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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Table of Contents

Introduction 5

1. Reporting Period 6

2. Waste Activities Carried Out at the Facility 6

3. Quantities and Composition of Material Received, Disposed of, and Recovered during 2014. 7

4. Methods of deposition of waste. 7

5. Environmental Monitoring 8

Surface Water 10

Ground Water 20

Leachate 26

Groundwater and Leachate Levels 34

Gas Monitoring 35

Noise 36

Dust levels 38

Macroinvertabrate Survey 39

5.11 General Conclusions 41

5.12 Meteorological Data. 41

6. Sequence and timescale for development and restoration of the facility 42

7. Topographical Survey 44

8. Schedule of Environmental Objectives and Targets for the forthcoming year 44

9. Full title and a written summary of any procedures continued during the reporting period 45

10. Reported Incidents and Complaints. 51

11. Management and Staffing Structure of the Facility. 51

12. Programme for Public Information. 51

13. Reports of Training of Staff. 51

14. Statement on costs of Landfill 52

15. Reports on Financial Charges and Provisions 53

16. Slope Stability Assessment 53

List of Appendices

Appendix A	Quantities and Composition of Material Received, Disposed of, and Recovered during 2016
Appendix B	Monitoring Locations
Appendix C	Surface Water Results (receiving Waters)
Appendix D	Monitoring of Constructed Wetland System
Appendix E	Ground Water Results
Appendix F	Leachate Results
Appendix G	Meteorological Data
Appendix H	Flare Servicing Reports and Landfill Gas Survey 2016
Appendix J	Management Structure
Appendix K	Pollutant Release Transfer Register 2016
Appendix L	Environmental Liability Risk Assessment Review

Introduction

Waterford County Council was granted a Waste Licence (Ref 32-1) by the Environmental Protection Agency on the 29th 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 30th 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 1st January 2016 – 31st 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 1st January 2016 to 31st December 2016.

2. Waste Activities carried out at the Facility

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

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 in surface water retention (s) ponds

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 1st January 2016 – 31st 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 30th 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.

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

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

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, water quality 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. Noise 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.

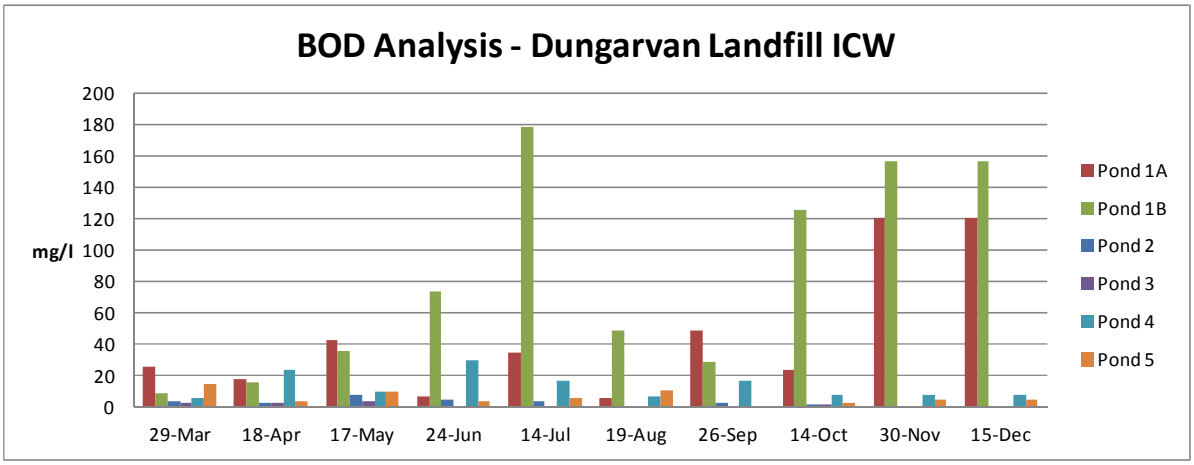
There are difficulties involved in monitoring surface water pollution from landfills adjacent to estuaries, as the salinity of the samples can interfere with many of the tests, (*ammonia, COD, arsenic, copper*). Additionally, many of the ions, which are considered indicators of leachate contamination, 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.

Table 5.1.1 Dungarvan landfill surface water monitoring Q1 2016

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
Visual Inspection/Odour		clear	clear/ saline
pH	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
TOC	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 5.1.2 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**		
Visual Inspection/Odour		clear	clear
pH	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
TOC	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

Table 5.1.3 Surface water quality Dungarvan landfill Q3 2016

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/Odour			clear	clear
pH	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
TOC	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/Odour		clear	clear
Temperature	0C	11.7	11.6
Dissolved Oxygen	% Sat	106	107
pH	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
TOC	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

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	oC		11.7	10	8.3	8.6	9.2	8.9	29-Mar
pH	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	oC		nm	nm	nm	nm	nm	nm	18-Apr
pH	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	oC		nm	nm	nm	nm	nm	nm	17-May
pH	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

Sampling Location		Ponds	Pond 1A	Pond 1B	Pond 2	Pond 3	Pond 4	Pond 5	Sample Date
Temperature	oC		14.6	15.4	17.4	16.2	16.8	17.2	24-Jun
pH	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	oC		17.4	13.9	15.6	17.7	17	18.4	14-Jul
pH	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	oC		17.4	14.3	15.5	16.2	14.8	15.5	19-Aug
pH	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
Dissolved Oxygen	% sat		121	nm	75	49	112	58	19-Aug

Sampling Location		Ponds	Pond 1A	Pond 1B	Pond 2	Pond 3	Pond 4	Pond 5	Sample Date
Temperature	oC		13.6	12.2	12.3	12.5	12.7	12.5	26-Sep
pH	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	oC		14.4	12.5	11.8	11.7	12.5	11.9	14-Oct
pH	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	oC		1.1	2.9	3.7	4.2	3.1	2.1	30-Nov
pH	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	oC		9.7	9.9	8.5	8.2	7.8	8.2	15-Dec
pH	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.

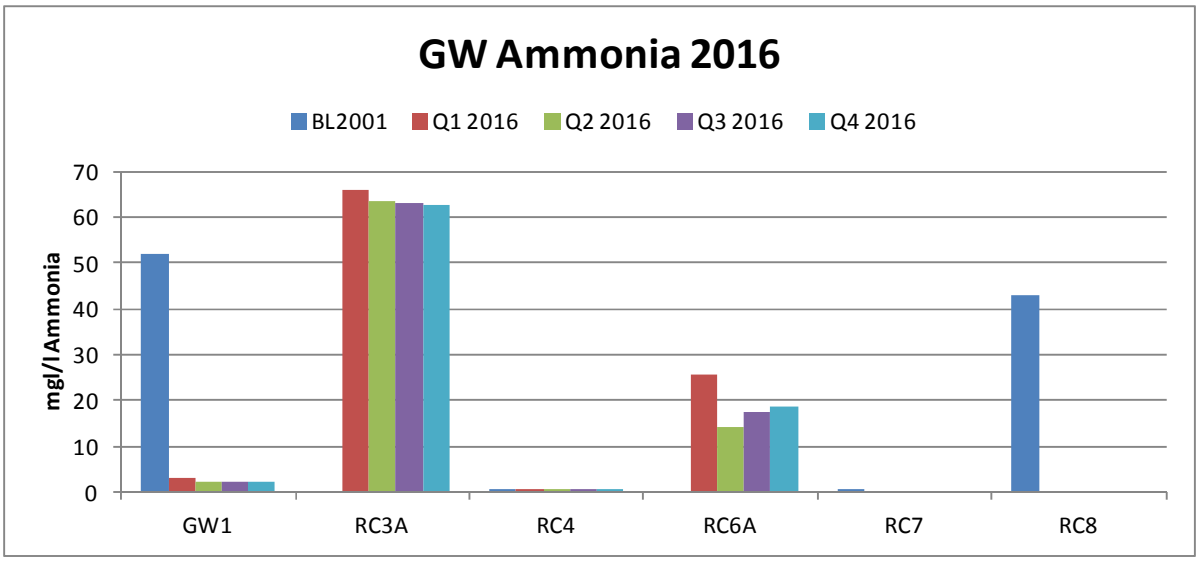
RC4 (south west of site) and RC7 (east of site) are outside the waste deposit area.

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.

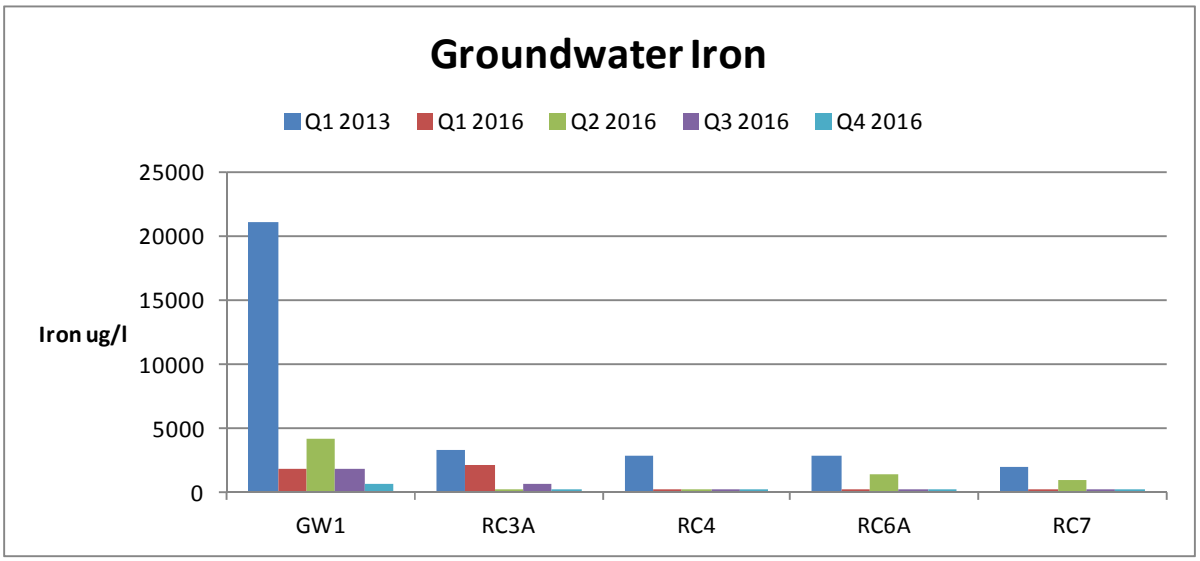
5.2.2 RESULTS

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

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

Table 5.2.2. Groundwater quality Dungarvan landfill Q2 2016

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

Table 5.2.3. Groundwater quality Dungarvan landfill Q3 2016

EntityName	Dungarvan	Dungarvan	Dungarvan	Dungarvan	Dungarvan	Groundwater quality standards S.I. No. 9 of 2010	Comment	Environmental 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
pH	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

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

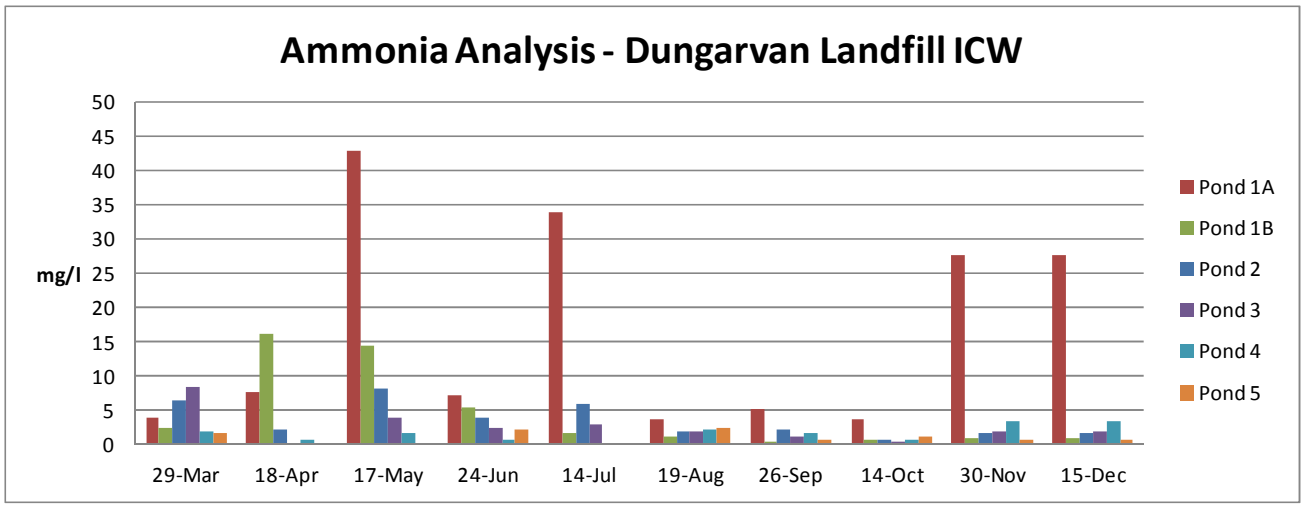
5.3 LEACHATE

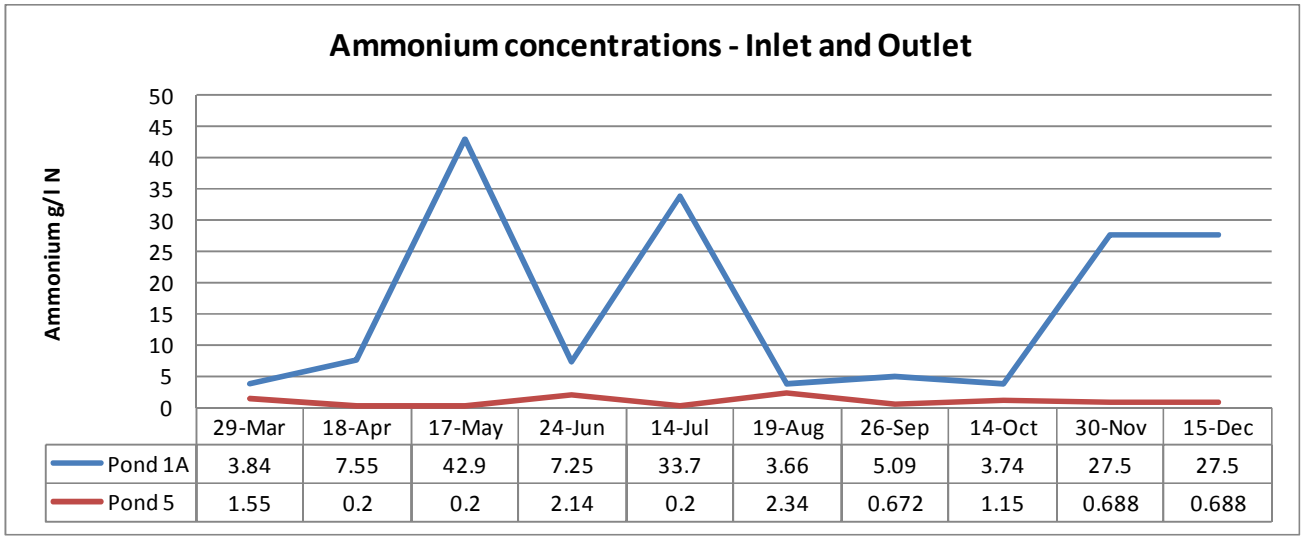
5.3.1 INTRODUCTION

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. Inlet and outlet concentrations for ammonia and chemical oxygen demand are graphed in figure 5.3.1.

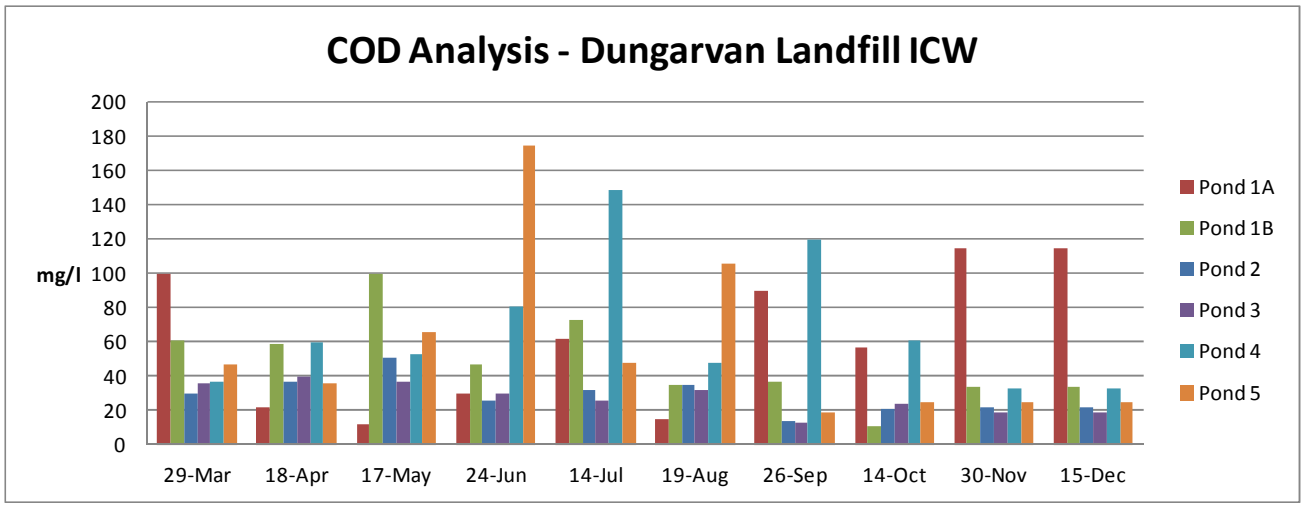
Table 5.3.1 Dungarvan landfill integrated constructed wetland estimated loadings – present and (future expected).

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





	29-Mar	18-Apr	17-May	24-Jun	14-Jul	19-Aug	26-Sep	14-Oct	30-Nov	15-Dec
Pond 1A	3.84	7.55	42.9	7.25	33.7	3.66	5.09	3.74	27.5	27.5
Pond 5	1.55	0.2	0.2	2.14	0.2	2.34	0.672	1.15	0.688	0.688



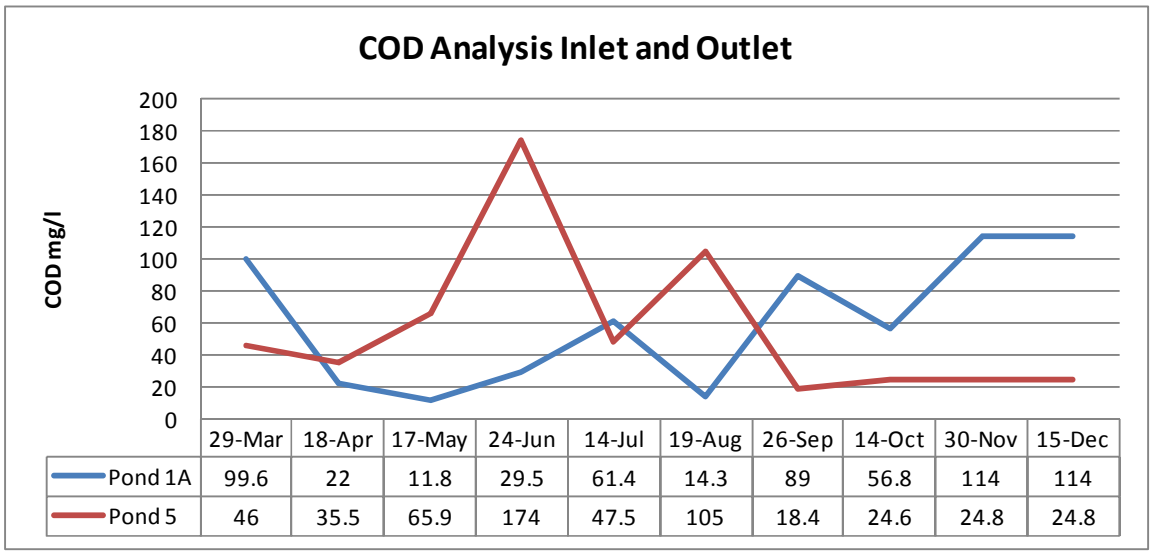


Figure 5.3.1: ICW inlet / outlet concentrations a) ammonium, b) chemical oxygen demand.

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.

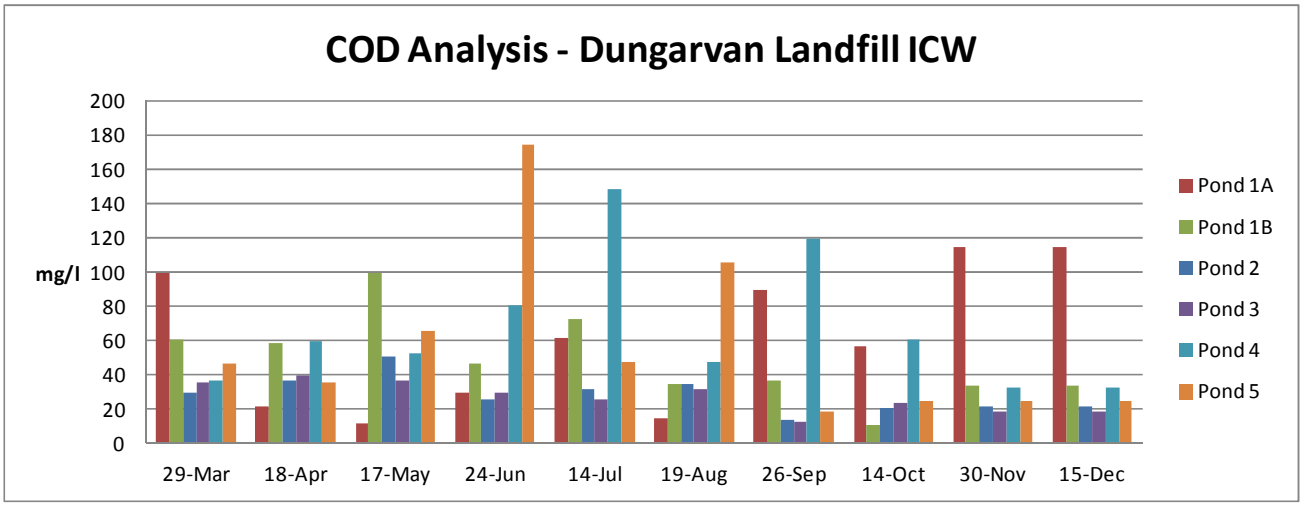


Figure 5.3.2 Leachate COD Trends 2016

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.

Table 5.3.3 Leachate quality Dungarvan landfill, Q1 2016

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

Table 5.3.4 Leachate Quality Dungarvan landfill, Q2 2016

Dungarvan Landfill W0032-02 Annual 2016
Leachates

LABORATORY NUMBER		**2255**	**2256**
		Lagoon	
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 Certificate of Analysis for Individual compounds		
****	See attached Certificate of Analysis for Individual metals		

Table 5.3.5 Leachate Quality Dungarvan landfill, Q3 2016

Dungarvan Landfill 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

Table 5.3.6 Leachate Quality Dungarvan landfill, Q4 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

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.

Table 5.4.1 Dungarvan landfill leachate levels 2016

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

D=Damaged

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.

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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.

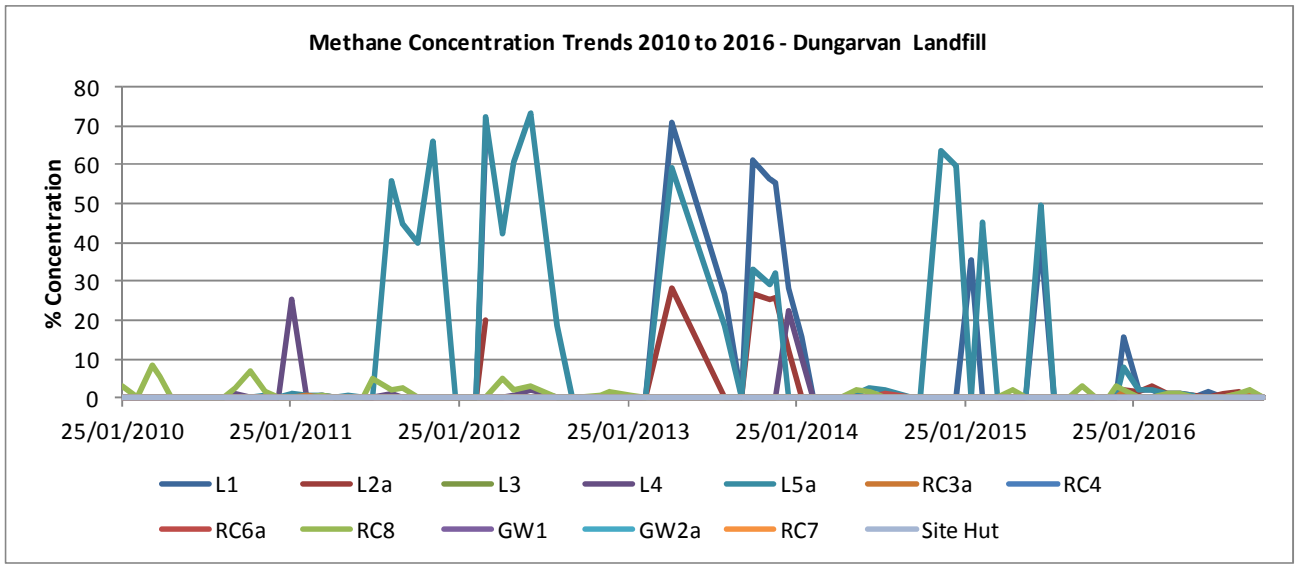


Figure 5.5.1 Methane temporal trends 2010 to 2016

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.

Table 5.5.1: Dungarvan Landfill Gas monitoring Q1 2016

Week No	Date	Operator	Gas	Site Hut	GW 1	GW 2A	L1	L2	L4	L5	RC3A	RC4	RC6A	RC 7	RC 8
1	05/01/2016	DR	CH_4	0.00	0.00	0.00	15.40	2.10	0.00	8.10	1.70	0.00	0.00	0.00	2.10
			CO_2	0.00	0.00	0.00	9.20	4.20	0.00	6.90	1.30	0.00	0.00	0.00	1.90
			O_2	20.90	20.90	20.90	6.40	15.70	20.90	11.10	18.10	20.90	20.90	20.90	17.70
			Air Pressure	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016
2	14/01/2016		CH_4	0.00											
			CO_2	0.00											
			O_2	20.90											
			Air Pressure	1023											
3	20/01/2016		CH_4	0.00											
			CO_2	0.00											
			O_2	20.90											
			Air Pressure	1012											
4	26/02/2016		CH_4	0.00											
			CO_2	0.00											
			O_2	20.90											
			Air Pressure	998											
5	04/02/2016		CH_4	0.00	0.00	0.00	1.90	1.60	0.00	2.20	0.00	0.00	0.00	0.00	0.00
			CO_2	0.00	0.00	0.00	2.10	4.00	0.00	4.70	0.00	0.00	0.00	0.00	0.00
			O_2	20.90	20.90	20.90	16.80	14.70	20.90	15.10	20.90	20.90	20.90	20.90	20.90
			Air Pressure	1023	1023	1023	1023	1023	1023	1023	1023	1023	1023	1023	1023
6	08/02/2016		CH_4	0.00											
			CO_2	0.00											
			O_2	20.90											
			Air Pressure	1021											
7	15/02/2016		CH_4	0.00											
			CO_2	0.00											
			O_2	20.90											
			Air Pressure	1011											
8	23/02/2016		CH_4	0.00											
			CO_2	0.00											
			O_2	20.90											
			Air Pressure	1012											
9	29/02/2016		CH_4	0.00											
			CO_2	0.00											
			O_2	20.90											
			Air Pressure	1021											
10	04/03/2016		CH_4	0.00	0.00	0.00	2.10	2.90	0.00	1.90	0.00	0.00	0.00	0.00	2.10
			CO_2	0.00	0.00	0.00	2.40	3.80	0.00	4.80	0.00	0.00	0.00	0.00	1.60
			O_2	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 Pressure	996	996	996	996	996	996	996	996	996	996	996	996
11	14/03/2016		CH_4	0.00											
			CO_2	0.00											
			O_2	20.90											
			Air Pressure	1032											
12	22/03/2016		CH_4	0.00											
			CO_2	0.00											
			O_2	20.90											
			Air Pressure	1018											
13	29/03/2016		CH_4	0.00											
			CO_2	0.00											
			O_2	20.90											
			Air Pressure	997											
Week No	Date	Operator	Gas	Site Hut	GW 1	GW 2A	L1	L2	L4	L5	RC3A	RC4	RC6A	RC 7	RC 8

Table 5.5.2: Dungarvan Landfill Gas monitoring Q2 2016

Week No	Date	Operator	Gas	Site Hut	GW 1	GW 2A	L1	L2	L4	L5	RC3A	RC4	RC6A	RC 7	RC 8
14	05/04/2016	DR	CH_4	0.00	0.00	0.00	0.00	1.20	0.00	1.10	0.00	0.00	0.00	0.00	0.90
			CO_2	0.00	0.00	0.00	0.00	2.90	0.00	2.10	0.00	0.00	0.00	0.00	1.20
			O_2	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
15	12/04/2016	DR	CH_4	0.00											
			CO_2	0.00											
			O_2	20.90											
			Air Pressure	1005											
16	18/04/2016	DR	CH_4	0.00											
			CO_2	0.00											
			O_2	20.90											
			Air Pressure	1021											
17	27/04/2016	DR	CH_4	0.00											
			CO_2	0.00											
			O_2	20.90											
			Air Pressure	1015											
18	04/05/2016	DR	CH_4	0.00	0.00	0.00	0.00	1.20	0.00	1.10	0.00	0.00	0.00	0.00	0.90
			CO_2	0.00	0.00	0.00	0.00	2.90	0.00	2.10	0.00	0.00	0.00	0.00	1.20
			O_2	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
19	10/05/2016	DR	CH_4	0.00											
			CO_2	0.00											
			O_2	20.90											
			Air Pressure	1005											
20	18/05/2016	DR	CH_4	0.00											
			CO_2	0.00											
			O_2	20.90											
			Air Pressure	1010											
21	23/05/2016	DR	CH_4	0.00											
			CO_2	0.00											
			O_2	20.90											
			Air Pressure	1003											
22	30/05/2016	DR	CH_4	0.00											
			CO_2	0.00											
			O_2	20.90											
			Air Pressure	1014											
23	03/06/2016	DR	CH_4	0.00	0.00	0.00	0.00	0.80	0.00	0.40	0.00	0.00	0.00	0.00	0.00
			CO_2	0.00	0.00	0.00	0.00	2.20	0.00	0.50	0.00	0.00	0.00	0.00	0.00
			O_2	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
24	14/06/2016	DR	CH_4	0.00											
			CO_2	0.00											
			O_2	20.90											
			Air Pressure	994											
25	22/06/2016	DR	CH_4	0.00											
			CO_2	0.00											
			O_2	20.90											
			Air Pressure	1014											
26	28/06/2016	DR	CH_4	0.00											
			CO_2	0.00											
			O_2	20.90											
			Air Pressure	1015											
Week No	Date	Operator	Gas	Site Hut	GW 1	GW 2A	L1	L2	L4	L5	RC3A	RC4	RC6A	RC 7	RC 8

Table 5.5.3: Dungarvan Landfill Gas monitoring Q3 2016

Week No	Date	Operator	Gas	Site Hut	GW 1	GW 2A	L1	L2	L4	L5	RC3A	RC4	RC6A	RC 7	RC 8
27	05/07/2016	DR	CH_4	0.00	0.00	0.00	1.50	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			CO_2	0.00	0.00	0.00	1.10	1.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			O_2	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
28	12/07/2016	DR	CH_4	0.00											
			CO_2	0.00											
			O_2	20.90											
			Air Pressure	1001											
29	20/07/2016	DR	CH_4	0.00											
			CO_2	0.00											
			O_2	20.90											
			Air Pressure	1008											
30	25/07/2016	DR	CH_4	0.00											
			CO_2	0.00											
			O_2	20.90											
			Air Pressure	1015											
31	29/07/2016	DR	CH_4	0.00											
			CO_2	0.00											
			O_2	20.90											
			Air Pressure	1006											
32	05/08/2016	DR	CH_4	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			CO_2	0.00	0.00	0.00	0.00	1.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			O_2	20.90	20.90	20.90	20.90	18.90	20.90	20.90	20.90	20.90	20.90	20.90	20.90
			Air Pressure	1002	1002	1002	1002	1002	1002	1002	1002	1002	1002	1002	1002
33	15/08/2016	DR	CH_4	0.00											
			CO_2	0.00											
			O_2	20.90											
			Air Pressure	1019											
34	23/08/2016	DR	CH_4	0.00											
			CO_2	0.00											
			O_2	20.90											
			Air Pressure	1019											
35	30/08/2016	DR	CH_4	0.00											
			CO_2	0.00											
			O_2	20.90											
			Air Pressure	1019											
36	06/09/2016	DR	CH_4	0.00	0.00	0.00	0.00	1.50	0.00	0.00	1.20	0.00	0.00	0.00	0.90
			CO_2	0.00	0.00	0.00	0.00	1.30	0.00	0.00	0.90	0.00	0.00	0.00	1.40
			O_2	20.90	20.90	20.90	20.90	19.10	20.90	20.90	18.70	20.90	20.90	20.90	17.90
			Air Pressure	1019	1019	1019	1019	1019	1019	1019	1019	1019	1019	1019	1019
37	12/09/2016	DR	CH_4	0.00											
			CO_2	0.00											
			O_2	20.90											
			Air Pressure	1000											
38	20/09/2016	DR	CH_4	0.00											
			CO_2	0.00											
			O_2	20.90											
			Air Pressure	1021											
39	26/09/2016	DR	CH_4	0.00											
			CO_2	0.00											
			O_2	20.90											
			Air Pressure	1015											
Week No	Date	Operator	Gas	Site Hut	GW 1	GW 2A	L1	L2	L4	L5	RC3A	RC4	RC6A	RC 7	RC 8

Table 5.5.4: Dungarvan Landfill Gas monitoring Q4 2016

Week No	Date	Operator	Gas	Site Hut	GW 1	GW 2A	L1	L2	L4	L5	RC3A	RC4	RC6A	RC 7	RC 8
40	03/10/2016	DR	CH_4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.70	0.00	0.00	0.00	2.10
			CO_2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.30	0.00	0.00	0.00	1.90
			O_2	20.90	20.90	20.90	20.90	20.90	20.90	20.90	18.10	20.90	20.90	20.90	17.70
			Air Pressure	1027	1027	1027	1027	1027	1027	1027	1027	1027	1027	1027	1027
41	11/10/2016	DR	CH_4	0.00											
			CO_2	0.00											
			O_2	20.90											
			Air Pressure	1023											
42	17/10/2016	DR	CH_4	0.00											
			CO_2	0.00											
			O_2	20.90											
			Air Pressure	1012											
43	24/10/2016	DR	CH_4	0.00											
			CO_2	0.00											
			O_2	20.90											
			Air Pressure	1010											
44	31/10/2016		CH_4												
			CO_2												
			O_2												
			Air Pressure												
45	07/11/2016		CH_4												
			CO_2												
			O_2												
			Air Pressure												
46	14/11/2016		CH_4												
			CO_2												
			O_2												
			Air Pressure												
47	21/11/2016		CH_4												
			CO_2												
			O_2												
			Air Pressure												
48	28/11/2016		CH_4												
			CO_2												
			O_2												
			Air Pressure												
49	05/12/2016		CH_4												
			CO_2												
			O_2												
			Air Pressure												
50	12/12/2016		CH_4												
			CO_2												
			O_2												
			Air Pressure												
51	19/12/2016		CH_4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	3.20
			CO_2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	1.10
			O_2	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00		20.00	17.10
			Air Pressure	1010	1010	1010	1010	1010	1010	1010	1010	1010		1010	1010
52	26/12/2016		CH_4												
			CO_2												
			O_2												
			Air Pressure												
Week No	Date	Operator	Gas	Site Hut	GW 1	GW 2A	L1	L2	L4	L5	RC3A	RC4	RC6A	RC 7	RC 8

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

Table 5.6.1 - 2012 Noise levels

1998 "Baseline" noise levels

Site	*Date of Monitoring*	*L(A)eq[30mins] dB*
Site entrance	11/6/14	**55.7**
	Baseline 1998	54

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.

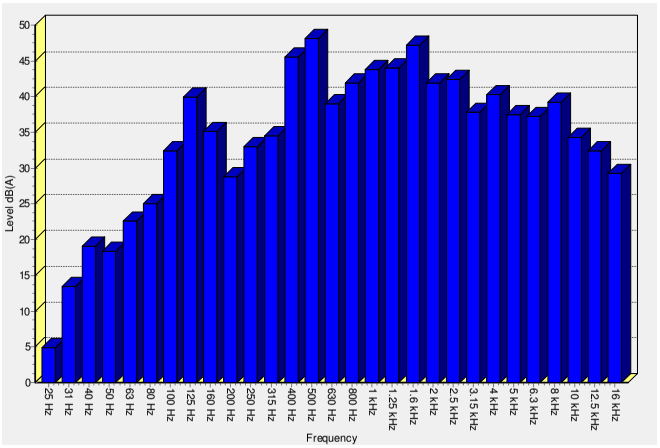


Fig 5.6 Dungarvan landfill noise monitoring 11/6/14, site entrance, octave band analysis, A weighting

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

RESULTS –

Table 5.8.1. Macroinvertebrate counts 12/12/12

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

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

	SW1	SW2
A1	Small Numbers	Small Numbers
A2	Small Numbers	Small Numberw
B	Numerous/Dominant	Numerous/Dominant
C	Absent	Absent
D	Absent	Absent
Assigned Q Rating	3/4	¾

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

Order	Family	Tolerance	SW2	SW1	SW4 Pond
Ephemeroptera (Mayflies)	Heptageniidae	A	1		
	Baetidae	C	4		
Trichoptera (Cased caddis)	Sericostomatidae	B	2	+	
	[illegible]	B	4		
Trichoptera (Uncased caddis)	Limnephilidae	B	1		
	Polycentropodidae	C			4
Coleoptera (Beetles)	Elmidae	C	7	3	
Crustacea (Crustaceans)	Gammaridae	C	60	120	
[illegible]	[illegible]	-			4
Diptera (Flies)	Chironomidae	C	1		
	Ceratopogonidae	C			1
	Chaoboridae	C			2
Gastropoda (Snails)	Lymnaeidae	D	2		69
	Hydrobiidae	C	20	11	
Fish	Pleuronectidae	-	3	4	
	Corixidae	-			11
Freshwater Worms	Oligochaeta	-			9
Cladocera (Water Flea)	Daphniidae	-			>500
Taxon Richness			11	5	8

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 €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.

6. 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. 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.

13. ***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.

14. ***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

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 €80,000, €70,000, and €20,000 for general management, leachate, and gas systems, respectively (as per extracted Table 7.3 below).

Costs of aftercare management proposals

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.

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

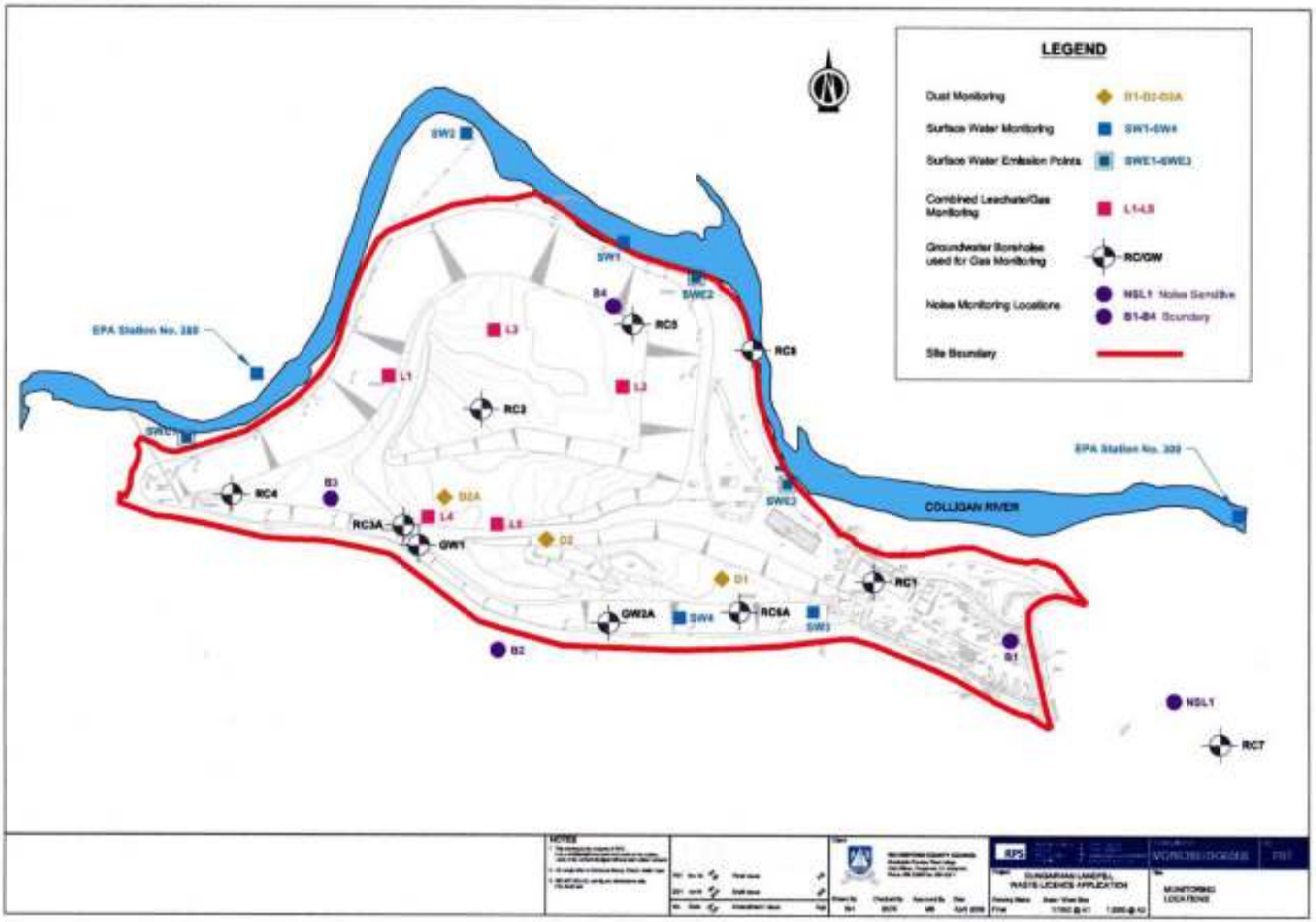
Waste Disposed	Type	EWC Code	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16	Dec-16	Total
Domestic	Bulky - Areas	20 03 01	51.62	6.84	19.94	18.12	14.70	13.10	45.25	15.70	53.06	23.54	0.00	0.00	261.87
	Bulky - Greenstar Skip	20 03 01	2.82	2.80	6.34	2.04	3.14	8.86	8.46	8.10	5.22	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 Recovery at Dungarvan Civic Amenity Site and Transfer Station between January 1st and December 31st 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**

Appendix B

Monitoring Locations


LEGEND
Dust Monitoring
D1-D2-D3A
Surface Water Monitoring
SW1-SW4
Surface Water Emission Points
SWE1-SWE3
Combined Leachate/Gas Monitoring
L1-L5
Groundwater Borehole used for Gas Monitoring
RC/GW
Noise Monitoring Locations
NSL1 Noise Sensitive
B1-B4 Boundary
Site Boundary
SW2
SW1
SWE2
B4
RC5
RC6
L3
L1
L2
RC2
EPA Station No. 288
SW3
RC4
B3
D3A
L4
L5
RC3A
GW1
D2
SWE3
EPA Station No. 309
COLLIGAN RIVER
D1
RC1
GW2A
SW4
RC5A
SW5
B2
B1
NSL1
RC7
NOTES
DUNGARVAN LANDFILL
WASTE LICENCE APPLICATION
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
Visual Inspection/Odour		clear	clear/ saline
pH	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
TOC	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/Odour		clear	clear
pH	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
TOC	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

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
pH	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
TOC	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	$_0$C	11.7	11.6
Dissolved Oxygen	% Sat	106	107
pH	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
TOC	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

Appendix D

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	oC		11.7	10	8.3	8.6	9.2	8.9
pH	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 **								

** Individual metals are in the Certificate of Analysis, enclosed

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 metals are contained in Certificate of Analysis, enclosed.

AL control Laboratories

Validated

CERTIFICATE OF ANALYSIS

BDG:	150991-107	Location:	Dungannon	Order Number:	
Job:	D_MCGARRY_KIL-6	Customer:	Jim McGarry	Report Number:	366016
Client Reference:		Attention:	Jim McGarry	Superseded Report:	

Sample Descriptions

Grain Sizes

very fine	<0.063mm	fine	0.063mm - 0.2mm	medium	0.2mm - 2mm	coarse	2mm - 10mm	very coarse	>10mm

Lab Sample No(s)	Customer Sample Ref.	Depth (m)	Colour	Description	Grain size	Inclusions	Inclusions 2
13179413	2.00m		Dark Brown	N/A	2.00 - 50.00mm	Stones	Vegetation
13179414	3.00m		Dark Brown	Sand	0.063 - 2.00mm	Stones	None
13179415	4.00m		Dark Brown	N/A	0.063 - 2.00mm	Stones	Vegetation
13179417	5.00m		Dark Brown	N/A	2.00 - 50.00mm	Stones	Vegetation
13179419	6.00m		Light Brown	N/A	2.00 - 50.00mm	Stones	Vegetation
13179411	7.00m		Dark Brown	N/A	2.00 - 50.00mm	Stones	Vegetation

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

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring 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.

09:13:43 07/04/2016

ALcontrol Laboratories

CERTIFICATE OF ANALYSIS

Validated

SDG:	190331-107	Location:	Dungarvan	Order Number:	
Job:	D_MCGARRY_KIL-6	Customer:	Jim McGarry	Report Number:	399016
Client Reference:		Attention:	Jim McGarry	Superseded Report:	

Component	LOD/Units	Method	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ammoniacal Nitrogen as N	<0.2 mg/l	TM099		6.36 ¥		0.33 #	1.99 ¥	
COD, unfiltered	<7 mg/l	TM107		29.5 ¥		28.8 #	36.4 ¥	
Aluminium (diss.filt)	<2.9 µg/l	TM152		15.6 ¥		9.8 #	8.24 ¥	
Arsenic (diss.filt)	<0.12 µg/l	TM152		0.646 ¥		1.05 #	1.3 ¥	
Boron (diss.filt)	<9.4 µg/l	TM152		110 ¥		111 #	108 ¥	
Cadmium (diss.filt)	<0.1 µg/l	TM152		<0.1 ¥		<0.1 #	<0.1 ¥	
Copper (diss.filt)	<0.85 µg/l	TM152		<0.85 ¥		<0.85 #	<0.85 ¥	
Lead (diss.filt)	<0.02 µg/l	TM152		0.373 ¥		0.202 #	0.503 ¥	
Manganese (diss.filt)	<0.04 µg/l	TM152		208 ¥		130 #	202 ¥	
Nickel (diss.filt)	<0.15 µg/l	TM152		3.06 ¥		3.38 #	3.61 ¥	
Zinc (diss.filt)	<0.41 µg/l	TM152		0.653 ¥		15.6 #	17 ¥	
Mercury (diss.filt)	<0.01 µg/l	TM183		<0.01 ¥		<0.01 #	<0.01 ¥	
Chromium (tot.unfilt)	<3 µg/l	TM181		5.4 ¥		4.33 #	4.78 ¥	
Calcium (diss.filt)	<0.012 mg/l	TM228		65.6 ¥		56.2 #	49.5 ¥	
Sodium (diss.filt)	<0.076 mg/l	TM228		60.2 ¥		70.5 #	73.7 ¥	
Magnesium (diss.filt)	<0.036 mg/l	TM228		14.2 ¥		13.7 #	13.4 ¥	
Potassium (diss.filt)	<1 mg/l	TM230		14.4 ¥		19.3 #	20.2 ¥	
Iron (diss.filt)	<0.019 mg/l	TM228		0.241 ¥		0.203 #	0.24 ¥	
Silver (diss.filt)	<1.5 µg/l	TM283		<1.5		<1.5	<1.5	
Moisture Content Ratio (% of as received sample)	%	PM024	66		20			75
Arsenic	<0.6 mg/kg	TM181	11.5		8.06 M			17.5
Cadmium	<0.02 mg/kg	TM181	1.23		1.04 M			1.44
Chromium	<0.9 mg/kg	TM181	10.3		14.7 M			25.6
Copper	<1.4 mg/kg	TM181	13.7		7.8 M			15
Lead	<0.7 mg/kg	TM181	14.3		8.28 M			18.3
Mercury	<0.14 mg/kg	TM181	<0.14		<0.14 M			<0.14
Nickel	<0.2 mg/kg	TM181	16.7		15.3 M			30.5
Selenium	<1 mg/kg	TM181	4.27		<1 #			3.06
Zinc	<1.9 mg/kg	TM181	68.5		39.8 M			64.8

09:13:43 07/04/2018

ALcontrol Laboratories

CERTIFICATE OF ANALYSIS

Validated

SDG:	160331-107	Location:	Dungarvan	Order Number:	
Job:	D_MCGARRY_KIL-6	Customer:	Jim McGarry	Report Number:	356316
Client Reference:		Attention:	Jim McGarry	Superseded Report:	

Component	LOD/Units	Method	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sample Type			Soil/Solid	Water(GW/SW)	Soil/Solid	Water(GW/SW)	Water(GW/SW)	Soil/Solid
Date Sampled			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Date Received / SDG Ref / Lab Sample No.(s)			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ammoniacal Nitrogen as N	<0.2 mg/l	TM099		1.55 ¥		3.34 #	2.36 ¥	
COD, unfiltered	<7 mg/l	TM107		48 ¥		99.5 #	50 ¥	
Aluminium (diss.filt)	<2.9 µg/l	TM152		<2.9 ¥		5.32 #	8.78 ¥	
Arsenic (diss.filt)	<0.12 µg/l	TM152		0.674 ¥		0.501 #	0.412 ¥	
Boron (diss.filt)	<9.4 µg/l	TM152		53 ¥		46.1 #	74.2 ¥	
Cadmium (diss.filt)	<0.1 µg/l	TM152		<0.1 ¥		<0.1 #	<0.1 ¥	
Copper (diss.filt)	<0.85 µg/l	TM152		<0.85 ¥		<0.85 #	<0.85 ¥	
Lead (diss.filt)	<0.02 µg/l	TM152		0.141 ¥		0.072 #	0.045 ¥	
Manganese (diss.filt)	<0.04 µg/l	TM152		135 ¥		12.2 #	190 ¥	
Nickel (diss.filt)	<0.15 µg/l	TM152		2.72 ¥		2.56 #	2.26 ¥	
Zinc (diss.filt)	<0.41 µg/l	TM152		13.6 ¥		1.12 #	0.817 ¥	
Mercury (diss.filt)	<0.01 µg/l	TM183		<0.01 ¥		<0.01 #	<0.01 ¥	
Chromium (tot.unfilt)	<3 µg/l	TM181		4.07 ¥		4.44 #	4.71 ¥	
Calcium (diss.filt)	<0.012 mg/l	TM228		<0.5 ¥		68.4 #	79.2 ¥	
Sodium (diss.filt)	<0.076 mg/l	TM228		51 ¥		34.8 #	41.1 ¥	
Magnesium (diss.filt)	<0.036 mg/l	TM228		7.54 ¥		13.8 #	14.1 ¥	
Potassium (diss.filt)	<1 mg/l	TM230		14.6 ¥		5.03 #	6.56 ¥	
Iron (diss.filt)	<0.019 mg/l	TM228		0.455 ¥		0.0384 #	0.136 ¥	
Silver (diss.filt)	<1.5 µg/l	TM283		<1.5		<1.5	<1.5	
Moisture Content Ratio (% of as received sample)	%	PM024	81		66			80
Arsenic	<0.6 mg/kg	TM181	16.5		11.1			10.5
Cadmium	<0.02 mg/kg	TM181	1.84		1.5			1.48
Chromium	<0.9 mg/kg	TM181	26.3		21.3			24.0
Copper	<1.4 mg/kg	TM181	20.5		17.7			23
Lead	<0.7 mg/kg	TM181	21.7		22.5			28.9
Mercury	<0.14 mg/kg	TM181	<0.14		<0.14			<0.14
Nickel	<0.2 mg/kg	TM181	27.3		31.6			30.9
Selenium	<1 mg/kg	TM181	1.61		<1			2.61
Zinc	<1.9 mg/kg	TM181	80.5		80.8			87.8

09:13:43 07/04/2016

ALcontrol Laboratories

CERTIFICATE OF ANALYSIS

Validated

SDG:	190331-107	Location:	Dungarvan	Order Number:	
Job:	D_MCGARRY_KIL-6	Customer:	Jim McGarry	Report Number:	369318
Client Reference:		Attention:	Jim McGarry	Superseded Report:	

Component	LOD/Units	Method	[illegible]	[illegible]
Ammoniacal Nitrogen as N	<0.2 mg/l	TM099	<0.2 #	
COD, unfiltered	<7 mg/l	TM107	24 #	24.9 §
Aluminium (diss.filt)	<2.9 µg/l	TM152	<2.9 #	
Arsenic (diss.filt)	<0.12 µg/l	TM152	1.03 #	
Boron (diss.filt)	<9.4 µg/l	TM152	32.3 #	
Cadmium (diss.filt)	<0.1 µg/l	TM152	<0.1 #	
Copper (diss.filt)	<0.85 µg/l	TM152	<0.85 #	
Lead (diss.filt)	<0.02 µg/l	TM152	0.262 #	
Manganese (diss.filt)	<0.04 µg/l	TM152	415 #	
Nickel (diss.filt)	<0.15 µg/l	TM152	2.47 #	
Zinc (diss.filt)	<0.41 µg/l	TM152	24 #	
Mercury (diss.filt)	<0.01 µg/l	TM183	<0.01 #	
Chromium (tot.unfilt)	<3 µg/l	TM101	<3 #	
Calcium (diss.filt)	<0.012 mg/l	TM228	70.4 #	
Sodium (diss.filt)	<0.076 mg/l	TM228	30.3 #	
Magnesium (diss.filt)	<0.036 mg/l	TM228	7.57 #	
Potassium (diss.filt)	<1 mg/l	TM230	8.04 #	
Iron (diss.filt)	<0.019 mg/l	TM228	0.182 #	
Silver (diss.filt)	<1.5 µg/l	TM283	<1.5	

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CERTIFICATE OF ANALYSIS

Validated

SDG:	190991-107	Location:	Dungannon	Order Number:	
Job:	D_MCGARRY_KL-6	Customer:	Jim McGarry	Report Number:	366016
Client Reference:		Attention:	Jim McGarry	Superseded Report:	

Test Completion Dates

Lab Sample No(s)	13179413	13179418	13179414	13179426	13179419	13179427	13179417	13179425	13179421	13179410
Customer Sample Ref.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
AGS Ref.										
Depth										
Type	SOLID	LIQUID	SOLID	LIQUID	SOLID	LIQUID	SOLID	LIQUID	LIQUID	SOLID
Ammonia as N by gas [illegible]		[illegible]		[illegible]		[illegible]		[illegible]	[illegible]	
COD Unfiltered		[illegible]		[illegible]		[illegible]		[illegible]	[illegible]	
Dissolved Metals by ICP-MS		27-Apr-2016		28-Apr-2016		28-Apr-2016		26-Apr-2016	27-Apr-2016	
Dissolved Mn, Ni and Zn by ICP-MS		[illegible]		[illegible]		[illegible]		[illegible]	[illegible]	
Mercury Dissolved		04-Apr-2016		04-Apr-2016		04-Apr-2016		04-Apr-2016	04-Apr-2016	
Metals by iCap-CDS Dissolved-WA		26-Apr-2016		28-Apr-2016		28-Apr-2016		26-Apr-2016	28-Apr-2016	
Metals in solid samples by CIS-S	[illegible]		[illegible]		[illegible]		[illegible]			[illegible]
Sample preparation	07-Apr-2016		07-Apr-2016		01-Apr-2016		07-Apr-2016			07-Apr-2016
Total Metals by ICP-MS		[illegible]		[illegible]		[illegible]		[illegible]	[illegible]	

Lab Sample No(s)	13179420	13179411	13179423	13179425
Customer Sample Ref.	[illegible]	[illegible]	[illegible]	
AGS Ref.				
Depth				
Type	LIQUID	SOLID	LIQUID	LIQUID
Ammonia as N by gas [illegible]	02-Apr-2016		02-Apr-2016	
COD Unfiltered	[illegible]		[illegible]	[illegible]
Dissolved Metals by ICP-MS	[illegible]		[illegible]	
Dissolved Mn, Ni and Zn by ICP-MS	03-Apr-2016		26-Apr-2016	
Mercury Dissolved	[illegible]		[illegible]	
Metals by iCap-CDS Dissolved-WA	05-Apr-2016		26-Apr-2016	
Metals in solid samples by CIS-S		05-Apr-2016		
Sample preparation		[illegible]		
Total Metals by ICP-MS	05-Apr-2016		26-Apr-2016	

09:13:43 07/04/2016

Monthly Wetland Analysis

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
pH	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 metals are in the Certificate of Analysis, enclosed

Monthly Wetland Analysis

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
pH	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 Compound	ug/l %%%	

**	Individual metals are in the Certificate of Analysis, enclosed
+++	Individual Phenols are in the Certificate of Analysis, enclosed
%%%	Individual Compounds are in the Certificate of Analysis, enclosed

ALcontrol Laboratories

Validated

CERTIFICATE OF ANALYSIS

SDG:	160421-14	Location:	Dungarvan	Order Number:	
Job:	D_MCGARRY_KIL-6	Customer:	Jim McGarry	Report Number:	353531
Client Reference:		Attention:	Jim McGarry	Superseded Report:	

Component	LOD/Units	Method	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Results Legend [illegible]		Customer Sample R / Depth (m) / Sample Type / Date Sampled / Sample Time / Date Received / SDG Ref / Lab Sample No.(s) / AGS Reference	Water(GW/SW) [illegible] 160421-14 [illegible]	Water(GW/SW) [illegible] 160421-14 [illegible]	Water(GW/SW) [illegible] 160421-14 [illegible]	Water(GW/SW) [illegible] 160421-14 [illegible]	Water(GW/SW) [illegible] 160421-14 [illegible]	Water(GW/SW) [illegible] 160421-14 [illegible]
Organic Carbon, Total	<3 mg/l	TM090					11.1 *	
Ammoniacal Nitrogen as N	<0.2 mg/l	TM099	2.04 #	0.335 *	0.589 #	<0.2 #		7.55 #
COD, unfiltered	<7 mg/l	TM107	80.7 #	80.6 *	53.6 #	86.5 #	80.2 *	22 #
Aluminium (diss.filt)	<2.9 µg/l	TM152	8.24 #	4.47 *	21.3 #	4.03 #		3.71 #
Arsenic (diss.filt)	<0.12 µg/l	TM152	1.15 #	0.809 *	1.24 #	0.612 #		0.607 #
Boron (diss.filt)	<9.4 µg/l	TM152	100 #	108 *	118 #	90.1 #		135 #
Cadmium (diss.filt)	<0.1 µg/l	TM152	<0.1 #	<0.1 *	<0.1 #	<0.1 #		<0.1 #
Copper (diss.filt)	<0.85 µg/l	TM152	<0.85 #	<0.85 *	<0.85 #	<0.85 #		0.909 #
Lead (diss.filt)	<0.02 µg/l	TM152	0.394 #	0.204 *	0.459 #	0.287 #		0.427 #
Manganese (diss.filt)	<0.04 µg/l	TM152	416 #	55 *	662 #	256 #		61.7 #
Nickel (diss.filt)	<0.15 µg/l	TM152	2.75 #	2.50 *	3.33 #	2.44 #		3.61 #
Zinc (diss.filt)	<0.41 µg/l	TM152	9.45 #	10.4 *	5.53 #	8.74 #		10.7 #
Mercury (diss.filt)	<0.01 µg/l	TM183	<0.01 #	<0.01 *	<0.01 #	<0.01 #		<0.01 #
Chloride	<2 mg/l	TM184					74.9 *	
Total Oxidised Nitrogen as N	<0.1 mg/l	TM184					<0.1 *	
Chromium (tot.unfilt)	<3 µg/l	TM191	<3 #	3.38 *	<3 #	<3 #		<3 #
Calcium (diss.filt)	<0.012 mg/l	TM228	56.0 #	53.1 *	35.7 #	44.3 #		71.8 #
Sodium (diss.filt)	<0.076 mg/l	TM228	47.5 #	46.5 *	45.5 #	47.7 #		40.9 #
Magnesium (diss.filt)	<0.030 mg/l	TM228	11.2 #	11.1 *	10.5 #	11 #		12.4 #
Potassium (diss.filt)	<1 mg/l	TM228	12.5 #	13 *	17.4 #	13.4 #		10.1 #
Iron (diss.filt)	<0.019 mg/l	TM228	0.123 #	0.12 *	0.025 #	0.372 #		0.0651 #
Phenol	<0.002 mg/l	TM259					<0.002 *	
Cresols	<0.006 mg/l	TM259					<0.006 *	
Xylenols	<0.008 mg/l	TM259					<0.008 *	
2,3,5-Trimethylphenol	<0.003 mg/l	TM259					<0.003 *	
2-Isopropylphenol	<0.006 mg/l	TM259					<0.006 *	
Phenols, Total Detected 6 speciated	<0.035 mg/l	TM259					<0.035	
Silver (diss.filt)	<1.5 µg/l	TM283	<1.5	<1.5	<1.5	<1.5		<1.5

11:20:00 27/04/2016

ALcontrol Laboratories

CERTIFICATE OF ANALYSIS

Validated

SDG:	150421-14	Location:	Dungarvan	Order Number:	
Job:	D_MCGARRY_KIL-6	Customer:	Jim McGarry	Report Number:	303531
Client Reference:		Attention:	Jim McGarry	Superseded Report:	

Component	LOD/Units	Method	Customer Sample R: [illegible]
Depth (m)			[illegible]
Sample Type			Water(GW/SW)
Date Sampled			[illegible]
Sample Time			[illegible]
Date Received			[illegible]
SDG Ref			[illegible]
Lab Sample No.(s)			[illegible]
AGS Reference			
Ammoniacal Nitrogen as N	<0.2 mg/l	TM099	16.1 #
COD, unfiltered	<7 mg/l	TM107	58.6 #
Aluminium (diss.filt)	<2.9 µg/l	TM152	3.6 #
Arsenic (diss.filt)	<0.12 µg/l	TM152	1.16 #
Boron (diss.filt)	<9.4 µg/l	TM152	495 #
Cadmium (diss.filt)	<0.1 µg/l	TM152	<0.1 #
Copper (diss.filt)	<0.85 µg/l	TM152	<0.85 #
Lead (diss.filt)	<0.02 µg/l	TM152	0.7 #
Manganese (diss.filt)	<0.04 µg/l	TM152	434 #
Nickel (diss.filt)	<0.15 µg/l	TM152	4.77 #
Zinc (diss.filt)	<0.41 µg/l	TM152	6.51 #
Mercury (diss.filt)	<0.01 µg/l	TM183	<0.01 #
Chromium (tot.unfilt)	<3 µg/l	TM181	0.14 #
Calcium (diss.filt)	<0.012 mg/l	TM228	76.3 #
Sodium (diss.filt)	<0.076 mg/l	TM228	79.1 #
Magnesium (diss.filt)	<0.036 mg/l	TM228	16.6 #
Potassium (diss.filt)	<1 mg/l	TM228	10.4 #
Iron (diss.filt)	<0.019 mg/l	TM228	0.101 #
Silver (diss.filt)	<1.5 µg/l	TM283	<1.5

11:20:00 27/04/2015

SDG:	190421-14	Location:	Dungarvan	Order Number:	
Job:	D_MCGARRY_KL-6	Customer:	Jim McGarry	Report Number:	368331
Client Reference:		Attention:	Jim McGarry	Superseded Report:	

VOC MS (W)

Compound	LOD/LOQ	Method						
Dibromofluoromethane**	%	TM208	106					
Toluene-d8**	%	TM208	101					
4-Bromofluorobenzene**	%	TM208	98.7					
Dichlorodifluoromethane	<1 µg/l	TM208	<1					
Chloromethane	<1 µg/l	TM208	<1					
Vinyl chloride	<1 µg/l	TM208	<1					
Bromomethane	<1 µg/l	TM208	<1					
Chloroethane	<1 µg/l	TM208	<1					
Trichlorofluoromethane	<1 µg/l	TM208	<1					
1,1-Dichloroethene	<1 µg/l	TM208	<1					
Carbon disulphide	<1 µg/l	TM208	<1					
Dichloromethane	<3 µg/l	TM208	<3					
Methyl tertiary butyl ether (MTBE)	<1 µg/l	TM208	<1					
trans-1,2-Dichloroethene	<1 µg/l	TM208	<1					
1,1-Dichloroethane	<1 µg/l	TM208	<1					
cis-1,2-Dichloroethene	<1 µg/l	TM208	<1					
2,2-Dichloropropane	<1 µg/l	TM208	<1					
Bromochloromethane	<1 µg/l	TM208	<1					
Chloroform	<1 µg/l	TM208	<1					
1,1,1-Trichloroethane	<1 µg/l	TM208	<1					
1,1-Dichloropropene	<1 µg/l	TM208	<1					
Carbon tetrachloride	<1 µg/l	TM208	<1					
1,2-Dichloroethane	<1 µg/l	TM208	<1					
Benzene	<1 µg/l	TM208	<1					
Trichloroethene	<1 µg/l	TM208	<1					
1,2-Dichloropropane	<1 µg/l	TM208	<1					
Dibromomethane	<1 µg/l	TM208	<1					
Bromodichloromethane	<1 µg/l	TM208	<1					
cis-1,3-Dichloropropene	<1 µg/l	TM208	<1					
Toluene	<1 µg/l	TM208	<1					
trans-1,3-Dichloropropene	<1 µg/l	TM208	<1					
1,1,2-Trichloroethane	<1 µg/l	TM208	<1					

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CERTIFICATE OF ANALYSIS

Validated

SDG:	150421-14	Location:	Dungarvan	Order Number:	
Job:	D_MCGARRY_KIL-6	Customer:	Jim McGarry	Report Number:	3C3631
Client Reference:		Attention:	Jim McGarry	Superseded Report:	

VOC MS (W)

Results Legend		Customer Sample R	[illegible]					
[illegible]		Depth (m)						
		Sample Type	Water(GW/SW)					
		Date Sampled	18/04/2015					
		Sample Time	.					
		Date Received	20/04/2015					
		SDG Ref	150421-14					
		Lab Sample No.(s)	[illegible]					
		AGS Reference						
Component	**LOD/Units**	**Method**						
1,3-Dichloropropane	<1 µg/l	TM208	<1 #					
Tetrachloroethene	<1 µg/l	TM208	<1 #					
Dibromochloromethane	<1 µg/l	TM208	<1 #					
1,2-Dibromoethane	<1 µg/l	TM208	<1 #					
Chlorobenzene	<1 µg/l	TM208	<1 #					
1,1,1,2-Tetrachloroethane	<1 µg/l	TM208	<1 #					
Ethylbenzene	<1 µg/l	TM208	<1 #					
m,p-Xylene	<1 µg/l	TM208	<1 #					
o-Xylene	<1 µg/l	TM208	<1 #					
Styrene	<1 µg/l	TM208	<1 #					
Bromoform	<1 µg/l	TM208	<1 #					
Isopropylbenzene	<1 µg/l	TM208	<1 #					
1,1,2,2-Tetrachloroethane	<1 µg/l	TM208	<1					
1,2,3-Trichloropropane	<1 µg/l	TM208	<1 #					
Bromobenzene	<1 µg/l	TM208	<1 #					
Propylbenzene	<1 µg/l	TM208	<1 #					
2-Chlorotoluene	<1 µg/l	TM208	<1 #					
1,3,5-Trimethylbenzene	<1 µg/l	TM208	<1 #					
4-Chlorotoluene	<1 µg/l	TM208	<1 #					
tert-Butylbenzene	<1 µg/l	TM208	<1 #					
1,2,4-Trimethylbenzene	<1 µg/l	TM208	<1 #					
sec-Butylbenzene	<1 µg/l	TM208	<1 #					
4-iso-Propyltoluene	<1 µg/l	TM208	<1 #					
1,3-Dichlorobenzene	<1 µg/l	TM208	<1 #					
1,4-Dichlorobenzene	<1 µg/l	TM208	<1 #					
n-Butylbenzene	<1 µg/l	TM208	<1 #					
1,2-Dichlorobenzene	<1 µg/l	TM208	<1					
1,2-Dibromo-3-chloropropane	<1 µg/l	TM208	<1					
1,2,4-Trichlorobenzene	<1 µg/l	TM208	<1 #					
Hexachlorobutadiene	<1 µg/l	TM208	<1 #					
tert-Amyl methyl ether (TAME)	<1 µg/l	TM208	<1 #					
Naphthalene	<1 µg/l	TM208	<1 #					

11:20:00 27/04/2015

AL control Laboratories

CERTIFICATE OF ANALYSIS

Validated

SDG:	190421-14	Location:	Dungarvan	Order Number:	
Job:	D_MCGARRY_KL-6	Customer:	Jim McGarry	Report Number:	368531
Client Reference:		Attention:	Jim McGarry	Superseded Report:	

VOC MS (W)

		Customer Sample ID						
		Matrix:						
		Sample Type:						
		Date Received:						
		LOD/Lot:						
		Lab Sample No.(s):						
		AGS Reference:						
Component	LOD/Units	Method						
1,2,3-Trichlorobenzene	<1 µg/l	TR/308	<1					
1,3,5-Trichlorobenzene	<1 µg/l	TR/308	<1					

AL control Laboratories

CERTIFICATE OF ANALYSIS

Validated

SDG:	150421-14	**Location:**	Dungannon	**Order Number:**	
Job:	D_MCGARRY_KL-6	**Customer:**	Jim McGarry	**Report Number:**	368331
Client Reference:		**Attention:**	Jim McGarry	**Superseded Report:**	

Test Completion Dates

Lab Sample No(s)	13203596	13203597	13203598	13203600	13203601	13203594	13203595
Customer Sample Ref.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
AGS Ref.							
Depth							
Type	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
Anionic by Kone (w)					27-Apr-2016		
COC Verified	22-Apr-2016	22-Apr-2016	22-Apr-2016	22-Apr-2016	22-Apr-2016	22-Apr-2016	22-Apr-2016
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
Dissolved Al, Mo and Zn by ICP/MS	26-Apr-2016	26-Apr-2016	26-Apr-2016	26-Apr-2016		26-Apr-2016	26-Apr-2016
Mercury Dissolved	22-Apr-2016	22-Apr-2016	22-Apr-2016	22-Apr-2016		22-Apr-2016	22-Apr-2016
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
Phenols by HPLC (W)					26-Apr-2016		
Total Cyanide by ICP-MS	27-Apr-2016	27-Apr-2016	27-Apr-2016	27-Apr-2016		27-Apr-2016	27-Apr-2016
[illegible]					28-Apr-2016		
VOC MS (W)					26-Apr-2016		

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	oC		nm	nm	nm	nm	nm	nm
pH	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 **								

** Individual metals are in the Certificate of Analysis, enclosed

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
pH	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 are in the Certificate of Analysis, enclosed	
***	Individual Compounds are in the Certificate of Analysis, enclosed	

ALcontrol Laboratories

Validated

CERTIFICATE OF ANALYSIS

SDG:	150615-115	Location:	Dungarvan	Order Number:	
Job:	D_MCGARRY_KIL-6	Customer:	Jim McGarry	Report Number:	362732
Client Reference:		Attention:	Jim McGarry	Superseded Report:	

Component	LOD/Units	Method	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ammoniacal Nitrogen as N	<0.2 mg/l	TM099	6.08 #	3.07 ¥	1.63 #	<0.2 #	<2.9 ¥	14.3 #
COD, unfiltered	<7 mg/l	TM107	50.4 #	36.7 ¥	53.6 #	65.9 #	1180 ¥	384 #
Aluminium (diss.filt)	<2.9 µg/l	TM152	<2.9 #	4.76 ¥	4.6 #	4.85 #	7.12 ¥	<2.9 #
Arsenic (diss.filt)	<0.12 µg/l	TM152	1.75 #	2.21 ¥	2.43 #	2.02 #	2.17 ¥	1.43 #
Boron (diss.filt)	<9.4 µg/l	TM152	107 #	108 ¥	130 #	115 #	303 ¥	105 #
Cadmium (diss.filt)	<0.1 µg/l	TM152	<0.1 #	<0.1 ¥	<0.1 #	<0.1 #	<0.1 ¥	<0.1 #
Copper (diss.filt)	<0.85 µg/l	TM152	<0.85 #	0.852 ¥	<0.85 #	<0.85 #	0.914 ¥	<0.85 #
Lead (diss.filt)	<0.02 µg/l	TM152	0.237 #	0.137 ¥	0.167 #	0.176 #	1.36 ¥	0.313 #
Manganese (diss.filt)	<0.04 µg/l	TM152	1230 #	560 ¥	4540 #	401 #	589 ¥	1270 #
Nickel (diss.filt)	<0.15 µg/l	TM152	3.99 #	1.21 ¥	2.61 #	2.38 #	7.57 ¥	3.87 #
Zinc (diss.filt)	<0.41 µg/l	TM152	1.92 #	1.52 ¥	2.06 #	1.44 #	4.7 ¥	2.25 #
Mercury (diss.filt)	<0.01 µg/l	TM183	<0.01 #	<0.01 ¥	<0.01 #	<0.01 #	<0.01 ¥	<0.01 #
Chromium (tot.unfilt)	<3 µg/l	TM101	<3 #	<3 ¥	<3 #	<3 #	62.6 ¥	30.0 #
Calcium (diss.filt)	<0.012 mg/l	TM228	84 #	67.5 ¥	56.9 #	56.1 #	67.2 ¥	35.1 #
Sodium (diss.filt)	<0.076 mg/l	TM228	64.7 #	72.2 ¥	56.3 #	54.8 #	144 ¥	65.7 #
Magnesium (diss.filt)	<0.036 mg/l	TM228	18.5 #	15.5 ¥	12.3 #	13.1 #	24.5 ¥	14.7 #
Potassium (diss.filt)	<1 mg/l	TM228	9.88 #	4 ¥	3.67 #	6.05 #	31.6 ¥	9.93 #
Iron (diss.filt)	<0.019 mg/l	TM228	0.63 #	1.07 ¥	1.73 #	1.67 #	0.281 ¥	0.634 #
Silver (diss.filt)	<1.5 µg/l	TM283	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5

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CERTIFICATE OF ANALYSIS

SDG:	190515-119	Location:	Dungarvan	Order Number:	
Job:	D_MCSARRY_KL-6	Customer:	Jim McSorry	Report Number:	362732
Client Reference:		Attention:	Jim McSorry	Superseded Report:	

[illegible]	[illegible]	[illegible]						
Compound	LOD/LOQ	Method						
Organic Carbon, Tota	<3 mg/l	TM030	11.4					
COD unfiltered	<7 mg/l	TM107	<40					
Chloride	<2 mg/l	TM184	77.2					
Total Oxidised Nitrogen as N	<0.1 mg/l	TM184	0.34					
Phenol	<0.002 mg/l	TM258	<0.010					
Cresols	<0.006 mg/l	TM259	<0.106					
Xylenols	<0.008 mg/l	TM260	<0.106					
2,3,5-Trimethylphenol	<0.003 mg/l	TM258	<0.010					
2-Isopropylphenol	<0.006 mg/l	TM259	<0.106					
Phenols, Total Determined as specified	<0.025 mg/l	TM258	<0.125					

SDG:	190615-119	Location:	Dungarvan	Order Number:	
Job:	D_MCSARRY_KL-6	Customer:	Jim McSorry	Report Number:	362732
Client Reference:		Attention:	Jim McSorry	Superseded Report:	

VOC MS (W)

[illegible]	[illegible]	[illegible]						
Compound	LOD/LOQ	Method						
Dibromofluoromethane**	%	TM208	106					
Toluene-d8**	%	TM208	98.1					
4-Bromofluorobenzene**	%	TM208	101					
Dichlorodifluoromethane	<1 µg/l	TM208	<1					
Chloromethane	<1 µg/l	TM208	<1					
Vinyl chloride	<1 µg/l	TM208	<1					
Bromomethane	<1 µg/l	TM208	<1					
Chloroethane	<1 µg/l	TM208	<1					
Trichlorofluoromethane	<1 µg/l	TM208	<1					
1,1-Dichloroethene	<1 µg/l	TM208	<1					
Carbon disulphide	<1 µg/l	TM208	<1					
Dichloromethane	<3 µg/l	TM208	<3					
Methyl tertiary butyl ether (MTBE)	<1 µg/l	TM208	<1					
trans-1,2-Dichloroethene	<1 µg/l	TM208	<1					
1,1-Dichloroethane	<1 µg/l	TM208	<1					
cis-1,2-Dichloroethene	<1 µg/l	TM208	<1					
2,2-Dichloropropane	<1 µg/l	TM208	<1					
Bromochloromethane	<1 µg/l	TM208	<1					
Chloroform	<1 µg/l	TM208	<1					
1,1,1-Trichloroethane	<1 µg/l	TM208	<1					
1,1-Dichloropropene	<1 µg/l	TM208	<1					
Carbon tetrachloride	<1 µg/l	TM208	<1					
1,2-Dichloroethane	<1 µg/l	TM208	<1					
Benzene	<1 µg/l	TM208	<1					
Trichloroethene	<1 µg/l	TM208	<1					
1,2-Dichloropropane	<1 µg/l	TM208	<1					
Dibromomethane	<1 µg/l	TM208	<1					
Bromodichloromethane	<1 µg/l	TM208	<1					
cis-1,3-Dichloropropene	<1 µg/l	TM208	<1					
Toluene	<1 µg/l	TM208	<1					
trans-1,3-Dichloropropene	<1 µg/l	TM208	<1					
1,1,2-Trichloroethane	<1 µg/l	TM208	<1					

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CERTIFICATE OF ANALYSIS

SDG:	180615-115	**Location:**	Dungarvan	**Order Number:**	
Job:	D_MCGARRY_KIL-6	**Customer:**	Jim McGarry	**Report Number:**	362732
Client Reference:		**Attention:**	Jim McGarry	**Superseded Report:**	

VOC MS (W)

Results Legend	Customer Sample R	[illegible]					
# ISO17025 accredited. M mCERTS accredited. aq Aqueous / settled sample. diss.filt Dissolved / filtered sample. tot.unfilt Total / unfiltered sample. * Subcontracted test. ** % recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery (F) Trigger breach confirmed 1-5&+§@ Sample deviation (see appendix)	Depth (m) Sample Type Date Sampled Sample Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	Water(GW/SW) 17/06/2018 [illegible] 18/06/2018 180615-115 [illegible]					

Component	LOD/Units	Method						
1,3-Dichloropropane	<1 µg/l	TM208	<1 #					
Tetrachloroethene	<1 µg/l	TM208	<1 #					
Dibromochloromethane	<1 µg/l	TM208	<1 #					
1,2-Dibromoethane	<1 µg/l	TM208	<1 #					
Chlorobenzene	<1 µg/l	TM208	<1 #					
1,1,1,2-Tetrachloroethane	<1 µg/l	TM208	<1 #					
Ethylbenzene	<1 µg/l	TM208	<1 #					
m,p-Xylene	<1 µg/l	TM208	<1 #					
o-Xylene	<1 µg/l	TM208	<1 #					
Styrene	<1 µg/l	TM208	<1 #					
Bromoform	<1 µg/l	TM208	<1 #					
Isopropylbenzene	<1 µg/l	TM208	<1 #					
1,1,2,2-Tetrachloroethane	<1 µg/l	TM208	<1					
1,2,3-Trichloropropane	<1 µg/l	TM208	<1 #					
Bromobenzene	<1 µg/l	TM208	<1 #					
Propylbenzene	<1 µg/l	TM208	<1 #					
2-Chlorotoluene	<1 µg/l	TM208	<1 #					
1,3,5-Trimethylbenzene	<1 µg/l	TM208	<1 #					
4-Chlorotoluene	<1 µg/l	TM208	<1 #					
tert-Butylbenzene	<1 µg/l	TM208	<1 #					
1,2,4-Trimethylbenzene	<1 µg/l	TM208	<1 #					
sec-Butylbenzene	<1 µg/l	TM208	<1 #					
4-iso-Propyltoluene	<1 µg/l	TM208	<1 #					
1,3-Dichlorobenzene	<1 µg/l	TM208	<1 #					
1,4-Dichlorobenzene	<1 µg/l	TM208	<1 #					
n-Butylbenzene	<1 µg/l	TM208	<1 #					
1,2-Dichlorobenzene	<1 µg/l	TM208	<1					
1,2-Dibromo-3-chloropropane	<1 µg/l	TM208	<1					
1,2,4-Trichlorobenzene	<1 µg/l	TM208	<1 #					
Hexachlorobutadiene	<1 µg/l	TM208	<1 #					
tert-Amyl methyl ether (TAME)	<1 µg/l	TM208	<1 #					
Naphthalene	<1 µg/l	TM208	<1 #					

16:06:03 27/06/2018

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CERTIFICATE OF ANALYSIS

Validated

BDG:	190615-119	Location:	Dungarvan	Order Number:	
Job:	D_MCSARRY_KL-6	Customer:	Jim McSorry	Report Number:	362732
Client Reference:		Attention:	Jim McSorry	Superseded Report:	

VOC MS (W)

	Customer Sample ID	2-STARTER CETTIA						
	Matrix							
	Sample Type							
	Date Received							
	LOD Set							
	Lab Sample No.(s)							
	AGS Reference							
Component	LOD/Units	Method						
1,2,3-Trichlorobenzene	<1 µg/l	TR/308	<1					
1,3,5-Trichlorobenzene	<1 µg/l	TR/308	<1					

SDG:	150515-119	**Location:**	Dungannon	**Order Number:**	
Job:	D_MCGARRY_KIL-6	**Customer:**	Jim McGarry	**Report Number:**	362732
Client Reference:		**Attention:**	Jim McGarry	**Superseded Report:**	

Test Completion Dates

Lab Sample No(s)	13455036	13455037	13455038	13455039	13455034	13455035	13455041
Customer Sample Ref.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
AGS Ref.							
Depth							
Type	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Anionic surfactants by MBAS							19-May-2016
COC Verified	27-May-2016	27-May-2016	27-May-2016	27-May-2016	27-May-2016	27-May-2016	27-May-2016
Dissolved Metals by ICP/MS	27-May-2016	27-May-2016	27-May-2016	27-May-2016	27-May-2016	27-May-2016	
Dissolved Al, Mo and Sb by ICP/MS	25-May-2016	25-May-2016	25-May-2016	25-May-2016	25-May-2016	25-May-2016	
Mercury Dissolved	24-May-2016	24-May-2016	24-May-2016	24-May-2016	24-May-2016	24-May-2016	
Mercury in Liquid (CVAF, Dissolved) (W)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Phenols by HPLC (W)							25-May-2016
Total Cyanide by ICP-MS	24-May-2016	24-May-2016	24-May-2016	24-May-2016	24-May-2016	24-May-2016	
Total Organic and Inorganic Carbon							19-May-2016
VOC MS (W)							23-May-2016

Monthly Wetland Analysis

Ponds - June 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	oC		14.6	15.4	17.4	16.2	16.8	17.2
pH	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 metals are in the Certificate of Analysis, enclosed

Monthly Wetland Analysis

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
pH	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$$$		
Phenols+++	mg/l	<0.025
Dissolved Oxygen	% sat	46
Volatiles (VOC's)***		
+++	Individual Phenols are in the Certificate of Analysis, enclosed	
***	Individual Compounds are in the Certificate of Analysis, enclosed	
$$$	Individual Metals are in the Certificate of Analysis, enclosed	

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CERTIFICATE OF ANALYSIS

SDG:	150625-27	Location:	Dungarvan	Order Number:	
Job:	D_MCGARRY_KIL-6	Customer:	Jim McGarry	Report Number:	364057
Client Reference:		Attention:	Jim McGarry	Superseded Report:	

Component	LOD/Units	Method	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Depth (m)			-	-	-	-	-	-
Sample Type			Water(GW/PW)	Water(GW/PW)	Water(GW/PW)	Water(GW/PW)	Water(GW/PW)	Water(GW/PW)
Date Sampled			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sample Time			-	-	-	-	-	-
Date Received			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SDG Ref			150625-27	150625-27	150625-27	150625-27	150625-27	150625-27
Lab Sample No.(s)			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
AGS Reference								
Ammoniacal Nitrogen as N	<0.2 mg/l	TM099	3.60 #	2.40 #	0.700 #	2.14 #	7.26 #	3.47 #
COD, unfiltered	<7 mg/l	TM107	25.3 #	26.5 #	60 #	174 #	26.5 #	4630 #
Aluminium (diss.filt)	<2.9 µg/l	TM152	6 #	<2.9 #	6.16 #	5.12 #	<2.9 #	7.04 #
Arsenic (diss.filt)	<0.12 µg/l	TM152	1.1 #	1.25 #	2.23 #	1.77 #	0.369 #	0.335 #
Boron (diss.filt)	<9.4 µg/l	TM152	90.5 #	166 #	141 #	145 #	57.9 #	76.5 #
Cadmium (diss.filt)	<0.1 µg/l	TM152	<0.1 #	<0.1 #	<0.1 #	<0.1 #	<0.1 #	<0.1 #
Copper (diss.filt)	<0.85 µg/l	TM152	<0.85 #	<0.85 #	<0.85 #	<0.85 #	0.94 #	<0.85 #
Lead (diss.filt)	<0.02 µg/l	TM152	0.235 #	0.105 #	0.364 #	0.096 #	0.605 #	0.333 #
Manganese (diss.filt)	<0.04 µg/l	TM152	214 #	461 #	133 #	1080 #	9.27 #	185 #
Nickel (diss.filt)	<0.15 µg/l	TM152	3.77 #	3.45 #	1.54 #	4.1 #	3.18 #	3.36 #
Zinc (diss.filt)	<0.41 µg/l	TM152	0.673 #	0.774 #	3.03 #	0.905 #	6.59 #	1.66 #
Mercury (diss.filt)	<0.01 µg/l	TM183	<0.01 #	<0.01 #	<0.01 #	<0.01 #	0.0548 #	<0.01 #
Chromium (tot.unfilt)	<3 µg/l	TM181	<3 #	<3 #	<3 #	<3 #	3.29 #	53.6 #
Calcium (diss.filt)	<0.012 mg/l	TM228	81.5 #	72.6 #	45.6 #	58.7 #	65.6 #	37.8 #
Sodium (diss.filt)	<0.076 mg/l	TM228	44 #	48.1 #	50.7 #	67 #	38.3 #	40.9 #
Magnesium (diss.filt)	<0.036 mg/l	TM228	14.3 #	14.6 #	15.6 #	15.3 #	13.1 #	13.4 #
Potassium (diss.filt)	<1 mg/l	TM228	6.51 #	6.25 #	4.93 #	2.33 #	6.43 #	7.28 #
Iron (diss.filt)	<0.019 mg/l	TM228	0.305 #	0.308 #	0.761 #	0.216 #	0.0222 #	0.0589 #
Silver (diss.filt)	<1.5 µg/l	TM288	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5

09:28:54 03/07/2016

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CERTIFICATE OF ANALYSIS

SDG:	180628-27	Location:	Dungarvan	Order Number:	
Job:	D_MCGARRY_KIL-6	Customer:	Jim McGarry	Report Number:	368057
Client Reference:		Attention:	Jim McGarry	Superseded Report:	

Results Legend			Customer Sample R	[illegible]
[illegible]			Depth (m)	
			Sample Type	[illegible]
			Date Sampled	[illegible]
			Sample Time	
			Date Received	[illegible]
			SDG Ref	180628-27
			Lab Sample No.(s)	[illegible]
			AGS Reference	
Component	LOD/Units	Method		
Organic Carbon, Total	<3 mg/l	TM090		13.0 #
Ammoniacal Nitrogen as N	<0.2 mg/l	TM099		0.21 #
COD, unfiltered	<7 mg/l	TM107		58.2 #
Aluminium (diss.filt)	<2.9 µg/l	TM152		<2.9 #
Arsenic (diss.filt)	<0.12 µg/l	TM152		1.55 #
Boron (diss.filt)	<9.4 µg/l	TM152		130 #
Cadmium (diss.filt)	<0.1 µg/l	TM152		<0.1 #
Copper (diss.filt)	<0.85 µg/l	TM152		<0.85 #
Lead (diss.filt)	<0.02 µg/l	TM152		0.111 #
Manganese (diss.filt)	<0.04 µg/l	TM152		292 #
Nickel (diss.filt)	<0.15 µg/l	TM152		4.04 #
Zinc (diss.filt)	<0.41 µg/l	TM152		3.33 #
Mercury (diss.filt)	<0.01 µg/l	TM183		<0.01 #
Sulphate	<2 mg/l	TM184		<2 #
Chloride	<2 mg/l	TM184		93.7 #
Phosphate (ortho) as P	<0.02 mg/l	TM184		<0.02 #
Total Oxidised Nitrogen as N	<0.1 mg/l	TM184		<0.1 #
Chromium (tot.unfilt)	<3 µg/l	TM181		<3 #
Calcium (diss.filt)	<0.012 mg/l	TM228		69.5 #
Sodium (diss.filt)	<0.076 mg/l	TM228		66.4 #
Magnesium (diss.filt)	<0.036 mg/l	TM228		15.5 #
Potassium (diss.filt)	<1 mg/l	TM228		4.53 #
Iron (diss.filt)	<0.019 mg/l	TM228		0.214 #
Phenol	<0.002 mg/l	TM259		<0.002 #
Cresols	<0.006 mg/l	TM259		<0.006 #
Xylenols	<0.008 mg/l	TM259		<0.008 #
2,3,5-Trimethylphenol	<0.003 mg/l	TM259		<0.003 #
2-Isopropylphenol	<0.006 mg/l	TM259		<0.006 #
Phenols, Total Detected 6 speciated	<0.035 mg/l	TM259		<0.035
Silver (diss.filt)	<1.5 µg/l	TM303		<1.5

09:28:54 03/07/2018

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CERTIFICATE OF ANALYSIS

Validated

SDG:	190625-27	Location:	Dungarvan	Order Number:	
Job:	D_MCGARRY_KL-6	Customer:	Jim McGarry	Report Number:	368357
Client Reference:		Attention:	Jim McGarry	Superseded Report:	

VOC MS (W)

[illegible]	[illegible]	[illegible]						
Compound	LOD/LOQ	Method						
Dibromofluoromethane**	%	TM208	104					
Toluene-d8**	%	TM208	99.5					
4-Bromofluorobenzene**	%	TM208	98.7					
Dichlorodifluoromethane	<1 µg/l	TM208	<1					
Chloromethane	<1 µg/l	TM208	<1					
Vinyl chloride	<1 µg/l	TM208	<1					
Bromomethane	<1 µg/l	TM208	<1					
Chloroethane	<1 µg/l	TM208	<1					
Trichlorofluoromethane	<1 µg/l	TM208	<1					
1,1-Dichloroethene	<1 µg/l	TM208	<1					
Carbon disulphide	<1 µg/l	TM208	<1					
Dichloromethane	<3 µg/l	TM208	<3					
Methyl tertiary butyl ether (MTBE)	<1 µg/l	TM208	<1					
trans-1,2-Dichloroethene	<1 µg/l	TM208	<1					
1,1-Dichloroethane	<1 µg/l	TM208	<1					
cis-1,2-Dichloroethene	<1 µg/l	TM208	<1					
2,2-Dichloropropane	<1 µg/l	TM208	<1					
Bromochloromethane	<1 µg/l	TM208	<1					
Chloroform	<1 µg/l	TM208	<1					
1,1,1-Trichloroethane	<1 µg/l	TM208	<1					
1,1-Dichloropropene	<1 µg/l	TM208	<1					
Carbon tetrachloride	<1 µg/l	TM208	<1					
1,2-Dichloroethane	<1 µg/l	TM208	<1					
Benzene	<1 µg/l	TM208	<1					
Trichloroethene	<1 µg/l	TM208	<1					
1,2-Dichloropropane	<1 µg/l	TM208	<1					
Dibromomethane	<1 µg/l	TM208	<1					
Bromodichloromethane	<1 µg/l	TM208	<1					
cis-1,3-Dichloropropene	<1 µg/l	TM208	<1					
Toluene	<1 µg/l	TM208	<1					
trans-1,3-Dichloropropene	<1 µg/l	TM208	<1					
1,1,2-Trichloroethane	<1 µg/l	TM208	<1					

09:28:04-08/07/2019

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CERTIFICATE OF ANALYSIS

SDG:	160625-27	Location:	Dungarvan	Order Number:	
Job:	D_MCGARRY_KIL-6	Customer:	Jim McGarry	Report Number:	393057
Client Reference:		Attention:	Jim McGarry	Superseded Report:	

VOC MS (W)

Component	LOD/Units	Method	[illegible]					
1,3-Dichloropropane	<1 µg/l	TM208	<1 #					
Tetrachloroethene	<1 µg/l	TM208	<1 #					
Dibromochloromethane	<1 µg/l	TM208	<1 #					
1,2-Dibromoethane	<1 µg/l	TM208	<1 #					
Chlorobenzene	<1 µg/l	TM208	<1 #					
1,1,1,2-Tetrachloroethane	<1 µg/l	TM208	<1 #					
Ethylbenzene	<1 µg/l	TM208	<1 #					
m,p-Xylene	<1 µg/l	TM208	<1 #					
o-Xylene	<1 µg/l	TM208	<1 #					
Styrene	<1 µg/l	TM208	<1 #					
Bromoform	<1 µg/l	TM208	<1 #					
Isopropylbenzene	<1 µg/l	TM208	<1 #					
1,1,2,2-Tetrachloroethane	<1 µg/l	TM208	<1					
1,2,3-Trichloropropane	<1 µg/l	TM208	<1 #					
Bromobenzene	<1 µg/l	TM208	<1 #					
Propylbenzene	<1 µg/l	TM208	<1 #					
2-Chlorotoluene	<1 µg/l	TM208	<1 #					
1,3,5-Trimethylbenzene	<1 µg/l	TM208	<1 #					
4-Chlorotoluene	<1 µg/l	TM208	<1 #					
tert-Butylbenzene	<1 µg/l	TM208	<1 #					
1,2,4-Trimethylbenzene	<1 µg/l	TM208	<1 #					
sec-Butylbenzene	<1 µg/l	TM208	<1 #					
4-iso-Propyltoluene	<1 µg/l	TM208	<1 #					
1,3-Dichlorobenzene	<1 µg/l	TM208	<1 #					
1,4-Dichlorobenzene	<1 µg/l	TM208	<1 #					
n-Butylbenzene	<1 µg/l	TM208	<1 #					
1,2-Dichlorobenzene	<1 µg/l	TM208	<1					
1,2-Dibromo-3-chloropropane	<1 µg/l	TM208	<1					
1,2,4-Trichlorobenzene	<1 µg/l	TM208	<1 #					
Hexachlorobutadiene	<1 µg/l	TM208	<1 #					
tert-Amyl methyl ether (TAME)	<1 µg/l	TM208	<1 #					
Naphthalene	<1 µg/l	TM208	<1 #					

09:28:54 03/07/2016

AL control Laboratories

CERTIFICATE OF ANALYSIS

Validated

SDG:	150825-27	Location:	Dungarvan	Order Number:	
Job:	D_MCGARRY_KL-6	Customer:	Jim McGarry	Report Number:	368357
Client Reference:		Attention:	Jim McGarry	Superseded Report:	

VOC MS (W)

	Customer Sample ID	2153-ACT						
	Matrix	[illegible]						
	Sample Type	[illegible]						
	Date Received	26/08/2015						
	SDG Ref	150819-27						
	Lab Sample No. (s)	[illegible]						
	AGS Reference							
Component	LOD/Units	Method						
1,2,3-Trichlorobenzene	<1 µg/l	TR/308	<1					
1,2,4-Trichlorobenzene	<1 µg/l	TR/308	<1					

AL control Laboratories

CERTIFICATE OF ANALYSIS

Validated

SDG:	150825-27	Location:	Dungarvan	Order Number:	
Job:	D_MCGARRY_KL-6	Customer:	Jim McGarry	Report Number:	368357
Client Reference:		Attention:	Jim McGarry	Superseded Report:	

Test Completion Dates

Lab Sample No(s)	13868919	13868920	13868922	13868925	13868917	13868918	13868924
Customer Sample Ref.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
AGS Ref.							
Depth							
Type	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Anions by Kone (w)							[illegible]
COC Verified	30-Jun-2015	30-Jun-2015	04-Jul-2015	30-Jun-2015	30-Jun-2015	30-Jun-2015	30-Jun-2015
Dissolved Metals by ICP/MS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Dissolved Al, Mn and Zn by ICP/MS	05-Jul-2015	05-Jul-2015	06-Jul-2015	05-Jul-2015	05-Jul-2015	06-Jul-2015	05-Jul-2015
Mercury Dissolved	05-Jul-2015	05-Jul-2015	06-Jul-2015	05-Jul-2015	05-Jul-2015	06-Jul-2015	05-Jul-2015
Mercury in Liquid (CVAF, Dissolved) (W)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Phenols by HPLC (W)							02-Jul-2015
Total Metals by ICP-MS	21-Jul-2015	21-Jul-2015	21-Jul-2015	21-Jul-2015	21-Jul-2015	21-Jul-2015	21-Jul-2015
[illegible]							[illegible]
VOC MS (W)							21-Jul-2015

Monthly Wetland Analysis

Ponds - July 2016

LABORATORY NUMBER			**1000**	**1001**	**1002**	**1003**	**1004**	**1005**
Sampling Location		**Ponds**	**1A**	**1B**	**2**	**3**	**4**	**5**
Date sampled	14/07/2016		14-Jul	14-Jul	14-Jul	14-Jul	14-Jul	14-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	^{0}C		17.4	13.9	15.6	17.7	17	18.4
pH	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

Monthly Wetland Analysis

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	0C	nm
pH	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 Phenols are in the Certificate of Analysis, enclosed	
***	Individual Compounds are in the Certificate of Analysis, enclosed	

ALcontrol Laboratories

CERTIFICATE OF ANALYSIS

Validated

SDG:	150716-34	Location:	Dungarvan	Order Number:	
Job:	D_MCGARRY_KIL-6	Customer:	Jim McGarry	Report Number:	371249
Client Reference:		Attention:	Jim McGarry	Superseded Report:	

Component	LOD/Units	Method	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ammoniacal Nitrogen as N	<0.2 mg/l	TM099	5.6 #	2.66 *	<0.2 #	<0.2 #	33.7 *	1.63 #
COD, unfiltered	<7 mg/l	TM107	31.1 #	28 *	146 #	47.5 #	514 *	72600 #
Aluminium (diss.filt)	<2 µg/l	TM152	8.65 #	20.7 *	13.2 #	6.6 #	9.41 *	51.0 #
Arsenic (diss.filt)	<0.81 µg/l	TM152	1.73 #	1.14 *	2.03 #	1.71 #	0.939 *	3.1 #
Boron (diss.filt)	<5 µg/l	TM152	114 #	165 *	132 #	125 #	260 *	139 #
Cadmium (diss.filt)	<0.08 µg/l	TM152	<0.08 #	<0.08 *	<0.08 #	<0.08 #	<0.08 *	<0.08 #
Copper (diss.filt)	<0.85 µg/l	TM152	<0.85 #	<0.85 *	<0.85 #	<0.85 #	<0.85 *	1.40 #
Lead (diss.filt)	<0.1 µg/l	TM152	0.133 #	<0.1 *	0.33 #	<0.1 #	<0.1 *	1.04 #
Manganese (diss.filt)	<0.76 µg/l	TM152	1020 #	279 *	67.8 #		430 *	1500 #
Nickel (diss.filt)	<0.44 µg/l	TM152	2.44 #	3.72 *	2.6 #	2.56 #	6.71 *	2.6 #
Zinc (diss.filt)	<1.3 µg/l	TM152	3.1 #	<1.3 *	<1.3 #	<1.3 #	4.86 *	6.67 #
Silver (diss.filt)	<1 µg/l	TM152	<1	<1	<1	<1	<1	<1
Mercury (diss.filt)	<0.01 µg/l	TM183	<0.01 #	<0.01 *	<0.01 #	<0.01 #	<0.01 *	
Chromium (tot.unfilt)	<3 µg/l	TM181	<3 #	<3 *	<3 #	<3 #	31.6 *	274 #
Calcium (diss.filt)	<0.012 mg/l	TM228	80.2 #	76.9 *	45.2 #	56.6 #	82.4 *	90.2 #
Sodium (diss.filt)	<0.076 mg/l	TM228	59.5 #	55.8 *	52 #	52 #	137 *	53.1 #
Magnesium (diss.filt)	<0.036 mg/l	TM228	16.5 #	16.2 *	15.3 #	15.9 #	23.1 *	17.1 #
Potassium (diss.filt)	<1 mg/l	TM228	9.62 #	7.58 *	5.32 #	6.05 #	23.2 *	13.2 #
Iron (diss.filt)	<0.010 mg/l	TM228	0.409 #	0.157 *	0.807 #	0.649 #	0.0012 *	1.86 #

11:10:37 30/07/2015

SDG:	190715-34	Location:	Dungarvan	Order Number:	
Job:	D_MCGARRY_KIL-6	Customer:	Jim McGarry	Report Number:	871243
Client Reference:		Attention:	Jim McGarry	Superseded Report:	

[illegible]	[illegible]	[illegible]						
Component	LOD/LOQ	Method						
Organic Carbon, Tota	<3 mg/l	TM030	10.1					
COD unfiltered	<7 mg/l	TM107	27.1					
Chloride	<2 mg/l	TM184	84.1					
Total Oxidised Nitrogen as N	<0.1 mg/l	TM184	<0.1					
Phenol	<0.002 mg/l	TM258	<0.002					
Cresols	<0.006 mg/l	TM259	<0.006					
Xylenols	<0.006 mg/l	TM259	<0.006					
2,3,5-Trimethylphenol	<0.003 mg/l	TM259	<0.003					
2-Isopropylphenol	<0.006 mg/l	TM259	<0.006					
Phenols, Total Determined as specified	<0.025 mg/l	TM258	<0.025					

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CERTIFICATE OF ANALYSIS

Validated

SDG:	150716-34	Location:	Dungarvan	Order Number:	
Job:	D_MCGARRY_KIL-6	Customer:	Jim McGarry	Report Number:	371243
Client Reference:		Attention:	Jim McGarry	Superseded Report:	

VOC MS (W)

Results Legend								
# ISO17025 accredited. M mCERTS accredited. aq Aqueous / settled sample. diss.filt Dissolved / filtered sample. tot.unfilt Total / unfiltered sample. * Subcontracted test. ** % recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery (F) Trigger breach confirmed 1-5&+§@ Sample deviation (see appendix)	Customer Sample R Depth (m) Sample Type Date Sampled Sample Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	[illegible] - Water(GW/SW) 14/07/2016 - 15/07/2016 150716-34 13290190						
Component	LOD/Units	Method						
Dibromofluoromethane**	%	TM208	114					
Toluene-d8**	%	TM208	98.5					
4-Bromofluorobenzene**	%	TM208	99.7					
Dichlorodifluoromethane	<1 µg/l	TM208	<1					
Chloromethane	<1 µg/l	TM208	<1 #					
Vinyl chloride	<1 µg/l	TM208	<1 #					
Bromomethane	<1 µg/l	TM208	<1 #					
Chloroethane	<1 µg/l	TM208	<1 #					
Trichlorofluoromethane	<1 µg/l	TM208	<1 #					
1,1-Dichloroethene	<1 µg/l	TM208	<1 #					
Carbon disulphide	<1 µg/l	TM208	<1 #					
Dichloromethane	<3 µg/l	TM208	<3 #					
Methyl tertiary butyl ether (MTBE)	<1 µg/l	TM208	<1 #					
trans-1,2-Dichloroethene	<1 µg/l	TM208	<1 #					
1,1-Dichloroethane	<1 µg/l	TM208	<1 #					
cis-1,2-Dichloroethene	<1 µg/l	TM208	<1 #					
2,2-Dichloropropane	<1 µg/l	TM208	<1					
Bromochloromethane	<1 µg/l	TM208	<1 #					
Chloroform	<1 µg/l	TM208	<1 #					
1,1,1-Trichloroethane	<1 µg/l	TM208	<1 #					
1,1-Dichloropropene	<1 µg/l	TM208	<1 #					
Carbontetrachloride	<1 µg/l	TM208	<1 #					
1,2-Dichloroethane	<1 µg/l	TM208	<1					
Benzene	<1 µg/l	TM208	<1 #					
Trichloroethene	<1 µg/l	TM208	<1 #					
1,2-Dichloropropane	<1 µg/l	TM208	<1 #					
Dibromomethane	<1 µg/l	TM208	<1 #					
Bromodichloromethane	<1 µg/l	TM208	<1 #					
cis-1,3-Dichloropropene	<1 µg/l	TM208	<1 #					
Toluene	<1 µg/l	TM208	<1 #					
trans-1,3-Dichloropropene	<1 µg/l	TM208	<1 #					
1,1,2-Trichloroethane	<1 µg/l	TM208	<1 #					

11:10:37 30/07/2016

ALcontrol Laboratories

CERTIFICATE OF ANALYSIS

Validated

SDG:	160716-34	Location:	Dungarvan	Order Number:	
Job:	D_MCGARRY_KIL-6	Customer:	Jim McGarry	Report Number:	371243
Client Reference:		Attention:	Jim McGarry	Superseded Report:	

VOC MS (W)

Results Legend		Customer Sample R	1000-WET EFF
#	ISO17025 accredited.		
M	mCERTS accredited.		
aq	Aqueous / settled sample.	Depth (m)	
diss.filt	Dissolved / filtered sample.	Sample Type	Water(GW/SW)
tot.unfilt	Total / unfiltered sample.	Date Sampled	14/07/2016
*	Subcontracted test.	Sample Time	
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery	Date Received	16/07/2016
		SDG Ref	160716-34
(F)	Trigger breach confirmed	Lab Sample No.(s)	14051790
1-5&+§@	Sample deviation (see appendix)	AGS Reference	

Component	LOD/Units	Method	1000-WET EFF
1,3-Dichloropropane	<1 µg/l	TM208	<1 #
Tetrachloroethene	<1 µg/l	TM208	<1 #
Dibromochloromethane	<1 µg/l	TM208	<1 #
1,2-Dibromoethane	<1 µg/l	TM208	<1 #
Chlorobenzene	<1 µg/l	TM208	<1 #
1,1,1,2-Tetrachloroethane	<1 µg/l	TM208	<1 #
Ethylbenzene	<1 µg/l	TM208	<1 #
m,p-Xylene	<1 µg/l	TM208	<1 #
o-Xylene	<1 µg/l	TM208	<1 #
Styrene	<1 µg/l	TM208	<1 #
Bromoform	<1 µg/l	TM208	<1 #
Isopropylbenzene	<1 µg/l	TM208	<1 #
1,1,2,2-Tetrachloroethane	<1 µg/l	TM208	<1
1,2,3-Trichloropropane	<1 µg/l	TM208	<1 #
Bromobenzene	<1 µg/l	TM208	<1 #
Propylbenzene	<1 µg/l	TM208	<1 #
2-Chlorotoluene	<1 µg/l	TM208	<1 #
1,3,5-Trimethylbenzene	<1 µg/l	TM208	<1 #
4-Chlorotoluene	<1 µg/l	TM208	<1 #
tert-Butylbenzene	<1 µg/l	TM208	<1 #
1,2,4-Trimethylbenzene	<1 µg/l	TM208	<1 #
sec-Butylbenzene	<1 µg/l	TM208	<1 #
4-iso-Propyltoluene	<1 µg/l	TM208	<1 #
1,3-Dichlorobenzene	<1 µg/l	TM208	<1 #
1,4-Dichlorobenzene	<1 µg/l	TM208	<1 #
n-Butylbenzene	<1 µg/l	TM208	<1 #
1,2-Dichlorobenzene	<1 µg/l	TM208	<1
1,2-Dibromo-3-chloropropane	<1 µg/l	TM208	<1
1,2,4-Trichlorobenzene	<1 µg/l	TM208	<1 #
Hexachlorobutadiene	<1 µg/l	TM208	<1 #
tert-Amyl methyl ether (TAME)	<1 µg/l	TM208	<1 #
Naphthalene	<1 µg/l	TM208	<1 #

11:10:37 30/07/2016

AL control Laboratories

CERTIFICATE OF ANALYSIS

Validated

SDG:	190715-24	Location:	Dungarvan	Order Number:	
Job:	D_MCGARRY_KL-6	Customer:	Jim McGarry	Report Number:	371243
Client Reference:		Attention:	Jim McGarry	Superseded Report:	

VOC MS (W)

	Customer Sample ID	1000 VLET EFF						
	Matrix							
	Sample Type							
	Date Sampled							
	Time Sampled							
	Lab Sample No.							
	AGS Reference							
Component	LOD/Units	Method						
1,2,3-Trichlorobenzene	<1 µg/l	TR/308	<1					
1,2,4-Trichlorobenzene	<1 µg/l	TR/308	<1					

11:12:37 SM/07/2019

AL control Laboratories

CERTIFICATE OF ANALYSIS

Validated

BDG:	190715-24	Location:	Dungarvan	Order Number:	
Job:	D_MCGARRY_KL-6	Customer:	Jim McGarry	Report Number:	371243
Client Reference:		Attention:	Jim McGarry	Superseded Report:	

Test Completion Dates

Lab Sample No(s)	13788170	13788171	13788175	13788179	13788167	13788168	13788169
Customer Sample Ref.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
AGS Ref.							
Depth							
Type	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Anions by Kone (w)							[illegible]
COD Unfiltered	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019	24-Jul-2019
Dissolved Metals by ICP/MS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Mercury Dissolved	21-Jul-2019	22-Jul-2019	21-Jul-2019	22-Jul-2019	21-Jul-2019	21-Jul-2019	
Metals by Kone-CDS Dissolved (W)	20-Jul-2019	20-Jul-2019	20-Jul-2019	20-Jul-2019	20-Jul-2019	20-Jul-2019	
[illegible]							[illegible]
Total Metals by ICP/MS	30-Jul-2019	30-Jul-2019	30-Jul-2019	30-Jul-2019	30-Jul-2019	30-Jul-2019	
Total Organic and Inorganic Carbon							23-Jul-2019
VOC MS (W)							[illegible]

11:12:37 30/07/2019

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	oC		17.4	14.3	15.5	16.2	14.8	15.5
pH	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

Monthly Wetland Analysis

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	0C	15.4
pH	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	

Monthly Wetland Analysis

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	$_0$C		13.6	12.2	12.3	12.5	12.7	12.5
pH	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 metals are in the Certificate of Analysis, enclosed							
			Copious Algae present	Muddy	from pipe clear	from pipe clear	algae present	

Monthly Wetland Analysis

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
pH	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$$$		
Phenols+++	mg/l	<0.025
Volatiles (VOC's)***		
+++	Individual Phenols are in the Certificate of Analysis, enclosed	
***	Individual Compounds are in the Certificate of Analysis, enclosed	
$$$	Individual Metals are in the Certificate of Analysis, enclosed	

ALcontrol Laboratories

Validated

CERTIFICATE OF ANALYSIS

SDG:	[illegible]	Location:	Dungiven	Order Number:	
Job:	[illegible]	Customer:	Jim McGarry	Report Number:	[illegible]
Client Reference:		Attention:	Jim McGarry	Superseded Report:	

Component	LOD/Units	Method	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ammoniacal Nitrogen as N	<0.2 mg/l	TM099	2.14 #	1.21 #	1.38 #	0.672 #	5.07 #	0.356 #
COD unfiltered	<7 mg/l	TM107	13.5 #	12.3 #	11.9 #	10.4 #	89 #	20900 #
Aluminium (diss.filt)	<2 µg/l	TM152	2.8 #	3.09 #	3.07 #	<2 #	3.45 #	231 #
Arsenic (diss.filt)	<0.5 µg/l	TM152	0.815 #	0.759 #	0.885 #	0.98 #	0.79 #	3.55 #
Boron (diss.filt)	<5 µg/l	TM152	64.4 #	71.2 #	75.1 #	78.6 #	59.3 #	36.5 #
Cadmium (diss.filt)	<0.03 µg/l	TM152	<0.03 #	<0.03 #	<0.03 #	<0.03 #	<0.03 #	<0.03 #
Copper (diss.filt)	<0.85 µg/l	TM152	<0.85 #	<0.85 #	<0.85 #	<0.85 #	<0.85 #	1.28 #
Lead (diss.filt)	<0.1 µg/l	TM152	0.113 #	<0.1 #	0.217 #	<0.1 #	0.115 #	0.932 #
Manganese (diss.filt)	<0.75 µg/l	TM152	113 #	108 #	45.2 #	175 #	33.5 #	1130 #
Nickel (diss.filt)	<0.4 µg/l	TM152	1.25 #	1.37 #	1.48 #	1.5 #	1.51 #	2.52 #
Zinc (diss.filt)	<1.3 µg/l	TM152	<1.3 #	<1.3 #	<1.3 #	<1.3 #	<1.3 #	1.75 #
Silver (diss.filt)	<1 µg/l	TM152	<1	<1	<1	<1	<1	<1
Mercury (diss.filt)	<0.01 µg/l	TM152	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium (hexavalent)	<3 µg/l	TM181	<3 #	<3 #	<3 #	<3 #	<3 #	287 #
Calcium (diss.filt)	<0.012 mg/l	TM228	80.5 #	78.3 #	72.6 #	80.5 #	78.3 #	73.8 #
Sodium (diss.filt)	<0.076 mg/l	TM228	30 #	31.6 #	32.7 #	36.5 #	30.7 #	42.5 #
Magnesium (diss.filt)	<0.036 mg/l	TM228	12.8 #	13.1 #	13.3 #	19.8 #	12.4 #	19 #
Potassium (diss.filt)	<1 mg/l	TM228	6.5 #	6.73 #	7.38 #	10.2 #	5.85 #	12.1 #
Iron (diss.filt)	<0.019 mg/l	TM228	0.0152 #	0.0302 #	0.11 #	0.0324 #	0.0194 #	0.346 #

14:31:41 03/11/2016

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CERTIFICATE OF ANALYSIS

SDG:	[illegible]	Location:	[illegible]	Order Number:	
Job:	[illegible]	Customer:	Jim McGarry	Report Number:	[illegible]
Client Reference:		Attention:	Jim McGarry	Superseded Report:	

Results Legend			
[illegible]	Customer Sample Ref.	[illegible]	
	Depth (m)		
	Sample Type	[illegible]	
	Date Sampled	[illegible]	
	Sample Time		
	Date Received	[illegible]	
	SDG Ref	[illegible]	
	Lab Sample No.(s)	[illegible]	
	AGS Reference		
Component	**LOD/Units**	**Method**	
Organic Carbon Total	<3 mg/l	TM090	11.7 #
BOD unfiltered	<1 mg/l	TM127	26.5 #
Chloride	<2 mg/l	TM184	10.4 #
Total Oxidised Nitrogen as N	<0.1 mg/l	TM184	[illegible] #
Phenol	<0.002 mg/l	TM259	<0.002 #
Cresols	<0.006 mg/l	TM259	<0.006 #
Xylenols	<0.008 mg/l	TM259	<0.008 #
2,3,5-Trimethylphenol	<0.001 mg/l	TM259	<0.001 #
2-Isopropylphenol	<0.002 mg/l	TM259	<0.002 #
Phenols, Total Detected speciated	<0.035 mg/l	TM259	<0.035

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CERTIFICATE OF ANALYSIS

SDG:	[illegible]	Location:	Dungiven	Order Number:	
Job:	[illegible]	Customer:	Jim McCarry	Report Number:	[illegible]
Client Reference:		Attention:	Jim McCarry	Superseded Report:	

VOC MS (W)

Results Legend
- # ISO17025 accredited.
- M mCERTS accredited.
- aq Aqueous / settled sample.
- diss.filt Dissolved / filtered sample.
- tot.unfilt Total / unfiltered sample.
- * Subcontracted test.
- ** % recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
- (F) Trigger breach confirmed
- 1-5&+§@ Sample deviation (see appendix)

Customer Sample Ref.			[illegible]					
Depth (m)								
Sample Type			Water(GW/SW)					
Date Sampled			[illegible]					
Sample Time								
Date Received			[illegible]					
SDG Ref			[illegible]					
Lab Sample No.(s)			[illegible]					
AGS Reference								
Component	**LOD/Units**	**Method**						
Dibromofluoromethane**	%	TM208	112					
Toluene-d8**	%	TM208	101					
4-Bromofluorobenzene**	%	TM208	103					
Dichlorodifluoromethane	<1 µg/l	TM208	<1					
Chloromethane	<1 µg/l	TM208	<1 ✓					
Vinyl chloride	<1 µg/l	TM208	<1 ✓					
Bromomethane	<1 µg/l	TM208	<1 ✓					
Chloroethane	<1 µg/l	TM208	<1 ✓					
Trichlorofluoromethane	<1 µg/l	TM208	<1 ✓					
1,1-Dichloroethene	<1 µg/l	TM208	<1 ✓					
Carbon disulphide	<1 µg/l	TM208	<1 ✓					
Dichloromethane	<3 µg/l	TM208	<3 ✓					
Methyl tertiary butyl ether (MTBE)	<1 µg/l	TM208	<1 ✓					
trans-1,2-Dichloroethene	<1 µg/l	TM208	<1 ✓					
1,1-Dichloroethane	<1 µg/l	TM208	<1 ✓					
cis-1,2-Dichloroethene	<1 µg/l	TM208	<1 ✓					
2,2-Dichloropropane	<1 µg/l	TM208	<1					
Bromochloromethane	<1 µg/l	TM208	<1 ✓					
Chloroform	<1 µg/l	TM208	<1 ✓					
1,1,1-Trichloroethane	<1 µg/l	TM208	<1 ✓					
1,1-Dichloropropene	<1 µg/l	TM208	<1 ✓					
Carbontetrachloride	<1 µg/l	TM208	<1 ✓					
1,2-Dichloroethane	<1 µg/l	TM208	<1					
Benzene	<1 µg/l	TM208	<1 ✓					
Trichloroethene	<1 µg/l	TM208	<1 ✓					
1,2-Dichloropropane	<1 µg/l	TM208	<1 ✓					
Dibromomethane	<1 µg/l	TM208	<1 ✓					
Bromodichloromethane	<1 µg/l	TM208	<1 ✓					
cis-1,3-Dichloropropene	<1 µg/l	TM208	<1 ✓					
Toluene	<1 µg/l	TM208	<1 ✓					
trans-1,3-Dichloropropene	<1 µg/l	TM208	<1 ✓					
1,1,2-Trichloroethane	<1 µg/l	TM208	<1 ✓					

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CERTIFICATE OF ANALYSIS

SDG:	[illegible]	Location:	Draycott	Order Number:	
Job:	[illegible]	Customer:	Jim McGarry	Report Number:	[illegible]
Client Reference:		Attention:	Jim McGarry	Superseded Report:	

VOC MS (W)

[illegible]	[illegible]	[illegible]							
Compound	LOD/Units	Method							
1,3-Dichloropropane	<1 µg/l	TM218	<1						
Tetrachloroethene	<1 µg/l	TM218	<1						
Dibromochloromethane	<1 µg/l	TM218	<1						
1,2-Dibromoethane	<1 µg/l	TM218	<1						
Chlorobenzene	<1 µg/l	TM218	<1						
1,1,1,2-Tetrachloroethane	<1 µg/l	TM218	<1						
Ethylbenzene	<1 µg/l	TM218	<1						
m & p-Xylene	<1 µg/l	TM218	<1						
o-Xylene	<1 µg/l	TM218	<1						
Styrene	<1 µg/l	TM218	<1						
Bromoform	<1 µg/l	TM218	<1						
Isopropylbenzene	<1 µg/l	TM218	<1						
1,1,2,2-Tetrachloroethane	<1 µg/l	TM218	<1						
1,2,3-Trichloropropane	<1 µg/l	TM218	<1						
Bromobenzene	<1 µg/l	TM218	<1						
Propylbenzene	<1 µg/l	TM218	<1						
2-Chlorotoluene	<1 µg/l	TM218	<1						
1,3,5-Trimethylbenzene	<1 µg/l	TM218	<1						
4-Chlorotoluene	<1 µg/l	TM218	<1						
tert-Butylbenzene	<1 µg/l	TM218	<1						
1,2,4-Trimethylbenzene	<1 µg/l	TM218	<1						
sec-Butylbenzene	<1 µg/l	TM218	<1						
4-iso-Propyltoluene	<1 µg/l	TM218	<1						
1,3-Dichlorobenzene	<1 µg/l	TM218	<1						
1,4-Dichlorobenzene	<1 µg/l	TM218	<1						
n-Butylbenzene	<1 µg/l	TM218	<1						
1,2-Dichlorobenzene	<1 µg/l	TM218	<1						
1,2-Dibromo-3-chloropropane	<1 µg/l	TM218	<1						
1,2,4-Trichlorobenzene	<1 µg/l	TM218	<1						
Hexachlorobutadiene	<1 µg/l	TM218	<1						
Naphthalene	<1 µg/l	TM218	<1						

14:31:41 05/11/2018

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CERTIFICATE OF ANALYSIS

BDG:	[illegible]	Location:	Draycott	Order Number:	
Job:	[illegible] MCSERRY RL-6	Customer:	Jill McGarry	Report Number:	[illegible]
Client Reference:		Attention:	Jill McGarry	Superseded Report:	

VOC MS (W)

[illegible]	Customer Sample Ref.	[illegible]						
	Analysis							
	Sample Type	Water (Potable)						
	Date Sampled	[illegible]						
	Time Sampled							
	Date Received	[illegible]						
	Client Ref.	[illegible]						
	Lab Sample No.(s)	[illegible]						
	AGS Reference							
Component	LOD/Units	Method						
1,2,3-Trichlorobenzene	<1 µg/l	TM218	<1					
1,2,4-Trichlorobenzene	<1 µg/l	TM218	<1					

14:31:41 05/11/2018

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CERTIFICATE OF ANALYSIS

SDG:	[illegible]	Location:	Dungiven	Order Number:	
Job:	[illegible]	Customer:	Jim McCarry	Report Number:	[illegible]
Client Reference:		Attention:	Jim McCarry	Superseded Report:	

Test Completion Dates

Lab Sample No(s)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Customer Sample Ref.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
AGS Ref.							
Depth							
Type	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID
Ammoniacal Nitrogen	[illegible]-Nov-2016	[illegible]-Nov-2016	[illegible]-Nov-2016	[illegible]-Nov-2016	[illegible]-Nov-2016	[illegible]-Nov-2016	
Anions by Kone (w)							[illegible]-Nov-2016
BOD unfiltered	[illegible]-Nov-2016	[illegible]-Nov-2016	[illegible]-Nov-2016	[illegible]-Nov-2016	[illegible]-Nov-2016	[illegible]-Nov-2016	[illegible]-Nov-2016
Dissolved Metals by ICP-MS	07-Nov-2016	07-Nov-2016	07-Nov-2016	07-Nov-2016	07-Nov-2016	07-Nov-2016	
Mercury Dissolved	07-Nov-2016	07-Nov-2016	07-Nov-2016	07-Nov-2016	07-Nov-2016	07-Nov-2016	
Metals by iCap-OES Dissolved (W)	[illegible]-Nov-2016	[illegible]-Nov-2016	[illegible]-Nov-2016	[illegible]-Nov-2016	[illegible]-Nov-2016	[illegible]-Nov-2016	
Phenols by HPLC (W)							[illegible]-Nov-2016
Total Metals by ICP-MS	[illegible]-Nov-2016	[illegible]-Nov-2016	[illegible]-Nov-2016	[illegible]-Nov-2016	[illegible]-Nov-2016	[illegible]-Nov-2016	
Total Organic and Inorganic Carbon							[illegible]-Nov-2016
VOC MS (W)							[illegible]-Nov-2016

Monthly Wetland Analysis

Ponds - October 2016

LABORATORY NUMBER			**2567**	**2568**	**2569**	**2570**	**2571**	**2572**
Sampling Location		**Ponds**	**1A**	**1B**	**2**	**3**	**4**	**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	oC		14.4	12.5	11.8	11.7	12.5	11.9
pH	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 **								
			Copious Algae present	Muddy	from pipe clear	from pipe clear	over pipe clear	clear

** Individual metals are in the Certificate of Analysis, enclosed

Monthly Wetland Analysis

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
pH	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 are in the Certificate of Analysis, enclosed	
***	Individual Compounds are in the Certificate of Analysis, enclosed	
$$$	Individual Metals are in the Certificate of Analysis, enclosed	

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CERTIFICATE OF ANALYSIS

SDG:	[illegible]	Location:	[illegible]	Order Number:	
Job:	[illegible]	Customer:	Jim McGerry	Report Number:	[illegible]
Client Reference:	[illegible]	Attention:	Jim McGerry	Superseded Report:	

Component	LOD/Units	Method	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ammoniacal Nitrogen as N	<0.2 mg/l	TM099	0.762 #	0.383 #	0.625 #	1.16 #	3.74 #	6.427 #
COD unfiltered	<7 mg/l	TM107	20.8 #	33.4 #	50.8 #	24.6 #	558 #	10600 #
Aluminium (diss.filt)	<2 µg/l	TM152	3.24 #	3.82 #	5.28 #	<2 #	17 #	21.5 #
Arsenic (diss.filt)	<0.5 µg/l	TM152	0.989 #	1.08 #	1.38 #	1.1 #	2.37 #	3.61 #
Boron (diss.filt)	<5 µg/l	TM152	61.5 #	63.1 #	58 #	62.5 #	57.5 #	31.5 #
Cadmium (diss.filt)	<0.08 µg/l	TM152	<0.08 #	<0.08 #	<0.08 #	<0.08 #	<0.08 #	<0.08 #
Chromium (diss.filt)	<1.2 µg/l	TM152	<1.2 #	<1.2 #	<1.2 #	<1.2 #	<1.2 #	<1.2 #
Copper (diss.filt)	<0.85 µg/l	TM152	<0.85 #	<0.85 #	<0.85 #	<0.85 #	<0.85 #	<0.85 #
Lead (diss.filt)	<0.1 µg/l	TM152	<0.1 #	0.101 #	0.131 #	<0.1 #	0.429 #	0.528 #
Manganese (diss.filt)	<3.5 µg/l	TM152	80.4 #	12.4 #	26.5 #	25.8 #	366 #	812 #
Nickel (diss.filt)	<0.15 µg/l	TM152	1.42 #	1.53 #	1.3 #	1.31 #	2.32 #	2.35 #
Zinc (diss.filt)	<1.3 µg/l	TM152	1.86 #	<1.3 #	<1.3 #	1.37 #	1.81 #	2.72 #
Silver (diss.filt)	<1 µg/l	TM152	<1	<1	<1	<1	<1	<1
Mercury (diss.filt)	<0.01 µg/l	TM183	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Calcium (diss.filt)	<0.012 mg/l	TM228	78.6 #	78.7 #	79.6 #	78.5 #	63.9 #	50 #
Sodium (diss.filt)	<0.076 mg/l	TM228	35 #	35.5 #	36.8 #	34.8 #	31.7 #	51 #
Magnesium (diss.filt)	<0.036 mg/l	TM228	15.7 #	16.3 #	14.4 #	16 #	12.1 #	19 #
Potassium (diss.filt)	<1 mg/l	TM228	11.2 #	11.7 #	11.6 #	11 #	7.42 #	17.3 #
Iron (diss.filt)	<0.019 mg/l	TM228	0.0744 #	0.0502 #	0.105 #	0.0312 #	0.279 #	0.702 #

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CERTIFICATE OF ANALYSIS

Validated

SDG:	[illegible]	Location:	Dungarvan	Order Number:	
Job:	[illegible]	Customer:	Jim McGarry	Report Number:	[illegible]
Client Reference:	[illegible]	Attention:	Jim McGarry	Superseded Report:	

Results Legend		Customer Sample Ref.	[illegible]					
[illegible]		Sample Type	[illegible]					
		Date Sampled	[illegible]					
		Sample Time						
		Date Received	[illegible]					
		SDG Ref	[illegible]					
		Lab Sample No.(s)	[illegible]					
		AGS Reference						
Component	LOD/Units	Method						
Organic Carbon Total	<3 mg/l	TM090	6.58 ✓					
BOD unfiltered	<1 mg/l	TM127	22.1 ✓					
Chloride	<2 mg/l	TM184	64.8 ✓					
Total Oxidised Nitrogen as N	<0.1 mg/l	TM184	0.225 ✓					
Phenol	<0.005 mg/l	TM259	<0.005 ✓					
Cresols	<0.005 mg/l	TM259	<0.005 ✓					
Xylenols	<0.005 mg/l	TM259	<0.005 ✓					
2,3,5-Trimethylphenol	<0.005 mg/l	TM259	<0.005 ✓					
2-Isopropylphenol	<0.005 mg/l	TM259	<0.005 ✓					
Phenols, Total Detected 5 speciated	<0.025 mg/l	TM259	<0.025					

16:08:50 24/11/2016

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CERTIFICATE OF ANALYSIS

SDG:	[illegible]	Location:	Drogheda	Order Number:	
Job:	[illegible]	Customer:	Jer McGarry	Report Number:	[illegible]
Client Reference:	[illegible]	Attention:	Jer McGarry	Superseded Report:	

VOC MS (W)

[illegible]		Customer Sample ID:	[illegible]
a	[illegible]		
b	[illegible]		
m	[illegible]	Type(s):	
[illegible]	[illegible]	Sample Type:	[illegible]
[illegible]	[illegible]	Date Sampled:	[illegible]
*	[illegible]	Time Sampled:	
	[illegible]	Date Received:	[illegible]
	[illegible]	SDG Ref:	[illegible]
	[illegible]	Lab Sample No.(s):	[illegible]
[illegible]	[illegible]	AGS Reference:	

Compound	LOD/LOQ (ug/kg)	Method	[illegible]					
Dibromofluoromethane**	%	TM32	105					
Toluene-d8**	%	TM32	97.4					
4-Bromofluorobenzene**	%	TM32	99.3					
Dichlorodifluoromethane	<1 µg/l	TM32	<1					
Chloromethane	<1 µg/l	TM32	<1					
Vinyl chloride	<1 µg/l	TM32	<1					
Bromomethane	<1 µg/l	TM32	<1					
Chloroethane	<1 µg/l	TM32	<1					
Trichlorofluoromethane	<1 µg/l	TM32	<1					
1,1-dichloroethene	<1 µg/l	TM32	<1					
Carbon disulphide	<1 µg/l	TM32	<1					
Dichloromethane	<3 µg/l	TM32	<3					
Methyl tertiary butyl ether (MTBE)	<1 µg/l	TM32	<1					
trans-1,2-Dichloroethene	<1 µg/l	TM32	<1					
1,1-Dichloroethane	<1 µg/l	TM32	<1					
cis-1,2-Dichloroethene	<1 µg/l	TM32	<1					
2,2-Dichloropropane	<1 µg/l	TM32	<1					
Bromochloromethane	<1 µg/l	TM32	<1					
Chloroform	<1 µg/l	TM32	<1					
1,1,1-Trichloroethane	<1 µg/l	TM32	<1					
1,1-Dichloropropene	<1 µg/l	TM32	<1					
Carbon tetrachloride	<1 µg/l	TM32	<1					
1,2-Dichloroethane	<1 µg/l	TM32	<1					
Benzene	<1 µg/l	TM32	<1					
Trichloroethene	<1 µg/l	TM32	<1					
1,2-Dichloropropane	<1 µg/l	TM32	<1					
Dibromomethane	<1 µg/l	TM32	<1					
Bromodichloromethane	<1 µg/l	TM32	<1					
cis-1,3-Dichloropropene	<1 µg/l	TM32	<1					
Toluene	<1 µg/l	TM32	<1					
trans-1,3-Dichloropropene	<1 µg/l	TM32	<1					
1,1,2-Trichloroethane	<1 µg/l	TM32	<1					

[illegible]

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CERTIFICATE OF ANALYSIS

Validated

SDG:	[illegible]	Location:	[illegible]	Order Number:	
Job:	[illegible]	Customer:	Jim McCarry	Report Number:	[illegible]
Client Reference:	[illegible]	Attention:	Jim McCarry	Superseded Report:	

VOC MS (W)

Results Legend: [illegible]

Customer Sample Ref.			[illegible]					
Depth (m) / Sample Type / Date Sampled / Sample Time / Date Received / SDG Ref / Lab Sample No.(s) / AGS Reference			[illegible]					
Component	LOD/Units	Method						
1,3-Dichloropropane	<1 µg/l	TM208	<1 ✓					
Tetrachloroethene	<1 µg/l	TM208	<1 ✓					
Dibromochloromethane	<1 µg/l	TM208	<1 ✓					
1,2-Dibromoethane	<1 µg/l	TM208	<1 ✓					
Chlorobenzene	<1 µg/l	TM208	<1 ✓					
1,1,1,2-Tetrachloroethane	<1 µg/l	TM208	<1 ✓					
Ethylbenzene	<1 µg/l	TM208	<1 ✓					
m,p-Xylene	<1 µg/l	TM208	<1 ✓					
o-Xylene	<1 µg/l	TM208	<1 ✓					
Styrene	<1 µg/l	TM208	<1 ✓					
Bromoform	<1 µg/l	TM208	<1 ✓					
Isopropylbenzene	<1 µg/l	TM208	<1 ✓					
1,1,2,2-Tetrachloroethane	<1 µg/l	TM208	<1					
1,2,3-Trichloropropane	<1 µg/l	TM208	<1 ✓					
Bromobenzene	<1 µg/l	TM208	<1 ✓					
Propylbenzene	<1 µg/l	TM208	<1 ✓					
2-Chlorotoluene	<1 µg/l	TM208	<1 ✓					
1,3,5-Trimethylbenzene	<1 µg/l	TM208	<1 ✓					
4-Chlorotoluene	<1 µg/l	TM208	<1 ✓					
tert-Butylbenzene	<1 µg/l	TM208	<1 ✓					
1,2,4-Trimethylbenzene	<1 µg/l	TM208	<1 ✓					
sec-Butylbenzene	<1 µg/l	TM208	<1 ✓					
4-iso-Propyltoluene	<1 µg/l	TM208	<1 ✓					
1,3-Dichlorobenzene	<1 µg/l	TM208	<1 ✓					
1,4-Dichlorobenzene	<1 µg/l	TM208	<1 ✓					
n-Butylbenzene	<1 µg/l	TM208	<1 ✓					
1,2-Dichlorobenzene	<1 µg/l	TM208	<1					
1,2-Dibromo-3-chloropropane	<1 µg/l	TM208	<1					
1,2,3-Trichlorobenzene	<1 µg/l	TM208	<1 ✓					
Hexachlorobutadiene	<1 µg/l	TM208	<1 ✓					
tert-Amyl methyl ether (TAME)	<1 µg/l	TM208	<1 ✓					
Naphthalene	<1 µg/l	TM208	<1 ✓					

AL control Laboratories

Validated

CERTIFICATE OF ANALYSIS

BDG:	[illegible]	Location:	Drayton	Order Number:	
Job:	[illegible]	Customer:	Jill McGarry	Report Number:	[illegible]
Client Reference:	[illegible]	Attention:	Jill McGarry	Superseded Report:	

VOC MS (W)

[illegible]	Customer Sample Ref.	[illegible]					
[illegible]	[illegible]	[illegible]					
Component	LOD/Units	Method					
[illegible]	<1 µg/l	TM218	<1				
[illegible]	<1 µg/l	TM218	<1				

ALcontrol Laboratories

Validated

CERTIFICATE OF ANALYSIS

SDG:	[illegible]	Location:	Dungarvan	Order Number:	
Job:	[illegible]	Customer:	Jim McGarry	Report Number:	[illegible]
Client Reference:	[illegible]	Attention:	Jim McGarry	Superseded Report:	

Test Completion Dates

Lab Sample No(s)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Customer Sample Ref.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
AGS Ref.							
Depth							
Type	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID
Ammoniacal Nitrogen	[illegible]	24-Nov-2016	24-Nov-2016	[illegible]	24-Nov-2016	24-Nov-2016	
Anions by Kone (w)							24-Nov-2016
COD Unfiltered	24-Nov-2016	24-Nov-2016	24-Nov-2016	24-Nov-2016	24-Nov-2016	24-Nov-2016	24-Nov-2016
Dissolved Metals by ICP-MS	21-Nov-2016	21-Nov-2016	21-Nov-2016	21-Nov-2016	21-Nov-2016	21-Nov-2016	
Mercury Dissolved	23-Nov-2016	24-Nov-2016	24-Nov-2016	24-Nov-2016	24-Nov-2016	24-Nov-2016	
Metals by iCap-OES Dissolved (W)	19-Nov-2016	19-Nov-2016	19-Nov-2016	19-Nov-2016	19-Nov-2016	19-Nov-2016	
Phenols by HPLC (W)							21-Nov-2016
Total Organic and Inorganic Carbon							22-Nov-2016
VOC MS (W)							22-Nov-2016

16:08:50 24/11/2016

Monthly Wetland Analysis

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	oC		1.1	2.9	3.7	4.2	3.1	2.1
pH	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 metals are in the Certificate of Analysis, enclosed							
			Frozen low level at manifold	Muddy	from pipe clear	from pipe clear	over pipe clear	clear

Monthly Wetland Analysis

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
pH	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 are in the Certificate of Analysis, enclosed	
***	Individual Compounds are in the Certificate of Analysis, enclosed	
$$$	Individual Metals are in the Certificate of Analysis, enclosed	

Validated

CERTIFICATE OF ANALYSIS

SDG:	161202-95	Client Reference:	Report Number: 399051
Location:	Dungeness	Order Number:	Superseded Report:

Component	LOD/Units	Method	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ammoniacal Nitrogen as N	<0.2 mg/l	TM099	1.02 #	1.09 #	3.5 #	0.683 #	27.5 #	0.837 #
COD unfiltered	<7 mg/l	TM107	21.7 #	18.5 #	32.3 #	24.8 #	14400 #	32300 #
Aluminium (diss.filt)	<2 µg/l	TM152	7.16 #	2.77 #	8.78 #	7.3 #	<2 #	16.7 #
Arsenic (diss.filt)	<0.12 µg/l	TM152	1.11 #	1.53 #	2.08 #	1.06 #	21.5 #	2.89 #
Boron (diss.filt)	<9.4 µg/l	TM152	69.5 #	65 #	68 #	66.5 #	55.7 #	63.5 #
Cadmium (diss.filt)	<0.08 µg/l	TM152	<0.08 #	<0.08 #	<0.08 #	<0.08 #	<0.08 #	<0.08 #
Chromium (diss.filt)	<0.22 µg/l	TM152	<0.22 #	<0.22 #	<0.22 #	<0.22 #	1.69 #	<0.22 #
Copper (diss.filt)	<0.85 µg/l	TM152	<0.85 #	<0.85 #	<0.85 #	<0.85 #	<0.85 #	1.47 #
Lead (diss.filt)	<0.02 µg/l	TM152	0.289 #	<0.02 #	0.0212 #	0.133 #	<0.02 #	0.542 #
Manganese (diss.filt)	<0.04 µg/l	TM152	166 #	278 #	437 #	263 #	2010 #	1070 #
Nickel (diss.filt)	<0.15 µg/l	TM152	1.90 #	1.03 #	1.73 #	1.44 #	7.77 #	2.55 #
Zinc (diss.filt)	<0.41 µg/l	TM152	<0.41 #	<0.41 #	<0.41 #	<0.41 #	<0.41 #	1.45 #
Silver (diss.filt)	<1.5 µg/l	TM152	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Mercury (diss.filt)	<0.01 µg/l	TM183	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Calcium (diss.filt)	<0.012 mg/l	TM228	75.6 #	78.3 #	72.8 #	75.1 #	150 #	85.4 #
Sodium (diss.filt)	<0.076 mg/l	TM228	26.1 #	28.3 #	31.3 #	25.8 #	13.7 #	30.1 #
Magnesium (diss.filt)	<0.0036 mg/l	TM228	14.5 #	14.4 #	14.6 #	14.1 #	23.1 #	15 #
Potassium (diss.filt)	<0.073 mg/l	TM228	13.1 #	12.4 #	14.5 #	13.2 #	23.7 #	15.2 #
Iron (diss.filt)	<0.019 mg/l	TM228	0.161 #	0.651 #	0.156 #	0.383 #	2.83 #	0.592 #

14:57:45 12/12/2016

Validated

CERTIFICATE OF ANALYSIS

SDG:	151202-55	Client Reference:		Report Number:	380051
Location:	Dungeness	Order Number:		Superseded Report:	

[illegible]	Customer Sample Ref	[illegible]					
[illegible legend]	Depth (m) / Sample Type / Date Sampled / Sample Time / Date Received / SDG Ref / Lab Sample No.(s) / AGS Reference	[illegible]					
Component	**LOD/Units**	**Method**					
Organic Carbon Total	<2 mg/l	TM090	7.6 #✓					
COD unfiltered	<7 mg/l	TM107	23.5 ✓					
Chloride	<2 mg/l	TM184	64.6 ✓					
Total Oxidised Nitrogen as N	<0.1 mg/l	TM184	<0.1 ✓					
Phenol	<0.002 mg/l	TM026	<0.002 ✓					
Cresols	<0.006 mg/l	TM026	<0.006 ✓					
Xylenols	<0.008 mg/l	TM026	<0.008 ✓					
2,3,5-Trimethylphenol	<0.003 mg/l	TM026	<0.003 ✓					
2-isopropylphenol	<0.005 mg/l	TM026	<0.005 ✓					
Phenols, Total Detected (speciated)	<0.035 mg/l	TM026	<0.035					

14:57:45 12/12/2016

Validated

CERTIFICATE OF ANALYSIS

SDG:	151202-55	Client Reference:		Report Number:	551051
Location:	Dungarvan	Order Number:		Superseded Report:	

VOC MS (W)

Compound	LOQ	Units	Method						
Dibromofluoromethane [#]		%	TM038	103					
Toluene-d8 [#]		%	TM038	99.1					
4-Bromofluorobenzene [#]		%	TM038	101					
Dichlorodifluoromethane	<1	µg/l	TM038	<1					
Chloromethane	<1	µg/l	TM038	<1					
Vinyl chloride	<1	µg/l	TM038	<1					
Bromomethane	<1	µg/l	TM038	<1					
Chloroethane	<1	µg/l	TM038	<1					
Trichlorofluoromethane	<1	µg/l	TM038	<1					
1,1-Dichloroethene	<1	µg/l	TM038	<1					
Carbon disulphide	<1	µg/l	TM038	<1					
Dichloromethane	<3	µg/l	TM038	<3					
Methyltertiarybutylether (MTBE)	<1	µg/l	TM038	<1					
trans-1,2-Dichloroethane	<1	µg/l	TM038	<1					
1,1-Dichloroethane	<1	µg/l	TM038	<1					
cis-1,2-Dichloroethene	<1	µg/l	TM038	<1					
2,2-Dichloropropane	<1	µg/l	TM038	<1					
Bromochloromethane	<1	µg/l	TM038	<1					
Chloroform	<1	µg/l	TM038	<1					
1,1,1-Trichloroethane	<1	µg/l	TM038	<1					
1,1-Dichloropropene	<1	µg/l	TM038	<1					
Carbon tetrachloride	<1	µg/l	TM038	<1					
1,2-Dichloroethane	<1	µg/l	TM038	<1					
Benzene	<1	µg/l	TM038	<1					
Trichloroethene	<1	µg/l	TM038	<1					
1,2-Dichloropropane	<1	µg/l	TM038	<1					
Dibromomethane	<1	µg/l	TM038	<1					
Bromodichloromethane	<1	µg/l	TM038	<1					
cis-1,3-Dichloropropene	<1	µg/l	TM038	<1					
Toluene	<1	µg/l	TM038	<1					
trans-1,3-Dichloropropene	<1	µg/l	TM038	<1					
1,1,2-Trichloroethane	<1	µg/l	TM038	<1					

14:57:45 12/12/2016

Validated

CERTIFICATE OF ANALYSIS

SDG:	161202-55	Client Reference:		Report Number:	561051
Location:	Dungarvan	Order Number:		Superseded Report:	

VOC MS (W)

Compound	LOR/Units	Method	[illegible]					
1,3-Dichloropropane	<1 µg/l	TM030	<1					
Tetrachloroethene	<1 µg/l	TM030	<1					
Dibromochloromethane	<1 µg/l	TM030	<1					
1,2-Dibromoethane	<1 µg/l	TM030	<1					
Chlorobenzene	<1 µg/l	TM030	<1					
1,1,1,2-Tetrachloroethane	<1 µg/l	TM030	<1					
Ethylbenzene	<1 µg/l	TM030	<1					
m & p Xylene	<1 µg/l	TM030	<1					
o-Xylene	<1 µg/l	TM030	<1					
Styrene	<1 µg/l	TM030	<1					
Bromoform	<1 µg/l	TM030	<1					
Isopropylbenzene	<1 µg/l	TM030	<1					
1,1,2,2-Tetrachloroethane	<1 µg/l	TM030	<1					
1,2,3-Trichloropropane	<1 µg/l	TM030	<1					
Bromobenzene	<1 µg/l	TM030	<1					
Propylbenzene	<1 µg/l	TM030	<1					
2-Chlorotoluene	<1 µg/l	TM030	<1					
1,3,5-Trimethylbenzene	<1 µg/l	TM030	<1					
4-Chlorotoluene	<1 µg/l	TM030	<1					
tert-Butylbenzene	<1 µg/l	TM030	<1					
1,2,4-Trimethylbenzene	<1 µg/l	TM030	<1					
sec-Butylbenzene	<1 µg/l	TM030	<1					
4-iso-Propyltoluene	<1 µg/l	TM030	<1					
1,3-Dichlorobenzene	<1 µg/l	TM030	<1					
1,4-Dichlorobenzene	<1 µg/l	TM030	<1					
n-Butylbenzene	<1 µg/l	TM030	<1					
1,2-Dichlorobenzene	<1 µg/l	TM030	<1					
1,2-Dibromo-3-chloropropane	<1 µg/l	TM030	<1					
1,2,4-Trichlorobenzene	<1 µg/l	TM030	<1					
Hexachlorobutadiene	<1 µg/l	TM030	<1					
tert-Butylmethyl ether (TBME)	<1 µg/l	TM030	<1					
Naphthalene	<1 µg/l	TM030	<1					

14:57:45 12/12/2016

Validated

CERTIFICATE OF ANALYSIS

SDG:	161202-55	Client Reference:		Report Number:	561051
Location:	Dungarvan	Order Number:		Superseded Report:	

VOC MS (W)

Compound	LOR/Units	Method	[illegible]					
1,2,3-Trichlorobenzene	<1 µg/l	TM30R	<1					
1,2,4-Trichlorobenzene	<1 µg/l	TM30R	<1					

Test Completion Dates

Lab Sample No(s)	14634834	14634835	14634837	14634838	14634839	14634842	14634843
Customer Sample Ref.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
AGS Ref.							
Depth							
Type	LOAD	LOAD	LOAD	LOAD	LOAD	LOAD	LOAD
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]							[illegible]
COD Unfiltered	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Manganese Dissolved	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Mercury Dissolved (W)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]							[illegible]
[illegible]							[illegible]
[illegible]							[illegible]

Monthly Wetland Analysis

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	oC		9.7	9.9	8.5	8.2	7.8	8.2
pH	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 metals are in the Certificate of Analysis, enclosed							
				Muddy	from pipe clear	from pipe clear	over pipe clear	clear

Monthly Wetland Analysis

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
pH	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 are in the Certificate of Analysis, enclosed
***	Individual Compounds are in the Certificate of Analysis, enclosed
$$$	Individual Metals are in the Certificate of Analysis, enclosed

Validated

CERTIFICATE OF ANALYSIS

SDG:	161217-28	Client Reference:	32-02-M12	Report Number:	392541
Location:	DUNGARVAN	Order Number:		Superseded Report:	

Component	LOD/Units	Method	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Organic Carbon, Total	<3 mg/l	TM090			9.70 +#			
Ammoniacal Nitrogen as N	<0.2 mg/l	TM099	4.28 #	1.65 #		1.27 #	1.33 #	1.96 #
COD, unfiltered	<7 mg/l	TM107	18.7 #	1290 #	10.6 #	24 #	28.1 #	78.7 #
Aluminium (diss.filt)	<2 µg/l	TM152	3.54 #	23.3 #		2.87 #	3.59 #	3.07 #
Arsenic (diss.filt)	<0.51 µg/l	TM152	0.78 #	3.73 #		1.08 #	1.19 #	1.48 #
Boron (diss.filt)	<5 µg/l	TM152	54.8 #	48.3 #		51.4 #	55.1 #	51 #
Cadmium (diss.filt)	<0.08 µg/l	TM152	<0.08 #	<0.08 #		<0.08 #	<0.08 #	<0.08 #
Copper (diss.filt)	<0.85 µg/l	TM152	<0.85 #	0.905 #		<0.85 #	<0.85 #	<0.85 #
Lead (diss.filt)	<0.1 µg/l	TM152	0.342 #	3.9 #		<0.1 #	<0.1 #	0.108 #
Manganese (diss.filt)	<0.73 µg/l	TM152	269 #	804 #		263 #	268 #	217 #
Nickel (diss.filt)	<0.46 µg/l	TM152	2.27 #	4.55 #		1.45 #	1.37 #	1.2 #
Zinc (diss.filt)	<1.3 µg/l	TM152	4.22 #	1.51 #		<1.3 #	<1.3 #	<1.3 #
Silver (diss.filt)	<1 µg/l	TM152	<1	<1		<1	<1	<1
Mercury (diss.filt)	<0.01 µg/l	TM152	<0.01	<0.01		<0.01	<0.01	<0.01
Chloride	<2 mg/l	TM184			32.5 #			
Total Oxidised Nitrogen as N	<0.1 mg/l	TM184			0.373 #			
Chromium (total unfilt)	<3 µg/l	TM181	<3 #	21.4 #		<3 #	<3 #	<3 #
Calcium (diss.filt)	<0.012 mg/l	TM228	61.1 #	58.3 #		69.7 #	68.9 #	58.3 #
Sodium (diss.filt)	<0.076 mg/l	TM228	30.6 #	20.1 #		22.6 #	21.5 #	30.3 #
Magnesium (diss.filt)	<0.036 mg/l	TM228	12.3 #	6.65 #		11.6 #	11.1 #	10.7 #
Potassium (diss.filt)	<1 mg/l	TM228	10 #	15.3 #		13.3 #	17 #	13.9 #
Iron (diss.filt)	<0.019 mg/l	TM228	0.229 #	0.613 #		0.310 #	0.292 #	0.181 #
Phenol	<0.002 mg/l	TM259			<0.002 #			
Cresols	<0.006 mg/l	TM259			<0.006 #			
Xylenols	<0.008 mg/l	TM259			<0.008 #			
2,3,5-Trimethylphenol	<0.002 mg/l	TM259			<0.002 #			
2-isopropylphenol	<0.006 mg/l	TM259			<0.006 #			
Phenols, Total Detected & speciated	<0.035 mg/l	TM259			<0.035			

07:56:47 04/01/2017

Validated

CERTIFICATE OF ANALYSIS

SDG:	151217-28	Client Reference:	32-02-M12	Report Number:	392541
Location:	DUNGARVAN	Order Number:		Superseded Report:	

[illegible]	Customer Sample Ref. / Sample Type / Date Sampled / Sample Time / Date Received / SDG Ref / Lab Sample No.(s)	[illegible]	[illegible]	[illegible]			
Component	**LOD/Units**	**Method**						

Component	LOD/Units	Method						
Suspended solids, Total	<3 mg/l	TM022			<3 #			
Ammoniacal Nitrogen as N	<0.2 mg/l	TM099	1.45 #					
COD unfiltered	<7 mg/l	TM107	33.8 #					
Aluminium (diss.filt)	<2 µg/l	TM152	<2 #					
Arsenic (diss.filt)	<0.12 µg/l	TM152	1.16 #					
Boron (diss.filt)	<5 µg/l	TM152	60 #					
Cadmium (diss.filt)	<0.03 µg/l	TM152	<0.03 #					
Copper (diss.filt)	<0.85 µg/l	TM152	<0.85 #					
Lead (diss.filt)	<0.1 µg/l	TM152	<0.1 #					
Manganese (diss.filt)	<0.75 µg/l	TM152	133 #					
Nickel (diss.filt)	<0.48 µg/l	TM152	1.10 #					
Zinc (diss.filt)	<1.3 µg/l	TM152	<1.3 #					
Silver (diss.filt)	<1 µg/l	TM152	<1					
Mineral oil >C10 C40 (aq)	<10 µg/l	TM172			<10			
Mercury (diss.filt)	<0.01 µg/l	TM183	<0.01					
Sulphate	<2 mg/l	TM184		<2 #				
Chloride	<2 mg/l	TM184		55.3 #				
Phosphate (ortho as P)	<0.02 mg/l	TM184		<0.02 #				
Chromium (hex as Cr)	<3 µg/l	TM181	<3 #					
Calcium (diss.filt)	<0.012 mg/l	TM228	67.2 #					
Sodium (diss.filt)	<0.076 mg/l	TM228	34.1 #					
Magnesium (diss.filt)	<0.036 mg/l	TM228	12.1 #					
Potassium (diss.filt)	<1 mg/l	TM228	16.1 #					
Iron (diss.filt)	<0.019 mg/l	TM228	0.244 #					
Phenol	<0.002 mg/l	TM259		<0.002 #				
Cresols	<0.006 mg/l	TM259		<0.006 #				
Xylenols	<0.008 mg/l	TM259		<0.008 #				
2,3,5 Trimethylphenol	<0.005 mg/l	TM259		<0.005 #				
2-Isopropylphenol	<0.004 mg/l	TM259		<0.004 #				
Phenols, Total Detected 5 speciated	<0.035 mg/l	TM259		<0.035				

07:56:47 04/01/2017

CERTIFICATE OF ANALYSIS		Validated
SDG: 161217-28	Client Reference: 32-02-M12	Report Number: 392541
Location: DUNGARVAN	Order Number:	Superseded Report:

VOC MS (W)

Results Legend	
#	ISO17025 accredited.
M	mCERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery.
(F)	Trigger breach confirmed.
1-5&+§@	Sample deviation (see appendix)

Customer Sample Ref.	[illegible]	[illegible]				
Depth (m)		-				
Sample Type	Water(GW/PW)	Water(GW/PW)				
Date Sampled	[illegible]	[illegible]				
Sample Time						
Date Received	[illegible]	[illegible]				
SDG Ref	[illegible]	[illegible]				
Lab Sample No.(s)	[illegible]	[illegible]				
AGS Reference						

Component	LOD/Units	Method						
Dibromofluoromethane**	%	TM208	121	118				
Toluene-d8**	%	TM208	108	107				
4-Bromofluorobenzene**	%	TM208	109	106				
Dichlorodifluoromethane	<1 µg/l	TM208	<1	<1				
Chloromethane	<1 µg/l	TM208	<1 #	<1 #				
Vinyl chloride	<1 µg/l	TM208	<1 #	<1 #				
Bromomethane	<1 µg/l	TM208	<1 #	<1 #				
Chloroethane	<1 µg/l	TM208	<1 #	<1 #				
Trichlorofluoromethane	<1 µg/l	TM208	<1 #	<1 #				
1,1-Dichloroethene	<1 µg/l	TM208	<1 #	<1 #				
Carbon disulphide	<1 µg/l	TM208	<1 #	<1 #				
Dichloromethane	<3 µg/l	TM208	<3 #	<3 #				
Methyl tertiary butyl ether (MTBE)	<1 µg/l	TM208	<1 #	<1 #				
trans-1,2-Dichloroethene	<1 µg/l	TM208	<1 #	<1 #				
1,1-Dichloroethane	<1 µg/l	TM208	<1 #	<1 #				
cis-1,2-Dichloroethene	<1 µg/l	TM208	<1 #	<1 #				
2,2-Dichloropropane	<1 µg/l	TM208	<1	<1				
Bromochloromethane	<1 µg/l	TM208	<1 #	<1 #				
Chloroform	<1 µg/l	TM208	<1 #	<1 #				
1,1,1-Trichloroethane	<1 µg/l	TM208	<1 #	<1 #				
1,1-Dichloropropene	<1 µg/l	TM208	<1 #	<1 #				
Carbontetrachloride	<1 µg/l	TM208	<1 #	<1 #				
1,2-Dichloroethane	<1 µg/l	TM208	<1 #	<1 #				
Benzene	<1 µg/l	TM208	<1 #	<1 #				
Trichloroethene	<1 µg/l	TM208	<1 #	<1 #				
1,2-Dichloropropane	<1 µg/l	TM208	<1 #	<1 #				
Dibromomethane	<1 µg/l	TM208	<1 #	<1 #				
Bromodichloromethane	<1 µg/l	TM208	<1 #	<1 #				
cis-1,3-Dichloropropene	<1 µg/l	TM208	<1 #	<1 #				
Toluene	<1 µg/l	TM208	<1 #	<1 #				
trans-1,3-Dichloropropene	<1 µg/l	TM208	<1 #	<1 #				
1,1,2-Trichloroethane	<1 µg/l	TM208	<1 #	<1 #				

Validated

CERTIFICATE OF ANALYSIS

SDG:	151217-28	Client Reference:	32-02-M12	Report Number:	392541
Location:	DUNGARVAN	Order Number:		Superseded Report:	

VOC MS (W)

Component	LOD/Units	Method	[illegible]	[illegible]
1,3-Dichloropropane	<1 µg/l	TM208	<1 #	<1 #
Tetrachloroethene	<1 µg/l	TM208	<1 #	<1 #
Dibromochloromethane	<1 µg/l	TM208	<1 #	<1 #
1,2-Dibromoethane	<1 µg/l	TM208	<1 #	<1 #
Chlorobenzene	<1 µg/l	TM208	<1 #	<1 #
1,1,1,2-Tetrachloroethane	<1 µg/l	TM208	<1 #	<1 #
Ethylbenzene	<1 µg/l	TM208	<1 #	<1 #
m/p-Xylene	<1 µg/l	TM208	<1 #	<1 #
o-Xylene	<1 µg/l	TM208	<1 #	<1 #
Styrene	<1 µg/l	TM208	<1 #	<1 #
Bromoform	<1 µg/l	TM208	<1 #	<1 #
Isopropylbenzene	<1 µg/l	TM208	<1 #	<1 #
1,1,2,2-Tetrachloroethane	<1 µg/l	TM208	<1	<1
1,2,3-Trichloropropane	<1 µg/l	TM208	<1 #	<1 #
Bromobenzene	<1 µg/l	TM208	<1 #	<1 #
Propylbenzene	<1 µg/l	TM208	<1 #	<1 #
2-Chlorotoluene	<1 µg/l	TM208	<1 #	<1 #
1,3,5-Trimethylbenzene	<1 µg/l	TM208	<1 #	<1 #
4-Chlorotoluene	<1 µg/l	TM208	<1 #	<1 #
tert-Butylbenzene	<1 µg/l	TM208	<1 #	<1 #
1,2,4-Trimethylbenzene	<1 µg/l	TM208	<1 #	<1 #
sec-Butylbenzene	<1 µg/l	TM208	<1 #	<1 #
4-iso-Propyltoluene	<1 µg/l	TM208	<1 #	<1 #
1,3-Dichlorobenzene	<1 µg/l	TM208	<1 #	<1 #
1,4-Dichlorobenzene	<1 µg/l	TM208	<1 #	<1 #
n-Butylbenzene	<1 µg/l	TM208	<1 #	<1 #
1,2-Dichlorobenzene	<1 µg/l	TM208	<1	<1
1,2-Dibromo-3-chloropropane	<1 µg/l	TM208	<1	<1
1,2,4-Trichlorobenzene	<1 µg/l	TM208	<1 #	<1 #
Hexachlorobutadiene	<1 µg/l	TM208	<1 #	<1 #
tert-Amyl methyl ether (TAME)	<1 µg/l	TM208	<1 #	<1 #
Naphthalene	<1 µg/l	TM208	<1 #	<1 #

07:56:47 04/01/2017

Validated

CERTIFICATE OF ANALYSIS

SDG:	161217-28	Client Reference:	SS/03/412	Report Number:	992541
Location:	DENGARWA	Order Number:		Superseded Report:	

VOC MS (W)

Compound	LOR/Unit	Method						
1,2,3-Trichlorobenzene	<1 µg/l	TM30	<1	<1				
1,2,4-Trichlorobenzene	<1 µg/l	TM30	<1	<1				

Test Completion Dates

Lab Sample No(s)	1425150	1425151	1425154	1425155	1425156	1425157	1425158	1425159	1425160
Customer Sample Ref.									
AGS Ref.									
Depth									
Type	LIQUID	LIQUID	SOLID	LIQUID	LIQUID	SOLID	LIQUID	LIQUID	SOLID
COD Unfiltered									
Mercury Dissolved									
Metals by ICP-OES Dissolved (W)									
Total Organic and Inorganic Carbon									

Appendix E

Groundwater Results

Dungarvan Landfill W0032-02 Qrt 1 2016

Ground Water

LABORATORY NUMBER		**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**
Sampling Location		**GW 1**	**GW 2A**	**RC 3A**	**RC 4**	**RC 6A**	**RC 7**	**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**							
Visual Inspection/Odour Taste		muddy brown	dry	clear	clear	sl muddy	muddy /saline	no tubing
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
pH	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

Ground Water

LABORATORY NUMBER		**2248**	**2249**	**2250**	**2251**	**2252**	**2253**	**2254**
Sampling Location		**GW 1**	**GW 2A**	**RC 3A**	**RC 4**	**RC 6A**	**RC 7**	**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
Time sampled		13:15	15:30	12:55	13:45	15:20	16:40	14:25
Parameters	**Units**							
Visual Inspection/Odour Taste		muddy brown	dry	cloudy	clear	light brown	muddy /saline	no tubing
Groundwater Level	m	2.1	1.7	10.5	15.7	7.8	5.6	11.9
Temp	oC	12.5		13.2	11.9	12.2	12.6	nm
pH	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 attached Certificate of Analysis for Individual compounds

**** See attached Certificate of Analysis for Individual metals

Dungarvan Landfill W0032-02 Qrt 3 2016

Ground Water

LABORATORY NUMBER		**2386**	**2387**	**2388**	**2389**	**2390**	**2391**	**2392**
Sampling Location		**GW 1**	**GW 2A**	**RC 3A**	**RC 4**	**RC 6A**	**RC 7**	**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**							
Visual Inspection/Odour		brownish	dry	brownish	clear	cloudy	brown	no tubing
Groundwater Level	m	3	2	11	14	7.8	10.7	nm
Temp	oC	12.6		12.9	11.6	11.8	12.9	nm
pH	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

Ground Water

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	JMcG	JMcG	JMcG	JMcG	JMcG	JMcG
Time sampled		12:15	12:40	12:45	13:35	14:30	17:00	14:15
Parameters	**Units**							
Visual Inspection/Odour		muddy	dry	clear	clear	grey	cloudy light brown	no 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
pH	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

Dungarvan Landfill W0032-02 Annual 2016
Leachates

LABORATORY NUMBER		**2255**	**2256**
		Lagoon	
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 Certificate of Analysis for Individual compounds		
****	See attached Certificate of Analysis for Individual metals		

Dungarvan Landfill 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

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

Station Name: JohnstownII
Station Height: 62 M
Latitude:52.292

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	pe	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

Station Name: JohnstownII
Station Height: 62 M
Latitude:52.292

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	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							
03-Feb-16	8.8	1.3					18		27							
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

Station Name: JohnstownII
Station Height: 62 M
Latitude:52.292

date: - 00 to 00 utc
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maxtp: - Maximum Air Temperature (C)
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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	pe	evap	smd_wd	smd_md	smd_pd	glorad
01-Mar-16	12.4	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	19	29	250	44	5.256	1.4	2.3	0	-6.8	-10	999
03-Mar-16	8.6	0.8	3.4	3.5	996	10.3	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	1.8	1.4	0	1000	10.6	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	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	0	1014	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	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	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	12	50	18	7.301	1.5	2.1	6.4	6.4	-1.2	1232
16-Mar-16	9.4	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	0	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	0	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	0	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	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	0	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	4	0.1	1008.6	5.5	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	0	1000.8	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	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	0	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	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	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

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smd_wd:- Soil Moisture Deficits(mm) well drained
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smd_pd:- Soil Moisture Deficits(mm) poorly drained
glorad:- Global Radiation (J/cm sq.)
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date	maxtp	mintp	gmin	rain	cbl	wdsp	hm	ddhm	hg	soil	pe	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

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smd_wd:- Soil Moisture Deficits(mm) well drained
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glorad:- Global Radiation (J/cm sq.)
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date	maxtp	mintp	gmin	rain	cbl	wdsp	hm	ddhm	hg	soil	pe	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

Station Name: JohnstownII
Station Height: 62 M
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date: - 00 to 00 utc
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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	pe	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

Station Name: JohnstownII
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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
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glorad:- Global Radiation (J/cm sq.)
ind: - Indicator (i)

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

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smd_wd:- Soil Moisture Deficits(mm) well drained
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date	maxtp	mintp	gmin	rain	cbl	wdsp	hm	ddhm	hg	soil	pe	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

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evap: - Evaporation (mm)
smd_wd:- Soil Moisture Deficits(mm) well drained
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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	pe	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	-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

Station Name: JohnstownII
Station Height: 62 M
Latitude:52.292

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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	pe	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

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date	maxtp	mintp	gmin	rain	cbl	wdsp	hm	ddhm	hg	soil	pe	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

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date	maxtp	mintp	gmin	rain	cbl	wdsp	hm	ddhm	hg	soil	pe	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

Appendix H

Flare Servicing Records and Landfill Gas Survey

SERVICE SHEET

Page No 2

JOB NO

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
www.afs-group.co.uk

SITE: Dungarvan Landfill site, Co Waterford

DATE: 12-10-2016

HEALTH AND SAFETY NOTICE

WEAR A HEAD 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 INSULAING DUST

TO BE COMPLETED FOR ALL HIRE INSTALLATION, SERVICE AND REPAIR VISITS

1. RECORD ALL INSTRUMENT READINGS AND VALVE SETTINGS ON ARRIVAL
2. RECORD ALL CHANGES AND REPAIRS MADE
3. RECORD ALL PARTS, MATERIALS & COMPONENTS FITTED OR USED
4. CHECK THAT PRESSURE AND VACUUM GAUGES ARE ZEROED
5. RECORD ALL INSTRUMENT READINGS AND VALVE SETTINGS ON DEPARTURE
6. LEAVE SITE CLEAN AND TIDY
7. NOTE FUTURE REMEDIAL ACTION NEEDED AND SEE THAT IT IS CARRIED OUT

FLARE AUTO TIMER SETTINGS

DAY	START	STOP
SUNDAY	11:00	17:00
MONDAY	11:00	17:00
TUESDAY	11:00	17:00
WEDNESDAY	11:00	17:00
THURSDAY	11:00	17:00
FRIDAY	11:00	17:00
SATURDAY	11:00	17:00

ENGINEERS NAME: Steve Hindle — Flare type HT100

ARRIVAL: **FLARE RUNNING on Auto Timer**

HOURS RUN	BOOSTER 1	20518	CH4	51.7 %	CO2	26.7	%
	BOOSTER 2	N/A	O2	0.8 %	PRESSURE	15.4	mbar

INLET VALVE SETTING % 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 VALVE SETTING % OPEN: 100%

INLET VACUUM GAUGE READINGS STARING SIDE NEAREST KNOCKOUT POT (mbarg)

NO 1	-2.0	NO 2	N/A	NO 3	N/A	NO4	N/A	NO 5	N/A	NO 6	N/A

INLET TEMP	20 °C	INLET VACUUM PRIOR TO KO POT FILTER	-2.0 MBAR
VACUUM AFTER KO POT FILTER	-3.0 MBAR	VACUUM AFTER INLET FLAME ARRESTER	N/A MBAR
OUTLET PRESSURE AFTER GAS BOOSTER	15.4 MBAR	OUTLET GAS TEMP	22 °C
PRESSURE AFTER SLAM SHUT	13 MBAR	PRESSURE AFTER OUTLET FLAME ARRESTER	N/A
TOTAL FLOW	1564231 m^3	BLOWER SPEED	38 %
DAMPER POSTION	21.0 %		
FLOW RATE	81.6 m^3/hr	MEASURING INSTRUMENT	OPFM
FLAME TEMP	1016 °C	MOTOR TEMP (drive bearing)	21 °C
FLAME QUALITY	OK	AMBIENT TEMP	14.0 °C
MANOMETER LIQUID LEVEL WITH RIG SHUT DOWN		AMBIENT PRESSURE	1021 MBAR

TYPE OF LIQUID: PERFLOW

RED SG - 0.8		EMISSIONS ANALYSER CO CELL	18	EMISSIONS ANALYSER NOX CELL	N/A

	Job No Dungarvan	**Automatic Flare Systems Ltd** Unit 8, Ensign Business Centre Coventry CV4 8JA United Kingdom

SERVICE SHEET Page No 2			Tel: +44 (0)24 7647 4877 Fax: +44 (0)24 7647 4834

CHECK FOR LEAKS WITH GAS DETECTOR		None	
CONDENSATE DRAIN SYSTEM CHECK		Yes	
DRAINS CORRECTLY	Yes	KNOCKOUT POT FILTER CLEAN	N/A
COMMENTS			
BOOSTER MODEL AND SERIAL NO	BG 30 / 34-3GX		
MOTOR & FAN SEAL GREASED	Yes	BOOSTER CORRECT ROTATION	Yes
NOTE: USE SHELL ALVANIA 3, GREASE EVERY SERVICE **IMPORTANT DO NOT OVERGREASE**			
BOOSTER OIL CHANGED (EVERY 5000 HOURS, USE 20W50 ENGINE OIL IN DONKIN V50			N/A

BOOSTER FLEXIBLE CONNECTORS	OK	MOUNTINGS	OK	BEARING NOISE	OK
BOLTS TIGHT	Yes	SLAMSHUT SPRING	OK	GAUGES ZEROED	Yes
FLAME ARRESTER INLET	OK	OUTLET	OK	PILOT	OK
PILOT LIGHT FUNCTION	Cleaned & set	UV SENSOR FUNCTION	Cleaned	CONDITION OF THERMOCOUPLER	OK
DAMPER OPERATION	OK	CONDITION OF BURNER CUPS	OK	CONDITION OF FLARE LINING	OK
LOUVERS CONDITION	OK	INTERIOR LIGHT	N/A	EXTERIOR LIGHT	N/A

ALL INDICATOR BULBS FUNCTION	Yes	ELECTRICAL CONNECTIONS CHECKED FOR TIGHTNESS	Yes
HINGES & VALVES LUBRICATED	Yes		

PRESSURE SWITCH FUNCTION

SUCTION	N/A	SETTING	N/A	VENT	N/A	SETTING	N/A
BOOSTER	Yes	SETTING	1.0 mbar	OTHER (specify)	N/A	SETTING	N/A
BURNER	N/A	SETTING	N/A			SETTING	

COMMENTS

SERVICE SHEET Page No 3	Job No 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

CHECK SIGNAL, CONTROL AND TELEMETRY FUNCTION	OK
SIGNAL, CONTROL & TELEMETRY REPORT FILLED OUT AS APPROPRIATE	N/A
REPORT ALL & ANY CHANGES MADE TO TELEMETRY SYSTEM	None
REPORT ALL & ANY CHANGES MADE TO CONTROL PROGRAMME	None
CH4 ANALYSER OPERATION	OK
O2 ANALYSER OPERATION	OK
C02 ANALYSER OPERATION	OK
CO EMISSION ANALYSER	OK
REPORT ALL & ANY REPAIRS	None
REPORT ALL & ANY PARTS REPLACED OR NEW PARTS FITTED INCLUDING PART NOS & SUFFICIENT DETAIL FOR THEM TO BE INVOICED	

	COMMENTS	NEW PARTS FITTED
	Clean moss from compound base.	none

GAS ANALYSER CALIBRATION REPORT:					
GAS USED: 1954 Compressed Gas.		Methane (CH4) 50 % concentration		Carbon Dioxide: Remaining Balance	
Before Calibration:	CH4	N/A %	CO2	N/A %	
After Calibration:	CH4	N/A %	CO2	N/A %	
Comments:	None				
GAS USED: 1954 Compressed Gas.		Oxygen (O_2) 20.9% Concentration		Nitrogen: Remaining Balance	
Before Calibration:	O_2	N/A %			
After Calibration:	O_2	N/A %			
Comments:	None				

SERVICE SHEET Page No 4	Job No 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

REPORT ANY FURTHER REPAIRS OR ACTION NEEDED:

The 10mm air line supplying to KOP 1 has blown a hole in it causing the compressor to run constantly, displacing all the oil and seizing. Requires new compressor and a new 10mm supply line.

DEPARTURE REPORT:

HOURS RUN: 20521				RUN RIG FOR 30 MINUTES BEFORE TAKING READINGS					
CH4	51.7	%	CO2	26.7	%	O2	0.6 %	CO	123.3

INLET VALVE SETTING % 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 VALVE SETTING % OPEN	100%

INLET VACUUM GAUGE READINGS STARTING SIDE NEAREST KNOCKOUT POT									(mbarg)	
NO 1	- 2.5	NO 2	N/A	NO 3	N/A	NO4	N/A	NO 5	N/A	NO 6	N/A

INLET TEMP	20	°C	INLET VACUUM PRIOR TO KO POT FILTER	-2.5	MBAR
VACUUM AFTER KO POT FILTER	-3.0	MBAR	VACUUM AFTER INLET FLAME ARRESTER	N/A	MBAR
OUTLET PRESSURE AFTER GAS BOOSTER	15.4	MBAR	OUTLET GAS TEMP	22	°C
PRESSURE AFTER SLAM SHUT	12.0	MBAR	PRESSURE AFTER OUTLET FLAME ARRESTER	N/A	
OTHER			BLOWER SPEED %	38	%
DAMPER POSITION	43.3	%	MANOMETER READING	75	m^3hr
FLOW RATE	78.4	m^3hr	FLAME QUALITY	OK	
FLAME TEMP	1024	°C	HAS RIG & COMPOUND BEEN LEFT CLEAN	Yes	

NAMES OF ALL AFS & SUB CONTRACTOR STAFF CARRYING OUT WORK			
Steve Hindle			
REPORT WRITER	Steve Hindle		
SIGNATURE			
DATE	12-10-2016		

a

REPAIR SHEET

Page No 5

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
www.automaticflaresystems.co.uk

SITE : Dungarvan Landfill site, Co Waterford	DATE 27/10/2016

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

TO BE COMPLETED FOR ALL HIRE INSTALLATION, SERVICE AND REPAIR VISITS
1. RECORD ALL INSTRUMENT READINGS AND VALVE SETTINGS ON ARRIVAL
2. RECORD ALL CHANGES AND REPAIRS MADE
3. RECORD ALL PARTS, MATERIALS & COMPONENTS FITTED OR USED
4. CHECK THAT PRESSURE AND VACUUM GAUGES ARE ZEROED
5. RECORD ALL INSTRUMENT READINGS AND VALVE SETTINGS ON DEPARTURE
6. LEAVE SITE CLEAN AND TIDY
7. NOTE FUTURE REMEDIAL ACTION NEEDED AND SEE THAT IT IS CARRIED OUT

ENGINEERS NAME	Steve Hindle	VEHICLE NO	BJ10 WPY
MILEAGE TO SITE		MILEAGE FROM SITE	

ARRIVAL RECORD Flare running

HOURS RUN	BOOSTER 1	20614	CH4	0	CO2	0
	BOOSTER 2		O2	0	PRESSURE	0

INLET VALVE SETTING (CLICKS FROM CLOSED) STARTING SIDE NEAREST KNOCKOUT POT

NO 1	0	NO 2		NO 3		NO 4		NO 5		NO 6	

MAIN CONTROL VALVE SETTING (CLICKS FROM CLOSED)	50%

INLET VACUUM GAUGE READINGS STARING SIDE NEAREST KNOCKOUT POT ( ) (mbarg)

NO 1	N/A	NO 2	N/A	NO 3		NO4		NO 5		NO 6	

INLET TEMP	N/A	INLET VACUUM PRIOR TO KO POT FILTER	N/A
VACUUM AFTER KO POT FILTER	N/A	VACUUM AFTER INLET FLAME ARRESTER	NA
OUTLET PRESSURE AFTER GAS BOOSTER	N/A	OUTLET GAS TEMP	^{O}C
PRESSURE AFTER SLAM SHUT	N/A	PRESSURE AFTER OUTLET FLAME ARRESTER	NA
TOTAL FLOW	1493476	DAMPER	%
FLOW RATE		MEASURING INSTRUMENT	
FLAME TEMP	^{O}C	MOTOR TEMP	OK
FLAME QUALITY		AMBIENT TEMP	N/A ^{O}C

MANOMETER LIQUID LEVEL WITH RIG SHUT DOWN	0

TYPE OF LIQUID: PERFLOW

RED SG - 0.8		EMISSIONS ANALYSER CO CELL	N/A	EMISSIONS ANALYSER NOX CELL	

CALL OUT SHEET Page No 2	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

REPORT ALL & ANY REPAIRS	
REPORT ALL & ANY PARTS REPLACED OR NEW PARTS FITTED INCLUDING PART NOS & SUFFICIENT DETAIL FOR THEM TO BE INVOICED	

	FAULTS FOUND OR SHUT DOWNS ACKNOWLEDGED	REPAIRS OR NEW PARTS FITTED
	Disconnected damaged compressor and removed from compound. Install new compressor. Replace 10mm Kop supply pipe. **Report** Condensate pump in KOP nearest flare is constantly pumping. Suspect fault with pump requires investigating. Compressor is switched off until pump is repaired. On site 8:45 to 9:45	1 x Compressor 50L-2HP (afs supplied) 20m x 10mm plastic pipe. (afs supplied)

CALL OUT SHEET

Page No 2

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
www.automaticflaresystems.co.uk

SITE: Dungarvan Landfill site, Co Waterford	DATE: 08-11-2016

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

TO BE COMPLETED FOR ALL HIRE INSTALLATION, SERVICE AND REPAIR VISITS
1. RECORD ALL INSTRUMENT READINGS AND VALVE SETTINGS ON ARRIVAL
2. RECORD ALL CHANGES AND REPAIRS MADE
3. RECORD ALL PARTS, MATERIALS & COMPONENTS FITTED OR USED
4. CHECK THAT PRESSURE AND VACUUM GAUGES ARE ZEROED
5. RECORD ALL INSTRUMENT READINGS AND VALVE SETTINGS ON DEPARTURE
6. LEAVE SITE CLEAN AND TIDY
7. NOTE FUTURE REMEDIAL ACTION NEEDED AND SEE THAT IT IS CARRIED OUT

ENGINEERS NAME	Steve Hindle	VEHICLE NO	BJ10 WPY
MILEAGE TO SITE		MILEAGE FROM SITE	

ARRIVAL RECORD

HOURS RUN	BOOSTER 1	20630	CH4		CO2	
	BOOSTER 2		O2		PRESSURE	

INLET VALVE SETTING (CLICKS FROM CLOSED) STARTING SIDE NEAREST KNOCKOUT POT

NO 1	F/O	NO 2		NO 3		NO 4		NO 5		NO 6	

MAIN CONTROL VALVE SETTING (CLICKS FROM CLOSED)	

INLET VACUUM GAUGE READINGS STARING SIDE NEAREST KNOCKOUT POT ( ) (mbarg)

NO 1	N/A	NO 2	N/A	NO 3		NO4		NO 5		NO 6	

INLET TEMP	N/A	INLET VACUUM PRIOR TO KO POT FILTER	N/A
VACUUM AFTER KO POT FILTER	N/A	VACUUM AFTER INLET FLAME ARRESTER	NA
OUTLET PRESSURE AFTER GAS BOOSTER	N/A	OUTLET GAS TEMP	N/A ^{O}C
PRESSURE AFTER SLAM SHUT	N/A	PRESSURE AFTER OUTLET FLAME ARRESTER	NA
TOTAL FLOW	15733230		
FLOW RATE	N/A	MEASURING INSTRUMENT	
FLAME TEMP	N/A	MOTOR TEMP	OK
FLAME QUALITY	OK	AMBIENT TEMP	N/A ^{O}C

MANOMETER LIQUID LEVEL WITH RIG SHUT DOWN	0

TYPE OF LIQUID: PERFLOW

RED SG - 0.8		EMISSIONS ANALYSER CO CELL	N/A	EMISSIONS ANALYSER NOX CELL	

CALL OUT SHEET Page No 2	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

REPORT ALL & ANY REPAIRS	
REPORT ALL & ANY PARTS REPLACED OR NEW PARTS FITTED INCLUDING PART NOS & SUFFICIENT DETAIL FOR THEM TO BE INVOICED	

	FAULTS FOUND OR SHUT DOWNS ACKNOWLEDGED	REPAIRS OR NEW PARTS FITTED
	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: 15:00 Time 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: 09:00 Time leaving site: 16:30	

	Return to site on 18-11-16 Use 63mm discharge as a ducted to take a new 32mm discharge pipe. Refit condensate pump Repair water damage to flare. 	

REPAIR SHEET

Page No 3

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
www.automaticflaresystems.co.uk

SITE : Dungarvan Landfill site, Co Waterford	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

TO BE COMPLETED FOR ALL HIRE INSTALLATION, SERVICE AND REPAIR VISITS
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6. LEAVE SITE CLEAN AND TIDY
7. NOTE FUTURE REMEDIAL ACTION NEEDED AND SEE THAT IT IS CARRIED OUT

ENGINEERS NAME	Steve Hindle, John Brown	VEHICLE NO	BJ10 WPY,
MILEAGE TO SITE		MILEAGE FROM SITE	

ARRIVAL RECORD Flare off

HOURS RUN	BOOSTER 1	20630	CH4	0	CO2	0
	BOOSTER 2		O2	0	PRESSURE	0

INLET VALVE SETTING (CLICKS FROM CLOSED) STARTING SIDE NEAREST KNOCKOUT POT

NO 1	0	NO 2		NO 3		NO 4		NO 5		NO 6	

MAIN CONTROL VALVE SETTING (CLICKS FROM CLOSED)	50%

INLET VACUUM GAUGE READINGS STARING SIDE NEAREST KNOCKOUT POT ( ) (mbarg)

NO 1	N/A	NO 2	N/A	NO 3		NO4		NO 5		NO 6	

INLET TEMP	N/A	INLET VACUUM PRIOR TO KO POT FILTER	N/A
VACUUM AFTER KO POT FILTER	N/A	VACUUM AFTER INLET FLAME ARRESTER	NA
OUTLET PRESSURE AFTER GAS BOOSTER	N/A	OUTLET GAS TEMP	^{O}C
PRESSURE AFTER SLAM SHUT	N/A	PRESSURE AFTER OUTLET FLAME ARRESTER	NA
TOTAL FLOW	15733230	DAMPER	%
FLOW RATE		MEASURING INSTRUMENT	
FLAME TEMP	^{O}C	MOTOR TEMP	OK
FLAME QUALITY		AMBIENT TEMP	N/A ^{O}C

MANOMETER LIQUID LEVEL WITH RIG SHUT DOWN	0

TYPE OF LIQUID: PERFLOW

RED SG - 0.8		EMISSIONS ANALYSER CO CELL	N/A	EMISSIONS ANALYSER NOX CELL	

CALL OUT SHEET Page No 2	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

REPORT ALL & ANY REPAIRS	
REPORT ALL & ANY PARTS REPLACED OR NEW PARTS FITTED INCLUDING PART NOS & SUFFICIENT DETAIL FOR THEM TO BE INVOICED	

	FAULTS FOUND OR SHUT DOWNS ACKNOWLEDGED	REPAIRS OR NEW PARTS FITTED
	Condensates pump & Discharge system modifications. The old 63mm discharge pipe was used as a ducted for the new 32mm pipe to reduce the head pressure on the pump. The 32mm pipe was pushed into the 63mm discharge pipe, after approx. 110m the weight and resistance was to great to push the pipe any further. The 32mm pipe had not reached the outlet end of the 63mm discharge pipe. The Distance was measured and the 32mm pipe was approx. 10m short from the end, but was at the close to the top of the landfill. A 63mm – 32mm compression coupler was used to seal the old 63mm discharge pipe with the new 32mm discharge pipe. A new 63mm – 32mm EF reducer coupler was used to seal the old 63mm entre to the KOP chamber lid with the new 32mm discharge pipe. The condensate pump was reinstated into the KOP and a new 32mm compression elbow. **Flare water damage repairs.** Drained water from Flares Condensate KOP. Drained water from Blower housing. Drained water from main gas line including down steam of orifice plate, Drained water from Poddy-meter display and pipes Drained water from feed and return gas sample	

	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	

	to be filled in by licensee		calculated by spreadsheet	

Flare No. 1

Flare type ?	AFS HT150	**If "other" enter flare description here**	
Is the flare an open or enclosed flare ?	Enclosed	**Rated flare capacity ?** 150	**m3/hr**
Month /year comissioned ?	July 2010		
Month decomissioned if decomissioned in 2016 ?	Select		
What is the function of the flare ?	Extraction from uncapped area	**If "other" enter flare function here**	

Monthly	Method M/C/E	Runtime days/month	Runtime hrs/day	Downtime hrs	Total runtime hrs/month	Average Inlet Pressure (mbg)	Average Inlet Temp ◦ C	Average Flow Rate (m^3/hr)	Average CH_4 %v/v	Average CO_2 %v/v	Average O_2 %v/v	Combustion efficiency (%)	Total CH_4 m^3	Total CH_4 kgs
January	C	30	10.0	24.0	276	-21	10	90	35.50	22.00	3.50	98.0	8,642	5,843
February	C	27	10.0	24.0	246	-21	10	90	35.50	22.00	3.50	98.0	7,703	5,208
March	C	30	10.0	24.0	276	-21	10	90	35.50	22.00	3.50	98.0	8,642	5,843
April	C	29	10.0	24.0	266	-21	10	90	35.50	22.00	3.50	98.0	8,329	5,631
May	C	30	10.0	24.0	276	-21	10	90	35.50	22.00	3.50	98.0	8,642	5,843
June	C	29	10.0	24.0	266	-21	10	90	35.50	22.00	3.50	98.0	8,329	5,631
July	C	30	10.0	24.0	276	-21	10	90	35.50	22.00	3.50	98.0	8,642	5,843
August	C	30	10.0	24.0	276	-21	10	90	35.50	22.00	3.50	98.0	8,642	5,843
September	C	29	10.0	24.0	266	-21	10	90	35.50	22.00	3.50	98.0	8,329	5,631
October	C	30	10.0	24.0	276	-21	10	90	35.50	22.00	3.50	98.0	8,642	5,843
November	C	29	10.0	24.0	266	-21	10	90	35.50	22.00	3.50	98.0	8,329	5,631
December	C	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

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

Yearly	Method M/C/E	Runtime days/year	Runtime hrs/day	Downtime hrs	Total runtime hrs/year	Average Inlet Pressure (mbg)	Average Inlet Temp ◦ C	Average Flow Rate m^3/hr	Average CH_4 %v/v	Average CO_2 %v/v	Average O_2 %v/v	Combustion efficiency (%)	Total CH_4 m^3	Total CH_4 kgs
2016					0		10					98.0	0	0

Appendix H

Management Structure

Management Structure of Waterford City and County Council

CEO Mr Michael Walsh

Director of Services

Environment, Roads & Water Services Mr. Fergus Galvin

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

Appendix K

Pollutant Release Transfer Register

Guidance to completing the PRTR workbook

PRTR Returns Workbook

Version 1.1.19

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	www.waterfordcouncil.ie

2. PRTR CLASS ACTIVITIES

Activity Number	Activity Name
50.1	General
50.1	General

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
01	Methane (CH4)	E	OTH	Estimated from Flare data and Landgem Model	93571.0	93571.0	0.0	0.0
03	Carbon dioxide (CO2)	E	OTH	Estimated from Flare data and Landgem Model	1440000.0	1440000.0	0.0	0.0
07	**Non-methane volatile organic compounds (NMVOC)**	E	OTH	Estimated from Flare data and Landgem Model	17000.0	17000.0	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

EMISSIONS (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					
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 (CH4) emission to the environment under T(total) KG/yr for Section A: Sector specific PRTR pollutants above. Please complete the table below:

Landfill: Dungarvan Waste Disposal Site

Please enter summary data on the quantities of methane flared and / or utilised	T (Total) kg/Year	M/C/E	Method Used: Method Code	Method Used: Designation or Description	Facility Total Capacity m3 per hour	
Total estimated methane generation (as per site model)	420750.0	E	OTH	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 previous years emissions data

SECTION A : SECTOR SPECIFIC PRTR POLLUTANTS

Data on ambient monitoring of storm/surface water or groundwater, conducted as part of your licence requirements, should NOT be submitted under AER / PRTR

RELEASES TO WATERS					Please enter all quantities in this section in KGs			
POLLUTANT					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					
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	0.0	0.0
71	Phenols (as total C)	E	ESTIMATE		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

EMISSIONS (as required in your Licence)

RELEASES TO WATERS					Please enter all quantities in this section in KGs			
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

Transfer Destination	European Waste Code	Hazardous	Quantity (Tonnes per Year)	Description of Waste	Waste Treatment Operation	Method Used M/C/E	Method Used	Location of Treatment	Haz Waste : Name and Licence/Permit No of Next Destination Facility Non Haz Waste: Name and Licence/Permit No of Recover/Disposer	Haz Waste : Address of Next Destination Facility Non Haz Waste: Address of Recover/Disposer	Name and License / Permit No. and Address of Final Recoverer / Disposer (HAZARDOUS WASTE ONLY)	Actual Address of Final Destination i.e. Final Recovery / Disposal Site (HAZARDOUS WASTE ONLY)
Within the Country	02 03 99	No	297.52	wastes not otherwise specified (Organic and Garden Waste)	R3	M	Weighed	Offsite in Ireland	O Toole Composting Ltd,W0284-01	Ballintrane,Fenagh,Co. Carlow,,,Ireland		
Within the Country	08 01 21	Yes	6.12	waste paint or varnish remover	D5	M	Weighed	Offsite in Ireland	ENVA Ireland,WCP/KK/059(A)06	Clonmanim Industrial Estate,Portlaoise,Co. Laois,,,Ireland	ENVA Ireland,WCP/KK/059(A)06,Clonmanim Industrial Estate,Portlaoise,Co. Laois,,,Ireland	Clonmanim Industrial Estate,Portlaoise,Co. Laois,,,Ireland
Within the Country	15 01 01	No	154.4	paper and cardboard packaging	R3	M	Weighed	Offsite in Ireland	Waterford Co. Council,W0189-01	Shandon,Dungarvan,Co. Waterford,,,Ireland		
Within the Country	15 01 07	No	22.36	glass packaging	R5	M	Weighed	Offsite in Ireland	Rehab Recycling Ltd,Reg no. 635 Permit No. 03/07	Monaghan Road,Cork,,,,,Ireland		
To Other Countries	16 02 11	Yes	30.292	discarded equipment containing chlorofluorocarbons, HCFC, HFC - FRIDGES	R4	M	Weighed	Abroad	KMK Metals Recycling,WCP/KK/069(A)/06	Cappincur Industrial Estate,Daingean Road,Tullamore,Co. Offaly,Ireland	Varies,Varies,Varies,Contact Laurence Kieran WEEE Ireland,EPA Auditor Dermot Burke,,,Ireland	Varies,Contact Laurence Kieran WEEE Ireland,EPA Auditor Dermot Burke,,,Ireland
To Other Countries	16 02 11	Yes	0.973	discarded equipment containing chlorofluorocarbons, HCFC, HFC - Flourescent Tubes	R4	M	Weighed	Abroad	KMK Metals Recycling,WCP/KK/069(A)/06	Cappincur Industrial Estate,Daingean Road,Tullamore,Co. Offaly,Ireland	Varies,Varies,Varies,Contact Laurence Kieran WEEE Ireland,EPA Auditor Dermot Burke,,,Ireland	Varies,Contact Laurence Kieran WEEE Ireland,EPA Auditor Dermot Burke,,,Ireland
To Other Countries	16 02 13	Yes	68.318	discarded equipment containing hazardous components (16) other than those mentioned in 16 02 09 to 16 02 12 - Large Household Items	R4	M	Weighed	Abroad	KMK Metals Recycling,WCP/KK/069(A)/06	Cappincur Industrial Estate,Daingean Road,Tullamore,Co. Offaly,Ireland	Varies,Varies,Varies,Contact Laurence Kieran WEEE Ireland,EPA Auditor Dermot Burke,,,Ireland	Varies,Contact Laurence Kieran WEEE Ireland,EPA Auditor Dermot Burke,,,Ireland
To Other Countries	16 02 13	Yes	35.131	discarded equipment containing hazardous components (16) other than those mentioned in 16 02 09 to 16 02 12 - TV Monitors	R4	M	Weighed	Abroad	KMK Metals Recycling,WCP/KK/069(A)/06	Cappincur Industrial Estate,Daingean Road,Tullamore,Co. Offaly,Ireland	Varies,Varies,Varies,Contact Laurence Kieran WEEE Ireland,EPA Auditor Dermot Burke,,,Ireland	Varies,Contact Laurence Kieran WEEE Ireland,EPA Auditor Dermot Burke,,,Ireland
To Other Countries	16 02 13	Yes	48.328	discarded equipment containing hazardous components (16) other than those mentioned in 16 02 09 to 16 02 12 - Small Household Items	R4	M	Weighed	Abroad	KMK Metals Recycling,WCP/KK/069(A)/06	Cappincur Industrial Estate,Daingean Road,Tullamore,Co. Offaly,Ireland	Varies,Varies,Varies,Contact Laurence Kieran WEEE Ireland,EPA Auditor Dermot Burke,,,Ireland	Varies,Contact Laurence Kieran WEEE Ireland,EPA Auditor Dermot Burke,,,Ireland
Within the Country	16 06 01	Yes	0.5	lead batteries	D5	M	Weighed	Offsite in Ireland	ENVA Ireland,WCP/KK/059(A)06	Clonmanim Industrial Estate,Portlaoise,Co. Laois,,,Ireland	ENVA Ireland,WCP/KK/059(A)06,Clonmanim Industrial Estate,Portlaoise,Co. Laois,,,Ireland	Clonmanim Industrial Estate,Portlaoise,Co. Laois,,,Ireland
Within the Country	17 05 04	No	52.86	soil and stones other than those mentioned in 17 05 03 - Rubble	R3	M	Weighed	Offsite in Ireland	Greenstar Ltd,WCP-KK-11-54-02	Unit 6 Ballylogan Industrial Park,Ballylogan Road,Dublin 13,,,Ireland		
Within the Country	17 05 04	No	21.66	soil and stones other than those mentioned in 17 05 03 - Clay	R3	M	Weighed	Offsite in Ireland	Greenstar Ltd,WCP-KK-11-54-02	Unit 6 Ballylogan Industrial Park,Ballylogan Road,Dublin 13,,,Ireland		
Within the Country	20 01 02	No	21.82	glass	R5	M	Weighed	Offsite in Ireland	Greenstar Ltd,WCP-KK-11-54-02	Unit 6 Ballylogan Industrial Park,Ballylogan Road,Dublin 13,,,Ireland		
Within the Country	20 01 10	No	4.26	clothes	R5	M	Weighed	Offsite in Ireland	Eco Environmental,Unknown	Mill River Business Park,Carrick on Suir,County ,Tipperary,Ireland		
Within the Country	20 01 38	No	171.94	wood other than that mentioned in 20 01 37	R3	M	Weighed	Offsite in Ireland	Greenstar Ltd,WCP-KK-11-54-02	Unit 6 Ballylogan Industrial Park,Ballylogan Road,Dublin 13,,,Ireland		
To Other Countries	20 01 39	No	19.34	plastics	R5	M	Weighed	Abroad	Eco Sky,Unknown	Unit A/2 Varis Business Park,Challenge Way,Blackburn,BB1 5QB,United Kingdom		
Within the Country	20 01 40	No	29.64	metals	R5	M	Weighed	Offsite in Ireland	Greenstar Ltd,WCP-KK-11-54-02	Unit 6 Ballylogan Industrial Park,Ballylogan Road,Dublin 13,,,Ireland		
Within the Country	20 03 01	No	1473.89	mixed municipal waste	D1	M	Weighed	Offsite in Ireland	Bord na Mona Ltd,W0201-01	Drehid Landfill,Kilnagh Upper,Carbury,Co. Kildare,Ireland		
Within the Country	20 03 03	No	577.24	street-cleaning residues	D1	M	Weighed	Offsite in Ireland	Bord na Mona Ltd,W0201-01	Drehid Landfill,Kilnagh Upper,Carbury,Co. Kildare,Ireland		
Within the Country	20 03 07	No	256.47	bulky waste	D1	M	Weighed	Offsite in Ireland	Bord na Mona Ltd,W0201-01	Drehid Landfill,Kilnagh Upper,Carbury,Co. Kildare,Ireland		
Within the Country	13 02 06	Yes	2.32	synthetic engine, gear and lubricating oils	R1	M	Weighed	Offsite in Ireland	ENVA Ireland,WCP/KK/059(A)06	Clonmanim Industrial Estate,Portlaoise,Co. Laois,,,Ireland	ENVA Ireland,WCP/KK/059(A)06,Clonmanim Industrial Estate,Portlaoise,Co. Laois,,,Ireland	Clonmanim Industrial Estate,Portlaoise,Co. Laois,,,Ireland
Within the Country	20 02 03	No	21.82	Mattresses	D1	M	Weighed	Offsite in Ireland	Bord na Mona Ltd,W0201-01	Drehid Landfill,Kilnagh Upper,Carbury,Co. Kildare,Ireland		

Appendix L

Environmental Liabilities Risk Assessment Review

Dungarvan Landfill

Hydrogeological Review

Document Control Sheet

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Project Title:	Dungarvan Landfill
Document Title:	Hydrogeological Review
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TABLE OF CONTENTS

1 INTRODUCTION 1
2 ENVIRONMENTAL SITE SETTING 2
2.1 Regional Geology 4
2.2 Regional Hydrogeology 5
2.3 Surface Water Features 7
2.4 Site Geology 8
2.5 Site Hydrogeology 9
3 CONCEPTUAL SITE MODEL 12
3.1 Potential Source Areas 12
3.1.1 Landfill Source Area 12
3.1.2 Leachate Composition 15
3.2 Pathways 15
3.3 Receptors 16
3.4 SPR Linkages - Risk Screening 17
3.5 Appropriate Tier of Assessment 21
3.6 Conclusion 21
4 ASSESSMENT OF GROUNDWATER IMPACTS & COMPLIANCE WITH GROUNDWATER REGULATIONS 22
4.1 Extent of Plume and Trends 22
4.2 Impact on Receptors 29
4.3 Chemical Status of Groundwater Body 32
4.3.1 Direct Discharges to Groundwater 32
4.3.2 Impact on Surface Water Bodies 32
4.3.3 Impact on Groundwater Bodies 32
5 REMEDIAL STRATEGY 34
6 GROUNDWATER COMPLIANCE MONITORING 35
7 SUMMARY, CONCLUSIONS & RECOMMENDATIONS 38

APPENDICES

Appendix A **Drawings**

Appendix B **Site Investigation Data**

Appendix C **Surface Water Quality Monitoring Data**

Appendix D **Groundwater Quality Monitoring Data**

Appendix E **Leachate Monitoring Data**

LIST OF TABLES

Table 2.1: Summary of Phasing of Restoration and Remedial Works Completed To Date 3
Table 2.2: Karst Features.. 6
Table 2.3: Groundwater Level Monitoring 2014 9
Table 3.1: Leachate Level Monitoring 2014 13
Table 3.2: Risk Assessment 18
Table 4.1: Screening Values Used To Identify Contaminants of Potential Concern 23
Table 4.2: Summary of Groundwater Monitoring 2014 - 2015 24
Table 6.1: Compliance Monitoring 35
Table 6.2: Compliance Values for Contaminants of Potential Concern 36

LIST OF FIGURES

Figure 2.1: Groundwater Level Monitoring 2014 10
Figure 3.1: Dungarvan Landfill Conceptual Site Model... 14
Figure 4.1: Ammonia Concentration 2009 - 2015 26

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 points and values, shall be included in the next AER. 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;
- Risk 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 "*Guidance 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).

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 (pNHA).

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 Iolnery, IPPC licence facility PO350-01).

The landfilling of waste within the existing facility boundary took place from circa 1968 to 2003. The landfill closed on the 30th 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 29th 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 06/05/2005 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" 1888 – 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 (1837 – 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 O.D. While along the southern

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 16.50mmOD to 10.70mOD. The landfill has no liner but there is some natural protection provided to the bedrock 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 Date

Element	Commencement	Completion
Final Capping	July 2007	September 2008
Gas Abstraction Wells		2009
Leachate Extraction Wells		2009
Leachate Storage Tank		2009
Permanent Gas Flare		2010
Leachate Abstraction & Pumping System	December 2011	July 2012

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^3/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;
- 1mm LLDPE 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, VDR0350/DG0712). An Integrated Constructed Wetland (ICW) of 18,000m^2 has been constructed to treat the leachate collected from the landfill. 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^3 glass lined 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.

A series of 6 no. constructed wetland ponds (1A, 1B, 2, 3, 4 & 5) were installed on site in 2008 for the treatment of leachate and planted with a mix of wetland 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 completion in July 2012.

The ponds were constructed by creating 1m x 3-4m wide perimeter bunds. The ponds are lined 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 l/m^2/d. The influent volume to the constructed wetlands is reported to be 26.9m^3/d (9,818.5m^3/annum).

The leachate from the interceptor tank and leachate boreholes 2 and 6 is diluted with groundwater from RCB and then pumped to the first ICW 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 leachate 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 VIDR0350/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 leachate monitoring 2008 – 2015.

2.1 REGIONAL GEOLOGY

The bedrock geology of the Dungarvan area is composed of rocks of Carboniferous 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).

In the area of the Ballinamuck Supply boreholes 500m to the west of the site the transmissivity is estimated at 900 – 13,000m²/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 valley 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" series 1888 – 1913 and 6" 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.**

Table 2.2: Karst Features

GSI Feature No.	Feature Type	Feature Name	Townland	Proximity to Landfill Site
2009SEK006	Enclosed Depression	Poulmore	Ballynamuck Middle	Between northern boundary of site & River Colligan
2009SEK009	Enclosed Depression	Poulbeg	Ballynamuck Middle	Located within site
2009SEK007	Enclosed Depression	Poulnaskeha	Killadangan	Approximately 100m west of site on west side of River Colligan
2009SEK008	Enclosed Depression	Un-named	Killadangan	Approximately 400m south west of landfill
2009SEK004	Cave	Un-named	Ballynamuck East	Approximately 600m south east of landfill
2009SEK010	Borehole Spring	Un-named	Ballynamuck West	Approximately 600m west of landfill

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 River 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 GSI 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 SW2, see Appendix A Monitoring Locations Drawing MDR0350/DG0505).

The closest EPA surface water monitoring station to the landfill site, (Station ID RS17C010250), located at bridge near Kildangan has a Q3-4 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 Register of Hydrometric Stations in Ireland 2007 provided information for an obsolete staff gauge on the Colligan at Poulnaskeha (NGR 224019, 94663) approximately 100m up gradient of the site. The catchment area to the staff gauge is reported as 96.354 km^2. 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%ile flow of 0.50 m^3/sec.

The historic maps for the area indicate that prior to the development of the landfill the alluvial 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.

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 8.1 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/DC0505).

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 RC3 and RC4 where black 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 clay, 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 1.98E-4m/d (2.3E-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).

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 B.1, Appendix B.

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.

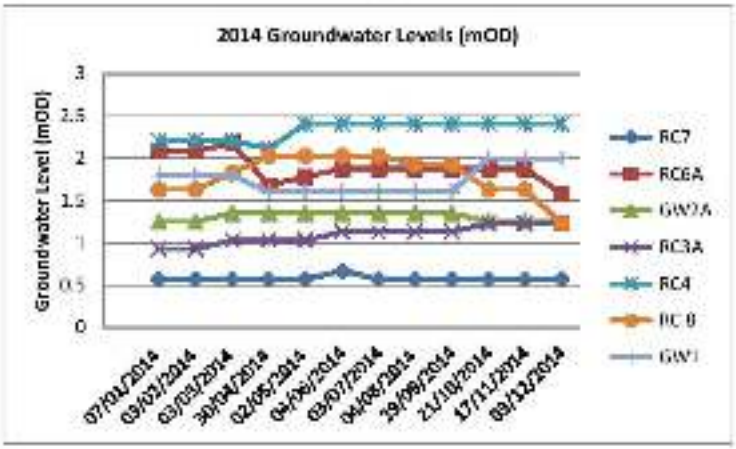
Groundwater Flow Direction

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 RC8 to dilute the leachate prior to leachate treatment within the constructed wetlands. The greatest fluctuation is seen at RC8 where a variation of 0.8m was measured in 2014.

Table 2.3: Groundwater Level Monitoring 2014

Date	RC7 Overburden	RC6A Rock	GW2A Overburden	RC3A Rock	RC4 Rock	RC 8 Overburden	GW1 Overburden
07/01/2014	0.570	2.080	1.250	0.980	2.210	1.630	1.800
03/02/2014	0.570	2.080	1.250	0.980	2.210	1.630	1.800
03/03/2014	0.570	2.180	1.350	1.080	2.210	1.830	1.800
30/04/2014	0.570	1.680	1.350	1.080	2.110	2.030	1.600
02/06/2014	0.570	1.780	1.350	1.080	2.410	2.030	1.600
04/06/2014	0.670	1.880	1.350	1.130	2.410	2.030	1.600
03/07/2014	0.570	1.880	1.350	1.130	2.410	2.030	1.600
04/08/2014	0.570	1.880	1.350	1.130	2.410	1.930	1.600
29/09/2014	0.570	1.880	1.350	1.130	2.410	1.930	1.600
21/10/2014	0.570	1.880	1.250	1.230	2.410	1.630	2.000
17/11/2014	0.570	1.880	1.250	1.230	2.410	1.630	2.000
05/12/2014	0.570	1.580	1.250	1.230	2.410	1.230	2.000

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^2/d. Permeabilities within the Waulsortian Limestone 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 Colligan 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.

The historic maps for the site and surrounding area have been examined. The 25" map (1888 – 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 River 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 River 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 Ireland in the 1999 publication Groundwater Protection Schemes the site specific vulnerability for the bedrock aquifer is classed as moderate which agrees with the GSI 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 368,770 tonnes of waste has been landfilled at the site based on the 198,984 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.

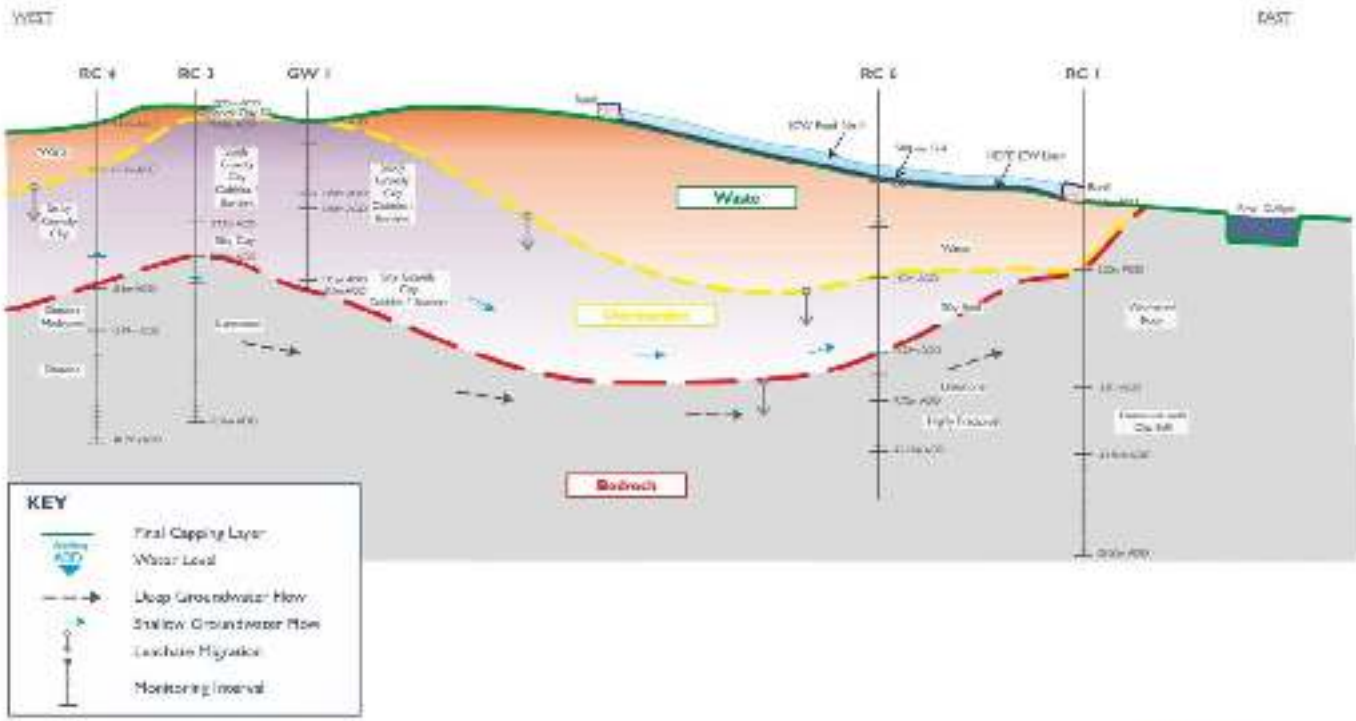
The source for potential groundwater contamination at the site is the leachate being generated from the degradation of the landfilled material. Prior to the installation of the final capping layer in 2008 rainfall was percolating through the waste body and generating leachate which subsequently discharged 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 41,709m^3/annum to 68,910m^3/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^2 and an effective rainfall of 820mm per annum (GSI website) this equates to into restored area The water balance estimated the leachate generation post capping to be of the order of 5,670m^3/annum.

Since the waste licence 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.

Table 3.1: Leachate Level Monitoring 2014

Date	L5A	L4	L1A
07/01/2014	0.83	2.3	0.25
03/02/2014	0.83	2.3	0.25
03/03/2014	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	2.3	2.15
04/08/2014	1.63	2.4	2.15
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

Figure 3.1: Dungarvan Landfill Conceptual Site Model



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. Leachate monitoring data is available from Waterford City and County Council from the following leachate monitoring locations: Interceptor; ICW Pond 1 In; ICW Pond 2 In; ICW Pond 3 In; ICW Pond 4 In; ICW Pond 5 In and ICW Pond Out 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 E.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 E.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 (17 – 26 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 aquifer 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 Colligan / 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.

3.3 RECEPTORS

The following receptors have been assessed:-

- Drinking 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 future 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 GSI delineated 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 River 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 inner portion 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 Shellfish 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 Shellfish Area. The Shellfish 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 SPA 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

Source	Pathway	Receptor	Risk
			contaminants of potential concern in the immediate vicinity of the site at SW2 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 SW2 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 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 SW2 and EPA Station No. 300. **No Risk identified to Shellfish Waters.**

Source	Pathway	Receptor	Risk
	Leachate vertically migrating to deeper groundwater in bedrock aquifer (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 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 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 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 elevated concentrations (i.e. elevated ammonia) and on the aquatic 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 for the deeper groundwater from beneath 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 elevated concentrations (i.e. elevated ammonia) and on the aquatic 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.**

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 (GQRA) 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.

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 S.I. 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.I. 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.I. 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

It is recommended that a new down gradient monitoring borehole be provided for monitoring of the groundwater composition in the bedrock aquifer 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^2. The dry weather flow is reported as 0.32m^3/s with a 95%ile flow of 0.50m^3/sec. The volume of leachate being generated at the site is estimated to be of the order of 5,670m^3/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.

Table 6.2: Compliance Values for Contaminants of Potential Concern

Parameter	Standard To be Achieved In Surface Water	Proposed Compliance Value
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/l
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

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	Annually	Annually
Dissolved Oxygen	Quarterly	Annually
Electrical Conductivity	Quarterly	Quarterly
Iron	Quarterly	Quarterly
Lead	Annually	Annually
Nickel	Annually	Annually
Magnesium	Annually	Annually
Manganese	Quarterly	Annually
Mercury	Annually	Annually
Ortho-phosphate	Annually	Annually
Total Phosphorus	Annually	Annually
pH	Quarterly	Quarterly
Potassium	Quarterly	Annually
Sulphate	Annually	Annually
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

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.

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 biochemical 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%ile. 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^3/annum to 63,910m^3/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^3/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

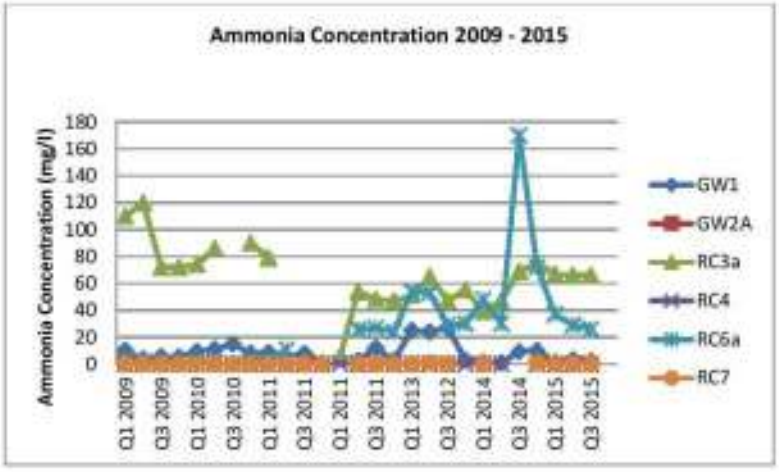
The aluminium concentration is monitored at the site even though it is not listed as a requirement of the waste licence. Elevated concentrations were measured at a number of locations on the same sampling dates. Elevated concentrations were measured at : GW1 in Q2 2014 1,700 ug/l and 1,000 ug/l in Q3 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

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 IGV 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.

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).

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

Parameter	EPA / GSI IGV Limits	Drinking Water Regulations S.I. No. 122 of 2014	S.I. 9 2010 GW Regs Limits Column 2 Adverse Impact on SW Bodies	S.I. 9 2010 GW Regs Limits Column 3 Drinking Water Protected Area	S.I. 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			
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			
Dissolved Oxygen	No Abnormal Change				
Sodium (mg/l)	150	200		150	
Potassium (mg/l)	5				
Total Organic Carbon (mg/l)	No Abnormal Change	No Abnormal Change			
Total Oxidised Nitrogen (mg/l)	No Abnormal Change				
Boron (ug/l)	1,000	1,000		750	750
Calcium (mg/l)	200	200			
Arsenic (ug/l)	10	10			7.5
Iron (ug/l)	200	200			
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			
Phenols (ug/l)	0.5				
T Coli (Cfu/100ml)	0	0			
E Coli (CFu/100ml)	0	0			

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.

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:-

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

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

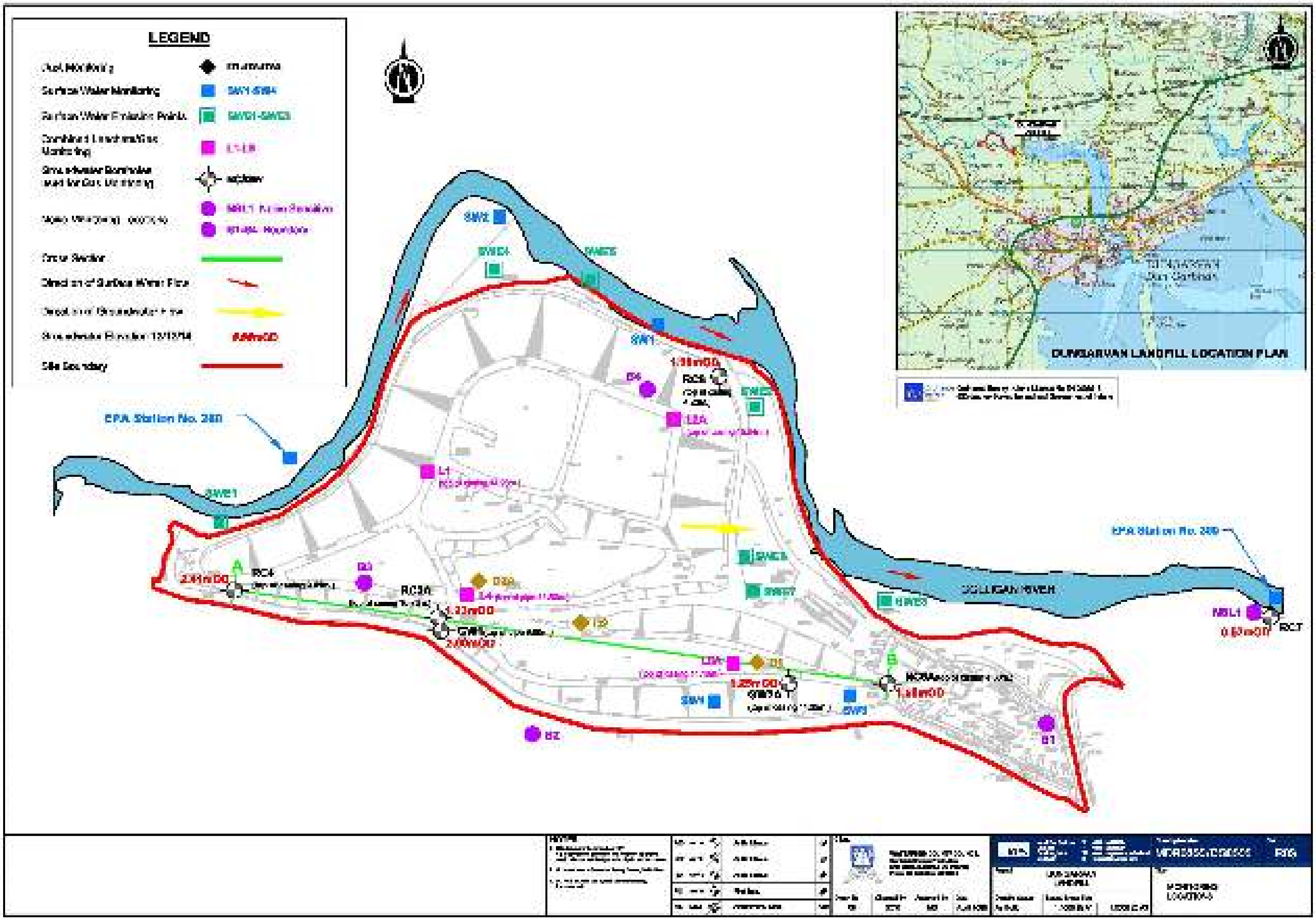
- All previous relevant reports for the Dungarvan Landfill including Annual Environmental Reports (2008 – 2014).
- All relevant historical groundwater levels and quality data and relevant surface water data.
- Relevant site investigation data.

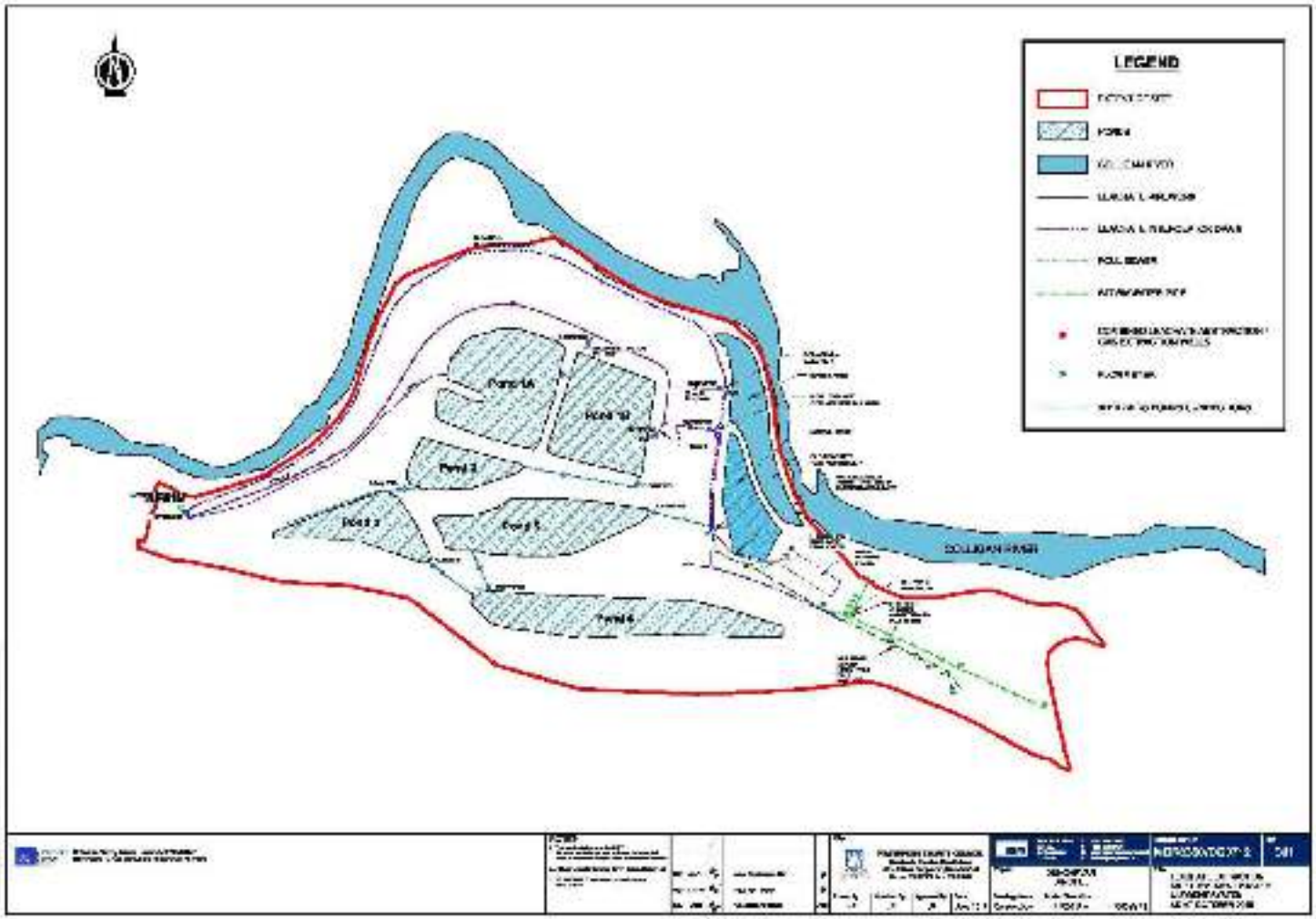
4.1 EXTENT OF PLUME AND TRENDS

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).


LEGEND
Surface Water Monitoring
Site Boundary
EPA Station No. 280
COLLIGAN RIVER
DUNGARVAN LANDFILL LOCATION PLAN
SW1
SW2
SW3
SW4
L1
B1
B2
B3
B4
NSL1
RC4
RC5
RC7


LEGEND
Pond 1A
Pond 1B
Pond 2
Pond 3
Pond 5
Pond 6

APPENDIX B

SITE INVESTIGATION DATA

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
GW1 Current	9.70m	9.50mOD		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 & cobbles. 5.40m to 5.70m brown sandy gravely CLAY. 5.70m to 8.60m brown sandy clayey GRAVEL with cobbles. 8.60m to 9.70m brown silty CLAY with fragments of cobbles & boulders.
GW7A Current	11.50m	11.35mOD	1.25mOD	Water strike 7.60m Water strike 9.70m	1.00m to 11.00m in overburden & possible leachate	GL to 1.50m Made ground (domestic refuse plastic and glass). 1.50m to 4.40m reddish brown silty SAND with occ fine gravel. 4.40m to 7.50m reddish brown silty sandy CLAY. 7.50m to 8.30m brown silty clayey GRAVEL with cobbles. 8.30m to 9.20m brown silty CLAY with some cobbles. 9.20m to 11.50m fine to coarse brown clayey GRAVEL.
RC1 Not monitored	25.50m			Not being monitored	16.50m to 23.30m 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 5.90m to 6.30m. 10.0m to 25.50m light grey white, calcitic LIMESTONE with localised clay infill.

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	4.58mOD	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		2.12mOD	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 clay. 0.20m to 6.00m Made ground composed of domestic refuse with brick, plastic, wood, concrete and some gravely clay.
L2 Leachate	7.50m	15.54m			1.00m to 7.00m	GL to 1.00m Made ground composed of brown gravely clay. 1.00m to 6.60m Made ground composed of domestic refuse with brick, plastic, wood, concrete and some gravely clay.

Borehole Code	Total Depth	Elevation Top Of Casing	Groundwater Level 07/01/14	Comment	Groundwater Monitoring Interval	Strata Encountered
RC2 Not monitored Groundwater in bedrock	23.00m			Borehole collapsing due to cavities 17.00m to 23.00m. Cavity 14.20m to 14.90m. Cavity 17.00m to 17.00m. Cavity 19.20m to 19.80m.	13.90m to 17.00m	GL to 1.60m brown sandy, gravely clay fill. 1.60m to 6.55m domestic waste. 6.55m to 13.00m brown sandy gravely CLAY. 13.00m to 23.00m grey fine grained slightly weathered LIMESTONE with prominent cavities throughout. 21.12 to 21.40m sand infill in matrix of limestone.
RC3 Current Groundwater in bedrock	19.30m	10.73mOD	0.93mOD. Top of rock 2.56mOD.	Cavity 9.10m to 9.40m and 9.90m to 10.00m. Cavities 10.81 to 10.82m and 11.00m to 11.10m. Highly fractured 14.37m to 14.60m. At 18.60m 20mm thick calcite vein.	8.90m to 19.30m	GL to 0.89m Overburden brown sandy clay fill with some concrete. 0.89m to 7.00m stiff brown sandy gravely CLAY with cobbles / boulders. 7.00m to 8.15m soft brown silty CLAY. 8.15m to 19.30m fine grained moderately weathered LIMESTONE with occasional localised clay infill.
RC4 Current Groundwater in bedrock	20.40m	9.41mOD	WL 2.21mOD confined. Top of rock 0.11mOD.	11.00m to 12.20m Sand / gravel infill. At 18m soft silt / clay infill.	11.40m to 20.40m.	GL to 2.90m Overburden / domestic waste. 2.90m to 9.90m brown sandy, gravely CLAY (boulder clay). 9.90m to 11.60m grey brown moderately weathered SILTSTONE / MUDSTONE. 11.60m to 20.40m dark grey, quartz rich sandy SILTSTONE.
RC5 Not monitored Groundwater in bedrock	35.00m			Cavity 25.10m to 26.80m with clay infill. Cavity 28.30m to	25.90m to 28.60m. Borehole collapsing below 28.60m.	GL to 0.83m overburden / clay fill. 0.83m to 6.55m overburden / domestic waste. 6.55m to 11.00m dark grey silty peaty CLAY.

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

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			
pH	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	‰									
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			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/l		< 0.02	< 0.02	< 0.02			5	3.75	5
Calcium	mg/l		51	86	8.3			200		200
Cobalt	ug/l		< 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

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
Selenium	ug/l		< 1.0	< 1.0	< 1.0					10
Sodium	mg/l		390	6,500	95	1,100	2,600	150	150	150
Strontium	ug/l		440	5,400	86					
Thallium	ug/l		< 1.0	< 1.0	< 1.0					
Uranium	ug/l		< 1.0	2	< 1.0			9		
Vanadium	ug/l		1.4	< 10	< 1.0					
Phenol	ug/l							0.5		
Nitrite	mg/l		-					0.1		0.50
Ortho-phosphate	mg/l		0.026					0.03	0.035 MRP	
Alkalinity	mg/l		212							
Fluoride	mg/l		< 0.75					1.0		0.8 / 1.5
Sulphate	mg/l		100					200	187.5	250
List I / II	ug/l									
Aluminium	ug/l		1,000	1,200	22			200	150	200
Barium	ug/l		11	120	1.5			100		
Mercury	ug/l		< 0.50					1	0.75	1
Antimony	ug/l		< 1.0							5
Chromium	ug/l		2					50	37.5	50
Copper	ug/l		2.5					30	1500	2,000
Molybdenum	ug/l		< 1.0							
Zinc	ug/l		16					100		

Table D.6: Summary of Groundwater Composition RC7

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	25/02/15	18/05/15	10/08/15			
Temp	°C	11.1	11.1	14.0	10.6	11.8	12.5			
Groudwed Oxygen % sat		29.5	30	42	77	46.1	30			
pH	pH units	7.3	7.2	7.1	6.7	7.3	7.0	6.5 – 9.5		6.5 to 9.5
EC	Us/cm	2860	2800	NM	NM	NM	NM	1,000	800 - 1875	1,500
Salinity	‰	1.3	1.3	22.3	3.1	3.9	8.4			
Ammonia	mg/l	0.02	< 0.02	0.85	0.026	< 0.02	< 0.02	0.15mg/l	65 – 175 ug/l	0.30 mg/l
Chloride	mg/l	670	NR	> 7,333	1,840	2,200	4,700	30	24 – 187.5	250
TON	mg/l	3.6	4.2	1.6	1.5	2.1	0.87			No abnormal change
TOC	mg/l									
Arsenic	ug/l		< 1.0	< 1.0	< 1.0			10	7.5	10
Beryllium	ug/l		< 1.0	< 1.0	< 1.0					
Boron	ug/l		230	2,500	43			1,000	750	1,000
Cadmium	ug/l		0.05	0.49	< 0.02			5	3.75	5
Calcium	mg/l		82	350	9.7			200		200
Cobalt	ug/l		< 1.0	1.8	< 1.0					
Iron	ug/l	1,500	730	1,500	29	990	1,900	200		200
Lead	ug/l		1.1	1.1	< 1.0			100	18.75	100
Magnesium	mg/l		50	820	11			50		50
Manganese	ug/l		52	81	< 5.0			50		50
Nickel	ug/l		1.8	3.1	< 1.0			20	15	20
Potassium	mg/l		20	230	3.4	46	95	5		12

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
Selenium	ug/l		< 1.0	< 1.0	< 1.0					10
Sodium	mg/l		61	150	9	70	72	150	150	150
Strontium	ug/l		240	300	36					
Thallium	ug/l		< 1.0	< 1.0	< 1.0					
Uranium	ug/l		< 1.0	< 1.0	< 1.0			9		
Vanadium	ug/l		2	1	< 1.0					
Nitrite	mg/l							0.1		0.50
Ortho-phosphate	mg/l		0.01					0.03	0.035 MRP	
Alkalinity	mg/l		305							
Fluoride	mg/l		0.5					1.0		0.8 / 1.5
Sulphate	mg/l		32					200	187.5	250
List I / II	ug/l		810							
Aluminium	ug/l		1,000	260	11			200	150	200
Barium	ug/l		34	37	3.9			100		
Mercury	ug/l		< 0.50					1	0.75	1
Antimony	ug/l		< 1.0							5
Chromium	ug/l		14					30	37.5	50
Copper	ug/l		12					30	1500	2,000
Molybdenum	ug/l		< 1.0							
Zinc	ug/l		88					100		

Table D.5: Summary of Groundwater Composition RC6a

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	15/08/14	23/02/15	18/05/15	10/08/15			
Temp	°C	10.9	12.0	12.2	11.5	12.0	12.4			
Dissolved Oxygen % sat		25.0	21.0	16	12.0	14.0	22			
pH	pH units	7.1	6.9	7.2	6.8	7.0	7.0	6.5 – 9.5		6.5 to 9.5
EC	Us/cm	1,529	1,225	2,170	1,443	1,294	1,291	1,000	800 - 1875	1,500
Salinity	‰	-	-	-	-	-	-			
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/l	9	8.9	8	8.1	8.3	7.1			No abnormal change
TOC	mg/l									
Arsenic	ug/l		2.1	1.2	< 1.0			10	7.5	10
Beryllium	ug/l		< 1.0	< 1.0	< 1.0					
Boron	ug/l		170	350	25			1,000	750	1,000
Cadmium	ug/l		0.55	0.5	< 0.02			5	3.75	5
Calcium	mg/l		100	130	12			200		200
Cobalt	ug/l		2.6	2.6	< 1.0					
Iron	ug/l	6,000	4,900	2,600	170	1,400	1,900	200		200
Lead	ug/l		200	6.5	2.5			100	18.75	100
Magnesium	mg/l		19	27	1			50		50
Manganese	ug/l		450	140	14			50		50
Nickel	ug/l		5.4	4.2	< 1.0			20	15	20
Potassium	mg/l		23	50	2.7	22	21	5		12

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
Selenium	ug/l		< 1.0	< 1.0	< 1.0					10
Sodium	mg/l		12	13	1.4	12	11	150	150	150
Strontium	ug/l		320	330	35					
Thallium	ug/l		< 1.0	< 1.0	< 1.0					
Uranium	ug/l		< 1.0	< 1.0	< 1.0			9		
Vanadium	ug/l		< 1.0	< 1.0	< 1.0					
Nitrite	mg/l		< 0.004					0.1		0.50
Ortho-phosphate	mg/l		< 0.01					0.05	0.035 MRP	
Alkalinity	mg/l		715							
Fluoride	mg/l		< 0.25					1.0		0.8 / 1.5
Sulphate	mg/l		38					300	187.5	250
List I / II	ug/l									
Aluminium	ug/l		11	13	< 10			200	150	200
Barium	ug/l		8.6	9	1.3			100		
Mercury	ug/l		< 0.50					1	0.75	1
Antimony	ug/l		< 1.0							5
Chromium	ug/l		1.1					30	37.5	50
Copper	ug/l		< 1.0					30	1500	2,000
Molybdenum	ug/l		< 1.0							
Zinc	ug/l		12					100		

Table D.4: Summary of Groundwater Composition RC4

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	10.8	11.4	11.7	10.7	12.0	12.5			
Dissolved Oxygen % sat		50.5	64	56	50	50	45			
pH	pH units	7.3	7.1	6.9	6.7	7.1	6.9	6.5 – 9.5		6.5 to 9.5
EC	Us/cm	679	649	640	649	644	615	1,000	800 - 1875	1,500
Salinity	‰	-								
Ammonia	mg/l	0.12	0.08	0.065	0.65	0.27	0.025	0.15mg/l	65 – 175 ug/l	0.30 mg/l
Chloride	mg/l	33	32	29	32	29	30	30	24 – 187.5	250
TON	mg/l	16	13	11	11	11	11			No abnormal change
TOC	mg/l									
Arsenic	ug/l		< 1.0	< 1.0	< 1.0			10	7.5	10
Beryllium	ug/l		< 1.0	< 1.0	< 1.0					
Boron	ug/l		29	27	< 10			1,000	750	1,000
Cadmium	ug/l		0.02	0.03	< 0.02			5	3.75	5
Calcium	mg/l		96	100	11			200		200
Cobalt	ug/l		< 1.0	< 1.0	< 1.0					
Iron	ug/l	8,900	110	180	23	200	240	200		200
Lead	ug/l		< 1.0	< 1.0	< 1.0			100	18.75	100
Magnesium	mg/l		10	10	< 0.25			50		50
Manganese	ug/l		9.9	20	< 5.0			50		50
Nickel	ug/l		< 1.0	< 1.0	< 1.0			20	15	20
Potassium	mg/l		1.5	1.6	< 0.25	1.5	1.4	5		12

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
Selenium	ug/l		< 1.0	< 1.0	< 1.0					10
Sodium	mg/l		100	110	15	120	130	150	150	150
Strontium	ug/l		410	510	54					
Thallium	ug/l		1.4	< 1.0	< 1.0					
Uranium	ug/l		1.8	1.9	< 1.0			9		
Vanadium	ug/l		< 1.0	< 1.0	< 1.0					
Nitrite	mg/l		< 0.004					0.1		0.50
Ortho-phosphate	mg/l		< 0.01					0.03	0.035 MRP	
Alkalinity	mg/l		565							
Fluoride	mg/l		1					1.0		0.8 / 1.5
Sulphate	mg/l		29					300	187.5	250
Det / D	ug/l									
Aluminium	ug/l		17	24	< 10.0			200	150	200
Barium	ug/l		110	210	18			100		
Mercury	ug/l		< 0.50					1	0.75	1
Antimony	ug/l		< 1.0							5
Chromium	ug/l		3.9					30	37.5	50
Copper	ug/l		1.5					30	1500	2,000
Molybdenum	ug/l		1.5							
Zinc	ug/l		18					100		

Table D.3: Summary of Groundwater Composition RC3a

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	23/01/15	18/06/15	10/08/15			
Temp	°C	11.8	11.2	12.5	11.8	12.8	13.1			
Dissolved Oxygen % sat		14.6	21.0	16.0	18.0	13.9	17.0			
pH	pH units	7.0	6.8	7.0	6.9	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	°/₀₀	-								
Ammonia	mg/l	39	47	75	67	66	66	0.15mg/l	65 – 175 ug/l	0.30 mg/l
Chloride	mg/l	95	112	165	140	119	113	30	24 – 187.5	250
TON	mg/l	0.24	0.67	< 0.20	1.3	< 0.20	< 0.20			No abnormal change
TOC	mg/l									
Arsenic	ug/l		4.1	21	1.6			10	7.5	10
Beryllium	ug/l		< 1.0	< 1.0	< 1.0					
Boron	ug/l		230	400	49			1,000	750	1,000
Cadmium	ug/l		0.36	0.18	< 0.02			5	3.75	5
Calcium	mg/l		110	120	11			200		200
Cobalt	ug/l		7.4	11	< 1.0					
Iron	ug/l	4,000	1,200	9,700	500	4,100	4,700	200		200
Lead	ug/l		< 1.0	< 1.0	< 1.0			100	18.75	100
Magnesium	mg/l		19	24	0.94			50		50
Manganese	ug/l		1,600	2,300	210			50		50
Nickel	ug/l		38	43	3.8			20	15	20
Potassium	mg/l		24	43	3.9	30	27	5		12

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	mg/l							5		12
Selenium	ug/l									10
Sodium	mg/l							150	150	150
Strontium	ug/l									
Thallium	ug/l									
Uranium	ug/l							9		
Vanadium	ug/l									
Phenol	ug/l							0.5		
Nitrite	mg/l							0.1		0.50
Ortho-phosphate	mg/l							0.03	0.035 MRP	
Alkalinity	mg/l									
Fluoride	mg/l							1.0		0.8 / 1.5
Sulphate	mg/l							200	187.5	250
Hot / U	ug/l									
Aluminium	ug/l							200	150	200
Barium	ug/l							100		
Mercury	ug/l							1	0.75	1
Antimony	ug/l									5
Chromium	ug/l							50	37.5	50
Copper	ug/l							50	2500	2,000
Molybdenum	ug/l									
Zinc	ug/l							100		

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
		No sample	No sample	No sample	Dry					
Date		22/01/14	07/04/14	15/09/14						
Temp	°C									
Dissolved Oxygen % sat										
pH	pH units							6.5 – 9.5		6.5 to 9.5
EC	uS/cm							1,000	800 - 1875	1,500
Salinity	‰									
Ammonia	mg/l							0.15 mg/l	85 – 175 ug/l	0.30 mg/l
Chloride	mg/l							30	24 – 187.5	250
TON	mg/l									No abnormal change
TOC	mg/l									
Arsenic	ug/l							10	7.5	10
Beryllium	ug/l									
Boron	ug/l							1,000	750	1,000
Cadmium	ug/l							5	3.75	5
Calcium	mg/l							200		200
Cobalt	ug/l									
Iron	ug/l							200		200
Lead	ug/l							100	18.75	100
Magnesium	mg/l							50		50
Manganese	ug/l							50		50
Nickel	ug/l							20	15	20

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	mg/l		2.7	5	0.3	3.7	3.8	5		12
Selenium	ug/l		< 1.0	< 1.0	< 1.0					10
Sodium	mg/l		9.6	15	1.3	15	13	150	150	150
Strontium	ug/l		230	340	44					
Thallium	ug/l		< 1.0	< 1.0	< 1.0					
Uranium	ug/l		1.7	< 1.0	< 1.0			9		
Vanadium	ug/l		4.1	2.2	< 1.0					
Nitrite	mg/l		0.008					0.1		0.50
Ortho-phosphate	mg/l		< 0.01					0.03	0.035 MRP	
Alkalinity	mg/l		317							
Fluoride	mg/l		< 0.25					1.0		0.8 / 1.5
Sulphate	mg/l		6.5					200	187.5	250
List I / II	ug/l		BLD							
Aluminium	ug/l		1,700	1,000	13			200	150	200
Barium	ug/l		70	120	10			100		
Mercury	ug/l		< 0.50					1	0.75	1
Antimony	ug/l		< 1.0							5
Chromium	ug/l		2.8					30	37.5	50
Copper	ug/l		43					30	1500	2,000
Molybdenum	ug/l		< 1.0							
Zinc	ug/l		43					100		

List I / II BLD except Q2 volume 0.7 ug/l but is less than IGV of 10 ug/l

Table D.1: Summary of Groundwater Composition GW1

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	10.5	10.5	12.6	10.8	13.3	14.2			
Dissolved Oxygen % sat		20.7	13.6	21.0	45	33.8	22			
pH	pH units	6.7	6.7	6.5	6.6	6.6	6.5	6.5 – 9.5		6.5 to 9.5
EC	Us/cm	905	680	930	1,049	1,145	1,108	1,000	800 - 1875	1,500
Salinity	‰	-	-	-	-	-	-			
Ammonia	mg/l	1.6	0.67	9.9	1.4	3.3	2.2	0.15mg/l	0.065 – 0.175 mg/l	0.30 mg/l
Chloride	mg/l	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			No abnormal change
Arsenic	ug/l		2.8	4.9	< 1.0			10	7.5	10
Beryllium	ug/l		< 1.0	< 1.0	< 1.0					
Boron	ug/l		22	37	< 10			1,000	750	1,000
Cadmium	ug/l		0.36	0.05	< 0.02			5	3.75	5
Calcium	mg/l		120	150	21			200		200
Cobalt	ug/l		4.7	5.9	< 1.0					
Iron	ug/l1	45,000	5,500	15,000	400	17,000	13,000	200		200
Lead	ug/l		12	1.6	< 1.0			100	18.75	100
Magnesium	mg/l		7.4	12	< 0.25			50		50
Manganese	ug/l		1,800	5,500	350			50		50
Nickel	ug/l		5.7	2.7	< 1.0			20	15	20

APPENDIX D

GROUNDWATER QUALITY MONITORING DATA

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

Parameter	Units	EQS Surface Waters GSI / EPA	Cat A1 SI 294 of 1989 Limits	SI No. 122 of 2014 Drinking Water Limits	SI No. 272 of 2009 AA-EQS 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	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	0.02NH_3	0.2 NH_4	0.30	-	-	-	-		0.075				
Chloride	mg/l	250	250	250	-	-	-	-		32				
Nitrite	mg/l	0.2	-	0.50	-	-	-	-		0.009				
Ortho-phosphate	mg/l	-			-	-	-	-		0.011				
Total Oxidised Nitrogen	mg/l	-			-	-	-	-		< 0.20				
Fluoride	mg/l	5.0	1	0.8 / 1.5	0.5	1.5	-	-		< 0.25	< 0.25			
Sulphate	mg/l	200	200	250	-	-	-	-		3.4	10			

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

Parameter	Units	EQS Surface Waters GSI / EPA	Cat A1 SI 294 of 1989 Limits	SI No. 122 of 2014 Drinking Water Limits	SI No. 272 of 2009 AA-EQS 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	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	0.02NH_3	0.2 NH_4	0.30	-	-	-	-		No sample				
Chloride	mg/l	250	250	250	-	-	-	-						
Nitrite	mg/l	0.2	-	0.50	-	-	-	-						
Ortho-phosphate	mg/l	-			-	-	-	-						
Total Oxidised Nitrogen	mg/l	-			-	-	-	-						
Fluoride	mg/l	5.0	1	0.8 / 1.5	0.5	1.5	-	-			3.3			
Sulphate	mg/l	200	200	250	-	-	-	-			110			

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

Parameter	Units	EQS Surface Waters GSI / EPA	Cat A1 SI 294 of 1989 Limits	SI No. 122 of 2014 Drinking Water Limits	SI No. 272 of 2009 AA-EQS 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	Station 280 2015	Station 280 2014	Station 280 2013	Station 280 2012	Station 280 2011	Station 280 2010
Sampling Date										07/04/14	11/05/13	No data	No data	No data
Ammonia	mg/l	0.02 NH_3	0.2 NH_3	0.30	-	-	-	-		< 0.02				
Chloride	mg/l	250	250	250	-	-	-	-		17				
Nitrite	mg/l	0.2	-	0.50	-	-	-	-		< 0.004				
Ortho-phosphate	mg/l	-			-	-	-	-		0.013				
Total Oxidised Nitrogen	mg/l	-			-	-	-	-		2.2				
Fluoride	mg/l	5.0	1	0.6 / 1.5	0.5	1.5	-	-		< 0.25	< 0.25			
Sulphate	mg/l	200	200	250	-	-	-	-		4.6	5.2			

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

Parameter	Units	EQS Surface Waters GSI / EPA	Cat A1 SI 294 of 1989 Limits	SI No. 122 of 2014 Drinking Water Limits	SI No. 272 of 2009 AA-EQS 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	SW2 2015	SW2 2014	SW2 2013	SW2 2012	SW2 2011	SW2 2010
Sampling Date										07/04/14	13/05/13	No data	No data	No data
Ammonia	mg/l	0.02NH_4	0.2 NH_4	0.30	-	-	-	-		0.021				
Chloride	mg/l	250	250	250	-	-	-	-		16				
Nitrite	mg/l	0.2	-	0.50	-	-	-	-		< 0.004				
Ortho-phosphate	mg/l	-			-	-	-	-		0.014				
Total Oxidised Nitrogen	mg/l	-			-	-	-	-		2.2				
Fluoride	mg/l	5.0	1	0.8 / 1.5	0.5	1.5	-	-		< 0.25	< 0.25			
Sulphate	mg/l	200	200	250	-	-	-	-		4.8	5.9			

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

Parameter	Units	EQS Surface Waters GSI / EPA	Cat A1 SI 294 of 1989 Limits	SI No. 122 of 2014 Drinking Water Limits	SI No. 272 of 2009 AA-EQS 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	SW1 2015	SW1 2014	SW1 2013	SW1 2012	SW1 2011	SW1 2010
Sampling Date										07/08/14	13/05/13	No data	No data	No data
Ammonia	mg/l	0.02 NH_3	0.2 NH_3	0.30	-	-	-	-		< 0.02	-			
Chloride	mg/l	250	250	250	-	-	-	-		16				
Nitrite	mg/l	0.2	-	0.50	-	-	-	-		< 0.004				
Ortho-phosphate	mg/l	-			-	-	-	-		0.011				
Total Oxidised Nitrogen	mg/l	-			-	-	-	-		2.2				
Fluoride	mg/l	5.0	1	0.8 / 1.5	0.5	1.5	-	-		< 0.25	< 0.25			
Sulphate	mg/l	200	200	250	-	-	-	-		5.4	5.9			

Table C.5: Quarterly Parameters SW300 Colligan Estuary

	Q1 2014	Q2 2014	Q3 2014	Q5 2014	Q1 2015	Q2 2015	Q3 2015	EQS EPA / GSI	Cat A1 SI 294 of 1989
Sample Date			03/07/14		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 (% saturation)			103		98	83			> 60%
pH (pH units)			6.8		7.2	7.6			5.5 – 8.5
Suspended Solids (mg/l)			< 4		11	< 8			50
Temperature (deg C)			17.0		5.5	11.0			25
Salinity	$^{3}/_{00}$				0.6	2.8			

Table C.3: Quarterly Parameters SW1 – 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	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	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0		5
COD (mg/l)	< 20	< 20	< 20	< 20	< 20	25	< 20		
Conductivity (us/cm)	168	150	1,403	1,090	273	NM	144	1,000	1,000
Dissolved Oxygen (% saturation)	100.2	114	105	102	105	118	107		> 60%
pH (pH units)	7.3	7.3	6.8	6.8	7.0	7.5	7.2		6.5 – 8.5
Suspended Solids (mg/l)	< 4	< 4	< 4	< 4	< 8	< 8	< 4		50
Temperature (deg C)	7.6	10.0	15.9	14.1	6.1	14.8	14.9		25
Salinity	‰				-	0.6			

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	07/04/14	08/07/14	15/09/14	23/02/15	18/06/15	10/08/15		
Ammonia (mg/l)								0.02	0.2
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	25	< 20		
Chloride (mg/l)								250	250
Conductivity (us/cm)	168	151	1,257	766	231	NM	142	1,000	1,000
Dissolved Oxygen (% saturation)	100.3	115	105	102	105	118.1	106		> 60%
pH (pH units)	7.2	7.3	6.7	6.8	7.1	7.0	7.2		6.5 – 8.5
Suspended Solids (mg/l)	< 4	< 4	< 4	< 4	< 4	< 4	< 4		50
Temperature (deg C)	7.6	10.1	16.0	14.6	6.2	14.8	15.0		25
Salinity	‰				-	0.5			

Table C.1: Quarterly Parameters SW Lagoon

	SW lagoon Q1 2014	SW lagoon Q2 2014	SW lagoon Q3 2014	SW lagoon Q3 2014	SW lagoon Q1 2015	SW lagoon Q2 2015	SW lagoon Q3 2015	EQS EPA / GSI	Cat A1 SI 294 of 1989
Sample Date	22/01/14	07/04/14	03/07/14	15/09/14	23/02/15	18/06/15	10/08/15		
BOD (mg/l)	2	1.4	< 1	1.2	< 1.0	3.6	1.9		5
COD (mg/l)	27	< 20	48	33	< 20	38	34		
Conductivity (us/cm)	537	483	566	923	699	589	519	1,000	1,000
Dissolved Oxygen (% saturation)	32.8	93	57	72	75.0	45	68		> 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)	5.6	11.5	17.1	14.2	5.5	15.6	15.4		25
Salinity	‰				-	-			

Table C.2: Quarterly Parameters SW 280 River Colligan

	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	07/04/14	03/07/14	15/09/14	23/02/15	18/06/15	10/08/15		
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		
Conductivity (us/cm)	158	143	160	155	142	161	132	1,000	1,000
Dissolved Oxygen (% saturation)	100.7	106.6	105	105	106	112	107		> 60%
pH (pH units)	7.2	7.3	6.7	6.8	6.7	7.4	7.2		5.5 – 8.5
Suspended Solids (mg/l)	< 4	< 4	< 4	< 4	15	< 4	< 4		50
Temperature (deg C)	7.5	10.2	15.9	14.1	5.9	14.9	15.2		25
Salinity	‰				-	-			

APPENDIX C

SURFACE WATER QUALITY MONITORING DATA

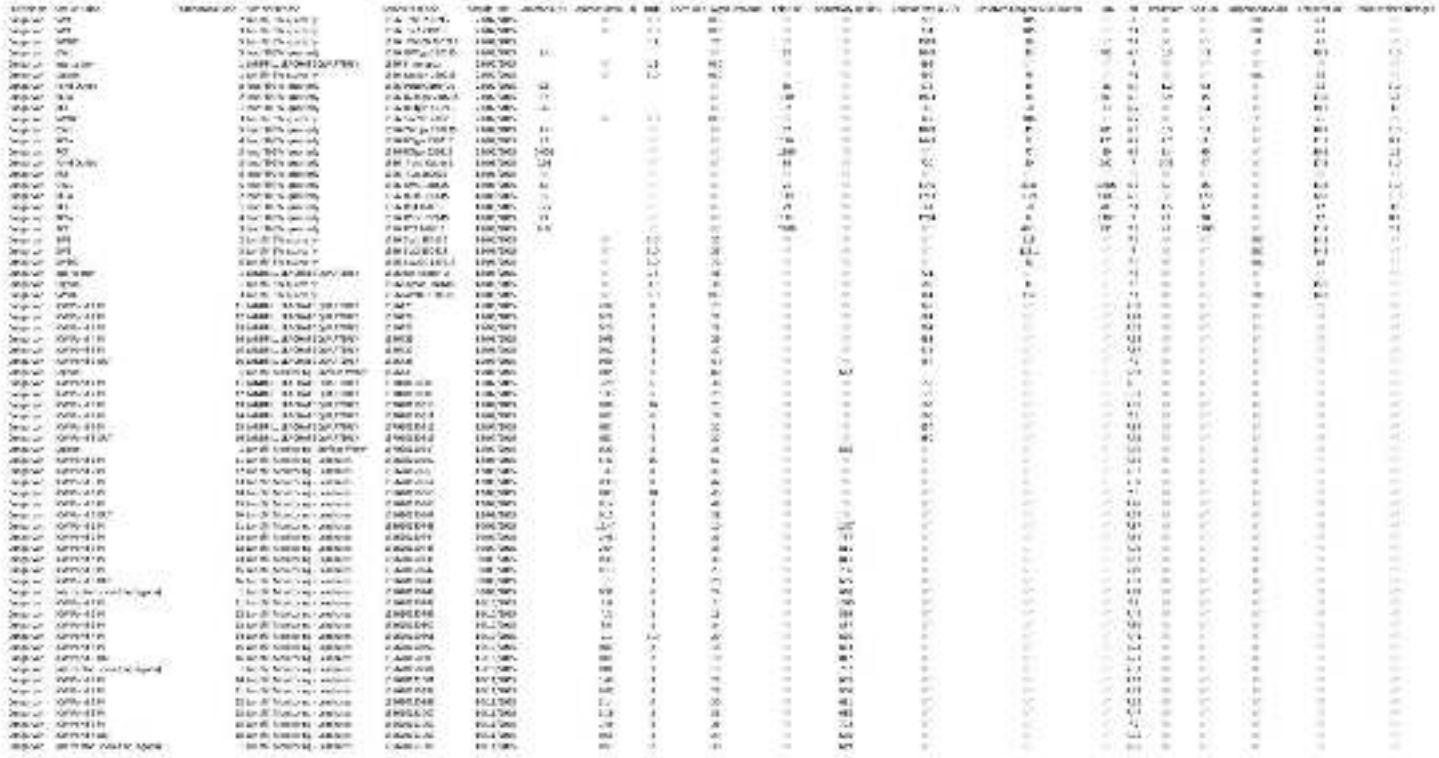
Borehole Code	Total Depth	Elevation Top Of Casing	Groundwater Level 07/01/14	Comment	Groundwater Monitoring Interval	Strata Encountered
						6.60m to 7.50m brown silty sandy gravely CLAY.
L3 Leachate	10.00m			Water strike 9.50m rose to 8.10m after 30 mins	1.00m to 9.00m	GL to 0.20m Made ground composed of brown gravely clay. 0.20m to 8.00m Made ground composed of domestic refuse with brick, plastic, wood, concrete and some gravely clay. 8.00m to 9.00m Made ground composed of decaying domestic waste. 9.00m to 10.00m Black silty (oily) GRAVEL with occ pockets of peaty clay with roots.
L4 Leachate	6.60m	11.80m		Water strike 3.80m rose to 3.20m in 30 mins	1.00m to 6.00m	GL to 0.30m Made ground composed of brown gravely clay. 0.30m to 4.60m Made ground composed of domestic refuse with brick, plastic, wood, concrete and some gravely clay. 4.60m to 6.60m brown black silty CLAY with roots and occ large cobbles.
L5 Leachate	5.70m	11.13m		Water strike 3.80m.	1.00m to 5.00m	GL to 0.30m Made ground composed of brown gravely clay. 0.30m to 4.40m Made ground composed of domestic refuse with brick, plastic, wood and paper. 4.40m to 5.70m black silty CLAY with roots.

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				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/100							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/l		< 1.0			2.4					
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		< 1.0			2.8					
COD	mg/l			31		147					
Copper	ug/l		< 1.0			3.5		30	1,500	2,000	< 0.02 to 0.62 mg/l
Cyanide	ug/l							10	37.5	50	
EC	Us/cm		530	703		1,720			800 - 1875	1,500	5,990 to 19,300
F Coli	Cfu/100							0		0	
Fluoride	mg/l		< 0.25	< 0.25		< 0.5		1.0		1,000	
Iron	ug/l		610			1,300				200	1.6 to 180 mg/l
Lead	ug/l		3.1			2.4			18.75	100	< 0.04 to 1.9 mg/l.
Ust I / II organics			80								
Magnesium	mg/l		7.2			7.9		50		50	40 to 1,580
Manganese	ug/l		600			510		20		50	0.04 to 3.59 mg/l
Mercury	ug/l		< 0.50			< 0.5		1	0.75	1	< 0.0001 to 0.0008 mg/l
Molybdenum	ug/l		< 1.0			1					
Nitrite	mg/l			< 0.002							
Nickel	ug/l		2.2			5.1			15	20	< 0.03 to 0.6 mg/l
Ortho-phosphate	mg/l		< 0.01	0.02		0.23					
Potassium	mg/l		12			26				12	100 to 1,580

Table E.2: Summary of Leachate Composition Interceptor

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)
Date			02/04/14	13/05/13	No data	14/03/11	No data				
Temp	°C		13.6	11.3		8.0					
pH	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
Aluminium	ug/l		40	-		< 25		200		200	
Ammonia	mg/l		< 0.02	0.11		59			0.065 to 0.375	0.30	283 to 2,040 ammoniacal nitrogen-N
Antimony	ug/l		< 1.0	-		1.7				5	
Arsenic	ug/l		< 1.0	-		3.6			7.5	10	< 0.001 to 0.485mg/l
Barium	ug/l		12			27		100			
Beryllium	ug/l		< 1.0			1.4					
BOD	mg/l		2.1	1.9							
Boron	ug/l		78			170		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		44			43		200		200	23 to 501
Chloride	mg/l		70	90		173			24 - 187.5	250	570 to 4,710
Chromium	ug/l		1.3			8.3		30	37.5	50	< 0.03 to 0.56 mg/l



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
Potassium	mg/l		9.3	4	1.2	0.73	3.5	5		12
Selenium	ug/l		< 1.0	< 1.0	< 1.0					10
Sodium	mg/l		38	28	4.3	47	39	150	150	150
Strontium	ug/l		110	270	25					
Thallium	ug/l		< 1.0	< 1.0	< 1.0					
Uranium	ug/l		< 1.0	< 1.0	< 1.0			9		
Vanadium	ug/l		< 1.0	< 1.0	< 1.0					
Phenol	ug/l							0.5		
Nitrite	mg/l		< 0.004					0.1		0.50
Ortho-phosphate	mg/l		< 0.01					0.03	0.035 MRP	
Alkalinity	mg/l		188							
Fluoride	mg/l		< 0.25					1.0		0.6 / 1.5
Sulphate	mg/l		2.5					200	187.5	250
List I / II	ug/l									
Aluminium	ug/l		18	< 10.0	< 10.0			200	150	200
Barium	ug/l		13	7.4	1.5			100		
Mercury	ug/l		< 0.50					1	0.75	1
Antimony	ug/l		< 1.0							5
Chromium	ug/l		1.1					50	37.5	50
Copper	ug/l		< 1.0					50	1500	2,000
Molybdenum	ug/l		< 1.0							
Zinc	ug/l		13					100		