic Carbon (as C)	E	ESTIMATE		0.0	0.0	0.0	0.0
306	COD	E	ESTIMATE		617.0	617.0	0.0	0.0
303	BOD	E	ESTIMATE		59.0	59.0	0.0	0.0
240	Suspended Solids	E	ESTIMATE		77.0	77.0	0.0	0.0
363	Total Dissolved Solids	E	ESTIMATE		0.0	0.0	0.0	0.0
374	Boron	E	ESTIMATE		0.0	0.0	0.0	0.0
305	Calcium	E	ESTIMATE		0.0	0.0	0.0	0.0
357	Iron	E	ESTIMATE		0.0	0.0	0.0	0.0
320	Magnesium	E	ESTIMATE		0.0	0.0	0.0	0.0
321	Manganese (as Mn)	E	ESTIMATE		0.0	0.0	0.0	0.0
338	Potassium	E	ESTIMATE		0.0	0.0	0.0	0.0
341	Sodium	E	ESTIMATE		0.0	0.0	0.0	0.0
355	Aluminium	E	ESTIMATE		0.0	0.0	0.0	0.0
354	Silver	E	ESTIMATE		0.0	0.0	0.0	0.0
343	Sulphate	E	ESTIMATE		0.0	0.0	0.0	0.0
387	Ortho-phosphate (as P)	E	ESTIMATE		0.0	0.0	0.0	0.0
238	Ammonia (as N)	E	ESTIMATE		24.0	24.0	0.0	0.0
					62.0	62.0	0.0	0.0

			Quantity (Tonnes per Year)				Method Used		<u>Haz Waste</u> : Name and Licence/Permit No of Next Destination Facility <u>Non Haz Waste</u> : Name and Licence/Permit No of Percover/Disponser	Haz Waste : Address of Next Destination Facility Non Haz Waste: Address of Becover/Dispaser	Name and License / Permit No. and Address of Final Recoverer / Disposer (HAZARDOUS WASTE ONI Y)	Actual Address of Final Destination i.e. Final Recovery / Disposal Site (HAZARDOUS WASTE CNI Y)
Transfer Destination	European Waste Code	Hazardous		Description of Waste	Waste Treatment Operation	M/C/E	Method Used	Location of Treatment				
Within the Country	02.02.00	Ne	207 52	wastes not otherwise specified (Organic			Mainhad	Offeite in Ireland	O Toole Composting	Ballintrane, Fenagh, Co.		
within the Country	02 03 99	NO	297.52	and Garden Waste)	на	IVI	weigned	Offsite in Ireland	Ltd, W0284-01	Clonmanim Industrial	ENVA Ireland,WCP/KK/059(A) 06,Clonmanim Industrial	Clonmanim Industrial
Within the Country	08 01 21	Yes	6.12	waste paint or varnish remover	D5	м	Weighed	Offsite in Ireland	ENVA Ireland,WCP/KK/059(A)06 Waterford Co. Council,W189	Estate,Portlaoise,Co. Laois,.,Ireland Shandon,Dungarvan,Co.	Estate,Portlaoise,Co. Laois,.,Ireland	Estate,Portlaoise,Co. Laois,.,Ireland
Within the Country	15 01 01	No	154.4	paper and cardboard packaging	R3	м	Weighed	Offsite in Ireland	01 Robob Requeing Ltd Reg	Waterford, ., Ireland		
Within the Country	15 01 07	No	22.36	glass packaging	R5	м	Weighed	Offsite in Ireland	no. 635 Permit No. 03/07	Road, Cork,, Ireland Cappincur Industrial	Varies, Varies, Varies, Contac	Varies, Contact Laurence
To Other Countries	16.02.11	Voc	30 393	discarded equipment containing chlorofluorocarbons, HCFC, HFC -	D4	м	Weighed	Abroad	KMK Metals Recycling,WCP/KK/069(A)/	Estate, Daingean Road, Tullamore, Co.	t Laurence Kieran WEEE Ireland, EPA Auditor Dermot	Kieran WEEE Ireland,EPA Auditor Dermot
To other obuilties	10 02 11	165	30.232	THEOLO		101	Weighed	Abidad	00	Cappincur Industrial	Varies, Varies, Varies, Contac	Varies,Contact Laurence
To Other Countries	16 02 11	Yes	0.973	discarded equipment containing chlorofluorocarbons, HCFC, HFC - Flourescent Tubes	R4	м	Weighed	Abroad	KMK Metals Recycling,WCP/KK/069(A)/ 06	Estate, Daingean Road, Tullamore, Co. Offaly, Ireland	t Laurence Kieran WEEE Ireland, EPA Auditor Dermot Burke,Ireland	Kieran WEEE Ireland,EPA Auditor Dermot Burke,Ireland
				discarded equipment containing hazardous					KMK Metals	Cappincur Industrial	Varies, Varies, Varies, Contac	Varies, Contact Laurence
				mentioned in 16 02 09 to 16 02 12 - Large					Recycling,WCP/KK/069(A)/	Road, Tullamore, Co.	Ireland, EPA Auditor Dermot	Auditor Dermot
To Other Countries	16 02 13	Yes	68.318	discarded equipment containing hazardous	H4	м	weighed	Abroad	06	Cappincur Industrial	Varies, Varies, Varies, Contac	Varies,Contact Laurence
				components (16) other than those					KMK Metals Recycling WCP/KK/069(A)/	Estate, Daingean Boad Tullamore Co	t Laurence Kieran WEEE	Kieran WEEE Ireland, EPA
To Other Countries	16 02 13	Yes	35.131	Monitors	R4	м	Weighed	Abroad	06	Offaly, Ireland	Burke,,Ireland	Burke,.,Ireland
				discarded equipment containing hazardous components (16) other than those					KMK Metals	Cappincur Industrial Estate, Daingean	Varies, Varies, Varies, Contac t Laurence Kieran WEEE	Kieran WEEE Ireland, EPA
To Other Countries	16.02.12	Voc	49 229	mentioned in 16 02 09 to 16 02 12 - Small	D4	м	Wojahad	Abroad	Recycling,WCP/KK/069(A)/	Road, Tullamore, Co.	Ireland, EPA Auditor Dermot	Auditor Dermot
To Other Countries	10 02 13	162	40.320	Household items	D4	IVI	weighed	Abioad	08	Olialy, lieland	ENVA	Buike,.,ireland
										Clonmanim Industrial	Ireland, WCP/KK/059(A) 06. Clonmanim Industrial	Clonmanim Industrial
	10.00.01	N/		land how doe	DE			Official in Instand	ENVA	Estate,Portlaoise,Co.	Estate, Portlaoise, Co.	Estate,Portlaoise,Co.
Within the Country	16 06 01	Yes	0.5	lead batteries	D5	м	weighed	Offsite in Ireland	Ireland, WCP/KK/059(A)06	Laois,.,Ireland Unit 6 Ballylogan Industrial	Laois,., Ireland	Laois,.,Ireland
Within the Country	17.05.04	No	52.86	soil and stones other than those mentioned in 17.05.03 - Rubble	R3	м	Weighed	Offsite in Ireland	Greenstar Ltd, WCP-KK-11- 54-02	Park, Ballylogan Road, Dublin		
Within the Country	17 03 04	NO	52.00		115	101	Weighed	Clisite III lieland	54-02	Unit 6 Ballylogan Industrial		
Within the Country	17 05 04	No	21.66	soil and stones other than those mentioned in 17 05 03 - Clay	R3	м	Weighed	Offsite in Ireland	Greenstar Ltd,WCP-KK-11- 54-02	Park,Ballylogan Road,Dublin 13,.,Ireland		
									Creanator Ltd WCD KK 11	Unit 6 Ballylogan Industrial		
Within the Country	20 01 02	No	21.82	glass	R5	м	Weighed	Offsite in Ireland	54-02	13,.,Ireland		
										Mill River Business		
Within the Country	20.01.10	No	4.26	clothes	D5	м	Wojahad	Offeito in Ireland	Eco Environmontal Unknown	Park, Carrick on Suir, County		
Within the Country	200110	140	4.20	CIGINES	115	101	Weighed	Clisite III lieland	Eco Enviolimental, onknown	Unit 6 Ballylogan Industrial		
Within the Country	20 01 38	No	171.94	wood other than that mentioned in 20 01 37	R3	м	Weighed	Offsite in Ireland	Greenstar Ltd, WCP-KK-11- 54-02	Park, Ballylogan Road, Dublin 13 Ireland		
										Unit A/2 Varis Business		
										Way,Blackburn,BB1		
To Other Countries	20 01 39	No	19.34	plastics	R5	м	Weighed	Abroad	Eco Sky,Unknown	SQB, United Kingdom		
	00.01.10	N			DE			Official in Instand	Greenstar Ltd,WCP-KK-11-	Park,Ballylogan Road,Dublin		
within the Country	20 01 40	INO	29.64	metals	нэ	IVI	vveigned	Offsite in Ireland	54-02	Drehid Landfill,Kilnagh		
Within the Country	20.03.01	No	1473.89	mixed municipal waste	D1	м	Weighed	Offsite in Ireland	Bord na Mona Ltd, W0201-	Upper,Carbury,Co.		
,									Develope Manage Ltd W/0004	Drehid Landfill, Kilnagh		
Within the Country	20 03 03	No	577.24	street-cleaning residues	D1	м	Weighed	Offsite in Ireland	Bord ha Mona Ltd, W0201- 01	Kildare,Ireland		
									Bord na Mona I td W0201-	Drehid Landfill, Kilnagh Upper Carbury Co		
Within the Country	20 03 07	No	256.47	bulky waste	D1	м	Weighed	Offsite in Ireland	01	Kildare, Ireland	<b>E</b> N1/4	
											Ireland, WCP/KK/059(A)	
									ENVA	Clonmanim Industrial Estate Portlaoise Co.	06, Clonmanim Industrial Estate Portlaoise Co	Clonmanim Industrial Estate Portlaoise Co
Within the Country	13 02 06	Yes	2.32	synthetic engine, gear and lubricating oils	R1	м	Weighed	Offsite in Ireland	Ireland, WCP/KK/059(A)06	Laois,,Ireland	Laois,.,Ireland	Laois,.,Ireland
										Drehid Landfill,Kilnagh		
Within the Country	20.02.03	No	21.92	Mattrasses	D1	м	Weighed	Offsite in Ireland	Bord na Mona Ltd, W0201-	Upper,Carbury,Co.		
			21.02					a long in notaliu	· · · · · · · · · · · · · · · · · · ·			

Appendix L

Environmental Liabilities Risk Assessment Review



### **Dungarvan Landfill**

### Hydrogeological Review

## **Document Control Sheet**

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#### DUNGARVAN LANDFILL - HYDROGEOLOGICAL REVIEW

#### **1 INTRODUCTION**

This hydrogeological review / technical assessment has been prepared in response to Condition 6.16.1 of licence W0032-03 which was issued by the Agency on the 21/10/2014 which specified "Within twelve months of the date of this licence, the licensee shall carry out a risk screening and where necessary a technical assessment in accordance with the Guidance on the Authorisation of Discharges to Groundwater, published by the Environmental Protection Agency. A report on the outcome of the screening and where relevant the recommendations of the technical assessment in relation to the setting of groundwater compliance paints and values, shall be included in the next A&R. Any actions required to demonstrate compliance with the European Communities Environmental Objectives (Groundwater) Regulations 2010, as amended shall be agreed by the Agency and implemented before 22nd December 2015. Groundwater monitoring results shall be submitted annually or as required in the Schedules to this licence".

The scope of works undertaken as part of this assessment was as follows:--

- Desk study to establish the baseline geological and hydrogeological conditions at the site;
- Review type and nature of current and past site activities to assess the potential impact on the hydrogeological regime;
- Bisk screening to determine the degree of risk posed by the landfill on the groundwater and surface water quality and receptors based on source-pathway-receptor model;
- Generic Quantitative Risk Assessment;
- Assessment of whether the hydrogeological impacts are compliant with the discharge limits;
- Remedial strategy required to ensure objectives of groundwater regulations will be met;
- Review of compliance values and monitoring regime and identification of additional mitigation measures if required.

The Groundwater Risk Assessment has been carried out in accordance with the EPA Document "Gividance On the Authorisation of Discharges To Groundwater (EPA, 2011). This guidance document covers point source discharges such as the escape of leachate from landfills (beyond engineered and/or geological barriers) and outlines the technical assessments that are required to permit discharges to groundwater in accordance with the European Communities Environmental Objectives (Groundwater) Regulations, 2010 (SI No. 9 of 2010) (Groundwater Regulations).

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#### 2 ENVIRONMENTAL SITE SETTING

The Dungarvan Landfill site is located in the townland of Ballinamuck Middle approximately 2km north west of Dungarvan. The site is located adjacent to the Colligan River which forms the western, northern and eastern boundary of the site. A local access road forms the southern boundary of the site.

The landfill site occupies an area of 6.5 ha. The site was in operation from 1968 to June 2003. The site is currently utilised as a transfer station for recyclable materials. The portion of the River Colligan adjacent to the eastern and northern boundary of the site is tidal in nature. The highest point to which ordinary tides flow is located close to the northern corner of the site (close to surface water monitoring location SW2). The River Colligan discharges to Dungarvan Harbour approximately 1.5km downstream of the landfill.

The Dungarvan Harbour Special Protection Area (SPA) is located adjacent to the landfill site and includes the estuarine portion of the River Colligan and the adjoining wetlands habitats. The Clonea-Beach Bathing Water Area is located approximately 6km east of the landfill site. There is a designated shellfish area located in Dungarvan Harbour, in the area immediately east of Cunnigar and Whitehouse Bank, approximately 4km south east of the landfill. Dungarvan Harbour has also been identified as a Proposed National Heritage Area (aNHA).

The farmland in the vicinity of the site is intensively farmed and composed of arable land and grazing pasture. There is an industrial unit located up gradient of the site (Waterford Joinery, IPPC licence facility PO350-01).

The landfilling of waste within the existing facility boundary took place from drea 1968 to 2003. The landfill closed on the 30<sup>th</sup> June 2003 but still acts as a transfer station for recyclable material. The landfill site accepted mainly domestic and commercial refuse. It is also reported that chromium contaminated organic sludge from a tannery in Portlaw and some lead containing sludge from a lead crystal factory in Dungarvan was also accepted. A Waste Licence W0032-01 was originally granted by the Environmental Protection Agency on 29<sup>th</sup> November 2002 for the continued acceptance of municipal waste within the existing facility. A new licence, W0032-02, was issued for the site on the 05/05/2005 which permitted the development of a Transfer Station and Composting Facilities. The most recent licence, W0032-03, was issued by the Agency on the 21/10/2014 following a licence review which authorised Waterford City and County Council to operate the constructed wetlands system at the site and to discharge treated leachate from the constructed wetlands system to the Colligan Estuary adjacent to the site.

The site is unlined and the landfilling of waste took place on top of the original ground surface resulting in the creation of a waste mound. The historic ordnance survey maps (25° 1988 – 1913) indicate the landfill has developed on an area of marshy ground adjacent the River Colligan. The low land adjacent to the river is liable to flooding. The landfilling of waste has taken place to the north and south of the former railway line. A mill race is indicated along the western portion of the site on the historic 6° map (1937 – 1842).

The Waste Licence application for the site indicated in 1998 that the landfill profile was between 6m, and 9m above the river levels and 2m above the surrounding agricultural profile. The 2009 topographic survey indicates the ground elevation at the base of the waste body along the western, northern and eastern portion of the site ranges from 2m to 3m OD. While along the southern

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boundary of the waste body the ground profile at the base of the waste mound ranges from 4.5m to 8m rising in a westerly direction. The ground elevation on top of the capped waste body ranges from 16.50mm00 to 10.70m00. The landfill has no liner but there is some natural protection provided to the bodrock aquifer from the layer of overburden deposits.

The restoration of the site has been completed. A summary of the restoration works completed at the site is provided in **Table 2.1**.

Table 2.1: Summary of Phasing of Restoration and Remedial Works Completed To Da
---

Commencement	Completion
kily 2007	September 2008
9	2009
	2009
4	2009
	2010
December 2011	July 2012
	Commencement kily 2007

The main capping contract works commenced in July 2007 and completed by September 2008. The installation of the gas / leachate extraction boreholes and associated pipework was completed in June 2009. The gas management system composed of 3 No. gas manifolds was installed in June 2009. A closed permanent flare 100m<sup>4</sup>/hr has been operational at the site since July 2010.

The final capping was completed in mid 2008 and comprised of a five layer composite system as follows:

- Top soil 150 300mm;
- Subsoil such that thickness of topsoil and subsoil is at least 1m thick;
- Surface Water geocomposite layer;
- Imm ILDPE geomembrane;
- Geocomposite gas collection layer.

The layout of the leachate extraction and treatment system is shown on Drawing Leachate Extraction and Treatment System – Current System as at October 2010 (Appendix A, MDR0350/DG0712). An Integrated Constructed Wetland (KW) of 18,000m<sup>2</sup> has been constructed to treat the leachate collected from the landfil. The leachate collection infrastructure (1,549m) at the site includes the leachate interceptor drain on the western, northern and eastern perimeter of the waste body between the site and the River Colligan and the leachate extraction boreholes (GW2 and GW6). Runoff and dirty water from the waste transfer station is also discharged to the leachate treatment system. Two 25m<sup>4</sup> glass fined leachate storage tanks were installed onsite in 2009. In May 2010 the tank on the western side of the site was brought into use and serves as the leachate monitoring and dilution tank.

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A series of 6 no, constructed wotland ponds (1A, 1B, 2, 3, 4 & 5) were installed on site in 2008 for the treatment of leachate and planted with a mix of wotland vegetation such as reeds and sedges. This results in 45% of the site area being occupied by artificial lakes and ponds. A partial leachate extraction system was installed in 2010 and monitored until March 2012. The final phase was to install a full leachate extraction system with works commencing in early December 2011 and reaching substantial complecion in July 2012.

The ponds were constructed by creating 1 m x 3-4 m wide perimeter bunds. The ponds are fined with HDPE and covered with a 500mm depth of subsoil to support the wetland vegetation. The sizing of the ICW was based on a leachate loading rate of  $0.2 \text{ l/m}^2/\text{d}$ . The influent volume to the constructed wetlands is reported to be  $26.9 \text{m}^2/\text{d}$  (9.818.5m<sup>3</sup>/annum).

The leachate from the interceptor tank and leachate boreholes 2 and 6 is diluted with groundwater from RC8 and then pumped to the first KW pond. From here it flows by gravity to each subsequent pond. The treated leachate is then discharged intermittently to the on-site surface water lagoon located in the south east corner of the site.

A monitoring programme is in place at the site to monitoring the leadwate composition and the groundwater and surface water quality in the vicinity of the landfill. The locations of the monitoring points are illustrated on Drawing Monitoring Locations (Appendix A, Drawing Number MDR0350/DG0505 (Rev R02).

in order to complete the assessment of the site the following reports have been consulted to obtain information on the site: -

- Annual Environmental Reports 2008 2014;
- Previous site investigations reports;
- Environmental monitoring data results of groundwater, surface water and leachater monitoring 2008 – 2015.

#### 2.1 REGIONAL GEOLOGY

The bedrock geology of the Dungarvan area is composed of rocks of Carbonilerous age which form the low-lying ground adjacent to the River Colligan and River Brickey. Information on the bedrock geology has been obtained from the Geological Survey of Ireland (GSI) 1:100,000 series bedrock geology map (Sheet 22 Geology of East Cork - Waterford, GSI, 1995). The bedrock geology map indicates that the site is underlain by the Waulsortian Limestone (WA) which is composed of massive unbedded lime mudstone.

Approximately 1km to the north of the site the Ballysteen Formation (BA), a fossiliferous dark grey muddy limestone or shale is mapped as forming the bedrock. The Ballysteen Formation also forms the bedrock in the area to the north east of the site at Knockateenmore.

Moving northwards, onto the higher ground on the foothill of the Knockmealdown Mountain, outside of the study area the bedrock changes to the rocks of Devonian age (Kiltorcan formation).

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In the area of the Ballinumuck Supply boreholes 500m to the west of the site the transmissivity is estimated at  $900 - 13,000m^2/d$ . Investigations in the Dungarvan area indicate that the central area of the syncline has permeability of 15 - 180m/d while the bedrock to the north and south has values of 15 - 70m/d. The higher permeabilities are associated with a higher degree of fracturing and faulting associated with a minor anticlinal axis. Sandy till is the dominant overburden type in the area and in often > 10m thick on the valuey floor.

The groundwater body description indicates that groundwater generally discharges in narrow zones along the major river in the area via springs or through sand and gravels in continuity with the rivers. The historic mapping for the area ( $25^\circ$  series 1899 - 1913 and  $6^\circ$  series 1837 - 1842) indicate the presence of a springs in the south west corner of the site. At the landfill site the main groundwater discharge is to the tidal portion of the River Colligan. The regional groundwater flow direction is expected to be in an easterly direction based on the surface water drainage.

There are a number of karst features identified in the vicinity of the site as outlined in Table 2.2.

GSIFeature No.	Feature Type	Feature Name	Townland	Proximity to Landfill Site
2009556005	Enclosed Depression	Poulmore	Bellynamuck Middle	Between northern boundary of site & River Colligan
2009508009	Undosed Depression	Poulbeg	Bellynamutk Middle	Located within site
2009SEK007	Enclosed Depression	Poulnaskeha	Kiladangan	Approximately 100m west of site on west side of River Colligen
20095EK008	Enclosed Depression	Up named	Kiladangan	Approximately 400m south west of landfill
20095EK004	Cave	Un named	Ballynamuck East	Approximately 600m south east of landfill
2009568016	Borehole Spring	Un named	Ballynamuck West	Approximately 600m west of landfill

#### Table 2.2: Karst Features

The GSI vulnerability map for the area indicates a moderate vulnerability classification for the majority of the landfill site. The area immediately north of the waste body adjacent to the Biver Colligan is classed as low vulnerability. The karst features mapped in the area are classed as having extreme vulnerability. The area of the civic amenity area in the south east of the landfill is classed as high to extreme vulnerability due to bedrock outcropping at or close to the surface in the former quarry area (as indicated on 25° map 1888 – 1913 series).

information on the location of potential private wells in the area has been obtained from the GS well database. There are no private wells located down gradient of the site. The groundwater down gradient of the site is expected to be discharging to the River Colligan and Dungarvan Harbour and is subject to tidal influence. The GSI Groundwater Data Viewer indicates the Source Protection Zones for the Dungarvan Water Supply (Ballinamuck Source) extend to within approximately 400m of the landfill site. Based on the expected regional groundwater flow direction the landfill is located down

gradient of this public water supply and is not located within the delineated source protection zones, for the public supply boreholes.

information on the EPA website indicates the Water Framework Directive (WFD) status 2007 – 2012 for the Dungarvan Groundwater Body indicates as "Good Status". The WFD Risk Score for the Dungarvan Groundwater Body Risk Score is category 1a "at risk of not achieving good status" however no risk score is provided for the area of the landfill site itself for which "no results returned".

#### 2.3 SURFACE WATER FEATURES

The landfill site is located in the catchment of the Colligan-Mahon. The regional surface water drainage is in an easterly direction towards the Dungarvan Harbour

The River Colligan forms the western, northern and eastern boundary of the site. The landfill site has developed on an area of marshy ground adjacent to the River Colligan. The River Colligan is tidal along the northern boundary of the site the most northerly point of the landfill site is located close to the highest point to which ordinary tides flow (close to surface water monitoring location 5W2, see Appendix A Monitoring Locations Drawing MDR0350/DG0505).

The closest EPA surface water monitoring station to the landfill site, (Station ID RS17CO10250), located at bridge near Kildangan has a G3-4 moderate status reported for 2013. This monitoring station is located approximately 1km up gradient of the site.

The Water Framework Directive (WFD) Status (2010 – 2012) for the River Colligan is "Good Status" and "Moderate Status" for the Colligan Estuary.

The WFD risk score for the River Colligan is category 2a "expected to achieve good status" while the risk score for the Colligan Estuary is category 1a "at risk of not achieving good status". The full report for the Colligan Estuary Waterbody indicates the risks relate to morphological risk and point source from waste water treatment plant.

The Begister of Hydrometric Stations in heland 2007 provided information for an obsolete staff gauge on the Colligan at Poulnaskeha (NGR 224019, 94563) approximately 100m up gradient of the site. The catchment area to the staff gauge is reported as 96.354 km<sup>2</sup>. The long term average rainfall for the period 1971-2000 was 1487.5mm and the dry weather flow (DWF) is reported as 0.32,  $m^3/s$  with a 95% leftlow of 0.50 m<sup>3</sup>/sec.

The historic maps for the area indicate that prior to the development of the landfill the allovial flats drained by several drains and streams that discharged to Colligan River. In addition the historic maps indicate the presence of a mill race in the western area of the site.

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#### 2.4 SITE GEOLOGY

The site investigation information from the landfill site and surrounding area has been examined. The original borehole logs for the monitoring boreholes within the landfill site have been reviewed and summary details of the site investigation borehole logs are presented in Table B.1 of Appendix B. The available site investigation data has been used in the development of the conceptual site model (CSM). A cross section through the waste body is presented on Figure 3.1 to illustrate the conceptual site model. The section line has been selected through the site to transect the waste body and intercept the available site investigation boreholes in a west to east direction. The location of the section line is shown on Monitoring Points Drawing (Appendix A, Drawing No. MDR0350/DG0505).

A Geological and Hydrogeological Study of the Dungarvan Landfill was undertaken by B.J. Murphy & Associates (BMA) in March 1999 as part of the Waste Licence Application. Background information on the geology of the site has been obtained from this report which included schematic cross sections of the geology at the site based on the site investigation data. A copy of these cross sections are included in Appendix B.

Bedrock outcrops are limited in the area but the Waulsortian Limestone is seen to outcrop immediately south east of the site. The site investigation confirm the presence of limestone bedrock, at depth ranging from 2.80m below ground level (mbgl) at RC1 in the south east corner of the site to 24.90mbgl at RC5 in the north east corner of the site with the depth to bedrock increasing towards the River Colligan. The rotary drilling indicated massive (unbedded) brown to grey fine grained limestone which correlates with the mapped geology (Waulsortian Formation). Typically the top 10m of the limestone was weathered and fractured. Cavities were found in the limestone bedrock across the site with localised sand, silt and clay infill which lead to unstable drilling conditions due to the extensive fracturing and karstification. The site investigation confirmed the presence of the Waulsortian Limestone Formation at the site except for the south west corner at RC1 and RC4 where block shales interbedded with dark argillaceous limestone with a well developed cleavage interpreted as Ballysteen Formation was encountered. The depth to top of bedrock is seen to increase moving northwards across the site from 8.15mbgl at RC3 to 13mbgl at RC2 and 24.90m at RC5.

The natural overburden material beneath the waste deposits at the site includes boulder day, silty clay, silty sand and occasional silty gravel. Stiff brown sandy boulder clay was encountered in south west part of site in RC3 and RC4 and as far north as TP1 and RC2 with a maximum depth 4m. The thickness of the gravel deposits is seen to increase moving northwards towards the river. The site investigation data has been interpreted as indicating on average 4m to 7m of overburden deposits beneath the waste body. The BMA report indicated that the alluvial deposits had a permeability of 1.985 4m/d (2.35 7cm/s) (An Foras Forbartha, 1985).

The site investigation data indicates there is a protective layer of overburden deposits present across the site between the waste body and the bedrock aquifer across the site. The only exception to this is at RC1 where made ground / waste is lying directly on bedrock however this is located outside of the main waste body and this area has been developed as the civic amenity / waste transfer area in an area which is now surfaced and from where waste material would have been removed prior to the construction of the hardstanding area.

The 1998 site investigation boreholes within the waste body confirm average waste thickness, ranging from 4.40m (L5) to 6.60m (L2).

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#### 2.5 SITE HYDROGEOLOGY

information on the site specific hydrogeology has been obtained from a review of the available site investigation information. A summary of the results of the site investigation boreholes is provided in Table 8.1, Appendix 8.

#### **Groundwater Flow Zones**

The main water bearing horizons are (1) the groundwater in the overburden deposits composed of sandy clayey gravel with cobbles (2) the upper 30m to 40m of bedrock where karst features and fracturing are dominant in the bedrock aquifer. The groundwater levels data indicates Confined conditions were encountered in RC4 and RC6A while unconfined confined conditions at RC3A.

There are no sand and gravel aquifers delineated by the GSI in the area. The aquifer of interest is the bedrock aquifer. Based on the site specific data the aquifer vulnerability for the bedrock aquifer would be classed extreme at RC1 and moderate at RC3, RC4, GW1, GW2 and GW5.

#### **Groundwater Flow Direction**

Monthly monitoring groundwater of groundwater levels takes place at the site and the data for 2014 is presented in **Table 2.3**, the data indicates limited seasonal variation in the groundwater levels. Pumping of groundwater is taking place on site from BCB to dilute the leachate prior to leachate treatment within the constructed wetlands. The greatest fluctuation is seen at BCB where a variation of 0.8m was measured in 2014.

Date	RC7 Overburden	RC6A Rock	GW2A Overbarden	RC3A Ruck	RC4 Rock	RC 8 Overburden	GW1 Overburden
07/01/2014	0.570	2.080	1.250	0.930	2,210	3.630	1.800
03/02/2014	0.570	2.080	1.250	0.930	2.210	1.630	1.800
03/03/2014	0.570	2.180	1.350	1.090	2.210	1.830	1.200
30/04/2014	0.570	1.680	1.350	1.090	2.110	2.030	1.600
02/05/2014	0.570	1,780	1.350	1.090	2.410	2.050	1.600
04/06/2014	0.670	1.880	1.350	1.130	2.410	2.030	1.699
03/07/2014	0.570	1.880	1.350	1.130	2.410	2.039	1.600
04/08/2014	0.570	1880	1.350	1.130	2,410	1.930	1.693
29/09/2014	0.570	1880	1.350	1.130	2410	1.930	1.600
21/10/2014	0.570	1,880	1.250	1.230	2.410	1.630	2.600
17/11/2014	0.570	1.880	1.250	1.230	2.410	1.630	2.000
03/12/2014	0.570	1.580	1.250	1.230	2.410	1.230	2.000

#### Table 2.3: Groundwater Level Monitoring 2014

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#### Figure 2.1: Groundwater Level Monitoring 2014



A seasonal variation of 0.10m to 0.80m is demonstrated Figure 2.1. The groundwater quality monitoring indicates that RC7 and RC8 are affected by saline intrusion from the estuary as seen in the intermittently high electrical conductivity levels due to the proximity of the Colligan Estuary which is tidal as far as SW2.

#### Hydraulic Parameters

There is no site specific information available on the hydraulic parameters from the previous site investigations undertaken at the site. Information on the hydrogeological parameters for the same geological units is available from the investigations at the Ballinamuck Public Supply which is located 500m west of the landfill site. Pump test data from the Dungarvan Public Supply at Ballinamuck indicates aquifer transmissivity in the range of 900 – 13,000m<sup>2</sup>/d. Permeabilities within the Waulsortian Linestone in the Dungarvan area have been assessed by the GSI as ranging from 25 to 190m/d with an effective porosity of 2.5% and a hydraulic gradient of 0.0015 being typical.

#### Geological Units of Interest

The main geologic units of interest with respect to groundwater flow and contaminant transport at the site are considered to be (i) sandy clayey gravel and cobbles layer within the overburden, deposits (ii) the regionally important karstified bedrock aquifer.

The landfill site is unlined and leachate from the waste body is discharging to the shallow groundwater in the overburden deposits and the deep groundwater in the bedrock aquifer beneath the site. Both the shallow groundwater and deep groundwater are discharging to the Coligan Estuary in the vicinity of the site. The proximity of the landfill to the tidally influenced section of the River Colligan results in the groundwater down gradient of the site being subject to saline intrusion.

The limestone bedrock beneath the site is classed as a Regionally Important Karst Aquifer. The main groundwater movement in the bedrock is expected to be top weathered interval and in the fractured and karstified intervals in the top 30m to 40m. The site specific data indicates significant development of cavities and karstification.

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The historic maps for the site and surrounding area have been examined. The 25° map (1898 – 1913) indicate potential for preferential flow zones former railway line which extended through the

site in a west to east direction; there was a mill race parallel to the Biver Colligan along the western site boundary. There is a spring shown in the south west corner of site; spring to north of site on north side of Biver Colligan; and a former quarry in the south east corner of the site. The area to the north east of the site on the north side of River Colligan is prone to flooding during spring tides.

The available site investigation information indicates 4m to 7m of overburden present beneath the waste body. Based on the guidelines published by the Department of Environment and Local Government, Environmental Protection Agency and Geological Survey of reland in the 1999 publication Groundwater Protection Schemes the site specific vulnerability for the bedrock aquifer is classed as moderate which agrees with the S5I map.

#### **3 CONCEPTUAL SITE MODEL**

A cross section has been prepared to graphically illustrate the conceptual site model for the Dungarvan Landfill Site and is presented as **Figure 3.1**. The section line was selected to intersect the available borehole locations in an approximate west to east direction.

#### 3.1 POTENTIAL SOURCE AREAS

#### 3.1.1 Landfill Source Area

The landfill site at Dungarvan operated from 1968 to 2003. The landfill ceased accepting waste for disposal in June 2003 but is currently being used as a civic amenity centre and transfer station for recyclable materials. It is estimated that 363,770 tonnes of waste has been landfilled at the site based on the 193,984 tonnes landfilled at the time of the licence application and a further 169,786 tonnes to be deposited post grant of licence. The landfill site is unlined and covers an area of approximately 6.5 hectares. The extent of the waste body for the licensed site is shown on the Site location & Site Layout Plan (Appendix A). The facility accepted mainly domestic and commercial refuse. It is also reported that chromium contaminated organic sludge from a tannery in Portlaw and some lead containing sludge from a lead crystal factory in Dungarvan was also deposited.

The source for potential groundwater contamination at the site is the leachate being generated from the degradation of the landfilled material. Prior to the installation of the final capping layer in 2008 rainfall was percolating through the waste body and generating leachate which subsequently discharged to the groundwater beneath the site and the River Colligan adjacent to the site. The installation of the engineered cap has significantly reduced the quantity of rainfall percolating through the waste body and consequently reduced the volume of leachate being generated. The original waste licence application calculated that the annual leachate generation at the site between 1985 and 2002 ranged from 41,209m<sup>3</sup>/annum to 63,910m<sup>3</sup>/annum. The EPA Landfill Site Design Manual (EPA, 2000) indicates a upper bound of 10% infiltration of effective rainfall for restored areas. Based on a site area of 69,143m<sup>3</sup> and an effective rainfall of 820mm per annum (CSI website) this equates to into restored area. The water belance estimated the leachate generation post capping to be of the order of 5,670m<sup>3</sup>/annum.

Since the waste lizence was granted for the site in 2002 a number of specified engineering works have taken place at the site to reduce the potential for leachate generation including the installation of surface water drains, leachate abstraction and collection system and final engineered capping layer in accordance with the licence conditions for the site. The leachate levels converted to mOD have been provided by Waterford City and County Council. Only data is available from L4 which indicates the leachate level is higher than groundwater elevations indicating the potential for migration of leachate to the shallow groundwater and the deeper groundwater through the base of the unlined waste body.

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#### Table 3.1: Leachate Level Monitoring 2014

Date	L5A	L4	LIA
.07/01/2014	0.83	2.3	0.25
03/02/2014	0.83	2.3	0.25
08/08/2014	0.83	2.4	0.25
30/04/2014	0.83	2.4	0.25
02/05/2014	0.83	2.7	0.25
04/06/2014	1.63	2.3	2.15
03/07/2014	1.63	2.8	2.15
04/08/2014	1.63	2,6	2.16
29/09/2014	1.63	2,4	2.15
21/10/2014	1.23	2.4	0.95
17/11/2014	1.23	2.4	0.95
03/12/2014	1.23	2.4	0.95

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Dungarvan Landfill - Conceptual Site Model Cross Section n.t.s.



#### 3.1.2 Leachate Composition

The leachate monitoring data for the period 2014 and 2015 has been reviewed to identify the contaminants of potential concern (COPC) at the site. The Waste Licence (W0032-03) requires the monitoring of the leachate composition at the leachate sumps (undiluted leachate) and the Lagoon Marsh. Monitoring at Lagoon Marsh is required until a discharge pipe from the constructed wetland system is commissioned and operational. Leochate monitoring data is available from Waterford Dity and County Council from the following leachate monitoring locations. Interceptor; ICW Pond 1 In, CW Pond 2 In; ICW Pond 3 In; ICW Pond 4 In; ICW Pond 5 In and ICW Pond Cut however this data represents diluted and treated leachate and is not representative of the leachate discharging, through the base of the waste mound. A copy of the available data is presented in Appendix E, Table £ 1 for information purposes.

The data for the interceptor sampling location has been compared to the Environmental Objectives Groundwater Regulations (SI No. 9 of 2010) threshold values and the typical leachate compositions (Landfill Site Design Manual, Table 7.2, EPA 2000) (Appendix E, Table 5.2). The data indicates the leachate composition is at the lower end of the range reported for methanogenic leachate (Landfill Site Design Manual, EPA 2000). The available data from 2010 to 2015 for the Interceptor was reviewed and identified the following potential contaminants of concern: ammonia (< 0.02 to 59 mg/l), chloride (70 – 173 mg/l), electrical conductivity (530 - 1,720 us/cm), Iron (610 - 1,300 ug/l), manganese (510 - 600 ug/l), potassium (12 - 25 mg/l). No List I / II substances were detected at concentrations above the detection limit. No hazardous substances have been detected at concentrations above the screening values.

#### 3.2 PATHWAYS

The Dungarvan Landfill site is an unlined site. The deposition of waste has taken place on top of the original ground surface in an area of reclaimed estuarine land. The waste body is separated from the underlying bedrock aguiler by 4m to 7m of overburden deposits.

The main pathway for the discharge of leachate from the site is expected to be to be via the shallow groundwater in the overburden deposits and the deeper groundwater in the bedrock aquifer to the estuarine portion of the River Colligan adjacent to the landfill site. The site investigation data indicate that the main pathways for the preferential migration of leachate off-site as shown on Figure 3.1 are:-

- Leachate vertically migrating to the shallow groundwater in the sandy clayey gravel layer within the overburden deposits.
- Leachate in the shallow groundwater vertically migrating to the deeper groundwater in the regionally important karstified limestone aquifer (groundwater flow concentrated in top 30 – 40m of bedrock).
- Shallow groundwater in the overburden deposits horizontally migrating to the River Eoligan / Colligan Estuary.
- Deeper groundwater in the bedrock aquifer horizontally migrating to the Colligan Estuary and Dungarvan Harbour.

The vulnerability of the groundwater in the bedrock aquifer beneath the waste body landfill, as per the GSI vulnerability classification scheme, is moderate.

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#### 3.3 RECEPTORS

The following receptors have been assessed:-

- Orinking Water Supplies.
- Recreational Waters.
- Designated Sites

#### **Drinking Water Supplies**

The landfill site is located on a Regionally important Aquifer (Rkd). In addition to the current groundwater usage in the area the "uture resource potential needs to be considered as the groundwater body is classed under the WFD Register of Protected Areas as Groundwater for Drinking Water.

The wells which supply groundwater to the Dungarvan Public Supply are located 500m west of the landfill site. The GS delinested the Groundwater Source Protection Zones for the Dungarvan Supply (June 1998). The landfill site is indicated as being down gradient and outside of the zone of contribution for the public supply.

No private well users have been identified down gradient of the site. There are no properties located hydraulically down gradient of the site between the landfill and the Biver Colligan. There are a number of private wells located on the north side of the River Colligan, north of the landfill site in the vicinity of the N72. These boreholes are not located down gradient of the waste body as groundwater flow in this area is expected to be towards the River Colligan in addition the landfill site would not be located within the zone of contribution of these private wells.

#### **Recreational Waters**

The Clonea Beach Bathing Water Area is located approximately 6km from the landfill site. The innerportion of Dungarvan Harbour is not included in "Surface Water in Bathing Locations". The groundwater from the vicinity of the landfill site is not included in "Groundwater in Bathing Locations". The landfill site does not directly discharge to the Surface Water in Bathing Locations however the landfill site may be indirectly linked to the Clonea Beach Bathing Water Area. Groundwater from the beneath the landfill site discharges to the River Colligan which subsequently discharges to Dungarvan Harbour which is classed as a Surface water in Bathing Locations.

#### Shellfish Waters

The EPA online mapping Indicates a Shelffish Area (Protected Area Code PA2\_0045) located approximately 4km from the landfill site. The Colligan Estuary (Transitional Water) is included as a surface water within this Shelffish Area. The Shelffish Area is located immediately east of Cunnigar and Whitehouse Bank.

#### **Designated Sites**

Dungarvan Harbour is a designated Special Protection Area (SPA) under the EU Birds Directive. The designated site covers an area of 1,041 ha located along the River Colligan Estuary as far upstream as the highest point to which ordinary tides flow (surface water monitoring location SW2). The River Colligan and groundwater are classed as contributing to SPA habitats.

Dungarvan Harbour is proposed for designation as a Natural Heritage Area (pNHA). The pNHA boundary extends above Ballyneety Bridge and adjacent to the landfill site boundary.

There is potential for the discharge of groundwater and surface water from the landfill to discharge to the Dungarvan Harbour 5PA and pNHA. There is no designated Special Area of Conservation (SAC) located down gradient of the landfill.

#### 3.4 SPR LINKAGES - RISK SCREENING

The risk screening process is based on the Source – Pathway – Receptor model. This requires the assessment of whether the source (waste body) and receptors are linked by one or more pathways as summarised in Table 3.2.

The assessment of risk as low, medium or high has been carried out by examining the link between each risk factor and a review of the site specific water quality monitoring data.

#### Table 3.2: Risk Assessment

Source	Pathway	Receptor	Risk
Waste body composed of domestic, commercial and construction and demolition waste. The site is unlined but the waste body is capped. The main contaminant of concern is ammonia. Elevated concentrations of iron, manganese, aluminium, chloride, arsenic, potassium, nickel, barium and lead have also been measured.	Leachate vertically migrating to shallow groundwater	Drinking Water Supplies No potential groundwater users have been identified for the shallow groundwater down gradient of site.	The site is unlined and waste is directly located on overburden deposits. Evidence from groundwater quality monitoring in the overburden indicates that leachate is discharging to shallow groundwater beneath the landfill site. No potential shallow groundwater users have been identified down gradient of the site. No risk identified.
	Leachate vertically migrating to deeper groundwater in bedrock aquifer (top 30m to 40m)	Drinking Water Supplies No potential groundwater users have been identified for the deeper groundwater down gradient of site.	The site is unlined and the waste is separated from the deeper groundwater by the 4m to 7m of overburden deposits. The groundwater quality monitoring from RC3A and RC6A for 2014 & 2015 indicates elevated concentrations in the deeper groundwater beneath the landfill site. It is recommended that an additional monitoring borehole be installed at the landfill site to monitor the composition of the groundwater in the bedrock aquifer for compliance monitoring purposes. No risk identified to drinking water supplies as no supplies at present.
	Leachate vertically migrating to shallow groundwater	Recreational Waters There is potential for shallow groundwater from beneath the site to indirectly discharge to the Clonea Beach Bathing Water which is located 6km down gradient of the landfill site.	The volume of leachate being produced is low in terms of the dilution available within the River Colligan and Colligan Estuary. In addition further dilution is available within Dungarvan Harbour. The surface water quality data indicates no issue with elevated concentrations of

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Source	Pathway	Receptor	Risk
			contaminants of potential concern in the Immediate vicinity of the site at 5W2 and EPA Station No. 300. The most recent Bathing Water Status for 2015 for Clonea Strand is classed as excellent. No Risk identified to Clonea Beach Bathing Water.
	Leachate vertically migrating to deeper groundwater in bedrock aquifer (top 30m to 40m)	Recreational Waters There is potential for the deeper groundwater from beneath the site to discharge indirectly to the Clonea Beach Bathing Water which is located 6km down gradient of the landfill site.	The volume of leachate being produced is low in terms of the dilution available within the River Colligan and Colligan Estuary. In addition further dilution is available within Dungarvan Harbour. The surface water quality data indicates no issue with elevated concentrations of contaminants of potential concern in the immediate vicinity of the site at 5W2 and EPA Station No. 300. The most recent Bathing Water Status for 2015 for Clonea Strand is classed as excellent. No Risk identified to Clonea Beach Bathing Water Status
	Leachate vertically migrating to shallow groundwater	Shellfish Waters There is potential for the shallow groundwater from beneath the site to indirectly discharge to the Shellfish area within Dungarvan Harbour located 4km down gradient of the landfill site.	The volume of leachate being produced is low in terms of the dilution available within the River Colligan and Colligan Estuary. In addition further dilution is available within Dungarvan Harbour. The surface water quality data indicates no issue with elevated concentrations of contaminants of potential concern in the immediate vicinity of the site at 5W2 and EPA Station No. 300. No Risk identified to Shellfish Waters.

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Source	Pathway	Receptor	Risk
	Leachate vertically migrating to deepan groundwater in bedrock squifer (top 30m to 40m).	Shellfish Waters There is potential for the deeper groundwater from beneath the site to indirectly discharge to the Shellfish area within Dungarvan Harbour losated 4km down gradient of the landfill site.	The volume of leachate being produced is low in terms of the dilution available within the River Coiligan and Coiligan Estuary. In addition further dilution is available within Dungarvan Harbour. The surface water quality data indicates no issue with elevated concentrations of contaminants of patential concern in the immediate vicinity of the site at SW2 and EPA Station No. 300. No: Risk identified to Shellfish Waters.
	Leachate vertically migrating to shallow groundwater	Designated Sites There is potential for the shallow groundwater from beneath the site to discharge to the Dungarwan Harbour Spacial Protection Area (SPA) which is located immediately adjacent to the landfill site. There is potential for landfill to impact on surface water quality due to elevated concentrations (i.e. elevated ammonia) and on the aquetic habitats.	The 2014 & 2015 monitoring data indicates no issues with surface water quality adjacent to the site. The volume of leachate being produced is low in terms of the dilution available within the River Colligan and Colligan Estuary. The risk is classed as Low Risk.
	Leachate vertically migrating to deeper groundwater in bedrock aquifer (top 30m to 40m).	Designated Sites There is potential far the deeper groundwater from baneath the site to discharge to the Dungarvan Harbour Special Protection Area (SPA) which is located immediately adjacent to the landfill site. There is potential for landfill to impact on surface water quality due to alevated concentrations (i.e. alevated ammonia) and on the aquatic habitats.	The 2014 S 2015 monitoring data indicates no issues with surface water guality adjacent to the site. The volume of leachate being produced is low in terms of the dilution available within the River Colligan and Colligan Estuary. The risk is classed as Low Risk.

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#### 3.5 APPROPRIATE TIER OF ASSESSMENT

The Source Pathway Receptor methodology has been followed. The EPA "Hydrogeological Review / Technical Assessment Report Template" outlines that a tiered approach is recommended in assessing potential impacts on groundwater and other potential receptors.

#### 3.6 CONCLUSION

The monitoring data indicates that the following parameters are present at concentrations above the screening levels: ammonia, iron, manganese, aluminium, chloride, arsenic, potassium, nickel, barium and lead. The main contaminant of concern at the site is ammonia.

Prior to the completion of this report a Generic Quantitative Risk Assessment (GORA) had not been prepared for this site. Generally all landfills are required undertake a Tier 3 assessment, which is considered to be analogous to a DQRA unless there is clear evidence that the risk to groundwater is low.

The risk screening indicates that the site represents a low risk to the identified receptors. Immediately down gradient of the site the groundwater is discharging to the tidal portion of the River Colligan. No groundwater users have been identified down gradient of the site and due to the proximity of saline water and none are likely to be developed in the future. The landfill site does not represent a risk to the Clonea Beach Bathing Water Area or the Shellfish Waters in Dungarvan due to the distance from the landfill site and the dilution available. The risk to the adjacent designated sites, Dungarvan harbour SPA and pNHA, is classed as low based on the existing water quality data, the low strength of the leachate and the dilution available in the River Colligan.

The results of the risk screening indicate no risk or a low risk to the all of the identified receptors at the site. A detailed quantitative risk assessment has not been undertaken at the site. Based on the identified low risks at the site and the results of the groundwater and surface water monitoring the undertaking of a Detailed Quantitative Risk Assessment (DQRA) is not considered necessary. The existing monitoring programme (existing surface water and groundwater) is considered to be adequate to monitor changing groundwater composition.

It is recommended that the current environmental monitoring programme be continued. It is recommended that an additional groundwater monitoring borehole be installed down gradient of the site to monitor the groundwater quality in the bedrock aquifer.

#### APPENDIX A

#### DRAWINGS

- 1. Monitoring Locations Drawing No. MDR0350/DG0505
- 2. Leachate Extraction & Treatment System Drawing MDR0350/Dg0712.

#### 7 SUMMARY, CONCLUSIONS & RECOMMENDATIONS

The conceptual site model has been presented in Chapter 3 of this report and is illustrated on Figure 3.1. There is considered to be sufficient site investigation data available for the development of the conceptual site model and the identification of the groundwater flow intervals.

The limit objective under the Groundwater Regulations requires that all necessary measures should be taken to limit inputs of non hazardous substances to groundwater to ensure that such inputs do not cause pollution, deterioration in status of groundwater bodies or cause sustained upward trends in groundwater concentrations. The site is considered to be compliant with the limit objective of the Water Framework Directive and Groundwater Directive.

The prevent objective of the Groundwater Regulations requires that hazardous substances should not be permitted to enter the groundwater. Arsenic was the only hazardous substance identified at concentrations above the threshold set in the groundwater regulations but this was limited to one sampling date and there is no evidence of a widespread issue with arsenic at the site.

Remedial measures have been undertaken at the site between 2008 and 2012 which have included the installation of a leachate abstraction system, surface water management system and engineered final cap. The purpose of these remedial works has been to prevent or limit the input of pollutants into groundwater beneath the site and surface water down gradient of the site. The installation of the engineered cap has reduced the volume of leachate being generated at the site.

The available groundwater monitoring data for 2014 and 2015 has been reviewed to identify the potential contaminants of concern. The potential contaminants of concern include: ammonia, iron, manganese, aluminium, chloride, arsenic, potassium, nickel, barium and lead. Ammonia is the main contaminant of concern. It is recommended that monitoring of COPC be undertaken at the frequencies outlined in Table 6.1 and at the proposed compliance monitoring locations in addition to the monitoring specified by the waste licence.

There is no evidence of an upward trend in contaminant concentrations at the site or an expanding plume of contamination. As the site is located in an estuarine location the area affected by the plume is limited to the immediate vicinity of the waste body as the groundwater and leachate is discharging to the adjacent estuarine waters where significant dilution is available (1:1,780).

There is no evidence of the existing surface water quality being impacted from leachate discharges from the landfill site.

No existing down gradient groundwater users have been identified and based on the proximity of site to the Colligan Estuary and the proximity of saline water groundwater is not expected to be developed down gradient of the site.

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#### Dungarian Lansfill - Hydrogeological Review

Parameter	Standard To be Achieved In Surface Water	Proposed Compliance Value
iron	There is no specific standard set for iron in S.I. No. 272 of 2009 Surface Water Regulations. There is no threshold specified for iron in S.I. No. 9 of 2010 Groundwater Regulations. The GSI / EPA publication Towards Setting indicated an EQS of 1.0mg/l for iron in surface water.	1,780 mg/l
Nickel	The threshold specified for nickel 5.1. No. 9 of 2010 Groundwater Regulations is 15 ug/l.	26.7 mg/l
Manganese	There is no specific standard set for manganese in S.J. No. 272 of 2009 Surface Water Regulations. There is no threshold specified for manganese in S.I. No. 9 of 2010 Groundwater Regulations. The GSI / EPA publication Towards Setting indicated an EQS of 0.3mg/l for manganese in surface water.	534 mg/l
Potassium	There is no threshold specified for potassium in S.J. No. 9 of 2010 Groundwater Regulations. The IGV is set as 5 mg/L	8,900 mg/l
Aluminium	There is no threshold specified for aluminium in S.I. No. 9 of 2010 Groundwater Regulations. The IGV is set as 200 ug/l.	356 mg/l
Barium	There is no threshold specified for barium in S.I. No. 9 of 2010 Groundwater Regulations. The IGV is set as 100 ug/l.	178 mg/l

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It is recommended that a new down gradient monitoring borehole be provided for monitoring of the groundwater composition in the bedrock aguifer down gradient of the landfill.

The standards which have been considered in the setting of compliance values for the groundwater include the following:-

- European Communities (Drinking Water) Regulations 2014 (S.I. No. 144 of 2014);
- European Communities Environmental Objectives (Groundwater) Regulations 2010 (S.I. No. 9 of 2010) (groundwater threshold values for assessment of whether groundwater intended for human consumption in drinking water protected areas is impacted by pollutants and / or is showing a significant and sustained rise in pollutant levels);
- European Communities Environmental Objectives (Surface Waters) Regulation 2009 (S.I. No. 272 of 2009);
- Bathing Water Quality Regulations S.I. No. 79 of 2008.

On this basis the compliance values outlined in **Table 6.2** have been set for groundwater. The use of these compliance values will ensure the Environmental Quality Standards for Surface Water are also met based on the available dilution in the down gradient surface water body.

The EPA online mapping indicates that the landfill site is located in the Hydrometric Area 17 catchment of Colligan-Mahon. The catchment area to the staff gauge located 100m up gradient of the site is 96.354km<sup>2</sup>. The dry weather flow is reported as 0.32m<sup>3</sup>/s with a 95%ile flow of 0.50m<sup>3</sup>/sec. The volume of leachate being generated at the site is estimated to be of the order of 5,670m<sup>3</sup>/annum. This equates to a dilution factor of 1: 1,780 taking the dry weather flow. This excludes the effect of dilution from the tidal action within the Colligan Estuary and is therefore a conservative estimate.

The dilution factor of 1,780 has been taken in to account in the back calculations of the compliance values for the contaminants of potential concern. This indicates compliance values are significantly higher than the current concentrations in the groundwater at the site. On this basis, the current groundwater quality is compliant with the proposed compliance values.

Parameter	Parameter Standard To be Achieved In Surface Water		
Ammonia	There is no specific standard set for ammonia in S.I. No. 272 of 2009 Surface Water Regulations. The 65 ug/l (0.065 mg/l) threshold value for assessment of adverse impacts of chemical inputs from groundwater on associated surface water bodies has been used as a more conservative measure.	115 mg/l	
Arsenic	There limit for arsenic is in surface water is 20ug/l (0.02 mg/l) based on annual average environmental quality standard, Table 10 S.I. 272 of 2009 for Other Surface Waters.	35.6 mg/i	
Chloride	The limit specified for chloride in S.I. No. 272 of 2009 Surface Water Regulations is 187.5 mg/l.	333,750 mg/l	

#### Table 6.2: Compliance Values for Contaminants of Potential Concern

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#### 6 GROUNDWATER COMPLIANCE MONITORING

The proposed monitoring frequencies and the proposed parameters for compliance monitoring for groundwater analysis are outlined in **Table 6.1**. Details of the current groundwater monitoring programme are also included in **Table 6.1** for information purposes. The contaminants of concern are highlighted in bold in Table 6.1.

#### Table 6.1: Compliance Monitoring

Parameter	Recommended Compliance Groundwater Monitoring	Current Groundwater Monitoring as per Licence W0032-03
Borehole Locations	Shallow groundwater: RC8 & RC7. Deep groundwater: RC6A and New Borehole.	GW1, GW2A, RC3A, RC4, RC6A, RC7, RC8a.
Visual Inspection / Odour	Quarterly	Quarterly
Groundwater Level	Monthly	Monthly
Ammonia	Quarterly	Quarterly
Arsenic	Quarterly	Not Required
Cadmium	Annually	Annually
Chloride	Quarterly	Quarterly
Chromium (total)	Annually	Annually
Copper	Annualty	Annually
Dissolved Oxygen	Quarterly	Annually
Electrical Conductivity	Quarterly	Quarterly
Iron	Quarterly	Quarterly
Lead	Annualty	Annually
Nickel	Annually	Annually
Magnesium	Annually	Annually
Manganese	Quarterly	Annually
Mercury	Annually	Annually
Ortho-phosphate	Annually	Annually
Total Phosphorus	Annually	Annually
pН	Quarterly	Quarterly
Potassium	Quarterly	Annually
Sulphate	Annually	Annualty
Temperature	Quarterly	Quarterly
Total Oxidised Nitrogen	Quarterly	Quarterly
Total Alkalinity	Annually	Annually
Zinc	Annually	Annually
Aluminium	Quarterly	Not Required
Barium	Quarterly	Not Required
Fluoride	Biannually	Biannually

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#### 5 REMEDIAL STRATEGY

The purpose of this report is to demonstrate compliance with the Groundwater Regulations (S.I. No. 9 of 2010). The aim of the Groundwater Regulations is to ensure the objectives for groundwater set by the Water Framework Directive (2000/60/EC) and the Groundwater Directive (2006/118/EC) are achieved. There are currently no authorised discharges of groundwater at the site.

The risk screening has determined no risk or a low level of risk at the site to potential receptors. The groundwater from beneath the landfill site is discharging to Colligan Estuary and Dungarvan Harbour. There is no evidence of a significant risk to the surface water quality down gradient of the site, to shellfish waters, bathing waters or to the designated sites (SPA and pNHA).

The site is considered to be compliant in terms of the limit objective of the groundwater regulations. The installation of the engineered final cap, leachate abstractions system and integrated constructed wetlands have significantly reduced the volume and strength of the leachate being generated at the site.

The site is considered to be compliant in terms of the prevent objective in terms of the discharge of hazardous substances. Arsenic was the only hazardous substance identified at concentrations above the threshold set in the groundwater regulations but this was limited to one sampling date and there is no evidence of a widespread issue with arsenic at the site. It is recommended that quarterly monitoring of arsenic be undertaken to monitor the situation.

It has not been possible to locate the borehole logs for RC7 and RC8 but they are reported to be monitoring the groundwater composition in the overburden deposits. There is currently no groundwater monitoring borehole in the bedrock aquifer located down gradient of the waste body outside of the landfill site. It is recommended that a monitoring borehole in the bedrock aquifer be installed along the eastern site boundary to serve as a compliance monitoring point in the bedrock aquifer. It is proposed that the monitoring borehole will be installed in Spring 2016 following receipt of approval from the EPA to progress. It is recommended that a groundwater monitoring borehole be installed in the bedrock aquifer down gradient of the waste body to serve as a compliance monitoring point in the bedrock aquifer.

Due to the proximity of the site to the Colligan Estuary both the shallow groundwater in the overburden deposits and the deeper groundwater in the bedrock aquifer will be discharging to the estuarine waters. This results in significant dilution of the groundwater. This limits the extent of the groundwater contamination to the groundwater in the immediate vicinity of the site.

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#### 4.3 CHEMICAL STATUS OF GROUNDWATER BODY

#### 4.3.1 Direct Discharges to Groundwater

Dungarvan Landfill site was developed as an unlined landfill site. Monitoring of the leachate composition at the site indicates a number of contaminants are above the groundwater threshold values. The site is unlined and leachate is discharging to the shallow and deep groundwater beneath the site. There is between 4m and 7 of overburden present across the site beneath the waste body. Previously waste was encountered at RC1 on top of bedrock in the south east corner of the site however this area is now occupied by the waste transfer station and surfaced resulting in no percolation of rainfall in this area. On this basis there are no direct discharges to groundwater. There are indirect discharges of pollutants to groundwater after percolation through the overburden deposits across the remainder of the site.

#### 4.3.2 Impact on Surface Water Bodies

Of the parameters of potential concern ammonia has been identified as the main parameter of concern due to the fact that its concentration in the groundwater beneath the landfill site is in excess of 100 times the screening value (0.065 mg/l S.I. 9 2010 GW Regs Limits Column 2 Adverse Impact on Surface Water Bodies). The ammonia concentration in both the shallow and deep groundwater is contributing to the River Colligan / Colligan Estuary at concentrations that are significantly higher than the river water standard for good status (0.065 mg/l). There are no standards specified for ammonia concentration in coastal waters. The results of surface water quality monitoring within River Colligan indicate no impact on the down gradient surface water quality.

The Water Framework Directive (WFD) Status (2010 – 2012) for the River Colligan is "Good Status" and "Moderate Status" for the Colligan Estuary.

The WFD risk score for the River Colligan is category 2a "expected to achieve good status" while the risk score for the Colligan Estuary is category 1a "at risk of not achieving good status". The full report for the Colligan Estuary Waterbody indicates the risks relate to morphological risk and point source from waste water treatment plant.

#### 4.3.3 Impact on Groundwater Bodies

Information on the EPA website indicates the Water Framework Directive (WFD) status 2007 – 2012 for the Dungarvan Groundwater Body indicates as "Good Status". The WFD Risk Score for the Dungarvan Groundwater Body Risk Score is category 1a "at risk of not achieving good status" however no risk score is provided for the area of the landfill site itself for which "no results returned".

Information on the groundwater shallow quality down gradient of the site is available from monitoring location RC7 which indicates no issue with the groundwater quality down gradient of the site. The available data for 2014 and 2015 for this monitoring location indicates the ammonia concentration is generally less than the 0.065 mg/l threshold value set in the groundwater regulations (highest concentration 0.85 mg/l Q3, 201).
Monitoring of the quarterly surface water composition includes the analysis of: BOD, COD, electrical conductivity, dissolved oxygen, pH, suspended solids and temperature. The available results of the quarterly monitoring for 2014 and 2015 are presented in Tables C.1 to C.5 in Appendix C. The results of the quarterly monitoring at the surface water monitoring locations indicate no issues with the water quality. The changing tidal conditions in the vicinity of the site can be seen in the variation of the electrical conductivity. Low blochemical oxygen demand and chemical oxygen demand results were obtained on all sampling dates.

SI No. 272 of 2009 European Communities Environmental Objectives (Surface Waters) Regulations outlines that for river water bodies the dissolved oxygen concentration should be between 80% and 120% saturation for 95% I. The dissolved oxygen concentrations on all sampling dates (except SW Lagoon) were within the range specified for both river water bodies and transitional water bodies. The pH was within the range specified for river water bodies. The BOD was below the 1.0mg/l detection limit at all of the sampling locations within the River Colligan and Colligan Estuary. The BOD concentration is within the limit set for high status for river water bodies. The concentration within the surface water lagoon ranged from < 1.0 to 3.6 mg/l and is within the limit of 4.0mg/l specified for transitional water body.

Information on the biological assessment of the surface water is available from the 2013 / 2014 Ecology Report from the 2014 Annual Environmental Report states "the results of the 2012 biological assessment of the River Colligan indicated good quality status at the upstream site (Site 1) following analysis of both the surface water quality and biological water quality data. An improvement of the water quality at Site 1 (in comparison with 2006) and the increase in the diversity of species at downstream connecting sites, coupled with the review of water quality measurements taken on site and the EPA chemical water quality data between 2007 and 2008, reflects good water quality indicating that the Dungarvan Landfill site is not negatively impacting the River Colligan".

The EPA surface water quality monitoring data 2010 – 2012 for the Colligan Estuary Transitional Water Body indicate "intermediate" status. The river water quality data 2004 to present indicates a Q3-4 moderate status for the closest monitoring point to the site which is Kildangan Bridge which is located approximately 1km up gradient of the site.

The WFD status 2010 – 2012 for the Colligan River is classed as "Good". The WFD status for Colligan Estuary Transitional Waterbody Status 2010 – 2012 is classed as "Moderate".

The WFD risk score for the Colligan River is classed as 2a "expected to achieve good status". The WRF risk score for the Transitional Water Body is 1a " at risk of not achieving good status".

The results of the surface water quality monitoring at EPA Station No. 280, SW2 and EPA Station No. 300 indicate no impact on the surface water quality in the River Colligan and Colligan Estuary. There are no identified drinking water sources down gradient of the site. Due to the proximity of the site to the estuarine section of the River Colligan and the saline conditions adjacent to the site there is no potential for the development of groundwater resources for drinking water purposes down gradient of the landfill site. No impact on drinking water sources has been identified.

There is potential for impact on the surface water bodies down gradient of the site due to the discharge of groundwater to the surface water bodies. Clonea Beach is located approximately 6km down gradient of the landfill site and is designated as a Bathing Water Area. The Bathing Water Quality In Ireland Report (EPA, 2015) indicates the Clonea Strand Bathing Water Area has an overall status assessment of excellent. No impact on bathing water down gradient of the site has been identified. Due to the distance from the landfill site and the dilution available in the Colligan Estuary and Dungarvan Harbour the landfill site is not considered to represent a risk to the Bathing Water Quality.

There is a shellfish area located 4km down gradient of the site. No impact on the shellfish water has been identified. Due to the distance from the landfill site and the dilution available in the Colligan Estuary and Dungarvan Harbour the landfill site is not considered to represent a risk to the shellfish area.

The Dungarvan Harbour SPA includes the Colligan Estuary which is located immediately adjacent to the site. The SPA extends to the highest point to which ordinary tides flow. There is potential for the leachate to impact on the surface water quality in the River Colligan and Colligan Estuary adjacent to the site. In particular increase nutrients such as ammonia could impact on the aquatic habitats. Surface water quality monitoring is undertaken by WCC at 5 no. locations as shown on Drawing MDR0350/DG0505 Monitoring Points (Appendix A):-

- SW1 northern eastern boundary of site in Colligan Estuary in area indicated as transitional water body with saline effects / brackish water expected;
- SW2 northern boundary of site also indicated as being within Colligan Estuary located to point to "highest point to which ordinary tides flow" based on historic maps;
- EPA Station No. 280 located on River Colligan upstream of landfill located in area of River Colligan unaffected by tidal conditions;
- EPA Station No. 300 located at Ballyneety Bridge in Colligan Estuary located downstream of landfill and subject to saline conditions;
- Surface water lagoon.

The surface water results have been compared to a number of limits for screening purposes:-

- EQS for surface water based on the EPA / GSI 2003 publication Towards Setting Guideline Values for the Protection of Groundwater In Ireland;
- Category A1 limits, i.e. least treatment, set by the European Communities (Quality of Surface Water Intended for the Abstraction of Drinking Water) Regulations, 1989;
- European Union (Drinking Water) Regulations 2014 (SI No. 122 of 2014).
- S.I. No. 272 of 2009 European Communities Environmental Objectives (Surface Waters) Regulations 2009 (Table 10 physico-chemcial conditions supporting the biological elements).
- European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2012.

#### Lead

Lead was not listed in EPA publication (Classification of Hazardous and Non Hazardous Substances In Groundwater, EPA December 2010). Lead was previously listed as List II i.e. substances that are to be controlled to prevent groundwater pollution. The Groundwater Regulations set the threshold value for lead at 18.75 ug/l. At RC6a elevated concentration of 200 ug/l reported on Q2 2014 but the levels subsequently reduced to less than screening value. In general the concentration of lead was below the screening values at the site.

#### Conclusion

The installation of the final capping has significantly reduced the volume of leachate being generated. The original waste licence application calculated that the annual leachate generation at the site between 1985 and 2002 ranged from 41,709m<sup>3</sup>/annum to 63,910m<sup>3</sup>/annum while post capping based on the upper bound figure of 10% infiltration of effective rainfall leachate generation is expected to be of the order of 5,670m<sup>3</sup>/annum. On this basis the site is considered to be meeting the limit objective with respect to the discharge of non hazardous substances (ammonia, iron, manganese, aluminium, chloride, potassium, nickel, barium and lead).

The dissolved oxygen levels and the iron and manganese concentrations indicate that natural attenuation is taking place at the site with reductions seen at RC7 the down gradient monitoring location in the overburden deposits.

No list I / II organic substances have been detected at concentrations above the detection limits at the site during the 2014 / 2015 monitoring rounds. Arsenic is the only hazardous substance identified to exceed the screening values at the site and the exceedance related to monitoring locations RC3a in the groundwater in the bedrock beneath the waste body during Q3 2014. The arsenic concentrations at the other monitoring locations were within the screening values and arsenic contamination is not considered to be an issue at the site. It is recommended that monitoring of arsenic levels be increased to quarterly and the situation monitored.

The contamination plume is limited to the area in the immediate vicinity of the waste body as the groundwater and leachate is discharging to the adjacent surface water (River Colligan/Colligan Estuary) where significant dilution is available.

# 4.2 IMPACT ON RECEPTORS

Prior to the preparation of this hydrogeological review a Generic Quantitative Risk Assessment had not been undertaken at the site. As part of this report the results of the 2014 and 2015 groundwater monitoring at the site have been reviewed and compared to screening values as part of the risk assessment process. The results indicate there is potential for impact on the groundwater quality beneath the landfill site.

The landfill site is unlined and the results of the groundwater monitoring at the site indicate that the shallow groundwater in the overburden deposits and the deeper groundwater in the bedrock aquifer beneath are contaminated based on the results from the current groundwater monitoring boreholes. Ammonia has been identified as the main contaminant of concern as it occurs in concentrations which exceed the 100 times the screening value (threshold value of 0.065 mg/l).

#### Chloride

RC4 indicates background chloride concentration of 29 to 33 mg/l in the groundwater in the bedrock. Down gradient of the waste body the chloride concentration in the deeper groundwater is seen to increase at RC3a (range 95 to 165 mg/l) and at RC6A (range 98 to 443 mg/l).

In the shallower groundwater in the overburden deposits the concentration at GW1 ranged from 16 to 54 mg/l. Monitoring location RC7 down gradient of the landfill site compared displayed a range of 670 to > 7,333 mg/l. Monitoring location RC7 is tidal in nature and the chloride concentration will be affected by saline conditions. Chloride is not classed as a hazardous substance.

### Arsenic

Arsenic is classed as a hazardous substance (Classification of Hazardous and Non Hazardous Substances In Groundwater, EPA December 2010). Concentrations in excess of the IGV of 10 ug/l and the threshold value (SI No. 9 of 2010) were measured at RC3a 21 ug/l in Q3 2014. No other exceedances were seen at any of the monitoring points for the remainder of the 2014 and 2015 samples date. On this basis arsenic not considered to be an issue at the site. It is recommended that the situation be monitored to confirm that arsenic is not an issue at the site with the quarterly monitoring of arsenic at the compliance monitoring points.

### Potassium

The background potassium concentration at RC4 ranged from < 0.25 to 1.6 mg/l. Potassium elevated in bedrock aquifer at RC3a {range 3.9 to 43 mg/l} and RC6a (range 2.7 to 50 mg/l) indicating impact on groundwater from landfill. In RC7 in the shallower groundwater the concentration ranged from 3.4 to 230 mg/l and is affected by saline conditions. Potassium is not classed as a hazardous substance.

### Nickel

At RC4 which is considered to represent background concentrations a nickel concentration < 1.0 ug/l (detection limit). Concentrations above the 15 ug/l threshold set in the groundwater regulations were measured at RC3a. At RC3a the nickel concentration in Q2 2014 was 38 ug/l and 43 ug/l in Q3 2014. The concentration subsequently reduced to 3.8 ug/l in Q1 2015. No indication of widespread nickel contamination in the groundwater with all other sampling locations indicting concentrations within the screening values. Nickel is listed as non hazardous substance (Classification of Hazardous and Non Hazardous Substances In Groundwater, EPA December 2010).

#### Barium

Barium is listed as non-hazardous substance (Classification of Hazardous and Non Hazardous Substances in Groundwater, EPA December 2010). Barium concentrations above the IGV of 100 ug/l were measured at a number of locations. At GW1 in Q3 2014 a concentration of 120 ug/l was reported. At RC3a in Q2 2014 a level of 110 ug/l was measured with 210 ug/l in Q3 2014 however the levels subsequently reduced in Q1 2015 to 18 ug/l. At RC7 in Q3 2014 a concentration of 120 ug/l was detected. Low iron concentrations are seen at RC4 which is considered to represent the background groundwater quality in the bedrock aquifer. The other groundwater monitoring boreholes in the bedrock indicated elevated concentrations. The iron concentration at RC3a indicated a range of 500 to 9,700 ug/l with a range of 170 to 6,000 ug/l at RC6a. Higher concentrations were seen in the groundwater in the overburden at GW1 where levels of 400 to 45,000 ug/l were observed but generally < 20,000 ug/l. RC7 in overburden deposits down gradient of site indicates a typical iron concentration of 730 to 1,900 ug/l. The elevated iron concentrations in the groundwater within the landfill site are as a result of the low levels of dissolved oxygen and indicate that natural attenuation processes are taking place beneath the waste body particularly within the overburden deposits.

The concentration of iron is currently monitored on a quarterly basis in accordance with the Waste Licence and it is recommended that this monitoring frequency be maintained at the compliance monitoring points.

#### Manganese

There are no groundwater threshold values specified for manganese in the Groundwater Regulations. Manganese is not classed as a hazardous substance in the EPA publication "Classification of Hazardous and Non Hazardous Substances In Groundwater" (EPA, December 2010). The IGV for manganese is 50 ug/l. The manganese concentration is only above 100 times the screening value at GW1 in Q3 2014.

RC4 which is considered to represent the background concentration in the bedrock aquifer indicated a concentration range of < 5 to 20 ug/l. Elevated manganese concentrations were measured in bedrock aquifer beneath the waste body at RC3a (range of 210 to 2,300 ug/l) and RC6a (range 14 to 450 ug/l). Significantly higher levels are seen in the groundwater in the overburden deposits at GW1 (range 350 to 5,500 ug/l). The concentrations are seen to significantly reduce at RC7 (range < 5 to 81 ug/l) down gradient of the landfill. The monitoring results indicate elevated manganese concentrations in the groundwater as a result of the low levels of dissolved oxygen and indicate that natural attenuation processes are taking place beneath the waste body particularly within the overburden deposits.

The Waste Licence for the site requires annual monitoring of manganese. It is recommended that the compliance monitoring include quarterly monitoring of manganese for monitoring of trends at the compliance monitoring points.

### Aluminium

The aluminium concentration is monitored at the site even though it is not listed as a requirement of the waste licence. Elevated concentrations were measured at a number of locations on the same sampling dates. Elevated concentrations were measured at : GW1 in Q2 2014 1,700 ug/l and 1,000 ug/l in Q3 2014; RC6a Q2 2014 1,000 ug/l and 260 ug/l in Q3 2014 and RC7 Q2 2014 concentration of 1,000 ug/l and Q3 2014 1,200 ug/l. Aluminium is not classed as a hazardous substance in the EPA publication "Classification of Hazardous and Non Hazardous Substances In Groundwater" (EPA, December 2010).

#### Ammonia

S.I. No. 9 of 2010 – European Communities Environmental Objectives (Groundwater) regulations, 2010, Schedule 5 specifies a threshold value of 0.065 mg/l for ammonia under the test "Assessment of adverse impacts of chemical inputs from groundwater on associated surface water bodies". Due to the proximity of the adjacent Dungarvan Harbour SPA this has been taken as the screening value.

Ammonia is not classed as a hazardous substance but it has been identified as the main parameter of concern at the site. Concentrations greater than 100 times the threshold value of 0.065 mg/l have been measured at the site at monitoring locations RC3a (bedrock) and RC6a (bedrock) on all sampling dates and at GW1 in Q3 2014. On this basis the monitoring data for ammonia for the period 2008 to 2015 was reviewed and is presented on Figure 4.1 to demonstrate trends to determine if there is any evidence of an expanding or shrinking plume at the site. Similar ammonia concentrations are seen at RC3a (range 39 to 75mg/) and RC6a (range 26 to 72 mg/l) for the 2014 and 2015 data. There is no borehole log is available for monitoring borehole RC7 but it is reported to be monitoring the shallow groundwater in the overburden deposits down gradient of the site. Monitoring at RC7 indicates there is no issue with elevated ammonia concentrations in the shallow groundwater in the overburden deposits down gradient of the site.

#### Figure 4.1: Ammonia Concentration 2009 - 2015



The concentration of ammonia is currently monitored on a quarterly basis in accordance with the Waste Licence and it is recommended that this monitoring frequency be maintained. It is recommended that a groundwater monitoring borehole be installed in the bedrock aquifer down gradient of the site to serve as a compliance monitoring point.

#### Iron

There are no groundwater threshold values specified for iron in the Groundwater Regulations. Iron is not classed as a hazardous substance in the EPA publication "Classification of Hazardous and Non Hazardous Substances In Groundwater" (EPA, December 2010). The IGV for iron is 200 ug/l. A concentration (45,000 ug/l) in excess of 100 times IGV was measured at GW1 in Q1, 2014

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BH Code	Interpretation of Monitoring Results 2014 & Q1 2015	Monitoring Interval
RC6a	The dissolved oxygen concentration is low ranged from 12 to 25% saturation. The electrical conductivity is high ranging from 1,291 to 2,170 us/cm. The ammonia concentration is high 26 to 72 mg/l. The chloride ranged from 98 to 443 mg/l. Iron concentration is elevated 2014 range 2,600 to 6,000 ug/l and 2015 range 170 to 1,900 ug/l above IGV 200 ug/l. Lead Q2 2014 200 ug/l above KSV 100 ug/l and threshold 18.75 ug/l but significantly lower in Q3 2014 and Q1 2015. Manganese in Q2 450 ug/l, 140 ug/l in Q3 but 14 ug/l in Q1 2015. Potassium elevated ranged from 2,7 to 50 mg/l. Aluminium elevated Q2 2014 1,000 ug/l and Q3 260 ug/l, but was < IGV in Q1 2015 with concentration of 11 ug/l.	Located in south eastern area of site. Monitoring interval groundwater in bedrock aquifer but waste fill present between ground level and 5.60mbgl.
RC7	The dissolved oxygen concentration ranged from 29.6 to 77% saturation. This monitoring location is influenced by the proximity to the Colligan Estuary and this results in elevated salinity with subsequent effects on electrical conductivity, chloride, boron, sodium, potassium and aluminium. The ammonia concentrations at this point are generally < IGV of 0.15 mg/l with only one sampling date Q3 2014 at 0.85mg/l being slightly above threshold value. The iron concentration is typically above the 200 ug/l IGV except Q1 2015 but typically > 700 ug/l. The manganese concentration is only slightly elevated with concentrations of 52 to 81 ug/l.	This borehole is located outside of the landfill site down gradient of site adjacent to River Colligan. There is no borehole log available but it is reported to be monitoring the groundwater composition in the overburden deposits. This monitoring location is affected by tidal influence.
RC8	This borehole is not currently being sampled. There is no sampling tubing present. This borehole is used to provide top up water for leachate dilution in the ICW.	There is no borehole log available for this monitoring location. It is reported to be monitoring the groundwater composition in the overburden deposits.

The assessment of the available groundwater monitoring data for 2014 and 2015 confirms that the following parameters are present at concentrations above the screening levels: ammonia, iron, manganese, aluminium, chloride, arsenic, potassium, nickel, barium and lead. The main contaminant of concern at the site is ammonia. The monitoring indicates low levels of dissolved oxygen. Of these parameters only arsenic is listed as hazardous in the EPA publication "Classification of Hazardous and Non Hazardous Substances in Groundwater" (EPA, December 2010). Based on the available monitoring results there is evidence that the landfill site is impacting on the composition of both the shallow and deep groundwater at the site.

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# Table 4.2: Summary of Groundwater Monitoring 2014 - 2015

BH Code	Interpretation of Monitoring Results 2014 & Q1 2015	Monitoring Interval
GW1	Dissolved oxygen levels low. Ammonia is elevated 0.67 to 9.9 mg/l in 2014 and 1.4 to 3.3 mg/l in 2015 which is above the 0.15 mg/l IGV. Iron concentration high 5,500 to 45,000 ug/l in 2014 and 400 to 17,000 ug/l in 2015 which is significantly above the IGV of 200 ug/l. Manganese also elevated 1,800 to 5,500ug/l in 2014 and 350 ug/l in 2015 above the IGV of 50 ug/l. Aluminium elevated 13 to 1,700 ug/l. With exception of iron, manganese and aluminium metals are not elevated. Electrical conductivity higher than IGV but less than drinking water limit. List I/II substances not detected. No hazardous substances at concentrations above screening levels.	Located close to southern boundary of landfill site. Expected to be monitoring up gradient groundwater quality in the overburden deposits. No evidence of waste in borehole log.
GW2a	GW2a was dry on all sampling dates in 2014 and 2015. No data available.	Located in southern area of site. This monitoring borehole is within overburden. Some made ground / waste material encountered between GL and 1.50m. Monitoring interval 1.00m to 11.00m monitoring shallow groundwater and possible leachate.
RC3a	Low dissolved oxygen. Electrical conductivity, chloride and potassium elevated. Ammonia ranged from 39 to 75 mg/l which is significantly higher than the level in the adjacent monitoring borehole GW1. Arsenic 21 ug/l Q3 2014 slightly above IGV 10 ug/l. The chloride concentration ranged from 85 to 165 mg/l which is above the IGV and significantly higher than concentration in adjacent GW1. Iron range 2014 1,200 to 9,700 ug/l and in 2015 ranged from 500 to 4,700 ug/l above 200 ug/l IGV. Manganese 210 – 2,300 2014 / 2015 higher than IGV 50 ug/l. Arsenic 21 ug/l in Q3 2014 but less than IGV on other sampling dates. The potassium concentration ranged from 3.9 to 43 mg/l above IGV of 5 mg/l. Nickel Q2 and Q3 elevated 38/43 ug/l above 20 ug/l IGV. Barium ranged from 18 to 210 ug/l above IGV of 100 ug/l.	Located in southern area of landfill, close to GW1. Monitoring groundwater in bedrock aquifer.
RC4	Dissolved oxygen levels higher than RC3a and GW1. Electrical conductivity closer to expected background levels. Ammonia ranged from 0.025 to 0.65 mg/l. Chloride ranged from 29 to 33 mg/l. TON a lot higher than GW1 and RC3a. Iron ranged from 23 to 8,900 ug/l but generally less than 200 ug/l IGV. Manganese less than IGV on all sampling dates. Aluminium ranged from < 10 to 13 ug/l which is less than IGV of 200 ug/l.	Located in south west area of site. Some waste encountered in top of borehole but monitoring interval in bedrock aquifer. Considered to be most representative location in terms of natural background concentrations in bedrock aquifer.

The screening values which have been used for the identification of the contaminants of potential concern are summarised in **Table 4.1** below. The IGV values have been taken as the screening levels (GAC). Where an IGV has not been specified the Drinking Water Limit has been taken as the screening value (GAC).

Parameter	EPA / GSI IGV Limits	Drinking Water Regulations 5.1. No. 122 of 2014	S.L. 9 2010 GW Regs Limits Column 2 Adverse Impact on SW Bodies	5.1.9 2010 GW Regs Limits Column 3 Drinking Water Protected Area	S.1. 9 2010 GW Regs Limits Column 4 Ability to Support Human Uses
Ammonia (mg/l)	0.15	0.30	0.065	0.175	0.175
Aluminium (ug/l)	200	200		2	2
Chloride (mg/l)	30	250		187.5	
Electrical Conductivity (us/cm)	1,000	2,500		1,875	
iron (ug/l)	200	200			
Manganese (ug/l)	50	50		0	
Dissolved Oxygen	No Abnormal Change				
Sodium (mg/l)	150	200		150	
Potassium (mg/l)	5	24 · · · · · ·			
Total Organic Carbon (mg/l)	No Abnormal Change	No Abnormal Change			
Total Oxidised Nitrogen (mg/l)	No Abnormal Change				
Soron (ug/l)	1,000	1,000		750	750
Calcium (mg/l)	200	200		(	
Arsenic (ug/l)	10	10		Q	7.5
iron (ug/l)	200	200		0	
Lead (ug/l)	100	100			18.75
Magnesium (mg/l)	50	50			
Manganese (ug/l)	50	50			
Nickel (ug/l)	20	20			15
Potassium (mg/l)	5	12			
Selenium (ug/l)		10			
Phenois (ug/l)	0.5				1
T Coli (Cfu/100mi)	0	0			
E Coli (CFu/100ml)	0	0			

# Table 4.1: Screening Values Used To Identify Contaminants of Potential Concern

The available results of the groundwater monitoring for 2014 and 2015 are presented in Appendix D. The assessment of the groundwater monitoring results to the screening values is presented in Table 4.2 below.

RPS

# 4 ASSESSMENT OF GROUNDWATER IMPACTS & COMPLIANCE WITH GROUNDWATER REGULATIONS

The EPA guidance document outlines the technical assessments that are required to permit discharges to groundwater in accordance with the European Communities Environmental Objectives (Groundwater) Regulations, 2010 (SI No. 9 of 2010) (Groundwater Regulations).

The objectives of the groundwater regulations are to:-

- Prevent or limit the input of pollutants into groundwater and to prevent the deterioration of the status of all bodies of groundwater.
- Protect, enhance and restore all bodies of groundwater to achieve good groundwater quantitative status and good groundwater chemical status by 22<sup>nd</sup> December, 2015.
- Reverse any significant sustained upward trend in concentration of any pollutant to reduce pollution of groundwater.
- Achieve compliance with any standards and objectives established for groundwater dependent protected area.

The technical assessment has included a review of the following data:-

- All previous relevant reports for the Dungarvan Landfill including Annual Environmental Reports (2008 – 2014).
- All relevant historical groundwater levels and quality data and relevant surface water data.
- Relevant site investigation data.

# 4.1 EXTENT OF PLUME AND TRENDS

The available results of the groundwater monitoring for 2014 and 2015 have been compared to the limits specified in the following regulations and guidance in order to identify the contaminants of potential concern:-

- European Communities Environmental Objectives (Groundwater) Regulations, 2010 (SI No. 9 of 2010).
- Towards Setting Guideline Values for the Protection of Groundwater In Ireland (EPA / GSI, 2003).
- Drinking Water Regulations (Si No. 122 of 2014).

The monitoring of the composition of the shallow groundwater in the overburden deposits is carried out at GW1,GW2A, RC7 and RC8. While the monitoring of the deeper groundwater in the bedrock aquifer takes place at RC3, RC4, RC6A. Monitoring location RC4 is considered to represent the groundwater quality up gradient of the site. The locations of the groundwater monitoring boreholes are illustrated on the Monitoring Locations Plan (Appendix A, Drawing MDR0350/DG0505).





APPENDIX B

SITE INVESTIGATION DATA

Borehole Code	Total Depth	Elevation Top Of Casing	Groundwater Level 07/01/14	Comment	Groundwater Monitoring Interval	Strata Encountered
GW1 Current	9.70m	9.50m0D		Water strike 5.60m Water strike 8.60m	1.00m to 9.00m in overburden	GL to 5.40m reddish brown sandy silty CLAY with occ large gravel & cobbies. 5.40m to 5.70m brown sandy gravely CLAY, 5.70m to 8.60m brown sandy clayey GRAVEL with cobbies. 8.60m to 9.70m brown silty CLAY with fragments of cobbies & boulders.
CW3A Current	11.50m	11.35mOD	1.25mOD	Water strike 7.60m Water strike 9.70m	1.00m to 11.00m in overburden & possible leachate	<ul> <li>GL to 1.50m Made ground (domestic refuse plastic and glass).</li> <li>1.50m to 4.40m reddish brown silty SAND with occ fine gravel.</li> <li>4.40m to 7.50m reddish brown silty sandy.</li> <li>CLAY.</li> <li>7.50m to 8.30m brown silty clayey GRAVEL with cobbles.</li> <li>8.30m to 9.20m brown silty CLAY with some cobbles.</li> <li>9.20m to 11.50m fine to coarse brown clayey GRAVEL.</li> </ul>
RC1 Not monitored	25.50m			Not being monitored	16.50m to 23.50m groundwater in bedrock	GL to 2.80m Made ground domestic waste in clayey matrix. 2.80m to 10.0m brown grey, fine grained moderately weathered LIMESTONE. Cavity present 5.50m to 6.30m. 10.0m to 25.50m light grey white, calcitic LIMESTONE with localised day infill.

# Table B.1: Summary Details of Site Investigation Boreholes Dungarvan Landfill

Borehole Code	Total Depth	Elevation Top Of Casing	Groundwater Level 07/01/14	Comment	Groundwater Monitoring Interval	Strata Encountered
				30.30m. Cavity 33.20m to 34.70m. Increasingly fractured from 33m.Water encountered at 6.55m, 11.60m and 25.10 prominant seepage.		11.00m to 24.90m purple brown clayey GRAVEL 24.90m to 35.00m light medium grey, fine grained LIMESTONE.
RC6A Current Groundwater in bedrock	17.00m	4.58m00	2.08mOD confined. Top of rock -4.32mOD.	Cavity 10.70m to 11.40m, 11.90m to 12.30m, 13.00m to 14.00m, 15.10m to 16.90m.	9.90m to 12.0m	GL to 0.30m Overburden / brown clay fill. 0.30m to 5.60m Overburden / domestic waste, 5.60m to 8.80m brown silty SAND. 8.90m to 17.00m light grey, fine to medium grained fresh to slightly weathered LIMESTONE. Highly weathered and fractured from 12.30m to 12.90m.
RC7	1	2.12m00	0.57mOD		Reported to be monitoring overburden	No borehole log
RC8			1.63mOD		Reported to be monitoring overburden	No borehole log
L1 Leachate	6.00m	14.26m			1.00m to 6.00m	GL to 0.20m Made ground brown gravely day. 0.20m to 6.00m Made ground composed of domestic refuse with brick, plastic, wood, concrete and some gravely day.
L2 Leachate	7.50m	15.54m			1.00m to 7.00m	GL to 1.00m Made ground composed of brown gravely day. 1.00m to 6.60m Made ground composed of domestic refuse with brick, plastic, wood, concrete and some gravely day.

Borehale Code	Total Depth	Elevation Top Of Casing	Groundwater Level 07/01/14	Comment	Groundwater Monitoring Interval	Strate Encountered
IN2 Not monitored Groundwater in bedrock	23.00m			Screihnie oollapsing due to cavities 17.00m to 23.00m Cavity 14.20m to 14.90m Cavity 17.00m to 17.90m Cavity 15.20m to 19.50m	13.90m to 17.00m	GL to 1.60m brown sendy, gravely clay fil. 1.60m to 6.55m domestic waste. 6.55m to 13.00m brown sandy gravely CLAV. 13.00m to 23.00m gray fine grained slightly weathered LIMESTONE with prominent cavities throughout. 21.12 to 21.40m sand infill in matrix of limestone.
RC3 Ourrent Groundwater in bedrock	19.30m	10.73mOD	0.93mOD. Top of rock 2.58mOD.	Cavity 9.10m to 9.40m and 9.90m to 10.00m Cavities 10.81 to 10.62m and 11.00m to 11.10m. Highly fractured 14.37m to 14.60m. At 18.60m 20mm thick calcitle vein	8.90m to 19.30m	GL to 0.89m Overburden brown sandy day NI with some concrete. 0.89m to 7.00m stiff brown sandy gravely CLAY with cobbies / boulders. 7.00m to 8.15m soft brown silty CLAY. 8.15m to 19.30m fine grained moderately westhered LIMESTONE with occasional localised day infil.
RC4 Current Groundwater in bedrock	.20.40m	9.41m00	WL2.21m00 confined. Top of rock 0.13m00	13.50m to 12.20m sand / gravel infill. At 18m soft sit / clay infil.	11,40m to 20,40m,	GL to 2 90m Overburden / domestic wester, 2.50m to 9.30m brown sandy, gravely CLAY (boulder clay). 9.30m to 11.60m grey brown moderately weathered SETSTONE / MUDSTONE. 11.60m to 20.40m dark grey, quarts rich sandy SETSTONE.
RC5 Not monitored Groundwater in bedrock	35.00m			Cavity 25.30m to 26.80m with day infit. Cavity 28.30m to	25 90m to 28,60m. Borehole collapsing below 28,60m.	GL to 0.89m overburden / day fill. 0.83m to 6.55m overburden / domistic. waste: 6.55m to 11.00m dark gray sity pastly CLAY.

Range	Units	Q1 2014	Q2 2014	Q3 2014	Q1 2015	Q2 2015	Q3 2015	IGV	Groundwater Regulations SI No. 9 of 2010 Threshold Range	Drinking Water Limit
Date		22/01/14	07/04/14	15/09/14	23/02/15	18/06/15	10/08/15			
Temp	C	6.0	11.0	14.2	5.8	17.6	19,8			
Dissolved Oxygen % sat		14.3	37	11	35	30	51.0			
pН	pH units	6.9	6.8	6.9	6.7	7.0	7.0	6.5-9.5		6.5 to 9.5
EC	Us/cm	426	521	925	673	720	623	1,000	800 - 1875	1,500
Salinity	100		j.		- 8	· · · · · · · · · · · · · · · · · · ·	-			
Ammonia	mg/l	0.053	0.12	< 0.02	9.5	0.03	0.069	0.15mg/l	65 - 175 ug/l	0.30 mg/l
Chloride	mg/l	40	56	106	80	64	57	30	24-187.5	250
TON	mg/l	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	-		No abnormal change
TOC	mg/l					-				
Arsenic	ug/l		< 1.0	< 1.0	< 1.0	1		10	7.5	10
Beryllium	ug/l		< 1.0	< 1.0	< 1.0					
Boron	ug/l		62	120	11			1,000	750	1,000
Cadmium	ug/t	1	< 0.02	< 0.02	< 0.02			5	3.75	5
Calcium	mg/l		51	86	8.3	-		200		200
Cobalt	ug/i	-	< 1.0	< 1.0	< 1.0					
Iron	ug/l	440	650	710	28	990	1,200	200		200
Lead	ug/l		< 1.0	< 1.0	< 1.0			100	18.75	100
Magnesium	mg/l		6.7	18	< 0.25		-	50		50
Manganese	ug/l		760	300	28	-		50		50
Nickel	ug/l		1.7	2.9	< 1.0			20	15	20

# Table D.7: Summary of Groundwater Composition Groundwater Pond Outlet

Range	Units	Q1 2014	6)2 2014	Q3 2014	Q1 2015	Q2 2015	Q3 2015	IGV	Groundwater Regulations SI No. 9 of 2010 Threshold Range	Drinking Water Umit
Selenium	ugA		<1.8	< 1.0	<1.0			0.0012	1 - may - 24	10
Sodium	mg/l	(	390	6,500	95	1,100	2,600	150	150	150
Strantium	HRIT		440	5,400	86					
Thallium	ug/t		<10	< 1.0	<1.0					
Uranium	UR/I	6 S	< 1.0	2	<1.0			9		
Vanadium	ug/t		1.4	< 10	<1.0					
Phenol	ugit	0						0.5		No. 117
Nitrite	me/i	1 1		1	2			0.1		0.50
Ortho-phosphate	mg/l		0.026					0.03	0.035 MRP	10.000
Alkalinity	mg/l	1	212	£	8 9					
Fluoride	mg/i	C 34	< 0.75		1. 12			1.0		0.8/15
Sulphate	mg/l	5 8	100	i.	1			200	187.5	250
tist1/0	Ug/I									
Aluminium	ug/i	2 9	1,000	1,208	22			200	150	200
Barium.	ug/l	7	11	120	1.5			100	1	20045
Mercury	6ga		< 0.50					1	0.75	1
Antimony	Ug/I	S – 0.	< 1.0					1.45		5
Overnium	Ngu	i 8	2		1 28			30	37.5	50
Copper	HEA		2.5					30	1500	2,000
Molybdenam	ug/i	1	< 1.0					-		
Zinc	lig/l		16	1				100		

Range	Units	Q1 2014	Q2 2014	Q3 2014	Q1 2015	Q2 2015	Q3 2015	IGV	Groundwater Regulations SI No. 9 of 2010 Threshold Range	Drinking Water Limit
		Course of		in and a second	Concert	1000078		8	1	- 1
Date	-	22/01/54	07/04/14	15/09/14	23/02/15	16/05/15	10/08/15	2		
Temp	°C	11.1	11.1	14.0	10.6	11,8	12.5			
Disatived Dagen % sat		29.5	30	42	77	46.5	30			
pH	pH units	7.3	7.2	7.1	0.7	23	7.0	5.5-9.5		6.5 to 9.5
FC.	Us/tm	2840	2800	NM.	NM	NM	NM	1,000	800-1875	1,500
Salinity	Tin.	1.3	13	22.3	3.1	3.9	B.4			
Ammonia	Nym	0.02	< 0.02	0.85	0.026	< 0.02	< 0.02	0.15mg/l	65 - 175 ugA	0.30 mg/l
Chloride	ngð	670	NR	> 7,333	1,840	2,200	4,700	30	24-187.5	250
TON	mgA	3.6	4.2	1.6	2.5	2,1	0.87	5		No abnormal change
TOC	mg/l	1575-51	interne a	A AND	191120	11000 0		1		1
Arsenic	ug/l		< 1.0	<10	<1.0			10	7.5	10
Beryllium	UE/	5 6	< 1.0	<10	<10			S	1	and the second second
Boron	ug/l		230	2,500	43			1,000	750	1,000
Cadmium	ug/l		0.05	0.49	< 8.02			5	3.75	5
Calcium	mg/i		82	350	9.7	. J.		200		200
Cobalt	reg/l		43.0	1.0	<1.0					1
Iron	(agu)	1,500	730	1,500	29	990	1,900	200		200
Level	lag/1	1 3	1.1	11	<1.6			100	18.75	100
Magnesium	ngñ	1 3	50	820	11	- 3		50	-	50
Manganese	log/L	2 77	52	81	<5.0			50	2	50
Nickei	ug/l		1.9	3.1	<10			20	15	20
Potaesium	Ingel	· 1	70	230	3.4	48	95	5		12

### Table D.6: Summary of Groundwater Composition RC7

Range	Units	Q1 2014	Q2 2014	Q3 2014	Q1 2015	C12 2015	Q3 2015	IGV	Groundwater Regulations SI No. 9 of 2010 Threshold Range	Drinking Water Umit
Selenium	18/T		< 1.0	< 1.0	<1.0					10
Sedium	mg/l;		61	150	9	70	72	150	150	150
Strontium	ug/I		240	300	36					
Thalliam	48/1		<1.0	< 1.0	<1.0					
Uranium	ug/l		< 1.0	< 1.0	\$1.0			9		
Venedium	ug/L		2	1	<1.0			in the second		2007
kitrite.	mg/l		(t			6 1		0.1		0.50
Ortho-phosphate	mg/l		0.01					0.03	0.035 MRP	10.000
Alkeinity	mg/l		395							200 M 10000
Fluoride	mg/l		0.5			(		3.0		0.8/1.5
Sulphate	mg/l		3,2					200	187.5	250
List 1/11	ug/I		BLO	- LLCCO - 2					a senses in	20040
Aluminium	ug/l		1,000	260	. 11	2		200	150	200
Beriam	ug/l		34	32	3.9			100		
Mensury	ug/L		< 0.50					1	0.75	1
Antimony	ug/l		<1.0			()				5
Oscomium	ug/l		14					30	32.5	.50
Copper	ug/I		12	3				30	1500	2,000
Molybdenum	ug/l		< 1.0							
Zine.	lug/l		88					100		

Range	Units	Q1 2014	CJ2 2014	Q3 2014	Q1 2015	Q2 2015	Q3 2015	ICV	Groundwater Begulations SI No. 9 of 2010 Threshold Range	Drinking Water Limit
1000	_		Laniza de la				Constant of			-
Date		22/00/14	07/04/34	15/06/14	23/00/15	18/05/15	10/08/15	-		
Temp	2	10.9	12.0	12.2	11.5	12.0	12.4			
Disarbed Oxygen % sat		25.0	21.0	16	12.0	14.0	22			
рн	μH units	7.5	6.9	7.2	6.8	7.0	7.0	6.5 - 9.5		6.5 to 9.5
EC	Us/tm	1,529	1,225	2.170	1,443	1,294	1,291	1,000	500 1875	1,900
Salinity	9m				1		- 1 · · ·			STATES IN CO.
Ammonia	mg/l	48	30	72	37	29	26	0.15mg/l	65 - 175 ug/l	0.30 mg/l
Chloride	mg/l	120	98	443	136	112	105	30	24-187.5	250
TON	mg/1	9	8.9	8	1.8	8.3	7,1			No abnormal change
TOC	mg/l		S	1000	10000	6 1	E.	8.0-5		2010
Arsenic	VE/		21	12	< 1.0	S	3 3	30	7.5	10
Beryllum	ug/l		< 1.0	< 1.0	< 1.0	0.000				
Bolon	UR/1		170	350	25	1	3	1,000	750	1,000
Cadmium	ug/l		0.55	0.5	< 0.02		8 - 3	5	3.75	5
Calcium	mg/l		100	110	12		<u> </u>	200		200
Cobalt	ug/l		2.6	2.6	< 1.0					
kon	ug/l	6,000	4,900	2,600	170	1,400	1,900	200		200
Leat	-84		200	55	2.5	8 10 1	3 11 1	100	18,75	185
Magnesium	mg/l		19	27	1	1	1	50		90
Manganese	Ug/i		450	140	14		2	50		50
Nickel	ug/i	1 3	5.4	4.2	<1.8	3 - 15 - 1	8 100 4	20	35	20
Potassium	mg/l		23	50	2.7	22	21	5		12

### Table D.S: Summary of Groundwater Composition RC6a

Range	Units	Q1 2014	QZ 2014	Q3 2014	01 2015	Q2 2015	Q3 2015	ISV	Groundwater Regulations SE No. 9 of 2010 Threshold Range	Orinking Water Limit
Selentum	100/1		<1.0	× 1.0	81,0					10
Sodium	mg/l		12	13	1.4	12	11	150	150	150
Stranitium	P.gur	1	320	\$30	35	2 Si				
Teallum	ug/l		<1.0	×10	<1.0	a - 6		-		6
Unitiam	400/1		×1.0	4.3.0	43.0			9		
Vanadium	Nga -		<1.0	< 1.0	4.1,0				1	
Nitrite	mg/)		<0.004	3 - D		3		0.1	d unancen-	0.50
Ortho-phosphete	-18/E		< 0.01	3 1				0.06	0.035.MRP	1998 - E
AlkaEntty	mg/l		215							
Fluoride	mg/l		<0.25	8 0		1 5		1.6		0.8/15
Sulphate	-mg/l		III			( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( )		300	387.5	250
Ust1/1	ug/f			8 8					1	20 M
Aluminium	ug/t		11	13	< 30			200	150	200
flarium	og/l		8.5	9	13			300		
Mercury:	02/9		< 0.50					1	0.75	1
Antimony	05/1	-	<1.0	8					1. 1210	5
Chromium	. ug/1		1.1					30	37.5	50
Copper	og/i		<1.0	S 1				30	1900	2,000
Molybdenum	ug/9		<1.D	71		1.1.1		0-181-		
Sint	- ug/l	-	12	14 - 24		9		100		

Range	Units	Q1 2014	Q2 2014	Q3 2014	Q1 2015	Q2 2015	Q3 2015	igv	Groundwater Regulations 31 No. 9 of 2010 Threshold Range	Drinking Water Umit
Date	100	22/01/14	07/04/14	15/09/14	23/02/15	18/06/15	10/08/15	ũ.		6 is
Temp	°C	10.8	11.5	11.7	10.7	11.0	22.5	2	1	
Dissolved Oxygen % ext		50.5	64	58	50	50	45			
рн	pH units	7,3	7.1	6.9	6.7	7.1	69	65-95		6.3 to 9.5
60	Us/cm	679	649	640	649	644	615	2,000	800 1875	1,500
Salinity	$\eta_{\rm m}$	1000	10000	100212	0.00	1008048	1192070	Ser Marson	1 1995-195 CT	and the second s
Ammonia	mg/t	0.12	0.08	0.065	0.65	0.27	0.025	0.15mg/l	65 + 175 ug/l	0.30 mg/l
Chloride	ing/l	33	32	29	32	29	30	30	24-187.5	250
TON	mg/I	16	33	31	31	11	11			No abnormal change
TOC	mg/s		2510	1 0.050	- Vand					9 2362 CAN
Arsenic	48/1		<1.0	<10	<1.0	1		10	7.5	10
Boryllum	ug/l		<1.0	<10	<1.0					
Boron	487		29	27	< 10	4		1,000	750	1,000
Cadmium	ug/i	1	0.02	0.03	< 0.02			5	3.75	5
Calcium	mgA	1.1.1	96	100	- 11	1		200		200
Cobalt	ug/i		<1.0	<1.0	31.0					
Iron	ug/i	8,900	110	180	23	200	240	200	10.000 Later	200
Lead	ug/i		<1.0	¢10	<1.0			100	18.75	200
Magnesium	mg/l		20	10	< 0.25	1		50	inclusion in the	50
Manganese	ug/l		9.9	20	< 5.0			50		50
Nicke	ug/L.		<1.0	<10	\$1.0	1		20	- 15	20
Potassium	man		1.5	1.6	< 0.25	1.5	1.4	5		12

### Table D.4: Summary of Groundwater Composition RC4

Range	Units	012014	QZ 2014	03 2014	01 2015	Q2 2015	03 2015	167	Groundwater Regulations SI No. 9 of 2010 Threshold Range	Drinking Water Limit
Selenium	=g/l	-	<1.0	< 1.0	<1.0	8				10
Southurn	trig/1		100	150	15	120	1.10	150	150	.350
Stransium	18/3		410	510	54					
Thailiun	184		16	< 1.0	×1.0			1. 1. 1. 1. 1.		
Unanium	=K/l		1.6	1.9	< 1.0	8 II.		. 8		
Manadium	- 4 <b>6</b> /9		<10 ···	< 1.0	<2.0	1 T		5		
Nitrite	0.621		< 0.004					0.1		0.50
Ortho-phosphate	Pigm /		40.00					0.03	D D35 MRP	
Alkalmity	ing/i		563			6		1 1100		10000335665
Fluorida	ma/l					1		3.0	or sizes	0.8/15
Sulphate	mg/1		29					200	187.5	250
Det 1/0	=g/1									
Auminium	=6/1		17	24	<30.0	S 1		200	150	2007
Barlum	+6/1		110	210	51			100		507
Mercury	102/	1	< 0.50	1 1107	11226			1	0.75	1
Antimony	=g/l		<10	6 di		3C		2		5
Chromium	- 1671		3.9					30	37.5	50
Copper	16/1		15					30	1900	2,000
Molybderum	- 400/l		15	8 8		2 I		S ages		
Zinit			18	i - 55		S 11		190	5. State 1995	

Range	Uelts	Q1 2014	Q2 2014	Q3 2014	Q1 2015	Q2 2015	Q3 2015	XGV	Groundwater Regulations SI No. 9 of 2010 Threshold Range	Drinking Water Limit
Date		22/01/14	07/04/14	15/09/14	23/02/15	18/06/15	10/08/15			
Temp	έ.	11.8	11.2	12.5	11.8	12.8	13.1			Q
Dissolved Oxygen % set		14.5	21.0	16.0	18.0	13.9	17.0			
рн.	pH units	7.0	6.8	7.0	5.9	6.9	6.9	6.5-9.5		6.5 to 9.5
EC	Us/cm	1,360	1,520	2,210	1,974	1,713	1,618	1,000	800-1875	1,500
Salinity	"lue									
Ammonia	ng/l	39	47	75	67	66	66	0.15mg/l	65 - 178 ug/l	0.30 mg/l
Chioride	mg/l	- 95	112	165	140	119	113	30	24-187.5	250
TON	mg/l	0.24	0.62	< 0.20	1.1	< 0.20	< 0.20			No abnormal change
TOC	mg/F		()		line-in-it				202	10
Arionic	ug/l		4.1	21	1.6	( ()		10	7.5	20
Beryllium	ug/l		< 1.0	<10	< 1.0					
Boron	ve/l		230	400	49			1,000	750	1,000
Cadmium	og/t		0.36	0.18	< 0.02			5	3.75	5
Calcium	mg/l		110	120	11			200		200
Cobalt	sig/i	10000	7.4	11	< 1.0		the second second second	- 1995- Y		i estera
Iron .	- 1/Bru	4,000	1,200	9,700	500	4,100	4,700	200		200
Lead	ing/i		<1.0	<10	< 1.0			100	18.75	100
Magnesium	mg/i		19	24	0.94	( ) (i)		50		50
Manganese	ug/l		1,600	2,300	210			50		50
Nickel	ug/i		38	43	3.8			20	15	20
Potassium	mg/l		24	43	3.9	30	27	5		12

# Table D.3: Summary of Groundwater Composition RC3a

Range	Units	Q1 2014	Q2 201.4	Q3 2914	01 2015	Q2 2015	43.2015	16V	Groundwater Regulations St No. 9 of 2010 Threshold Range	Drinking Water Limit
Potossium.	Cone A			1				/ 5	1	12
Selections	195									10
Sodium	Agm							150	1,50	150
Scontium	197						<u> </u>			
Thailium	161			- 9			8. I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I	7		
Uranium	Light .				- Q		2	9	1	
Variadium	1.001	1					0	220	1	
Phanol	1403							0.5		
North	fam	1					1.	241		0,50
Orno-phosphane	mg.1							0.0	CIUS NRF	
Abalinity	ng.l									
Rundde	mal							1.0	-	0.8/1.5
Sulphate	figm							200	187.5	250
Det1/0	10/		-				8	1 (1)	25 000 0	0.55
Aluminium	165						8	200	159	200
821011	165			1 10			8	100	20	
Mercarix	155							1	0.75	1
Antimates	161			2			2	1	3	5
Chromium	140			. 8			ê	30	37.5	30
Copper	Lg.T	2			- 3		2	50	1500	2,000
Molybdeture	Lan I	1 1					<u></u>	1-855-		0000
A11	1.9.1				51		2	100		

Range	Units	Q1 3014	Q2 2014	Q3 2014	Q3 2015	Q2 2015	0,3 2015	IGV	Groundwater Regulations SI No. 9 of 2010 Threshold Range	Drinking Water Limit
		NO	- No-	No sample	Dry				and the second se	
1		sample	sample	10.000 10.000			-			
Date		22/01/14	07/04/14	15/09/14	_		-			
Тепр	<u>36</u>									
Disonived Coygen % S2E										1-1-1022-0-5-
pH	pH Units						2	6.3-9.5		65 m N.5
EC	Ub/cm	1					8 8	3,080	800-1675	1,500
Salimity	. Yet									
Ammonia	mg/l			-				0.15mg/i	65 - 175 ug/l	0.30 mg/l
Chloride	mg/l							30	24-1875	250
TON	mg/l				2 C		2) î		1 1000000000	No abnormal change
TOE	- mg/l									
Araunic	- 16/I	1			8		12 - S	10	75	30
Berylium	ug/l							1	1	0.000
Boron	10/1							1,000	750	1.000
Carimium	1001				0		8 8	5	3.75	5
Caldum	mg/i							200		200
Cobalt	26/1				8		e 2		19	CDCVI.
Iran	ug/II						11 - S	200	15 News 1	200
Lead	ug/l					_		100	18.75	100
Magnesium .	mg/l							50		30
Manganese	Fige				<u>.</u>		÷	50	· · · · · · · · · · · · · · · · · · ·	-50
Nickel	ug/l						- N	20	15	20

### Table D.2: Summary of Groundwater Composition GW2A

Range	Units	Q1 2014	Q2 2014	Q3 2014	Q1 2015	Q2 2015	Q3 2015	IGV	Groundwater Regulations SI No. 9 of 2010 Threshold Range	Drinking Water Limit
Potassium	ing/i		2.7	5	0.3	3.7	3.8	5	0 0	12
Selenium	ng/i		<1.0	<10	<1.0					10
Socium	mg/l		9.6	15	1.3	15	13	150	150	150
Strontium	ug/l		230	340	44					
Thallium	ug/i		<1.0	< 1.0	<1.0					
Uranium	ug/i		1.7	< 1.0	< 1.0	1		9	1	
Vanadium	ug/i	1	41	2.2	<1.0					
Nitrite	mg/i		800.0					0.1		0.50
Ortho-phosphate	mg/1	1	< 0.01			8		0.03	0.035 MRP	
Alkalinity	mg/l	-	317		1 3	8		C. C. C. S. L. C.	1	
Fluorida	mg/1		< 0.25					1.0		0.8/1.5
Sulphate	mg/i		6.5		1			200	187.5	250
list171	ug/l		BLD					1.000		
Aluminium	ug/l		1,700	1,000	13			200	150	200
Barium	ug/i		70	120	10			100		
Mercury	ug/I		< 0.50					1	0.25	1
Antimony	ug/l		<10	-					6 con 4	5
Chromium	ug/l		2.8					30	37.5	50
Copper	ug/I		43	-	1. Carlos (1997)			30	1500	2,000
Molybdenum	Ug/I		<10							
Zinc	ug/i		43					100		

List ( / II BLD except Q2 tokums 0.7 ug/l but is less than KiV of 10 ug/l

Range	Units	Q1 2014	Q2 2014	Q3 2014	QI 2015	Q2 2015	Q3 2015	IGV	Groundwater Regulations Si No. 9 of 2010 Threshold Range	Drinking Water Limit
Date	100	22/01/14	67/04/14	15/09/14	23/02/15	18/06/15	10/08/15			
Temp	1	30.5	10.5	12.6	10.8	13.3	14.2			
Dissolved Daygen %. set		20.7	13.4	21.0	45	33.8	22			
ρн	pH units	6.7	6.7	6.5	6.6	6.6	6.5	6.5-9.5		6.5 10 9.5
EC	Us/cm	905	680	930	1.049	1.145	1,108	1,000	800-1875	1,500
Salinity	"la	-				2 - 1 <b>-</b> - 1	( (+)) ()			
Ammonia	rog/1	1.6	0.67	9.9	1.4	3.3	2.2	0.15mg/)	0.065 - 0.175 mg/l	0.30 mg/l
Chioride	mg/i	22	19	54	32	21	16	30	24-187.5	250
TON	mg/l	< 0.20	< 0.20	0.57	< 0.20	< 0.20	<0.20			Nu almormal thange
Arsenic	sig/i		2.8	4.9	<10		3	10	7.5	10
Beryllum	ve/l		<1.0	<10	<10					
Boron	se/i			37	< 20			1,000	750	1,000
Cadmium	ug/i		0.36	0.05	< 0.02	8	2 2	S	3.75	5
Calcium	mg/i		120	150	21			200		200
Cobalt	UB/I	0.000	4.7	5.9	<1.0	low-poster 14	Service A			2000
Iron	ug/II.	45,000	5,500	15,000	400	17,000	13,000	200		200
Lead	ug/t		12	1.6	<10			100	18.75	100
Magnesium	ng/l		7.4	12	< 0.25			50		50
Manganese	ug/i	-	1,800	5,500	350		ê (j. 1997) 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 -	50	S	50
Nickel	ug/t		5.7	2.7	<10			20	15	20

# Table D.1: Summary of Groundwater Composition GW1

APPENDIX D

GROUNDWATER QUALITY MONITORING DATA

Parameter	Units	EQS Surface Waters GSI / EPA	Cat A1 51 294 of 1989 Limita	Si No. 122 of 2014 Drinking Water Limits	SI No. 272 of 2009 AA- EQS Inland Surface Waters	SI No. 272 of 2000 AA- BQS Other Surface Waters	SI No. 272 of 2009 MMC EQ5 Inland Surface Waters	SI No. 272 of 2009 MAC EQS Other Surface Waters	Station 300 2015	Station 300 3014	Station 300 2013	Stations 300 2012	Station 300 2011	Station 300 2010
Sampling Date			S			$c_1 = -1$		1-13		07/04/14	13/05/13	No data	No.data	No data
Ammonia	mg/1	6.02NH,	0.2 MH	0.30		1.1	- 33	-		0.075				
Choride	mg/I	250	250	250		1 F.C.	+	1		52			8	
Nitrite	mg/l	0.2		0.50	- 25	0.00	- 12	2.8		0.009				
Ortho-phosphate	mg/l	(e)					- 25	+11		0.011				
Total Oxidised Nitrogen	/mg/l						- (2)			< 0.20				
Fluoride	mg/l	5.0	2	0.8/1.5	0.5	3.5	100	- 403g		< 0.25	< 0.25			
Sulphate	mg/l	200	200	250	~	-	- (R)			3.4	10			

Table C.10: Surface Water Quality Monitoring Annual Parameters Surface Water Lagoon

Paramater	Units	EQS Surface Waters QSI / EPA	Cat A5 SI 294 of 1989 Limits	Si No. 122 of 2014 Drinking Water Limits	SI No. 272 of 2009 AA- EQ5 Inland Surface Waters	SI No. 272 of 2009 AA- EQ5 Other Surface Waters	St No. 272 of 2009 MAC EQ5 Inland Surface Waters	SI No. 272 of 2009 MAC EQS Other Surface Waters	Station 300 2015	Station 300 2014	Station 300 2013	Station 300 2012	Station 300 2011	Station 300 2010
Sampling Date	-									07/04/14	13/05/13	No data	No data	No data
Ammonia	mg/l	0.02NH3	0.2 NH,	0.30	1	10				No sample	1000		l. I	
Chioride	mg/l	250	250	250	180 (M	8		199						
Nitrite	mg/l	0.7	1. 100	0.50	- 41		1.44	1974-19						
Ortho-phosphate	mg/l	+)			18	- 13	1.0							
Total Oxidised Nitrogen	rog/I													
Fluoride	mg/l	5.0	3.	08/15	0.5	1.5		114			3.3			
Sulphate	mg/l	200	200	250		+		100		ç	110		1 2	

Table C.9: Surface Water Quality Monitoring Annual Parameters EPA Station No. 300

Parameter	Units	EQS Surface Widors QSI/ TPA	Cat A1 SI 254 of 1089 Limits	Si No. 122 of 2014 Drinking Water Umits	SI No. 272 of 2009 A4- EQS Inland Surface Waters	SI No. 272 of 2009 AA- EQS Other Surface Waters	Si No. 272 of 2009 MAC EQS Inland Surface Waters	SENO. 272 of 2009 MAC EQS Other Surface Waters	Station 280 2015	Station 280 2014	Station 280 2013	Station 280 2012	Station 280 2011	5cation 280 2010
Sampling Date		Same and	Here and	A. Carlos	( <u> </u>		A			07/04/14	13/05/13	No data	Nordata	No data
Ammonia	mg/I	3.02NH,	0.2 NH4	0.30						< 0.02		111	_	
Chloride	mg/l	250	250	290	1.10		-			17				
Nitrite	mg/l	0.2	1.0	0.90		-				+0.004				
Ortho-phosphate	mg/l	100	8	1002500	1000	- @		. 20		0.013			1	i
Total Osidiaed Nitrogen	moʻl	25	3				1			22				
Fluoride	Pgm	5.0	1	0.6/15	0.5	15	+			<0.25	< 0.75			
Sulphate	rtqj/l	200	200	250		-				4.6	5.2	1	( ) 	

Table C.8: Surface Water Quality Monitoring Annual Parameters EPA Station No. 280

Parameter	Units	EQS Surface Waters GSL/ EPA	Cat A1 SI 294 of 1009 Limits	SI No. 122 of 2014 Drinking Water Umits	SI No. 272 of 2009 AA- EQS Inland Surfaces Waters	SI No. 272 of 2009 AA- EQS Other Surface Waters	SLNo, 272 of 2009 MAC EQS Inland Surface Waters	SI No. 272 of 2609 MAC EQS Other Surface Waters	5W2 2015	5W2 2014	SW2 2013	5W2 2012	SW2 2011	5W7 2010
Sampling Date		Burnson	Bernowl	1			8 B	0	5	07/04/14	13/05/13	No data	No deta	No data
Ammonia	mg/l	0.02NH <sub>4</sub>	0.2 NH	0.30	100		(	- c.t 12		0.021	×11.572.00	10000		1000000000
Chloride	mg/l	250	250	250	19	14	- 5	28		16				
Nitrite	mg/1	0.2		0.50			1.00	19 B	8	< 0.004	6			1
Ortho-phosphate	mg/l				. +	161	1			0.034				
Total Oxidised Nitrogen	mg/1							24		2.2				
Fluoride	mg/l	5.0	1	0.8/15	0.5	1.5		-07-11		< 0.25	< 0.25	1 3		
Sulphate	mg/i	200	200	250	1.4	- (9)				4.8	5.9			

Table C.7: Surface Water Quality Monitoring Annual Parameters SW2

Parameter	Units	EQS Surface Waters GSL/ EPA	Cot A1 9/794 of 1989 Limits	Si No. 122 of 2014 Drinking Water Limits	SI No. 272 of 2009 AA- SQS Inland Surface Waters	SI No. 272 of 2009 AA- EQS Other Surface Waters	SI No. 272 of 2009 MAC EQS Inland Surface Waters	SI No. 272 of 2009 MAC EQS Other Surface Waters	5W1 2015	5W1 2014	SW1 2013	5W1 1012	5W1 2011	5W1 2010
Sampling Date										.07/04/34	13/05/13	No data	No data	No data
Ammonia	=6/1	0.02NH	0.2 NH.	0.30		- 53 - )	- 63-		-	<0.02	0.50	8	(	8
Chloride	==6/I	250	250	250	1.00		-			16				
Nitrite	=6/1	0.2	1.4	0.50	1.0	1.1		1.1		< 0.004				
Ortho-phosphate	me/l			1	1 - 2	14 (	1 20	1.4		0.011	1	8 1		2
Total Oxidised Nitrogen	mg/l	1			1.15		100			2.2				
Ruoride	mig/1	5.0	1	0.8/1.5	0.5	1.5	12	1.0		× 0.25	×0.25			
Sulphate	=46/1	200	200	.250	1-1-1		-			5.4	5.9			3

Table C.6: Surface Water Quality Monitoring Annual Parameters SW1

	Q1 2014	Q2 2014	Q3 2014	Q3 2014	Q1 2015	QZ 2015	Q3 2015	EQS EPA / GSI	Cat A1 SI 294 of 1989
Sample Date			08/07/14		23/02/15	18/06/15			
BOD (mg/l)			<1.0		1.2	< 1.0			5
COD (mg/l)			85		27	71			
Conductivity (us/cm)			7,820		1,583	NM		1,000	1,000
Dissolved Oxygen	2	-	103		- 96	83			× 60%
(% seturation)									
pH (pH units)			6.8		- 7.2	7.6	_		5.5-85
Suspended Solids (mg/l)			<4		11	< 8			50
Lemperature (deg C)			17.0		5.5	13.0			25
Sainty	¥20		1	â	0.6	2.8			2

# Table C.5: Quarterly Parameters SW300 Colligan Estuary
	QL 2014	02 2014	Q3 2014	113 2014	Q1 2015	Q2 2015	Q3 2015	EQS EPA / GSI	Cat A1 5I 204 of 1989
Sample Date	22/01/14	07/04/14	08/07/14	15/09/14	23/02/15	18/06/15	10/08/15		
BOD (mg/l)	< 1.0	<1.0	¢10	<1.0	<10	<10	<1.0		5
COD (mg/l)	< 20	<29	< 20	< 20	< 20	25	< 20		
Conductivity (us/cin)	168	190	1,403	1,093	273	8M	144	1,000	1,000
Dissolved Dwygen (% saturation)	100.2	114	105	102	105	118	107		> 60%
pet (pet units)	7.3	7.3	6.6	6.8	7.0	7.5	7.2		\$.5 ~ B.5
Suspended Solids (mg/l)	<4	×4	×4	e.4	<8	<8	c4		50
Temperature (dag C)	7.6	10.0	15.9	14.1	6.1	14.8	14.9		25
Salinity	100	-		- and the second		0.6	1		

#### Table C.3: Quarterly Parameters SW1 - Colligan Estuary

### Table C.4: Quarterly Parameters SW2 - Colligan Estuary

	Q1 2014	Q2 2014	Q3 2014	Q3 2014	Q1 2015	Q2 2015	Q3 2015	EQS EPA / GSI	Cat A1 SI 294 of 1989
Sample Date	22/01/14	02/04/14	03/07/14	15/09/14	23/02/15	18/06/15	10/06/15	1	
Ammonia (mg/0	C	a the second	Sector and the		1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.		Y	0.02	0,2
BOD (Hig/I)	< 1.0	×1.0	<1.0	<1.0	< 1.0	<1.0	<1.0		5
COD (mg/l)	< 20	< 20	< 20	< 20	< 20	25	< 20	1	
Chioride (mg/l)	30.00	Pager-	(approx)	286	0.00		Y	250	250
Conductivity (us/om)	168	151	1,257	765	231	NM	142	1,000	1,000
Disacheed Coygen (% saturation)	100.3	135	105	102	105	118.1	105		> 60%
pH (pH units)	7.2	7.3	6.7	5.8	7,1	7.0	7.7		5.5-6.5
Suspended Solids (mg/l)	<4	< 4		<4	*4	<4	<4		50
Temperature [deg C]	7.6	10.1	16.0	14.5	6.2	14.8	15.0		25
Salinity	Jes	8	d			0.5			

	SW lagoon Q1 2014	SW lagoon Q2 2014	5W bigoon Q3 2014	SW lagoon Q3 2014	SW lagoon Q1 2015	SW lagoon Q2 2015	SW lagoon Q3 2015	EQS EPA/ GSI	Cat A1 5i 294 of 1989
Sample Date	22/01/14	87/04/14	08/07/14	15/00/14	23/02/15	18/06/15	10/08/15		
000 (mg/l)	2	1.4	145	1.2	< 1.0	3.6	19		5
C00 (mg/l)	27	< 20	48	33	<20	38	34		1
Conductivity (us/cm)	537	483	565	923	699	389	519	1,000	1,000
Dissolved Grygen (% saturation)	32.B	93	57	72	75.0	45	62		> 60%
pH (pH units)	7.4	7.1	7.0	7.1	7.1	7,3	7.1		5.5-8.5
Suspended Solids (mg/l)	<4	<4	<4	<4	<4	15	<4		50
Temperature (deg C)	5.5	21.5	17.1	14.2	5.5	15.6	25.4		25
Satirity	- Var		91	0	19-11-11-11-1-1-1-1-1-1-1-1-1-1-1-1-1-1	S 34 - 8	1	· · · · · · · · · · · · · · · · · · ·	

# Table C.1: Quarterly Parameters SW Lagoon

#### Table C.2: Quarterly Parameters SW 280 River Colligan

	Q1 2014	Q2 2014	Q3 201.4	Q3 2014	Q1 2015	Q2 2015	Q3 2015	EQS EPA/	Cat A1 51 294 of 1989
Sample Date	22/01/14	07/04/14	03/07/14	15/09/14	23/02/35	18/06/13	10/08/35		
BOD (mg/l)	\$1.0	<1.0	< 1.0	<1.0	< 1.0	< 1.0	< 1.0		5
COD (mg/l)	< 20	< 20	< 20	< 20	< 20	< 20	< 20	1.000	17 602
Conductivity (us/cm)	158	143	160	155	142	161	132	1,000	1,000
Disached Oxygen (% saturation)	100.7	106.6	105	105	106	112	107		> 60%
pH (pH units)	7.2	73	6.7	5.8	6.7	7.4	7.2		5.5 8.5
Suspended Solids (mg/l)	< 6	《音	<4	<4	15	=4	< 6		50
Temperature (deg C)	7.6	20.2	15.9	14.1	5.9	14.9	15.2		25
Salinity	- Yae				19-11-19	( <u>1</u> 64 )			· · · · · · · · · · · · · · · · · · ·

APPENDIX C

SURFACE WATER QUALITY MONITORING DATA

Barchole Code	Total Depth	Elevation Top Of Casing	Groundwater Level 07/01/14	Comment	Groundwater Monitoring Interval	Strata Encountered
	- net and					6.60m to 7.50m brown silty sandy gravely CLAY.
L1 Léachate	30.00m			Water strike 9.50m rose to 8.10m after	1.00m to 9.00m	Gi, to 0.20m Made ground composed of brown gravely day.
				30 mics		0.20m to 6.00m Made ground composed of domestic refuse with brick, plastic, wood, concrete and some grevely day.
						8.00m to 9.00m Made ground composed of decaying domestic waste.
1						9 00m to 10.00m Black sitty (oily) GRAVEL with poc pockets of peaky day with roots.
14 Leachate	6.60m	11.80m		Water strike 3.80m rose to 3.20m in 30	1.00m to 6.00m	GL to 0.30m Made ground composed of brown gravely day.
				mins.		0.30m to 4.60m Made ground composed of domestic refuse with brick, plastic, word, concrete and some gravely day.
						4.60m to 6.60m brown black sity CLAY with roots and occlarge cobbles.
15 Leachste	5.70=	11.13m		Water strike 3.80m.	1.00m to 5.00m	GL to 0.30m Made ground composed of brown gravely day.
						<ul> <li>0.30m to 4.40m Made ground compared of domestic refuse with brick, plastic, wood and paper.</li> <li>4.40m to 5.70m black sity CL44 with roots.</li> </ul>

Range	Units	2015	2014	2013	2012	2011	2010	Interim Guideline Value for Groundwater GSI / EPA	Environmental Objectives Groundwater Regulations SI No. 9 of 2010 Threshold Range	Drinking Water Limit	Methanogenic Leachate Landfill Site Design Manual (EPA, 2000 Table 7.2)
Selenium	ug/l		< 1.0			3.7			1	10	
Sodium	mg/l		49			110			150	150	474 to 3,650
Strontium	ug/l		100								
Sulphate	mg/l		< 2.5	9.5		20		200	187.5	250	< 5 to 322
T Coli	Cfu/1 00							0		0	
Thallium	ug/l		<1.0			1.7					-
TOC	mg/l										
TON	mg/l		< 0.20	1.28		< 0.50				No abnormal change	
Vanadium	ug/I		<1.0			2.4			4		
Zinc	ug/l		13			13		100		5,000	0.03 to 6.7

Range	Units	2015	2014	2013	2012	2011	2010	Interim Guideline Value for Groundwater GSI / EPA	Environmental Objectives Groundwater Regulations SI No. 9 of 2010 Threshold Range	Drinking Water Limit	Methanogenic Leachate Landfill Site Design Manual (EPA, 2000 Table 7.3)
Cobalt	-ug/l	8-11	×<3,0		1 - 12	2.8	-	- Ki			
COD	mig/1			31		147					
Copper	AD/I	í i	< 1.0	Ĩ	1	3.5		30	1,500	2.000	< 0.02 to 0.62 mg/l
Cyanide	ug/l				1			10	37.5	50	9754007
EC	Us/c m		530	703		1,729			800 - 1875	1,500	5,990 to 19,900
FCOL	Ctu/1 00	1	10000		Ĵ	1		0		Ø	
Fluorida	mg/l	5	< 0.25	× 0.25		< 0.5		1.0		1,000	
Iron	ught		610			1,300				200	1.6 to 160 mg/l
Lead	ob/i		3.1	i i	Ĩ	2.4		· · · · · ·	18.75	100	< 0.04 to 1.9 ==g/l.
Ust 1/11 organics		<u>[</u> ]	800	),	J						
Magnesium	mg/i		7.2			7.9		50		50	40101,380
Mangariese	ug/I	1	600	1	1	510		20	550.00	50	0.04 to 3.59 mg/l
Mercury	u6/1		∢ 0,50			<0.5		1	0.75	1	< 0.0001 to 0.0008 mg/l
Molybdenum	ug/l		× 1.0			1					
Nitrite	mg/l	s		< 0.002	1	100 8					C. Martinet Martinet
Nickel	ug/1	8	2.2		1	5.1			15	20	< 0.03 to 0.6 mg/l
Ortho- phosphate	mg/l		× 0.01	0.02		0.23					
Petassium	mg/1	<u>- 1</u>	12		1	26				12	100 to 1,580

Range	Units	2015	2014	2013	2012	2011	2010	Interim Guideline Value for Groundwater GSI / EPA	Environmental Objectives Groundwater Regulations SI No. 9 of 2010 Threshold Range	Drinking Water Limit	Methanogenic Leachate Landfill Site Dosign Manual (1PA, 2000 Table 7.2)
Oate			07/04/ 14	13/09/13	No deta	34/03/11	No data	( )			
Temp	3°	-1	13.6	11.3		8.0	8	2. A		Second and	March Street and
рH	pH units		6.8	7.3		7.3				6.5 to 9.5	6.8 to 8.2
Alkalinity.	mg/l					565		No abnormal change			3,000 to 9,130
Auminium	ug/l		40	55.		< 25		200		200	51 - 74 - 13 - 50 - 20 -
Ammonia	mB,J		< 0.02	0.11		39			0.065 to 0.125	0.30	283 to 2,040 ammoniacal nitrogen-N
Andirately	ug/l		< 1.0			1.7				5	
Amenic	nßy	î î	< 1.0	- 24	1	3.6			7.5	30	< 0.000 to 0.485mg/T
Sector	ug/l	3 3	17		8	22	8	100		8	(2) (for 200-1000)
Servilium	ug/l		< 1.0			1.4					
80D	mg/l		2.1	1.9		E. Long	6	E. anno E			
Baron	ug/l	1 9	75			170	14	1000	750	1,000	
Cadmium	ug/l		< 0.02			< 0.5		5	3.75	5	< 0.01 to 0.08 mg/l
Calcium	mg/l	1	44			43		200	- and the second	200	23 to 501
Chloride	ing/l	1 9		90	1	173	18	Q	24 - 187.5	250	570 to 4,710
Chromium	ug/l		1.3			8.3		30	37.5	90	< 0.03 to 0.56 mg/l

# Table E.2: Summary of Leachate Composition Interceptor

	10000-00	Set all saids.	Sectors and the sectors	1/1/2/11/11/12/	1008-001	4000411	Alexandria A		DOT BY SERVICE	100100	STATISTICS IN MILE	And the Arriver	Investment of the second second		- 14	interior.	20.00	100/10/00/00	12032	10010101010101
	- singular	-27	7 MAY 80 YO M 10 YO H 10 YO M 10 YO H	INFORMATION PROPERTY.	105,1871		10 C	100	-		10	801	ar.		- 1.	0.00	10.0			
Dep         Dep <thdep< th=""> <thdep< th=""> <thdep< th=""></thdep<></thdep<></thdep<>	Sec.	1478	The Rel Department	THE SAME IN	100,000			100	100		1.00	1.4	10 <sup>1</sup>		11	0.00	100		144	
	Sugar and	Server .	A Sec-With contribu-	THE PROPERTY.	1000,0003			110	-	1.74		Pizz.		100	-11	- NO	- MVC		41.	38.2
	Married.	-7W1	Since (BCN spectral)	CHARGE CODE.	1540,9875	100			- 24 -			86-15		100	40.0	- 35	100	1.00		6.5
	2014	THE A DOT	CONTRACT ADDRESS OF A DRESS OF A	2 Million and a	166,262		100	1.5	140.0	1.1							196.0		- 14	
	Sec.	- and	A BAT HE FOR BALLY IN	2 in America Clinical	LINK WELL			125	-						14	1.00	- Contra - C	-		
	and the second	1010 2000	in the life of desired.	a la instanciator las	100,000												100		1.1	E.C.
	100.00	1.0	A star bir to second.	10.0.0.0.0.00.0	100, 100	1.2						15.1			100	1.00				1.2
	200.000		CONTRACTOR AND AND AND AND AND AND AND AND AND AND	CARD OF SUCH	100,000				100	1.1				11	100		1.0	1.00		1 C
	2221	with the	The Division of the second second	P 24 YO 200 LAND	100.000					_	-	10 C	1 mm	1.00	100		120			
	02.0		The second second	minuted in the m	1000 1001	1.1			100	1.00		Marin .		1.00	100	1.00	1.0	100	100	6.00
Sec.         Sec. <th< td=""><td>0255</td><td>100</td><td>Allow With controls</td><td>THE PARTY OF A</td><td>1000 7001</td><td>11</td><td></td><td></td><td>1.00</td><td></td><td></td><td>Add T</td><td></td><td>17</td><td></td><td>14.4</td><td></td><td></td><td></td><td>81.</td></th<>	0255	100	Allow With controls	THE PARTY OF A	1000 7001	11			1.00			Add T		17		14.4				81.
Second         Second<	- C	17	The Party Law and	CARDON - CONT 1	1102 2010	1.00				1.00				1.00		1.6			444	-
	1.000	Contraction .	and the second	And Low Column	And Tarle	1.14						19.6		-5-	12.1	100	- Th		100	
				and the second	100 000							255				- 22	2.5	0.0		100
				and the second	1000				-	10			22		411					151
	1000									1000				100		100	- CE			25.7
			Contraction of the second	COLUMN TRANS	100000	1.11			-	- CZ -		121			100	1.00	122			122
Norm         Norm <th< td=""><td></td><td></td><td>THE R. P. LEWIS CO.</td><td>Contraction of the</td><td>the second</td><td>0.22</td><td></td><td></td><td></td><td>100</td><td></td><td></td><td></td><td>100</td><td>2</td><td></td><td>-</td><td></td><td>100</td><td></td></th<>			THE R. P. LEWIS CO.	Contraction of the	the second	0.22				100				100	2		-		100	
	and the set of the		a new party descently	Contraction of the		0.022								121			1.20			
	20.0		a set the set of the set	Contraction of the second				12.2		-				1.5	- 21		100		- CE (CC)	
	2440.00	100	-11/1 (F) 19/1 (F) 19/1 (F)	194790 8081	1000,000			-22					14		2.2		100		0.0000	100
	200	321	A DATE OF THE DATE OF	NUMBER OF STREET	11111-1252			- 250					4.3		2.1	- M			100	
Alter         Alter <th< td=""><td>1000</td><td>1996</td><td>S MONTH S MARKING</td><td>0.0014453493-0</td><td>1795.050</td><td></td><td></td><td>194</td><td>- 78-</td><td></td><td></td><td>2.0</td><td></td><td></td><td>- 20-</td><td></td><td></td><td>-</td><td></td><td></td></th<>	1000	1996	S MONTH S MARKING	0.0014453493-0	1795.050			194	- 78-			2.0			- 20-			-		
Monte         Monte <th< td=""><td>35.00</td><td>100. 10 PMT</td><td>- ENGLISH AND ENVIRED</td><td>2.000 Million 12</td><td>ALC: NO.</td><td></td><td></td><td></td><td>-</td><td></td><td></td><td>5.6</td><td></td><td></td><td>100</td><td></td><td></td><td></td><td></td><td></td></th<>	35.00	100. 10 PMT	- ENGLISH AND ENVIRED	2.000 Million 12	ALC: NO.				-			5.6			100					
Web         Max         Max <td>- MO-WP</td> <td>18 M.</td> <td>1 BALEN THE REPORT OF</td> <td>14422, 1661</td> <td>100,005</td> <td></td> <td></td> <td>- 55</td> <td></td> <td></td> <td></td> <td>- 19 C</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>- P/1</td> <td></td>	- MO-WP	18 M.	1 BALEN THE REPORT OF	14422, 1661	100,005			- 55				- 19 C							- P/1	
Var.         Var. <th< td=""><td>and the second</td><td>5498 C. C. C.</td><td>144.00 (N 5.400.0)</td><td>PAPELER.</td><td>100,505</td><td></td><td>2815</td><td>- 14-1</td><td>78-</td><td></td><td>1.00</td><td>114</td><td>1.00</td><td></td><td></td><td></td><td>- 10</td><td></td><td>1.00</td><td></td></th<>	and the second	5498 C. C. C.	144.00 (N 5.400.0)	PAPELER.	100,505		2815	- 14-1	78-		1.00	114	1.00				- 10		1.00	
Name         Name <th< td=""><td>Constraint of</td><td>5495-31 B</td><td>COMPACT OF A CONTRACT OF A CON</td><td>1.MT</td><td>410,000</td><td></td><td>100</td><td></td><td>100</td><td></td><td></td><td>No. 1</td><td>1.</td><td></td><td></td><td></td><td></td><td></td><td>1071</td><td></td></th<>	Constraint of	5495-31 B	COMPACT OF A CONTRACT OF A CON	1.MT	410,000		100		100			No. 1	1.						1071	
Number         Numer         Numer         Numer <td>Note: No.</td> <td>10000-01281</td> <td>COMPANY, RECEIPTING</td> <td>2.0475</td> <td>1100,7003</td> <td></td> <td>5.7</td> <td></td> <td></td> <td></td> <td></td> <td>194</td> <td></td> <td></td> <td>111</td> <td></td> <td>10.0</td> <td></td> <td></td> <td></td>	Note: No.	10000-01281	COMPANY, RECEIPTING	2.0475	1100,7003		5.7					194			111		10.0			
Dev         OWN IN         Holf (1)         Holf (1) <thholf (1)<="" th=""> <thholf (1)<="" th=""> <thholf< td=""><td>March 1</td><td>-008-418</td><td>DEPENDING STORAGE PROPERTY.</td><td>2.9410</td><td>100,003</td><td></td><td>NO</td><td></td><td></td><td></td><td></td><td>1.4</td><td></td><td></td><td>ALC: N</td><td></td><td>100</td><td></td><td></td><td></td></thholf<></thholf></thholf>	March 1	-008-418	DEPENDING STORAGE PROPERTY.	2.9410	100,003		NO					1.4			ALC: N		100			
James         Original         Distant Action (Control of the Control	1000	X0FBy 6 BY	HERE ADDRESS ADDRESS	EMIR	1101.203		240		- 28						-UE			1.1		
matrix         control of the state is stat	Contraction (Contraction)	SPORTED IN	of additional Architectory Tables	4.8532	1045/0608		246		- 16.			4.1			-940-		100			
Alterna       Constraints	ALC: NO	- Artificture ( and )	economics and set and the fi	4.00.4	1000 2000		100	0.00	0420		200	101			14		10.0			
No.         No. <td>ARRIVE:</td> <td>1000</td> <td>can be reading as taking which</td> <td>1.44.8</td> <td>100.505</td> <td></td> <td>100</td> <td>1.00</td> <td></td> <td></td> <td>M.7</td> <td></td> <td></td> <td></td> <td>12.8</td> <td></td> <td>100</td> <td></td> <td></td> <td></td>	ARRIVE:	1000	can be reading as taking which	1.44.8	100.505		100	1.00			M.7				12.8		100			
$\Delta_{\mu\nu}$ $\mu\nu_{\mu\nu}$	ing our l	14775-00181	COMPLEX AN INCOME.	1.000.000	100,505		200	- N	1.00			34.5			16.1	0.00				
Var.         Number of the state of t	1000	TANK ALL PL	COMPANY IN MALERAL PROPERTY.	1.0000.000	100,000		100	- 642				245			1.4	0.00	10.0			
Varial         Late:         Late: <t< td=""><td>Company of C</td><td>20010-0100</td><td>RESIDENT BARBAR SECTION.</td><td>PROPERTY.</td><td>1000,0000</td><td></td><td>100</td><td>1.04</td><td>-</td><td></td><td></td><td>- 162</td><td></td><td></td><td>1000</td><td>100</td><td></td><td></td><td></td><td>1000</td></t<>	Company of C	20010-0100	RESIDENT BARBAR SECTION.	PROPERTY.	1000,0000		100	1.04	-			- 162			1000	100				1000
Sec.         OWERTED         District Constraints         Distretent         Distretent	Sec. 1	CONTRACTOR OF CONTRACTOR OFFICATOR FFICATOR OFFICO	ta catally in Article 1990 (1990)	DOM: NOT	1.040/1001		Auto -	140				- MC-			- 110	100		1.00		100 C
Sector         Original Sector         Description         Description <thdescription< th=""> <thdescription< th=""></thdescription<></thdescription<>	5000	XMM-#151	DESCRIPTION OF A DESCRI	2401012	1001263		HE -	- 14	30			-01			41.		100	1.161		100
Jack Strip         Alef St	Series and	SPA-HIAT	PERMIT AND DEPARTMENT	3463343	1805,2608		100	- A.	- 20			#1			O.L			1.167		
Alter of Protein         Long to Name attach         Constrained attach         Constrai	ALC: NOT THE OWNER OF	ALC: NOT	A lot of the first of the first	1000000	Link Sect.		1.6	1.4			444				144					
Maps         Lands         Lands <thlands< th="">         L</thlands<>	10000	Automation and a service of the serv	to set the home to be addressed.	a milestre	A Rep Weeks		1.16		-		1.00				144	- m				
Algo         Prod P         Prod P <td>and ref.</td> <td>automotive and</td> <td>17 Staf Striven Viel, Landson</td> <td>P. Build up &amp;</td> <td>a service of the</td> <td></td> <td>64.0</td> <td>1.4</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>4.1</td> <td></td> <td></td> <td></td> <td></td> <td></td>	and ref.	automotive and	17 Staf Striven Viel, Landson	P. Build up &	a service of the		64.0	1.4							4.1					
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	100.00	10000-00-00	Man Andrew Street and a second to	Proceeding 1	A REPORT		100	1.00	-						4.14		10.0			
Varial         File	Contraction of the	Shink wat shi	All Conferences on the second second	PROFESSION.	11001000		ter 1		- 20							1.00	100			
Sec.         ONL-107         High Shape area         Calified         High State         High State <td>- Carlor 1</td> <td>CONTRACTORY AND INCOME.</td> <td>Without W. Salard Street, and street.</td> <td>If safet PART</td> <td>1100.0075</td> <td></td> <td>10.00</td> <td></td> <td>-</td> <td></td> <td>1.00</td> <td>10.1</td> <td></td> <td></td> <td>444</td> <td></td> <td>1000</td> <td>1.1</td> <td></td> <td></td>	- Carlor 1	CONTRACTORY AND INCOME.	Without W. Salard Street, and street.	If safet PART	1100.0075		10.00		-		1.00	10.1			444		1000	1.1		
Sec.         Off-LP         Lo 2 March and billion         Lord Lands         Lord Lands <thlord lands<="" th=""> <thlord la<="" td=""><td>Sector 1</td><td>-00%-4108*</td><td>Million (N. Million) and a stationer</td><td>1 1407 1444</td><td>1144,7475</td><td></td><td>10.1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>4.10</td><td>1.84</td><td>- 20</td><td>1.00</td><td></td><td></td></thlord></thlord>	Sector 1	-00%-4108*	Million (N. Million) and a stationer	1 1407 1444	1144,7475		10.1								4.10	1.84	- 20	1.00		
Alter         Constraint         Alter         Constraint	Second and	00%-418	Labor Di Namara, Caminana	APPENDA.	1000 2008		1.00	1.00	1.00		100				141	1.00	- 24	1.2		
March Marchine         March	determine the	Contracted 1 (etc.)	to per all institution, and some	a which the	Print Date:		1.00				100				140		- 20			
Market         Market<	and the set	Address of Line	Lange de Lange de Lange	10000000	Trans. Camp						1000				122		- 20			
Non-operation         Non-oper	diam'r.	10000000000	CONTRACTOR ADDRESS OF ADDRESS	and description.	100 100			- 61			- CEO	- 20			- 22	- C -	- 20			
No.p.         No.p. No.p.         No.p. No.p.         No.p. No.p.         No.p. No.p.         No.p. <t< td=""><td>10.0.00</td><td>Extended into</td><td>R. M. M. Marketter, Marketter,</td><td>1.400.04</td><td>100 100</td><td></td><td>100</td><td>- 21</td><td></td><td></td><td>124</td><td>- 20</td><td></td><td></td><td>1.00</td><td>- C -</td><td>- 22</td><td></td><td></td><td></td></t<>	10.0.00	Extended into	R. M. M. Marketter, Marketter,	1.400.04	100 100		100	- 21			124	- 20			1.00	- C -	- 22			
Note:         Note: <th< td=""><td></td><td>Service of the local service o</td><td>A. A. W. Martin and Annual State</td><td>COMPANY OF A</td><td>1000</td><td></td><td>200</td><td></td><td></td><td></td><td>1.0</td><td></td><td></td><td></td><td>- 222</td><td>- 21 -</td><td>- 20</td><td></td><td></td><td></td></th<>		Service of the local service o	A. A. W. Martin and Annual State	COMPANY OF A	1000		200				1.0				- 222	- 21 -	- 20			
Non-off         Lock bases were         Sample         Non-off	0201	has to make which have a	The State of State of State of State	of states in a st	1000 0000		1.00	- 21			100	- C. I			1.11			0.21		
State         Ministry within state         Disciplination within the state         Disciplination state         Disciplination state <thdisciplination state         <thdisciplination< td=""><td>25.0</td><td>cont. Attai</td><td>the second second second second</td><td>2 MARTINE</td><td>A.4. 1 1997</td><td></td><td>72.0</td><td></td><td></td><td></td><td>100</td><td></td><td></td><td></td><td>- 27</td><td></td><td></td><td>0.0</td><td></td><td></td></thdisciplination<></thdisciplination 	25.0	cont. Attai	the second second second second	2 MARTINE	A.4. 1 1997		72.0				100				- 27			0.0		
According         Discription         Discription <thdiscription< th=""> <thdiscription< th="">         &lt;</thdiscription<></thdiscription<>	2010	where a fue	The second second second second second second second second second second second second second second second se	100000.000	And Colored		100	- 121	1.00		100				1.11	- E	1.0			
All of the second sec	100	0000000000	Little of Automatics and Automatics	A PRODUCTS	10		220	- 11	-						-2.2					
All of Schwart (Structure)     Die Schwart (Structure)	1000	20000000	PERCENT AND A PERCENT	A PARAMENTS	Prove Service			12.5							22		12.2			
All Control In         Description         Description <thdescription< th="">         Description         <thdescription< th=""> <thdescription< th=""></thdescription<></thdescription<></thdescription<>	100.00	President and	the scheme is address.	a determe	1000			1.00			Sec.									
Wipe afficient     Not winds (Not 1000)     Not 1000     Not 1000<	and the second	Service of the	to an exchange of the second	1 August 1004	a second second		100	- 120	- C		100	20			125		2.0			
Mark Schwidt         Die Schwidt Schwidt	where,	and a second second	PROPERTY AND ADDRESS	400.000	100,000										1995	-	2.0			
Ways     March March	A.4. W.	Martin and Constitutional	the type for an end of a station of	CARL AND	1000		100	12.			0.5				2.5			- 1		
No.0         Operation         Decision         Decision <thdecision< th="">         Decision         <th< td=""><td>A desired</td><td></td><td>the bar, the bar of a long a machine</td><td>100000000</td><td>10.000</td><td></td><td></td><td>25</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>- 22.5</td><td>100</td><td></td><td></td></th<></thdecision<>	A desired		the bar, the bar of a long a machine	100000000	10.000			25									- 22.5	100		
Preve offentile and former and provide states of a state of the states o	and the last		C. Service Server, a service section	1.0000.000	Pro Canal		-	- 55							2.2		22.5			
Development between the second	200000	1000 alle	Eller M Multiple, - Jelicie	2 991,248	41CT-260		E.C.	1.5	- 00		10.0	- C			515			1.00		
Development and the second sec	2010/14/	SPACE	DEPUK TURIUM CONSUL	SHORE OF	10.1264		1.8		- 18			- KO -			22.5	100	- 10	1.00		
AND ATTAIN REPORT OF THE ADDRESS AND ADDRESS TO THE ADDRESS ADDRES	ALC: NO.	Approx 1 in	an any set. A second star watches a	A DATE & AL	10.4 985		100				168	10.0			- 54	1.00				
THEY HERE WAS AND THE WAS AND		ARTISTICATION	as any the house of a stationer.	a shafta ta cha	10.4 980		104		140		Adv		1. The second second second second second second second second second second second second second second second		-					
	market.	an in the country species	In the Schurzsky's advance	1.06000-001	IN CORE		PR	1.5	385		107									

APPENDIX E

LEACHATE MONITORING DATA

Range	Units	Q1 2014	Q2 2014	Q3 2014	Q1 2015	Q2 2015	Q3 2015	IGV	Groundwater Regulations Si No. 9 of 2010 Threshold Range	Drinking Water Limit
Potzesium	mg/i		9,3	4	3.2	0.23	3.5	5		12
Selenium	1.get		<1.0	<1.0	<10					10
Sodium	mg/i		38	78	4.3	347	39	150	150	150
Strentium	1. Agu		110	270	25				1	
Thallium.	lgu		<1.0	<1.8	<1.0					
Utanium	Lig/I		<1.0	<1.0	<1.0			9		
Vanadium	118/1		<1.0	< 1.0	< 1.0					
Phenol	ug/i	_						0.5	-	
Nibrite	mg/l		< 0.004					0.1	Company of Company	0.90
Orthe-phosphate.	mg/t		×0.01		-			0.08	0.035 MRP	
Alkalinity	mg/l		185							
Fluoride	mg/1		< 0.25			Ξ	_	1.0	and and and and and and and and and and	0.8/1.5
Sulphate	mgA		2,5	1				200	187.5	250
tist1/II	ug/i									_
Aluminium	light		38	< 10.0	<10.0			200	150	200
Barium	hyp		13	7.4	3.5			100		2,1,10
Mercury	цал		< 0.58					1	0.75	1
Antimony	Lig/1		<1.0							5
Chromium	18/1		1.1					30	37.5	50
Copper	ug/1		<1.0					30	1500	2,000
Molybdenum	ugit		<1.0		· · · · · ·					
Zinc	lig/l:		13					100		