February 2013

TIER 3 ENVIRONMENTAL RISK ASSESSMENT

Pollardstown Depot, Newbridge, Co. Kildare

Submitted to:
Environment Section
Kildare County Council
Aras Chill Dara
Devoy Park
Naas
Co. Kildare

REPORT

Report Number. 11507190200.R1.V2

Distribution:

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Table of Contents

APPENDIX C
LandSim Model Printout

APPENDIX D
Appropriate Assessment

1.0 INTRODUCTION

Kildare County Council (KCC) retained Golder Associates Ireland Ltd (Golder) in January 2012 to prepare a Tier 3 Environmental Risk Assessment of a former waste disposal site (ca. 3.5 ha in size) located at Pollardstown, The Curragh, Co. Kildare (the Site). The purpose of this assessment is to comply with the EPA Code of Practice for Unregulated Sites (2007).

This Tier 3 Risk Assessment is based on the following documents:

- Code of Practice (COP) – Environmental Risk Assessment for Unregulated Waste Disposal Sites (EPA, 2007);
- Tier 2 - Environmental Risk Assessment (Golder, November 2010);
- Additional landfill gas monitoring data for the Pollardstown Site for one monitoring event during 2011 by KCC; and
- Additional groundwater monitoring data for the Pollardstown Site for three monitoring events during 2011 and 2012 by KCC.

A conceptual Site model is attached at Appendix A of this report.

2.0 BACKGROUND

It is understood that the Site at Pollardstown, The Curragh, County Kildare was a former limestone ballast quarry owned by CIE (Coras Iompair Eireann). It is also understood that sand and gravel was extracted at the Site. Records indicate that KCC leased the Site from CIE to use as a waste disposal Site for municipal and industrial waste generated in the Newbridge area. Moreover it is understood that KCC ceased to use the Site as a waste facility in 1972 and it was used by KCC's Roads Section as a depot to store materials, dispose of street sweepings and to dispose of construction and demolition waste associated with road works. Dumping of this waste and other unknown waste classified as 'municipal' waste has ceased since 2009.

The Site is used as a storage depot for the KCC Roads Section and it is our understanding that there will be no disposal of any waste material at the Site in the future.

A Tier 1 risk assessment was completed by Kildare County Council in September 2010. The findings of this assessment indicated that the Site was a High Risk (Class A) and so a Tier 2 risk assessment was deemed necessary. A Tier 2 risk assessment was completed by Golder Associates Ireland Ltd (Golder) in November 2009.

The findings of the Tier 2 assessment indicated that, in Tier 1 assessment, identified linkage for lateral landfill gas migration to humans does not apply for the Pollardstown Site. However the assessment identified a possible linkage between the migration of contaminated groundwater to the nearby Pollardstown Fen, a Special Area of Conservation, and the underlying Curragh Aquifer, a Regionally Important Aquifer.

In accordance with the EPA COP, a Tier 3 stage of the Risk Assessment is required for the Pollardstown former waste disposal Site.

3.0 SCOPE OF WORKS

The objective of this report is the preparation of a Tier 3 Risk Assessment of a former waste disposal site located at Pollardstown, The Curragh Co. Kildare in compliance with the requirements identified in the EPA Code of Practice (EPA, 2007).

The scope of works of this report includes the review of the Tier 1 and 2 reports and any additional monitoring data compiled by KCC since the Tier 2 assessment. Further to refine the Conceptual Site Model

(CSM), repeat the risk screening exercise and carry out a Generic Quantitative Risk Assessment (QRA) for the Site. In addition, the scope includes the preparation of a Remediation Plan for the Site, running a groundwater flow model (Landsim v 2.5) and preparation of an Appropriate Assessment.

4.0 GENERIC QUANTITATIVE RISK ASSESSMENT

A Generic Risk Assessment approach was applied for this Tier 3 assessment. The previous assessments (Tier 1 and Tier 2) stated the following in relation to possible SPR (Source-Pathway-Receptor) linkages for the Site:

- Tier 2 assessment concluded that the Tier 1 assessment identified original SPR linkage for lateral migration of landfill gas to humans does not apply at the Pollardstown Site; and
- A SPR linkage exists for the migration of contaminated groundwater to the nearby Pollardstown Fen, a Special Area of Conservation.

Golder recommended in the Tier 2 Assessment (November 2010) that further works should be carried out to assess if a linkage of the migration of contaminated groundwater would exist. Namely these works were:

- To install a down gradient groundwater monitoring well within the Pollardstown Site; and
- To carry out further groundwater monitoring within and outside of the Pollardstown Site.

A further downstream groundwater monitoring well (BH04) was installed by KCC at the northern part of the Pollardstown Site and three (3 No) round of groundwater and one (1 No) landfill gas monitoring events were carried out within the Sites four (4 No) monitoring locations since 2011. Refer to Appendix A for locations.

4.1 Generic Assessment Criteria

According to the EPA COP the potential risk shall be assessed for each identified pollutant linkage by comparing the representative site concentrations with generic assessment criteria (GAC) or screening levels. In the absence of GAC values for water, the Interim Guideline Values (IGV) (EPA, 2003) have been used as guideline values for parameters with elevated concentrations.

4.2 Environmental Monitoring

4.2.1 Groundwater Monitoring

For this Tier 3 assessment groundwater quality data was assessed at four (4 No) on site and two (2 No) further off Site locations. The following Table 1 depicts details of these groundwater monitoring wells.

Table 1: Details of on and off Site Groundwater Monitoring Locations

ID	Depth of Well (in meters)	Groundwater Elevation (in m OD)	Relative to the Site
BH01	17.8	90.26	Upstream and On Site
BH02	13.6	91.44	Upstream and On Site
BH03	14.1	88.81	Upstream and On Site
BH04	16.3	87.49	Downstream and On Site
BH204	15.0	85.73	Downstream and Off Site
MW2	16.0	88.88	Downstream and Off Site

4.2.1.1 On-Site Locations

The most recent groundwater monitoring occasions for on-Site groundwater monitoring locations BH01, BH02 and BH03 were 4 October 2010 (by Golder), 29 November 2011, and 28 May 2012 (by KCC), and for

BH04 29 November 2011 and 28 May 2012 (by KCC). The complete results are included in Appendix B of this report.

The following Table 2 depicts observed elevated concentrations within above mentioned groundwater monitoring locations when compared against the IGV values (EPA, 2003) and SI No 9 of 2010.

Table 2: Groundwater Monitoring Results – Exceedances within On-Site Locations

Parameter	Unit	BH01			BH02			BH03			BH04		Guideline Values	
		04/10/2010	29/11/2011	28/05/2012	04/10/2010	29/11/2011	28/05/2012	04/10/2010	29/11/2011	28/05/2012	29/11/2011	28/05/2012	IGV 1)	SI No 9 2)
Sulphate	mg/l	-	-	-	190.31	220.25	315.01	-	Dry	Dry	-	-	200	187.5
Ammonium	mg/l	-	-	-	0.28	-	-	-	Dry	Dry	-	-	0.15	0.065 – 0.175
Potassium	mg/l	-	-	-	9.8	8	-	-	Dry	Dry	-	-	5	n/a
Chloride	mg/l	-	-	-	34.6	-	-	-	Dry	Dry	30	-	30	24 – 187.5
Ortho Phosphate	mg/l	12.07	-	-	1.5	-	-	22.38	Dry	Dry	-	-	0.03	n/a

1) *Environmental Protection Agency 2003. Towards Setting Guideline Values for the Protection of Groundwater in Ireland, Interim Report*

2) *Statutory Instruments. S.I. No.9 of 2010. European Communities Environmental Objectives (Groundwater) Regulations, 2010.*

From the above data summary, chloride concentrations from BH04 only have been identified as having the potential to exceed the relevant IGV threshold downstream of the Site. The 30mg/l chloride concentration noted is considered to be well below any relevant drinking water quality standard and within the range of what can be observed elsewhere naturally in Ireland.

Moreover, KCC recently carried out hazardous substance screening in accordance with UK EA Guidance document (Hydrogeological Risk Assessment for Landfills, UK EA). This approach was aimed at helping to demonstrate compliance with the Groundwater Directive which prohibits discharge of these substances at discernible concentrations. A comprehensive suite of hazardous screening was carried out on the 28 May 2012. A further follow up analysis for selected compounds was carried out on the 27th September 2012 (analysis only for Mercury and some Organotin compounds). Two hazardous substances were identified at downstream locations of the Site on the 28th May 2012 sampling event – these are described in following:

- Mercury concentrations were identified at BH204 (off site location), which is located downgradient of the waste mass. The mercury concentration recorded was relatively low at 0.02 ug/l, and below the EU Drinking Water Standard for mercury (1 ug/l). Mercury was not identified within the on-Site groundwater samples during either of the most recent sampling rounds 28 May 2012 or 27 September 2012; and

- Triphenyltin was recorded at locations close to the waste mass only (BH01, BH02 and BH04). These concentrations were observed up to 1.78 ug/l at BH01 (neighbouring the site entrance), which is the most 'up gradient' of the three locations. Organotin compounds have historically been used in antifouling marine paints. The concentrations recorded are considered to be relatively elevated. The EPA have not provided a recommended or mandatory limit value for Organotin compounds in their guidance covering Parameters of Water Quality – Interpretation and Standards. The UK Technical Advisory Group on the Water Framework Directive issued proposals for Environmental Quality Standards for Annex VII substances in 2008. A freshwater value of 0.02 ug/l is suggested for Triphenyltin. It is noted that Triphenyltin was not identified within the on-Site groundwater samples during either of the most recent sampling rounds 28 May 2012 or 27 September 2012.

Analysis of groundwater for mercury and Organotin compounds obtained from BH01, BH02 and BH04 on 27 September has returned all parameters below detection limit. Laboratory sheets are provided in Appendix B.

Reference should be made to the conceptual Site model (Appendix A) for locations.

4.2.1.2 Off Site Locations

Golder received groundwater quality monitoring data from KCC for ten (10 No) wells located downstream of the Pollardstown Site. It is understood that the data has been collected by KCC on seven monitoring occasions during the period between April 2008 and October 2011.

These wells have been installed and monitored in order to assess the groundwater quality within and around the Pollardstown Fen. The following Table 3 depicts parameters that indicate exceedances when compared against the IGV concentrations.

Table 3: Summary of Exceedances when Compared against IGV Values

	Chloride	Sulphate	TDS	Ammonia	Lead	Nickel	Potassium	Zinc	Arsenic
	mg/l	mg/l	mg/l	mg/l	ug/l	ug/l	mg/l	ug/l	ug/l
IGV	**30**	**200**	**1000**	**0.15**	**10**	**20**	**5**	**100**	**10**
On Site	**34.6**	**220.25**		**0.28**			**8**		
GW1	41-63			3.7-26	1-54	12-37	7.6-59		10-20
GW3	32-56.3	584-859	1794-2093	0.1-15	1-13	6-53	2-54		
GW4	26-42			0.02-0.42					
MBH42				0.02-1.35					
BH204							8.2-12		
BH206				0.03-6.7	7-15				
BH207	8-42.1			0.02-4.4			1.6-13		
MW2	18-45.4			0.02-2.5	1-33		0.05-39	2-147	

Locations MW2 and BH204 are the closest to the Pollardstown Site – see Figure 1 and 2 for more details.

4.2.2 Landfill Gas Monitoring

Landfill gas was monitored by KCC at the on-Site groundwater monitoring locations on the 7 December 2011 using a portable landfill gas detector. The following Table 4 depicts the monitoring results.

Table 4: Landfill Gas Monitoring Results.

Parameter	BH01	BH02	BH03	BH04
	7/12/2011			
Methane (CH_4)	0	0	0	0
Carbon Dioxide (CO_2)	0	0	0.2	0
Oxygen (O_2)	21.1	21.1	20.8	21.2
Hydrogen Sulphide (H_2S)	0	0	0	0
Carbon Monoxide (CO)	0	0	0	0

As the above Table 3 indicates, no landfill gas was observed within the Pollardstown Site.

4.3 Conceptual Site Model

In the following section the Site refined Conceptual Model will be discussed – refer to Appendix A for a detailed Figure 1 depicting a Conceptual Site Model for the Pollardstown Site.

The previous Tier 1& 2 assessments identified a possible SPR linkage of the migration of contaminated groundwater to the nearby Pollardstown Fen, a Special Area of Conservation, and Curragh Aquifer, a Regionally Important Aquifer. No further SPR linkages have been identified to exist at the Site currently.

4.3.1 Body of Waste

Tier 2 Assessment (Golder, November 2010) estimated that ca. 78,000m^3 of mixed waste materials were placed within the Site prior to 1972.

4.3.2 Leachate

There is no engineered landfill capping at the Pollardstown Site. Given that the natural ground encountered comprised sands and gravels, it can be assumed that much of the precipitation falling on the Site runs directly through the waste piles and leaches into the underlying natural ground. There are no leachate wells at the Site.

4.3.3 Gas

Tier 2 Assessment (Golder, November 2010) suggested that a SPR linkage in relation to landfill gas migration outside of the body of the waste does not apply for the Pollardstown Site.

5.0 APPROPRIATE ASSESSMENT

The Appropriate Assessment has been attached at Appendix D of this report.

6.0 NUMERICAL GROUNDWATER TRANSPORT MODEL

As a part of this Tier 3 assessment Golder agreed to utilise LandSim model, a numerical contaminant transport model (Golder, 2002), to assess the potential for contaminant migration to the nearby Pollardstown Fen. The following sections describe the details of the approach and data used and outcome of the LandSim model.

6.1 Infiltration

Infiltration to the waste mass has been constrained based upon long term average total rainfall data (1961 to 1990) from Kildare G.S. and potential evapotranspiration data from Casement Aerodrome (1964 – 1990). These equate to 831 mm and 510.2 mm respectively. These data amount to an effective rainfall rate of 320.8 mm.

A small area of the Site is covered by hard standing, and it is understood that the current restoration has a poor vegetative cover. A bulk gradient across the Site from the south to north of approximately 0.05 has been determined based upon Site topographic survey data. Using this information, descriptions of capping materials at the Site and a nomogram produced by the former Coal Board for tip drainage[1], a runoff coefficient for the Site in the order of 0.45 is evident. This would allow for approximately 175 mm of effective rainfall as infiltration.

6.2 Source term

6.2.1 Waste geometry

The Site has been reported to have a footprint area of approximately 3.5 Ha; although there is some uncertainty with regard to the absolute extent of wastes within this context. Waste volumes on the Site have been estimated in the Tier 2 Assessment (Golder, November 2010) at 78,000 m^3. Given the shape of the Site and these data, within the model the waste geometry has been assigned a dimension of 250 m by 140 m, and with a waste thickness range varying between 2 and 3m.

[1] National Coal Board 1982. Technical Management of Water in the Coal Mining Industry – Ref 628:1:622.

6.2.2 Leachate Concentrations

Waste soil samples have previously been collected from thirty one (31 No) trial pits across the Site[2]. Three 'representative' samples (from trail pits 1, 14 and 17) were chosen to undergo CEN leaching test analysis at a 10:1 liquid to solid ratio. The output concentrations in leachable weight of contaminant per kg of waste material (i.e. mg/kg) have been converted to a liquid concentration in mg/l by dividing by 10. This is essentially equivalent to the eluate analysis result. The determined concentrations which have been used here to constrain a source term or leachate concentration range are presented against published threshold values in Table 5 below.

Table 5: Summary of Determined Leachate Concentrations (all Values in mg/l)

Parameter	TP01	TP14	TP17	IGV Values[3]	SI No.9 2010[4]
Arsenic	<0.001	<0.001	0.006	0.01	0.0075
Barium	0.013	0.033	0.022	0.1	-
Cadmium	<0.001	<0.001	<0.001	0.005	0.00375
Chromium	0.002	0.002	<0.002	0.03	0.0375
Copper	<0.012	<0.012	<0.012	0.03	1.5
Mercury	<0.0001	<0.0001	<0.0001	0.001	0.00075[#]
Molybdenum	<0.005	0.010	0.005	-	-
Nickel	<0.006	<0.006	<0.006	0.02	0.015
Lead	<0.01	<0.01	<0.01	0.01	0.018
Antimony	<0.003	0.003	0.008	-	-
Selenium	<0.003	<0.003	<0.003	-	-
Zinc	<0.004	<0.004	<0.004	0.1	-
Chloride	0.3	0.1	<0.1	30	24 - 187.5
Fluoride	<0.1	<0.1	<0.1	1.0	-
Sulphate	5.4	2.2	0.8	200	187.5
Phenol	<0.1	<0.1	<0.1	0.0005	-
DOC	1.1	0.6	0.6	-	-
TDS	16.1	11.3	7.7	1000	-

[#] *Laboratory detection limits are above the Threshold Value*

From the above it should be noted that no contaminants for the source exceed either the EPA IGV criteria or those specified under SI No.9 2010, and on the basis of this data set and the approach adopted there are no obvious parameters in the source of particular concern.

However, in line with Waste Acceptance Criteria testing, it should be noted that total pollutant content for BTEX substances, PCBs, mineral oil and PAHs were determined for the three samples tested. This is not a leachate test but essentially a determination of soil concentrations. Only PAHs were determined above the detection limit and with a concentration range of between (<0.64mg/kg (TP01 and TP17) and 3.95 mg/kg (TP14)). A leachate concentration has been derived from this soil concentration using the following equation (as provided in ConSim version 2[5]), and assuming all PAHs present are represented as naphthalene:

[2] Golder Associates Ireland Ltd. 2010. Tier 2 Environmental Risk Assessment, Pollardstown Dept, Newbridge, Co. Kildare.

[3] Environmental Protection Agency 2003. Towards Setting Guideline Values for the Protection of Groundwater in Ireland, Interim Report.

[4] Statutory Instruments. S.I. No.9 of 2010. European Communities Environmental Objectives (Groundwater) Regulations, 2010.

[5] Environment Agency. ConSim version 2

Cl = Cs/(Kdc + (Øw+ØaH)/Pc)

Where:

Cl = leachate concentrations (mg/l);

Cs = contaminant concentration (taken as 3.95 mg/kg);

Kdc = partition coefficient for contaminant (taken as 386 ml/g i.e. foc (assumed as 0.3) times koc (taken as 1288 l/kg, ConSim Help Files));

Øw = water filled porosity of contaminant (assumed to be 0.15 (fraction));

Øa = air filled porosity of contaminant (assumed to be 0.1 (fraction));

H = Henry's Law constant for naphthalene (4.9E-2 (dimensionless)); and

Pc = waste dry bulk density (assumed to be 1.5 g/cm^3).

The resultant concentration is 0.01 mg/l. Naphthalene has been used in this assessment as a surrogate for the PAH group as a whole due to its relative mobility and persistence.

Although not part of the any waste analysis undertaken to date, a source term concentration has also been added for ammoniacal nitrogen in recognition that this parameter has a typically high level in landfill leachate in comparison to regulatory threshold values[6]. Chloride concentrations derived have also been utilised, primarily as a check again observed down gradient concentrations and therefore in a model calibration capacity.

6.2.3 Unsaturated Zone

Topography varies across the Site from approximately 109.5 mAOD along the southern boundary to 100 mAOD along the northern boundary. The elevation of the underlying groundwater table has been determined to slope in a similar direction from approximately 91 mAOD to 87.5 mAOD. Given that geophysical assessment of the Site has determined that wastes in any areas of the Site are unlikely to exceed about 7m in thickness[7], the unsaturated zone beneath the landfill has been estimated to vary between 6m and 12m across the footprint.

6.2.4 Aquifer

In 2009 IGSL installed three boreholes surrounding the landfill to between depths of 14.2m (BH03) and 17.8m (BH01). No installation details are available, but these encountered gravels, sands and clays. BH02 and BH03 were progressed to refusal; which may be a representation of rock head.

Based on the available information it is assumed that all seepage from the waste mass, as a result of infiltration, will progress through the above described sediments, both within the unsaturated zone and below the groundwater table. Groundwater drainage could be expected to occur laterally within the aquifer towards the north. Published values for aquifer properties have been used and referenced within the LandSim model. The receptor for non-hazardous pollutants and non-listed substances (i.e. ammoniacal nitrogen and chloride) has been taken as the groundwater system 20m from the Site boundary. The receptor for naphthalene has been taken as just prior to the groundwater table.

6.3 Results

Results are presented below in Table 6 for the parameters modelled. They amount to the maximum concentrations predicted at the relevant receptor, and corresponding travel times to his concentration are also provided. No account has been taken of up gradient concentrations, already in groundwater, within the

[6] Erskin, A.D. 2000. Transport of ammonium in aquifers: retardation and degradation. Quarterly Journal of Engineering Geology and Hydrogeology, 33, 161-170.

[7] Golder Associates Ireland Ltd. 2010. Geophysical Survey, Historical Waste Site, Pollardstown, Newbridge, Co. Kildare.

model. The 50%ile output represents the most likely results, and the 95%ile can be viewed as a 'worst case' output within the context of the range of inputs utilised and assumptions made.

Table 6: Results for the Parameters Modelled

	50%ile		95%ile	
Contaminant simulated	**Concentration (mg/l)**	**Travel time (years)**	**Concentration (mg/l)**	**Travel time (years)**
Chloride	0.04	10.0	0.13	17.0
Ammoniacal Nitrogen	0.12	35.1	0.47	38.6
Naphthalene*	Not applicable	Not applicable	0.00078	11.0

** Hazardous substance*

Both naphthalene and chloride concentrations predicted to derive from the landfill are considered to likely be below any perceptible threshold at the perimeter monitoring points; within the context of laboratory capability and background variability respectively. Given the source term assumed, ammoniacal nitrogen may have the potential to be perceptible above background and to be detectable at the downstream perimeter boundary. This parameter is covered by on-going downstream monitoring.

6.4 LandSim Model Conclusions

In addition to on-going monitoring for major ion chemistry, it is recommended that groundwater boreholes surrounding the landfill area are sampled and tested for hazardous substance screening in accordance with guidance[8]. This approach will help demonstrate compliance with the Groundwater Directive which prohibits discharge of these substances at discernible concentrations.

7.0 RISK EVALUATION

The following details summarise the risk evaluation of the Pollardstown Site:

- **The End Use of the Site -** It is understood that waste disposal activities for mixed waste materials generated in the Newbridge area ceased at the site in 1972. The site was used to dispose of street sweepings and construction and demolition waste associated with road works up to recent years. Dumping of other waste types was reported over this period. The site is currently used as a storage depot by Kildare County Council's Roads Section. It is assumed that there will be no direct exposure to shallow soils or groundwater in the near future and that there will be no disposal of any waste material at the site in the future;
- **Source -** The wastes deposited within the Site prior to 1972 and subsequently generated leachate are considered as a potential source of contamination;
- **Pathway -** Groundwater has been identified as a potential pathway for contaminated leachate and waters to migrate off site; and
- **Receptor -** The nearby Pollardstown Fen, a Special Area of Conservation at the downstream Site boundary is considered as the key receptor of a potential groundwater contamination deriving from the Pollardstown Site.

This Tier 3 Assessment has not established any material evidence that Pollardstown Fen is receiving significant contamination via groundwater drainage from beneath the Site. Leach tests carried out on

[8] Environment Agency 2003. Hydrogeological Risk Assessment for Landfills and the Derivation of Groundwater Control and Trigger Levels, LFTGN01.

selected wastes largely produced concentrations below comparative thresholds, and a LandSim model simulation of the Site performance predicted that concentrations would likely be below any perceptible threshold at the perimeter monitoring points.

Hazardous substance screening in accordance with UK EA Guidance document (Hydrogeological Risk Assessment for Landfills, UK EA) was carried out at the Site and at locations directly downstream of the Site during May 2012. In summary, Mercury was observed at a detectable concentration downstream of the Site, but not within the Site. Triphenyltin was detected at several locations both upstream and downstream of the Site. Further analysis of groundwater's in September/October 2012 for mercury and Organotin compounds at BH01, BH02 and BH04 have return all parameters below detection limit. Continued monitoring is recommended in the short term to confirm these findings.

8.0 CONCLUSIONS AND RECOMMENDATIONS

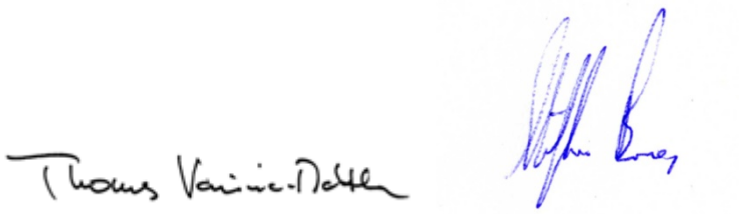
This Tier 3 Assessment has evaluated information as described in Section 1 of this report. Based on the available data, and the results of the numerical model, it can be concluded that the Pollardstown Depot Site is not contributing to significant contamination of Pollardstown Fen (as described in Section 4.2.1.2).

However, it is recommended that in addition to on-going monitoring for major ion chemistry, groundwater boreholes surrounding the landfill area are sampled and tested for hazardous substances including Mercury and Organotin compounds (in particular). This approach will help demonstrate compliance with the Groundwater Directive which prohibits discharge of these substances at discernible concentrations.

Furthermore, it is recommended that groundwater trigger concentrations that are considered to be protective of the receptor are established for selected key parameters from the list mentioned in Table 3 of this report (i.e. chloride, sulphate, TDS, ammonia, lead, arsenic, nickel potassium, zinc).

Report Signature Page

GOLDER ASSOCIATES IRELAND LIMITED



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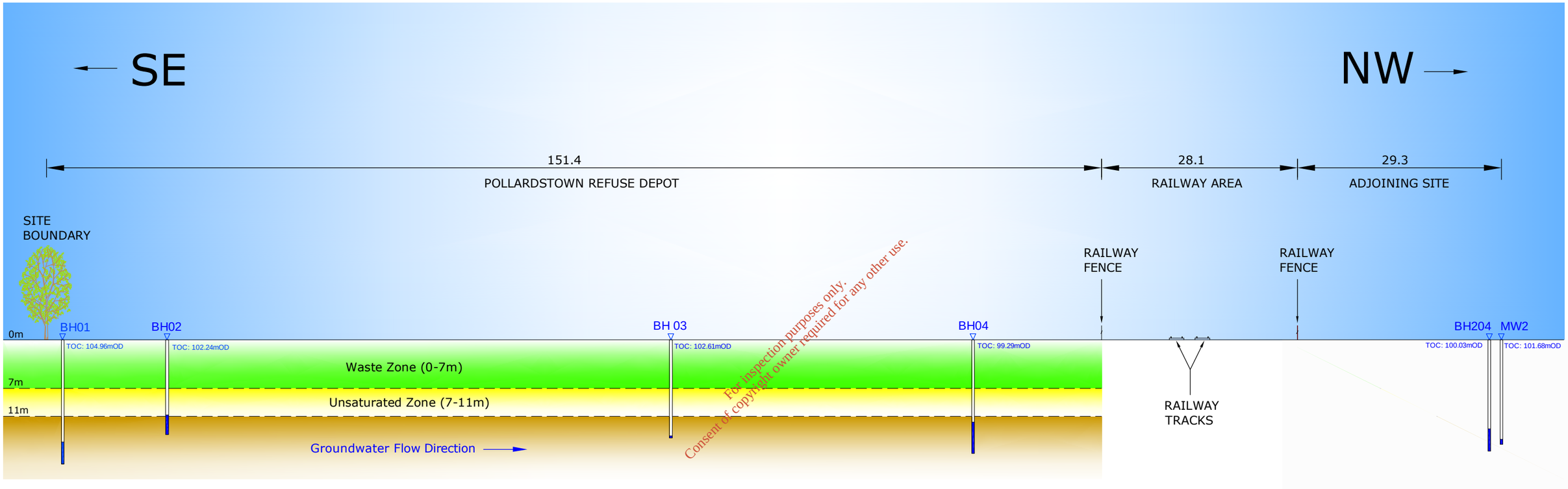
Directors: M. Gilligan, A. Harris (British)
VAT No.: 8297875W

APPENDIX A

Figure 1 - Conceptual Site Model



Borehole ID	Depth (Metres)	Groundwater Depth (m below groud)
BH01	17.8	14.7
BH02	13.6	10.8
BH03	14.1	13.8
BH04	16.3	11.8
MW02	15.0	14.3
BH204	16.0	12.8

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Client: **Kildare County Council**	Project number 11.5071.9.0200	Created By POB	Issue to *Kildare County Council*	Date *Mar. '12*	Version *A*
Location: Pollardstown Refuse Depot, Newbridge	File Location Graphics(July2008)/Waste/KildareCoCo/Poll&Carrig/Asbuilt/Autocad/Pollardstown-Fig05	Checked by TVM			
Project: Tier 3 Risk Assessment	ORDNANCE SURVEY IRELAND LICENCE NUMBER **AR0056012**	Reviewed by TVM			

Title: CONCEPTUAL SITE MODEL

Scale: Not to scale

Figure: **01**

APPENDIX B

Groundwater Monitoring Results

ANUA
Bord na Móna - with nature

Analysis Report

ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.0837

Project Code : 12-31561 **Report Unique ID:** 36208

Report Date : 15-Jun-2012 **Commen. Date:** 29/05/2012

Customer: **Mr. Gavin McDermott**

Mr. Gavin McDermott
Kildare County Council
Aras Cill Dara
Devoy Park
Naas
Co. Kildare

Contact Details:
gmcdermott@kildarecoco.ie

Approved by : **Roisin Kavanagh**
Team Leader

Sample Number : 321462 Client ID: BH-01 28/05/12
Sample Type:Groundwater Received: 28/05/2012 16:48 Condition: Good

Analysis	*Component*	*Specification*	*Result*	*Units*
Alkalinity	* Total Alkalinity	-	246	mg/L CaCO3
BOD	BOD	-	2	mg/l
Chloride	* Chloride	-	44	mg/l
COD	* COD	-	10	mg/l
Anions	* Sulphate	-	34.71	mg/l
Nitrate as N	* N03-N	-	2.0	mg/l
Nitrite as N	* N02-N	-	<0.02	mg/l
pH	* pH	-	7.6	pH units
Dissolved Solids	* Total dissolved solids	-	444	mg/l
Organic Carbon	* Total Organic Carbon	-	<5	mg/l
TON as N	* TON as N	-	2.0	mg/l

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ANUA
Bord na Móna - with nature

Analysis Report

ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.0837

Project Code : 12-31561 **Report Unique ID:** 36208

Sample Number : 321463 Client ID: BH-02 28/05/12

Sample Type:Groundwater Received: 28/05/2012 16:48 Condition: Good

Analysis	Component	Specification	Result	Units
Alkalinity	* Total Alkalinity	-	240	mg/L CaCO3
BOD	BOD	-	<2	mg/l
Chloride	* Chloride	-	30	mg/l
COD	* COD	-	17	mg/l
Anions	* Sulphate	-	315.01	mg/l
Nitrate as N	* N03-N	-	15	mg/l
Nitrite as N	* N02-N	-	0.02	mg/l
pH	* pH	-	7.6	pH units
Dissolved Solids	* Total dissolved solids	-	916	mg/l
Organic Carbon	* Total Organic Carbon	-	<5	mg/l
TON as N	* TON as N	-	15	mg/l

Sample Number : 321464 Client ID: BH-04 28/05/12

Sample Type:Groundwater Received: 28/05/2012 16:48 Condition: Good

Analysis	Component	Specification	Result	Units
Alkalinity	* Total Alkalinity	-	399	mg/L CaCO3
BOD	BOD	-	<2	mg/l
Chloride	* Chloride	-	30	mg/l
COD	* COD	-	11	mg/l
Anions	* Sulphate	-	77.26	mg/l
Nitrate as N	* N03-N	-	4.94	mg/l
Nitrite as N	* N02-N	-	0.02	mg/l
pH	* pH	-	7.2	pH units
Dissolved Solids	* Total dissolved solids	-	616	mg/l
Organic Carbon	* Total Organic Carbon	-	<5	mg/l
TON as N	* TON as N	-	5.0	mg/l

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ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.0837

Project Code : 12-31561 **Report Unique ID:** 36208

Sample Number : 321465 Client ID: BH-204 28/05/12

Sample Type:Groundwater Received: 28/05/2012 16:48 Condition: Good

Analysis	Component	Specification	Result	Units
Alkalinity	* Total Alkalinity	-	530	mg/L CaCO3
BOD	BOD	-	<2	mg/l
Chloride	* Chloride	-	16	mg/l
COD	* COD	-	30	mg/l
Anions	* Sulphate	-	106.40	mg/l
Nitrate as N	* N03-N	-	5.8	mg/l
Nitrite as N	* N02-N	-	0.02	mg/l
pH	* pH	-	7.2	pH units
Dissolved Solids	* Total dissolved solids	-	804	mg/l
Organic Carbon	* Total Organic Carbon	-	6	mg/l
TON as N	* TON as N	-	5.8	mg/l

Sample Number : 321466 Client ID: MW-2 28/05/12

Sample Type:Groundwater Received: 28/05/2012 16:48 Condition: Good

Analysis	Component	Specification	Result	Units
Alkalinity	* Total Alkalinity	-	512	mg/L CaCO3
BOD	BOD	-	2	mg/l
Chloride	* Chloride	-	23	mg/l
COD	* COD	-	10	mg/l
Anions	* Sulphate	-	113.39	mg/l
Nitrate as N	* N03-N	-	4.01	mg/l
Nitrite as N	* N02-N	-	0.04	mg/l
pH	* pH	-	7.0	pH units
Dissolved Solids	* Total dissolved solids	-	814	mg/l
Organic Carbon	* Total Organic Carbon	-	6	mg/l
TON as N	* TON as N	-	4.04	mg/l

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ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.0837

Project Code : 12-31561 **Report Unique ID: 36208**

Sample Number : 321469 Client ID: BH-01 28/05/12
Sample Type:Groundwater Received: 28/05/2012 16:48 Condition: Good

Analysis	Component	Specification	Result	Units
Ammonia	* NH3-N	-	<0.02	mg/l

Sample Number : 321470 Client ID: BH-01 28/05/12
Sample Type:Groundwater Received: 28/05/2012 16:48 Condition: Good

Analysis	Component	Specification	Result	Units
Boron(dissolved)	Boron (dissolved)	-	30	µg/l
Metals	* Arsenic (diss)	-	<2	µg/l
	* Chromium (diss)	-	2	µg/l
	* Cadmium (diss)	-	5	µg/l
	* Copper (diss)	-	14	µg/l
	Potassium (diss)	-	1.8	mg/l
	Sodium (diss)	-	28	mg/l
	* Nickel (diss)	-	12	µg/l
	* Lead (diss)	-	11	µg/l
	* Selenium (diss)	-	<2	µg/l
	* Zinc (diss)	-	186	µg/l
Mercury	Mercury (diss)	-	<1	µg/l

Sample Number : 321471 Client ID: BH-02 28/05/12
Sample Type:Groundwater Received: 28/05/2012 16:48 Condition: Good

Analysis	Component	Specification	Result	Units
Ammonia	* NH3-N	-	0.03	mg/l

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ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.0837

Project Code : 12-31561 **Report Unique ID: 36208**

Sample Number : 321472 Client ID: BH-02 28/05/12
Sample Type:Groundwater Received: 28/05/2012 16:48 Condition: Good

Analysis	Component	Specification	Result	Units
Boron(dissolved)	Boron (dissolved)	-	462	µg/l
Metals	* Arsenic (diss)	-	<2	µg/l
	* Chromium (diss)	-	8	µg/l
	* Cadmium (diss)	-	<2	µg/l
	* Copper (diss)	-	3	µg/l
	Potassium (diss)	-	7.7	mg/l
	Sodium (diss)	-	21	mg/l
	* Nickel (diss)	-	2	µg/l
	* Lead (diss)	-	7	µg/l
	* Selenium (diss)	-	7	µg/l
	* Zinc (diss)	-	29	µg/l
Mercury	Mercury (diss)	-	<1	µg/l

Sample Number : 321473 Client ID: BH-04 28/05/12
Sample Type:Groundwater Received: 28/05/2012 16:48 Condition: Good

Analysis	Component	Specification	Result	Units
Ammonia	* NH3-N	-	<0.02	mg/l

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ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.0837

Project Code : 12-31561 **Report Unique ID: 36208**

Sample Number : 321474 Client ID: BH-04 28/05/12
Sample Type:Groundwater Received: 28/05/2012 16:48 Condition: Good

Analysis	Component	Specification	Result	Units
Boron(dissolved)	Boron (dissolved)	-	990	µg/l
Metals	* Arsenic (diss)	-	<2	µg/l
	* Chromium (diss)	-	2	µg/l
	* Cadmium (diss)	-	4	µg/l
	* Copper (diss)	-	<2	µg/l
	Potassium (diss)	-	2.6	mg/l
	Sodium (diss)	-	21	mg/l
	* Nickel (diss)	-	<2	µg/l
	* Lead (diss)	-	11	µg/l
	* Selenium (diss)	-	<2	µg/l
	* Zinc (diss)	-	43	µg/l
Mercury	Mercury (diss)	-	<1	µg/l

Sample Number : 321475 Client ID: BH-204 28/05/12
Sample Type:Groundwater Received: 28/05/2012 16:48 Condition: Good

Analysis	Component	Specification	Result	Units
Ammonia	* NH3-N	-	0.02	mg/l

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ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.0837

Project Code : 12-31561 **Report Unique ID: 36208**

Sample Number : 321476 Client ID: BH-204 28/05/12
Sample Type:Groundwater Received: 28/05/2012 16:48 Condition: Good

Analysis	Component	Specification	Result	Units
Boron(dissolved)	Boron (dissolved)	-	222	µg/l
Metals	* Arsenic (diss)	-	<2	µg/l
	* Chromium (diss)	-	6	µg/l
	* Cadmium (diss)	-	2	µg/l
	* Copper (diss)	-	6	µg/l
	Potassium (diss)	-	9.6	mg/l
	Sodium (diss)	-	13	mg/l
	* Nickel (diss)	-	2	µg/l
	* Lead (diss)	-	12	µg/l
	* Selenium (diss)	-	<2	µg/l
	* Zinc (diss)	-	40	µg/l
Mercury	Mercury (diss)	-	<1	µg/l

Sample Number : 321477 Client ID: MW-2 28/05/12
Sample Type:Groundwater Received: 28/05/2012 16:48 Condition: Good

Analysis	Component	Specification	Result	Units
Ammonia	* NH3-N	-	0.03	mg/l

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ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.0837

Project Code : 12-31561 **Report Unique ID:** 36208

Sample Number : 321478 Client ID: MW-2 28/05/12

Sample Type:Groundwater Received: 28/05/2012 16:48 Condition: Good

Analysis	*Component*	*Specification*	*Result*	*Units*
Boron(dissolved)	Boron (dissolved)	-	276	µg/l
Metals	* Arsenic (diss)	-	2	µg/l
	* Chromium (diss)	-	2	µg/l
	* Cadmium (diss)	-	3	µg/l
	* Copper (diss)	-	15	µg/l
	Potassium (diss)	-	25	mg/l
	Sodium (diss)	-	18	mg/l
	* Nickel (diss)	-	14	µg/l
	* Lead (diss)	-	63	µg/l
	* Selenium (diss)	-	<2	µg/l
	* Zinc (diss)	-	50	µg/l
Mercury	Mercury (diss)	-	<1	µg/l

Project Code : 12-31561 **Report Unique ID: 36208**

Sample Number : 321482 Client ID: BH-204 28/05/12

Sample Type:Groundwater Received: 28/05/2012 16:48 Condition: Good

Analysis	Component	Specification	Result	Units
	2,3,6-TBA**	-	<0.1	µg/l
	2,4,5-T**	-	<0.1	µg/l
	2,4,5-TP (fenoprop)**	-	<0.1	µg/l
	2,4-D**	-	<0.1	µg/l
	2,4-DB**	-	<0.1	µg/l
	4-CPA**	-	<0.1	µg/l
	benazolin**	-	<0.1	µg/l
	bentazone**	-	<0.1	µg/l
	bromoxynil**	-	<0.1	µg/l
	clopyralid**	-	<0.1	µg/l
	dicamba**	-	<0.1	µg/l
	dicloroprop (2,4-DP)**	-	<0.1	µg/l
	diclofop**	-	<0.1	µg/l
	flamprop**	-	<0.1	µg/l
	flamprop-isopropyl**	-	<0.1	µg/l
	ioxynil**	-	<0.1	µg/l
	MCPA**	-	<0.1	µg/l
	MCPB**	-	<0.1	µg/l
	MCPP**	-	<0.1	µg/l
	pentachlorophenol**	-	<0.1	µg/l
	picloram**	-	<0.1	µg/l
	triclopyr**	-	<0.1	µg/l
Triazine Herbicides	Atrazine**	-	<1	µg/l
Metal Scan	Cadmium**	-	<0.5	µg/l
	Mercury**	-	0.02	µg/l
	Dibutyltin**	-	<0.01	µg/l
	Tributyltin**	-	<0.01	µg/l
	Triphenyltin**	-	<0.01	µg/l
OrganCl Pesticides	Tecnazene**	-	<0.01	µg/l
	Trifluralin**	-	<0.01	µg/l
	Alpha - BHC**	-	<0.01	µg/l
	Hexachlorobenzene**	-	<0.01	µg/l
	Beta - BHC**	-	<0.01	µg/l
	Gamma - BHC(lindane)**	-	<0.01	µg/l
	Quintozene(PCNB)**	-	<0.01	µg/l
	Triallate**	-	<0.01	µg/l
	Chlorothalonil**	-	<0.01	µg/l
	Heptachlor**	-	<0.01	µg/l
	Aldrin**	-	<0.01	µg/l
	Triadimefon**	-	<0.01	µg/l
	Pendimethalin**	-	<0.01	µg/l

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ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.0837

Project Code : 12-31561 **Report Unique ID: 36208**

Sample Number : 321482 Client ID: BH-204 28/05/12

Sample Type:Groundwater Received: 28/05/2012 16:48 Condition: Good

Analysis	*Component*	*Specification*	*Result*	*Units*
OrganCl Pesticides	heptachlor epoxide**	-	<0.01	µg/l
	o, p'-DDE**	-	<0.01	µg/l
	Endosulphan I**	-	<0.01	µg/l
	p,p'-DDE**	-	<0.01	µg/l
	Dieldrin**	-	<0.01	µg/l
	p,p'-TDE(DDD)**	-	<0.01	µg/l
	Endrin**	-	<0.01	µg/l
	Endosulphan II**	-	<0.01	µg/l
	o,p'-TDE(DDD)**	-	<0.01	µg/l
	Endosulfan Sulphate**	-	<0.01	µg/l
	o, p'-Methoxychlor**	-	<0.01	µg/l
	p, p'-Methoxychlor**	-	<0.01	µg/l
	Permethrin 1**	-	<0.01	µg/l
	Permethrin 11**	-	<0.01	
	Telodrin**	-	<0.01	µg/l
	Isodrin**	-	<0.01	µg/l
	trans-Chlordane**	-	<0.01	µg/l
	cis-Chlordane**	-	<0.01	µg/l
	o,p-DDT**	-	<0.01	µg/l
	p,p-DDT**	-	<0.01	µg/l
	Ethion **	-	<0.01	
	Hexachlorobutadiene**	-	<0.01	
OP Pesticides	Dichlorvos**	-	<0.01	µg/l
	Mevinphos**	-	<0.01	µg/l
	Dimethoate**	-	<0.01	µg/l
	Propetamphos**	-	<0.01	µg/l
	Diazinon**	-	<0.01	µg/l
	Etrimphos**	-	<0.01	µg/l
	Chlorphyrifos-methyl**	-	<0.01	µg/l
	Fenitrothion**	-	<0.01	µg/l
	Malathion**	-	<0.01	µg/l
	Fenthion**	-	<0.01	µg/l
	Chlorpyrifos**	-	<0.01	µg/l
	Chlorfenvinphos**	-	<0.01	µg/l
	Ethion**	-	<0.01	µg/l
	Triazophos**	-	<0.01	µg/l
	Carbophenothion**	-	<0.01	µg/l
	Phosalone**	-	<0.01	µg/l
	Azinphos ethyl**	-	<0.01	µg/l
	Azinphos methyl**	-	<0.01	µg/l
	Methyl Parathion**	-	<0.01	µg/l

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ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.0837

Project Code : 12-31561 **Report Unique ID: 36208**

Sample Number : 321482 Client ID: BH-204 28/05/12

Sample Type:Groundwater Received: 28/05/2012 16:48 Condition: Good

Analysis	Component	Specification	Result	Units
OP Pesticides	Parathion**	-	<0.01	µg/l
SVOC'S	1,2,4-Trichlorobenzene**	-	<10	µg/l
	1,2-Dichlorobenzene**	-	<10	µg/l
	1,3-Dichlorobenzene**	-	<10	µg/l
	1,4-Dichlorobenzene**	-	<10	µg/l
	2,4,5-Trichlorophenol**	-	<10	µg/l
	2,4,6-Trichlorophenol**	-	<10	µg/l
	2,4-Dichlorophenol**	-	<10	µg/l
	2,4-Dimethylphenol**	-	<10	µg/l
	2-Chloronaphthalene**	-	<10	µg/l
	2-Chlorophenol**	-	<10	µg/l
	2-Methylnaphthalene**	-	<10	µg/l
	2-Methylphenol**	-	<10	µg/l
	2-Nitroaniline**	-	<10	µg/l
	2-Nitrophenol**	-	<10	µg/l
	3-Nitroaniline**	-	<10	µg/l
	4-Bromophenylphenylether**	-	<10	µg/l
	4-Chloro-3-methylphenol**	-	<10	µg/l
	4-Chloroaniline**	-	<10	µg/l
	4-Chlorophenylphenylether**	-	<10	µg/l
	4-Methylphenol**	-	<10	µg/l
	4-Nitrophenol**	-	<10	µg/l
	4-Nitroaniline**	-	<10	µg/l
	Azobenzene**	-	<10	µg/l
	Acenaphthylene**	-	<10	µg/l
	Acenaphthene**	-	<10	µg/l
	Anthracene**	-	<10	µg/l
	Bis(2-Chloroethyl)ether**	-	<10	µg/l
	Bis(2-chloroethoxy)methane**	-	<10	µg/l
	Bis(2-ethylhexyl)phthalate**	-	<10	µg/l
	Benzo(a)anthracene**	-	<10	µg/l
	Butylbenzylphthalate**	-	<10	µg/l
	Benzo(a)pyrene**	-	<10	µg/l
	Benzo(ghi)perylene**	-	<10	µg/l
	Carbazole**	-	<10	µg/l
	Chrysene**	-	<10	µg/l
	Dibenzofuran**	-	<10	µg/l
	Diethyl phthalate**	-	<10	µg/l
	Dibenzo(a,h)anthracene**	-	<10	µg/l
	Dimethyl phthalate**	-	<10	µg/l
	Flourene**	-	<10	µg/l

Project Code : 12-31561 **Report Unique ID:** 36208

Sample Number : 321482 Client ID: BH-204 28/05/12

Sample Type:Groundwater Received: 28/05/2012 16:48 Condition: Good

Analysis	Component	Specification	Result	Units
SVOC'S	Hexachlorobenzene**	-	<10	µg/l
	hexachlorobutadiene**	-	<10	µg/l
	Pentachlorophenol**	-	<10	µg/l
	Phenol**	-	<10	µg/l
	N-nitrosodi-n-propylamine**	-	<10	µg/l
	Hexachloroethane**	-	<10	µg/l
	Nitrobenzene**	-	<10	µg/l
	Naphthalene**	-	<10	µg/l
	Isophorone**	-	<10	µg/l
	Hexachlorocyclopentadiene**	-	<10	µg/l
	Phenanthrene**	-	<10	µg/l
	Indenol(1,2,3-cd)pyrene**	-	<10	µg/l
	Pyrene**	-	<10	µg/l
VOC's	Trichloroethene**	-	<3	µg/l
	1,2-Dichlorobenzene**	-	<3	µg/l
	Chlorobenzene**	-	<2	µg/l
	Tetrachloroethene**	-	<3	µg/l

Project Code : 12-31561 **Report Unique ID: 36208**

Sample Number : 321483 Client ID: MW-2 28/05/12

Sample Type:Groundwater Received: 28/05/2012 16:48 Condition: Good

Analysis	Component	Specification	Result	Units
	2,3,6-TBA**	-	<0.1	µg/l
	2,4,5-T**	-	<0.1	µg/l
	2,4,5-TP (fenoprop)**	-	<0.1	µg/l
	2,4-D**	-	<0.1	µg/l
	2,4-DB**	-	<0.1	µg/l
	4-CPA**	-	<0.1	µg/l
	benazolin**	-	<0.1	µg/l
	bentazone**	-	<0.1	µg/l
	bromoxynil**	-	<0.1	µg/l
	clopyralid**	-	<0.1	µg/l
	dicamba**	-	<0.1	µg/l
	dicloroprop (2,4-DP)**	-	<0.1	µg/l
	diclofop**	-	<0.1	µg/l
	flamprop**	-	<0.1	µg/l
	flamprop-isopropyl**	-	<0.1	µg/l
	ioxynil**	-	<0.1	µg/l
	MCPA**	-	<0.1	µg/l
	MCPB**	-	<0.1	µg/l
	MCPP**	-	<0.1	µg/l
	pentachlorophenol**	-	<0.1	µg/l
	picloram**	-	<0.1	µg/l
	triclopyr**	-	<0.1	µg/l
Triazine Herbicides	Atrazine**	-	<1	µg/l
Metal Scan	Cadmium**	-	<0.5	µg/l
	Mercury**	-	<0.01	µg/l
	Dibutyltin**	-	<0.01	µg/l
	Tributyltin**	-	<0.01	µg/l
	Triphenyltin**	-	<0.01	µg/l
OrganCl Pesticides	Tecnazene**	-	<0.01	µg/l
	Trifluralin**	-	<0.01	µg/l
	Alpha - BHC**	-	<0.01	µg/l
	Hexachlorobenzene**	-	<0.01	µg/l
	Beta - BHC**	-	<0.01	µg/l
	Gamma - BHC(lindane)**	-	<0.01	µg/l
	Quintozene(PCNB)**	-	<0.01	µg/l
	Triallate**	-	<0.01	µg/l
	Chlorothalonil**	-	<0.01	µg/l
	Heptachlor**	-	<0.01	µg/l
	Aldrin**	-	<0.01	µg/l
	Triadimefon**	-	<0.01	µg/l
	Pendimethalin**	-	<0.01	µg/l

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ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.0837

Project Code : 12-31561 **Report Unique ID: 36208**

Sample Number : 321483 Client ID: MW-2 28/05/12

Sample Type:Groundwater Received: 28/05/2012 16:48 Condition: Good

Analysis	*Component*	*Specification*	*Result*	*Units*
OrganCl Pesticides	heptachlor epoxide**	-	<0.01	µg/l
	o, p'-DDE**	-	<0.01	µg/l
	Endosulphan I**	-	<0.01	µg/l
	p,p'-DDE**	-	<0.01	µg/l
	Dieldrin**	-	<0.01	µg/l
	p,p'-TDE(DDD)**	-	<0.01	µg/l
	Endrin**	-	<0.01	µg/l
	Endosulphan II**	-	<0.01	µg/l
	o,p'-TDE(DDD)**	-	<0.01	µg/l
	Endosulfan Sulphate**	-	<0.01	µg/l
	o, p'-Methoxychlor**	-	<0.01	µg/l
	p, p'-Methoxychlor**	-	<0.01	µg/l
	Permethrin 1**	-	<0.01	µg/l
	Permethrin 11**	-	<0.01	
	Telodrin**	-	<0.01	µg/l
	Isodrin**	-	<0.01	µg/l
	trans-Chlordane**	-	<0.01	µg/l
	cis-Chlordane**	-	<0.01	µg/l
	o,p-DDT**	-	<0.01	µg/l
	p,p-DDT**	-	<0.01	µg/l
	Ethion **	-	<0.01	
	Hexachlorobutadiene**	-	<0.01	
OP Pesticides	Dichlorvos**	-	<0.01	µg/l
	Mevinphos**	-	<0.01	µg/l
	Dimethoate**	-	<0.01	µg/l
	Propetamphos**	-	<0.01	µg/l
	Diazinon**	-	<0.01	µg/l
	Etrimphos**	-	<0.01	µg/l
	Chlorphyrifos-methyl**	-	<0.01	µg/l
	Fenitrothion**	-	<0.01	µg/l
	Malathion**	-	<0.01	µg/l
	Fenthion**	-	<0.01	µg/l
	Chlorpyrifos**	-	<0.01	µg/l
	Chlorfenvinphos**	-	<0.01	µg/l
	Ethion**	-	<0.01	µg/l
	Triazophos**	-	<0.01	µg/l
	Carbophenothion**	-	<0.01	µg/l
	Phosalone**	-	<0.01	µg/l
	Azinphos ethyl**	-	<0.01	µg/l
	Azinphos methyl**	-	<0.01	µg/l
	Methyl Parathion**	-	<0.01	µg/l

Bord na Móna Environmental Ltd., (Trading as ANUA),
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ANUA
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Analysis Report

ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.0837

Project Code : 12-31561 **Report Unique ID: 36208**

Sample Number : 321483 Client ID: MW-2 28/05/12

Sample Type:Groundwater Received: 28/05/2012 16:48 Condition: Good

Analysis	Component	Specification	Result	Units
OP Pesticides	Parathion**	-	<0.01	µg/l
SVOC'S	1,2,4-Trichlorobenzene**	-	<10	µg/l
	1,2-Dichlorobenzene**	-	<10	µg/l
	1,3-Dichlorobenzene**	-	<10	µg/l
	1,4-Dichlorobenzene**	-	<10	µg/l
	2,4,5-Trichlorophenol**	-	<10	µg/l
	2,4,6-Trichlorophenol**	-	<10	µg/l
	2,4-Dichlorophenol**	-	<10	µg/l
	2,4-Dimethylphenol**	-	<10	µg/l
	2-Chloronaphthalene**	-	<10	µg/l
	2-Chlorophenol**	-	<10	µg/l
	2-Methylnaphthalene**	-	<10	µg/l
	2-Methylphenol**	-	<10	µg/l
	2-Nitroaniline**	-	<10	µg/l
	2-Nitrophenol**	-	<10	µg/l
	3-Nitroaniline**	-	<10	µg/l
	4-Bromophenylphenylether**	-	<10	µg/l
	4-Chloro-3-methylphenol**	-	<10	µg/l
	4-Chloroaniline**	-	<10	µg/l
	4-Chlorophenylphenylether**	-	<10	µg/l
	4-Methylphenol**	-	<10	µg/l
	4-Nitrophenol**	-	<10	µg/l
	4-Nitroaniline**	-	<10	µg/l
	Azobenzene**	-	<10	µg/l
	Acenaphthene**	-	<10	µg/l
	Anthracene**	-	<10	µg/l
	Bis(2-Chloroethyl)ether**	-	<10	µg/l
	Bis(2-chloroethoxy)methane**	-	<10	µg/l
	Bis(2-ethylhexyl)phthalate**	-	<10	µg/l
	Benzo(a)anthracene**	-	<10	µg/l
	Butylbenzylphthalate**	-	<10	µg/l
	Benzo(a)pyrene**	-	<10	µg/l
	Benzo(ghi)perylene**	-	<10	µg/l
	Carbazole**	-	<10	µg/l
	Chrysene**	-	<10	µg/l
	Dibenzofuran**	-	<10	µg/l
	Diethyl phthalate**	-	<10	µg/l
	Dibenzo(a,h)anthracene**	-	<10	µg/l
	Dimethyl phthalate**	-	<10	µg/l
	Flourene**	-	<10	µg/l
	Hexachlorobenzene**	-	<10	µg/l

Project Code : 12-31561 **Report Unique ID:** 36208

Sample Number : 321483 Client ID: MW-2 28/05/12

Sample Type:Groundwater Received: 28/05/2012 16:48 Condition: Good

Analysis	*Component*	*Specification*	*Result*	*Units*
SVOC'S	hexachlorobutadiene**	-	<10	µg/l
	Pentachlorophenol**	-	<10	µg/l
	Phenol**	-	<10	µg/l
	N-nitrosodi-n-propylamine**	-	<10	µg/l
	Hexachloroethane**	-	<10	µg/l
	Nitrobenzene**	-	<10	µg/l
	Naphthalene**	-	<10	µg/l
	Isophorone**	-	<10	µg/l
	Hexachlorocyclopentadiene**	-	<10	µg/l
	Phenanthrene**	-	<10	µg/l
	Indenol(1,2,3-cd)pyrene**	-	<10	µg/l
	Pyrene**	-	<10	µg/l
VOC's	Trichloroethene**	-	<3	µg/l
	1,2-Dichlorobenzene**	-	<3	µg/l
	Chlorobenzene**	-	<2	µg/l
	Tetrachloroethene**	-	<3	µg/l

Methods of Analysis

Analysis Name:	Method:
Organic Carbon	TOC Analyser
Metal Scan	
Anions	G/39 Ion Chromatography
COD	G/03: Based on APHA, 2005, 21st Edition, Method 5220D
Mercury	ICP-MS
pH	G/05 Based on APHA,2005,21st Edition,Method 4500 H+B
Alkalinity	G/69 Based on Standard Methods for examination of Water + Waste Water,2005,21st Edition,4500-P.E.
Triazine Herbicides	GC -MS
Nitrate as N	G/67 Based on APHA 2005,21st Edition,4500-N02B colorimetric method
Metals	G57 Based on EPA Method 200.8
BOD	G/04: Based on APHA, 2005, 21st Edition, Method 5210B. TCMP Nitrification inhibition.
Ammonia	G/67 Based on APHA 2005,21st Edition,4500-NH3 and bluebook Ammonia in waters 1981
Chloride	Based on G67 Konelab
SVOC'S	
OP Pesticides	GC-MS
TON as N	G/67 Based on APHA,2005,21st Edition,4500-N02B.Colorimetric method
Boron(dissolved)	ICP -MS
OrganCl Pesticides	
Dissolved Solids	G/18: Standard methods for the Examination of water and wastewater, 2005, 21st Edition, 2540 C
Nitrite as N	G/67 Based on APHA 2005,21st Edition,4500-N02B.Colorimetric method
VOC's	

Notes

* = INAB accredited test ** = subcontracted test *** = outside accredited range

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3. All Comments concerning this report or its contents should be forwarded to the Laboratory Manager

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DRAFT

Analysis Report

Project Code : 12-31733 **Report Unique ID:**

Report Date : 04-Jul-2012 **Commen. Date:**

Customer: **Mr. Gavin McDermott**

Mr. Gavin McDermott
Kildare County Council
Aras Cill Dara
Devoy Park
Naas
Co. Kildare

Contact Details:
gmcdermott@kildarecoco.ie

Approved by :

Sample Number : 323096 Client ID: BH-01 11/06/12

Sample Type:Groundwater Received: 11/06/2012 13:39 Condition: Good

Analysis	Component	Specification	Result	Units
	2,3,6-TBA**	-	<0.1	µg/l
	2,4,5-T**	-	<0.1	µg/l
	2,4,5-TP (fenoprop)**	-	<0.1	µg/l
	2,4-D**	-	<0.1	µg/l
	2,4-DB**	-	<0.1	µg/l
	4-CPA**	-	<0.1	µg/l
	benazolin**	-	<0.1	µg/l
	bentazone**	-	<0.1	µg/l
	bromoxynil**	-	<0.1	µg/l
	clopyralid**	-	<0.1	µg/l
	dicamba**	-	<0.1	µg/l
	dicloroprop (2,4-DP)**	-	<0.1	µg/l
	diclofop**	-	<0.1	µg/l
	flamprop**	-	<0.1	µg/l
	flamprop-isopropyl**	-	<0.1	µg/l
	ioxynil**	-	<0.1	µg/l
	MCPA**	-	<0.1	µg/l
	MCPB**	-	<0.1	µg/l
	pentachlorophenol**	-	<0.1	µg/l
	picloram**	-	<0.1	µg/l
	triclopyr**	-	<0.1	µg/l
Triazine Herbicides	Atrazine**	-	<1	µg/l
Metal Scan	Cadmium**	-	<0.5	µg/l
	Mercury**	-	<0.01	µg/l
	Dibutyltin**	-	<0.01	µg/l
	Tributyltin**	-	<0.01	µg/l

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Analysis Report

Project Code : 12-31733 **Report Unique ID:**

Sample Number : 323096 Client ID: BH-01 11/06/12

Sample Type:Groundwater Received: 11/06/2012 13:39 Condition: Good

Analysis	*Component*	*Specification*	*Result*	*Units*
	Triphenyltin**	-	1.78	µg/l
OrganCl Pesticides	Tecnazene**	-	<0.01	µg/l
	Trifluralin**	-	<0.01	µg/l
	Alpha - BHC**	-	<0.01	µg/l
	Hexachlorobenzene**	-	<0.01	µg/l
	Beta - BHC**	-	<0.01	µg/l
	Gamma - BHC(lindane)**	-	<0.01	µg/l
	Quintozene(PCNB)**	-	<0.01	µg/l
	Triallate**	-	<0.01	µg/l
	Chlorothalonil**	-	<0.01	µg/l
	Heptachlor**	-	<0.01	µg/l
	Aldrin**	-	<0.01	µg/l
	Triadimefon**	-	<0.01	µg/l
	Pendimethalin**	-	<0.01	µg/l
	heptachlor epoxide**	-	<0.01	µg/l
	o, p'-DDE**	-	<0.01	µg/l
	Endosulphan I**	-	<0.01	µg/l
	p,p'-DDE**	-	<0.01	µg/l
	Dieldrin**	-	<0.01	µg/l
	p,p'-TDE(DDD)**	-	<0.01	µg/l
	Endrin**	-	<0.01	µg/l
	Endosulphan II**	-	<0.01	µg/l
	o,p'-TDE(DDD)**	-	<0.01	µg/l
	Endosulfan Sulphate**	-	<0.01	µg/l
	o, p'-Methoxychlor**	-	<0.01	µg/l
	p, p'-Methoxychlor**	-	<0.01	µg/l
	Permethrin 1**	-	<0.01	µg/l
	Permethrin 11**	-	<0.01	µg/l
	Telodrin**	-	<0.01	µg/l
	Isodrin**	-	<0.011	µg/l
	trans-Chlordane**	-	<0.01	µg/l
	cis-Chlordane**	-	<0.01	µg/l
	o,p-DDT**	-	<0.01	µg/l
	p,p-DDT**	-	<0.01	µg/l
	Ethion **	-	<0.01	µg/l
	Hexachlorobutadiene**	-	<10	µg/l
SVOC'S	1,2,4-Trichlorobenzene**	-	<10	µg/l
	1,2-Dichlorobenzene**	-	<10	µg/l
	1,3-Dichlorobenzene**	-	<10	µg/l
	1,4-Dichlorobenzene**	-	<10	µg/l
	2,4,5-Trichlorophenol**	-	<10	µg/l

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Analysis Report

Project Code : 12-31733 **Report Unique ID:**

Sample Number : 323096 Client ID: BH-01 11/06/12

Sample Type:Groundwater Received: 11/06/2012 13:39 Condition: Good

Analysis	*Component*	*Specification*	*Result*	*Units*
SVOC'S	2,4,6-Trichlorophenol**	-	<10	µg/l
	2,4-Dichlorophenol**	-	<10	µg/l
	2,4-Dimethylphenol**	-	<10	µg/l
	2,4-Dinitrotoluene**	-	<10	µg/l
	2,6-Dinitrotoluene**	-	<10	µg/l
	2-Chloronaphthalene**	-	<10	µg/l
	2-Chlorophenol**	-	<10	µg/l
	2-Methylnaphthalene**	-	<10	µg/l
	2-Methylphenol**	-	<10	µg/l
	2-Nitroaniline**	-	<10	µg/l
	2-Nitrophenol**	-	<10	µg/l
	3-Nitroaniline**	-	<10	µg/l
	4-Bromophenylphenylether**	-	<10	µg/l
	4-Chloro-3-methylphenol**	-	<10	µg/l
	4-Chloroaniline**	-	<10	µg/l
	4-Chlorophenylphenylether**	-	<10	µg/l
	4-Methylphenol**	-	<10	µg/l
	4-Nitrophenol**	-	<10	µg/l
	4-Nitroaniline**	-	<10	µg/l
	Azobenzene**	-	<10	µg/l
	Acenaphthylene**	-	<10	µg/l
	Acenaphthene**	-	<10	µg/l
	Anthracene**	-	<10	µg/l
	Bis(2-Chloroethyl)ether**	-	<10	µg/l
	Bis(2-chloroethoxy)methane**	-	<10	µg/l
	Bis(2-ethylhexyl)phthalate**	-	<10	µg/l
	Benzo(a)anthracene**	-	<10	µg/l
	Butylbenzylphthalate**	-	<10	µg/l
	Benzo(a)pyrene**	-	<10	µg/l
	Benzo(ghi)perylene**	-	<10	µg/l
	Carbazole**	-	<10	µg/l
	Chrysene**	-	<10	µg/l
	Dibenzofuran**	-	<10	µg/l
	n-Di-butylphthalate**	-	<10	µg/l
	Diethyl phthalate**	-	<10	µg/l
	Dibenzo(a,h)anthracene**	-	<10	µg/l
	Dimethyl phthalate**	-	<10	µg/l
	n-Di octyl phthalate**	-	<10	µg/l
	Fluoranthene**	-	<10	µg/l
	Flourene**	-	<10	µg/l

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Analysis Report

Project Code : 12-31733 **Report Unique ID:**

Sample Number : 323096 Client ID: BH-01 11/06/12

Sample Type:Groundwater Received: 11/06/2012 13:39 Condition: Good

Analysis	*Component*	*Specification*	*Result*	*Units*
SVOC'S	Hexachlorobenzene**	-	<10	µg/l
	hexachlorobutadiene**	-	<10	µg/l
	Pentachlorophenol**	-	<10	µg/l
	Phenol**	-	<10	µg/l
	N-nitrosodi-n-propylamine**	-	<10	µg/l
	Hexachloroethane**	-	<10	µg/l
	Nitrobenzene**	-	<10	µg/l
	Naphthalene**	-	<10	µg/l
	Isophorone**	-	<10	µg/l
	Hexachlorocyclopentadiene**	-	<10	µg/l
	Phenanthrene**	-	<10	µg/l
	Indenol(1,2,3-cd)pyrene**	-	<10	µg/l
	Pyrene**	-	<10	µg/l
VOC's	Chloromethane**	-	<3	µg/l
	Trichloroethene**	-	<3	µg/l
	1,2-Dichlorobenzene**	-	<3	µg/l
	Chlorobenzene**	-	<2	µg/l
	Tetrachloroethene**	-	<3	µg/l

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Analysis Report

Project Code : 12-31733

Report Unique ID:

Sample Number : 323097 Client ID: BH-02 11/06/12

Sample Type:Groundwater Received: 11/06/2012 13:39 Condition: Good

Analysis	*Component*	*Specification*	*Result*	*Units*
	2,3,6-TBA**	-	<0.1	µg/l
	2,4,5-T**	-	<0.1	µg/l
	2,4,5-TP (fenoprop)**	-	<0.1	µg/l
	2,4-D**	-	<0.1	µg/l
	2,4-DB**	-	<0.1	µg/l
	4-CPA**	-	<0.1	µg/l
	benazolin**	-	<0.1	µg/l
	bentazone**	-	<0.1	µg/l
	bromoxynil**	-	<0.1	µg/l
	clopyralid**	-	<0.1	µg/l
	dicamba**	-	<0.1	µg/l
	dicloroprop (2,4-DP)**	-	<0.1	µg/l
	diclofop**	-	<0.1	µg/l
	flamprop**	-	<0.1	µg/l
	flamprop-isopropyl**	-	<0.1	µg/l
	ioxynil**	-	<0.1	µg/l
	MCPA**	-	<0.1	µg/l
	MCPB**	-	<0.1	µg/l
	pentachlorophenol**	-	<0.1	µg/l
	picloram**	-	<0.1	µg/l
	triclopyr**	-	<0.1	µg/l
Triazine Herbicides	Atrazine**	-	<1	µg/l
Metal Scan	Cadmium**	-	<0.5	µg/l
	Mercury**	-	<0.01	µg/l
	Dibutyltin**	-	<0.01	µg/l
	Tributyltin**	-	<0.01	µg/l
	Triphenyltin**	-	0.33	µg/l
OrganCl Pesticides	Tecnazene**	-	<0.01	µg/l
	Trifluralin**	-	<0.01	µg/l
	Alpha - BHC**	-	<0.01	µg/l
	Hexachlorobenzene**	-	<0.01	µg/l
	Beta - BHC**	-	<0.01	µg/l
	Gamma - BHC(lindane)**	-	<0.01	µg/l
	Quintozene(PCNB)**	-	<0.01	µg/l
	Triallate**	-	<0.01	µg/l
	Chlorothalonil**	-	<0.01	µg/l
	Heptachlor**	-	<0.01	µg/l
	Aldrin**	-	<0.01	µg/l
	Triadimefon**	-	<0.01	µg/l
	Pendimethalin**	-	<0.01	µg/l
	heptachlor epoxide**	-	<0.01	µg/l

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Analysis Report

Project Code : 12-31733 **Report Unique ID:**

Sample Number : 323097 Client ID: BH-02 11/06/12

Sample Type:Groundwater Received: 11/06/2012 13:39 Condition: Good

Analysis	*Component*	*Specification*	*Result*	*Units*
OrganCl Pesticides	o, p'-DDE**	-	<0.01	µg/l
	Endosulphan I**	-	<0.01	µg/l
	p,p'-DDE**	-	<0.01	µg/l
	Dieldrin**	-	<0.01	µg/l
	p,p'-TDE(DDD)**	-	<0.01	µg/l
	Endrin**	-	<0.01	µg/l
	Endosulphan II**	-	<0.01	µg/l
	o,p'-TDE(DDD)**	-	<0.01	µg/l
	Endosulfan Sulphate**	-	<0.01	µg/l
	o, p'-Methoxychlor**	-	<0.01	µg/l
	p, p'-Methoxychlor**	-	<0.01	µg/l
	Permethrin 1**	-	<0.01	µg/l
	Permethrin 11**	-	<0.01	
	Telodrin**	-	<0.01	µg/l
	Isodrin**	-	<0.01	µg/l
	trans-Chlordane**	-	<0.01	µg/l
	cis-Chlordane**	-	<0.01	µg/l
	o,p-DDT**	-	<0.01	µg/l
	p,p-DDT**	-	<0.01	µg/l
	Ethion **	-	<0.01	
	Hexachlorobutadiene**	-	<0.01	
OP Pesticides	Dichlorvos**	-	<0.01	µg/l
	Mevinphos**	-	<0.01	µg/l
	Dimethoate**	-	<0.01	µg/l
	Propetamphos**	-	<0.01	µg/l
	Diazinon**	-	<0.01	µg/l
	Etrimphos**	-	<0.01	µg/l
	Chlorphyrifos-methyl**	-	<0.01	µg/l
	Pirimiphos Methyl**	-	<0.01	µg/l
	Fenitrothion**	-	<0.01	µg/l
	Malathion**	-	<0.01	µg/l
	Fenthion**	-	<0.01	µg/l
	Chlorpyrifos**	-	<0.01	µg/l
	Chlorfenvinphos**	-	<0.01	µg/l
	Ethion**	-	<0.01	µg/l
	Triazophos**	-	<0.01	µg/l
	Carbophenothion**	-	<0.01	µg/l
	Phosalone**	-	<0.01	µg/l
	Azinphos ethyl**	-	<0.01	µg/l
	Azinphos methyl**	-	<0.01	µg/l
	Methyl Parathion**	-	<0.01	µg/l

DRAFT

Analysis Report

Project Code : 12-31733 **Report Unique ID:**

Sample Number : 323097 Client ID: BH-02 11/06/12

Sample Type:Groundwater Received: 11/06/2012 13:39 Condition: Good

Analysis	*Component*	*Specification*	*Result*	*Units*
SVOC'S	1,2,4-Trichlorobenzene**	-	<10	µg/l
	1,2-Dichlorobenzene**	-	<10	µg/l
	1,3-Dichlorobenzene**	-	<10	µg/l
	1,4-Dichlorobenzene**	-	<10	µg/l
	2,4,5-Trichlorophenol**	-	<10	µg/l
	2,4,6-Trichlorophenol**	-	<10	µg/l
	2,4-Dichlorophenol**	-	<10	µg/l
	2,4-Dimethylphenol**	-	<10	µg/l
	2,4-Dinitrotoluene**	-	<10	µg/l
	2,6-Dinitrotoluene**	-	<10	µg/l
	2-Chloronaphthalene**		<10	µg/l
	2-Chlorophenol**	-	<10	µg/l
	2-Methylnaphthalene**	-	<10	µg/l
	2-Methylphenol**	-	<10	µg/l
	2-Nitroaniline**	-	<10	µg/l
	2-Nitrophenol**	-	<10	µg/l
	3-Nitroaniline**	-	<10	µg/l
	4-Bromophenylphenylether**	-	<10	µg/l
	4-Chloro-3-methylphenol**	-	<10	µg/l
	4-Chloroaniline**	-	<10	µg/l
	4-Chlorophenylphenylether**	-	<10	µg/l
	4-Methylphenol**	-	<10	µg/l
	4-Nitrophenol**	-	<10	µg/l
	4-Nitroaniline**	-	<10	µg/l
	Azobenzene**	-	<10	µg/l
	Acenaphthylene**	-	<10	µg/l
	Acenaphthene**	-	<10	µg/l
	Anthracene**	-	<10	µg/l
	Bis(2-Chloroethyl)ether**	-	<10	µg/l
	Bis(2-chloroethoxy)methane***	-	<10	µg/l
	Bis(2-ethylhexyl)phthalate**	-	<10	µg/l
	Benzo(a)anthracene**	-	<10	µg/l
	Butylbenzylphthalate**	-	<10	µg/l
	Benzo(a)pyrene**	-	<10	µg/l
	Benzo(ghi)perylene**	-	<10	µg/l
	Carbazole**	-	<10	µg/l
	Chrysene**	-	<10	µg/l
	Dibenzofuran**	-	<10	µg/l
	n-Di-butylphthalate**	-	<10	µg/l
	Diethyl phthalate**	-	<10	µg/l
	Dibenzo(a,h)anthracene**	-	<10	µg/l

DRAFT

Analysis Report

Project Code : 12-31733 **Report Unique ID:**

Sample Number : 323097 Client ID: BH-02 11/06/12

Sample Type:Groundwater Received: 11/06/2012 13:39 Condition: Good

Analysis	*Component*	*Specification*	*Result*	*Units*
SVOC'S	Dimethyl phthalate**	-	<10	µg/l
	n-Di octyl phthalate**	-	<10	µg/l
	Fluoranthene**	-	<10	µg/l
	Flourene**	-	<10	µg/l
	Hexachlorobenzene**	-	<10	µg/l
	hexachlorobutadiene**	-	<10	µg/l
	Pentachlorophenol**	-	<10	µg/l
	Phenol**	-	<10	µg/l
	N-nitrosodi-n-propylamine**	-	<10	µg/l
	Hexachloroethane**	-	<10	µg/l
	Nitrobenzene**	-	<10	µg/l
	Naphthalene**	-	<10	µg/l
	Isophorone**	-	<10	µg/l
	Hexachlorocyclopentadiene**	-	<10	µg/l
	Phenanthrene**	-	<10	µg/l
	Indenol(1,2,3-cd)pyrene**	-	<10	µg/l
	Pyrene**	-	<10	µg/l
VOC's	Chloromethane**	-	<3	µg/l
	Trichloroethene**	-	<3	µg/l
	1,2-Dichlorobenzene**	-	<3	µg/l
	Chlorobenzene**	-	<2	µg/l
	Tetrachloroethene**	-	<3	µg/l

Project Code : 12-31733 **Report Unique ID:**

Sample Number : 323098 Client ID: BH-04 11/06/12

Sample Type:Groundwater Received: 11/06/2012 13:39 Condition: Good

Analysis	*Component*	*Specification*	*Result*	*Units*
	2,3,6-TBA**	-	<0.1	µg/l
	2,4,5-T**	-	<0.1	µg/l
	2,4,5-TP (fenoprop)**	-	<0.1	µg/l
	2,4-D**	-	<0.1	µg/l
	2,4-DB**	-	<0.1	µg/l
	4-CPA**	-	<0.1	µg/l
	benazolin**	-	<0.1	µg/l
	bentazone**	-	<0.1	µg/l
	bromoxynil**	-	<0.1	µg/l
	clopyralid**	-	<0.1	µg/l
	dicamba**	-	<0.1	µg/l
	dicloroprop (2,4-DP)**	-	<0.1	µg/l
	diclofop**	-	<0.1	µg/l
	flamprop**	-	<0.1	µg/l
	flamprop-isopropyl**	-	<0.1	µg/l
	ioxynil**	-	<0.1	µg/l
	MCPA**	-	<0.1	µg/l
	MCPB**	-	<0.1	µg/l
	pentachlorophenol**	-	<0.1	µg/l
	picloram**	-	<0.1	µg/l
	triclopyr**	-	<0.1	µg/l
Triazine Herbicides	Atrazine**	-	<1	µg/l
Metal Scan	Cadmium**	-	<0.5	µg/l
	Mercury**	-	<0.01	µg/l
	Dibutyltin**	-	<0.01	µg/l
	Tributyltin**	-	<0.01	µg/l
	Triphenyltin**	-	0.73	µg/l
OrganCl Pesticides	Tecnazene**	-	<0.01	µg/l
	Trifluralin**	-	<0.01	µg/l
	Alpha - BHC**	-	<0.01	µg/l
	Hexachlorobenzene**	-	<0.01	µg/l
	Beta - BHC**	-	<0.01	µg/l
	Gamma - BHC(lindane)**	-	<0.01	µg/l
	Quintozene(PCNB)**	-	<0.01	µg/l
	Triallate**	-	<0.01	µg/l
	Chlorothalonil**	-	<0.01	µg/l
	Heptachlor**	-	<0.01	µg/l
	Aldrin**	-	<0.01	µg/l
	Triadimefon**	-	<0.01	µg/l
	Pendimethalin**	-	<0.01	µg/l
	heptachlor epoxide**	-	<0.01	µg/l

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Analysis Report

Project Code : 12-31733 **Report Unique ID:**

Sample Number : 323098 Client ID: BH-04 11/06/12

Sample Type:Groundwater Received: 11/06/2012 13:39 Condition: Good

Analysis	*Component*	*Specification*	*Result*	*Units*
OrganCl Pesticides	o, p'-DDE**	-	<0.01	µg/l
	Endosulphan I**	-	<0.01	µg/l
	p,p'-DDE**	-	<0.01	µg/l
	Dieldrin**	-	<0.01	µg/l
	p,p'-TDE(DDD)**	-	<0.01	µg/l
	Endrin**	-	<0.01	µg/l
	Endosulphan II**	-	<0.01	µg/l
	o,p'-TDE(DDD)**	-	<0.01	µg/l
	Endosulfan Sulphate**	-	<0.01	µg/l
	o, p'-Methoxychlor**	-	<0.01	µg/l
	p, p'-Methoxychlor**	-	<0.01	µg/l
	Permethrin 1**	-	<0.01	µg/l
	Permethrin 11**	-	<0.01	
	Telodrin**	-	<0.01	µg/l
	Isodrin**	-	<0.01	µg/l
	trans-Chlordane**	-	<0.01	µg/l
	cis-Chlordane**	-	<0.01	µg/l
	o,p-DDT**	-	<0.01	µg/l
	p,p-DDT**	-	<0.01	µg/l
	Ethion **	-	<0.01	
	Hexachlorobutadiene**	-	<0.01	
SVOC'S	1,2,4-Trichlorobenzene**	-	<10	µg/l
	1,2-Dichlorobenzene**	-	<10	µg/l
	1,3-Dichlorobenzene**	-	<10	µg/l
	1,4-Dichlorobenzene**	-	<10	µg/l
	2,4,5-Trichlorophenol**	-	<10	µg/l
	2,4,6-Trichlorophenol**	-	<10	µg/l
	2,4-Dichlorophenol**	-	<10	µg/l
	2,4-Dimethylphenol**	-	<10	µg/l
	2-Chloronaphthalene**	-	<10	µg/l
	2-Chlorophenol**	-	<10	µg/l
	2-Methylnaphthalene**	-	<10	µg/l
	2-Methylphenol**	-	<10	µg/l
	2-Nitroaniline**	-	<10	µg/l
	2-Nitrophenol**	-	<10	µg/l
	3-Nitroaniline**	-	<10	µg/l
	4-Bromophenylphenylether**	-	<10	µg/l
	4-Chloro-3-methylphenol**	-	<10	µg/l
	4-Chloroaniline**	-	<10	µg/l
	4-Chlorophenylphenylether**	-	<10	µg/l
	4-Methylphenol**	-	<10	µg/l

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Analysis Report

Project Code : 12-31733 **Report Unique ID:**

Sample Number : 323098 Client ID: BH-04 11/06/12

Sample Type:Groundwater Received: 11/06/2012 13:39 Condition: Good

Analysis	*Component*	*Specification*	*Result*	*Units*
SVOC'S	4-Nitrophenol**	-	<10	µg/l
	4-Nitroaniline**	-	<10	µg/l
	Azobenzene**	-	<10	µg/l
	Acenaphthene**	-	<10	µg/l
	Anthracene**	-	<10	µg/l
	Bis(2-Chloroethyl)ether**	-	<10	µg/l
	Bis(2-chloroethoxy)methane**	-	<10	µg/l
	Bis(2-ethylhexyl)phthalate**	-	<10	µg/l
	Benzo(a)anthracene**	-	<10	µg/l
	Butylbenzylphthalate**	-	<10	µg/l
	Benzo(a)pyrene**	-	<10	µg/l
	Benzo(ghi)perylene**	-	<10	µg/l
	Carbazole**	-	<10	µg/l
	Chrysene**	-	<10	µg/l
	Dibenzofuran**	-	<10	µg/l
	Diethyl phthalate**	-	<10	µg/l
	Dibenzo(a,h)anthracene**	-	<10	µg/l
	Dimethyl phthalate**	-	<10	µg/l
	Flourene**	-	<10	µg/l
	Hexachlorobenzene**	-	<10	µg/l
	hexachlorobutadiene**	-	<10	µg/l
	Pentachlorophenol**	-	<10	µg/l
	Phenol**	-	<10	µg/l
	N-nitrosodi-n-propylamine**	-	<10	µg/l
	Hexachloroethane**	-	<10	µg/l
	Nitrobenzene**	-	<10	µg/l
	Naphthalene**	-	<10	µg/l
	Isophorone**	-	<10	µg/l
	Hexachlorocyclopentadiene**	-	<10	µg/l
	Phenanthrene**	-	<10	µg/l
	Indenol(1,2,3-cd)pyrene**	-	<10	µg/l
	Pyrene**	-	<10	µg/l
VOC's	Chloromethane**	-	<3	µg/l
	Trichloroethene**	-	<3	µg/l
	1,2-Dichlorobenzene**	-	<3	µg/l
	Chlorobenzene**	-	<2	µg/l
	Tetrachloroethene**	-	<3	µg/l

Project Code : 12-31733 **Report Unique ID:**

Methods of Analysis

Analysis Name:	Method:
VOC's	
SVOC'S	
Metal Scan	
Triazine Herbicides	GC -MS
OrganCl Pesticides	
OP Pesticides	GC-MS

Notes

* = INAB accredited test ** = subcontracted test *** = outside accredited range

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Telephone: +353-45-439416, Fax: +353-45-434207

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Analysis Report

Project Code : 12-33042 **Report Unique ID:** 37951
Report Date : 17-Oct-2012 **Commen. Date:** 28/09/2012

Customer: **Mr. Gavin McDermott**

Mr. Gavin McDermott
Kildare County Council
Aras Cill Dara
Devoy Park
Naas
Co. Kildare

Contact Details:
gmcdermott@kildarecoco.ie

Approved by : **Roisin Kavanagh**
Team Leader

Sample Number : 335964 Client ID: BH-01 27/09/12
Sample Type:Groundwater Received: 27/09/2012 13:55 Condition: Good

Analysis	*Component*	*Specification*	*Result*	*Units*
Metal Scan	Mercury (total)**	-	<1	µg/l
	Comment:	-	Jones	
Metal Scan	Mercury (total)**	-	<0.01	µg/l
	Comment:	-	Alcontrol	
	Dibutyltin**	-	<0.1	µg/l
	Tributyltin**	-	<0.1	µg/l
	Triphenyltin**	-	<0.1	µg/l
	Comment:	-	Jones	
	Dibutyltin**	-	<50	µg/l
	Tributyltin**	-	<10	µg/l
	Triphenyltin**	-	<10	µg/l
	Comment:	-	Alcontrol	

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Analysis Report

Project Code : 12-33042 **Report Unique ID:** 37951

Sample Number : 335965 Client ID: BH-02 27/09/12
Sample Type:Groundwater Received: 27/09/2012 13:55 Condition: Good

Analysis	Component	Specification	Result	Units
Metal Scan	Mercury (total)**	-	<1	µg/l
	Comment:	-	Jones	
Metal Scan	Mercury (total)**	-	<0.01	µg/l
	Comment:	-	Alcontrol	
	Dibutyltin**	-	<0.1	µg/l
	Tributyltin**	-	<0.1	µg/l
	Triphenyltin**	-	<0.1	µg/l
	Comment:	-	Jones	
	Dibutyltin**	-	<50	µg/l
	Tributyltin**	-	<10	µg/l
	Triphenyltin**	-	<10	µg/l
	Coment:	-	Alcontrol	

Sample Number : 335966 Client ID: BH-04 27/09/12
Sample Type:Groundwater Received: 27/09/2012 13:55 Condition: Good

Analysis	Component	Specification	Result	Units
Metal Scan	Mercury (total)**	-	<1	µg/l
	Comment:	-	jones	
Metal Scan	Mercury (total)**	-	<0.01	µg/l
	Comment:	-	Alcontrol	
	Dibutyltin**	-	<0.1	µg/l
	Tributyltin**	-	<0.1	µg/l
	Triphenyltin**	-	<0.1	µg/l
	Comment:	-	Jones	
	Dibutyltin**	-	<100	µg/l
	Tributyltin**	-	<20	µg/l
	Triphenyltin**	-	<20	µg/l
	Comment:	-	Alcontrol	

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Telephone: +353-45-439416, Fax: +353-45-434207

Analysis Report

Project Code : 12-33042 **Report Unique ID:** 37951

Methods of Analysis

Analysis Name:	Method:
Metal Scan	

Notes

* = INAB accredited test ** = subcontracted test *** = outside accredited range

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APPENDIX C

LandSim Model Printout

Calculation Settings

Number of iterations: 501

Results calculated using sampled PDFs

Full Calculation

Clay Liner:

Unretarded values used for simulation

No Biodegradation

Unsaturated Pathway:

Retarded values used for simulation

Biodegradation

Saturated Vertical Pathway:

No Vertical Pathway

Aquifer Pathway:

Retarded values used for simulation

Biodegradation

Timeslices at: 30, 100, 300, 1000

Decline in Contaminant Concentration in Leachate

Ammoniacal_N	Non-Volatile
c (kg/l): 0.59	m (kg/l): 0
Chloride	Non-Volatile
c (kg/l): 0.2919	m (kg/l): 0.0298
Naphthalene	Non-Volatile
c (kg/l): 0.59	m (kg/l): 0

Contaminant Half-lives (years)

Aquifer Pathway:

Chloride	SINGLE(1e+009)
Naphthalene	UNIFORM(0.55,2.74)

Background Concentrations of Contaminants

Justification for Contaminant Properties

No background values input

All units in milligrams per litre

Phase: Pollardstown

Infiltration Information

Cap design infiltration (mm/year):	NORMAL(175,17.5)
Infiltration to waste (mm/year):	NORMAL(175,17.5)
End of filling (years from start of waste deposit):	10

Justification for Specified Infiltration

Infiltration values estimated based upon derived area specific effective rainfall values, descriptions of current restoration materials, derived site specific topographic gradients, and current vegetative cover descriptions. No variation has been introduced to these conditions during the lifecycle of the landfill.

Duration of management control (years from the start of waste disposal): 10

Cell dimensions

Cell width (m):	250
Cell length (m):	139.6
Cell top area (ha):	3.5
Cell base area (ha):	3.49
Number of cells:	1
Total base area (ha):	3.49
Total top area (ha):	3.5
Head of Leachate when surface water breakout occurs (m)	SINGLE(5)
Waste porosity (fraction)	UNIFORM(0.1,0.25)
Final waste thickness (m):	UNIFORM(2,3)
Field capacity (fraction):	UNIFORM(0.1,0.15)
Waste dry density (kg/l)	UNIFORM(1.25,1.75)

Justification for Landfill Geometry

Landfill footprint area of 3.5Ha has been reported in the Tier 2 Assessment (Golder 2010). Waste thickness determined based upon the reported footprint, and the total waste tonnage estimated with Golder 2010. Waste porosity, field capacity and dry density based on Golder judgement.

Source concentrations of contaminants

All units in milligrams per litre

Declining source term

Ammoniacal_N	TRIANGULAR(1,2,3)
	Data are spot measurements of Leachate Quality
Chloride	UNIFORM(0.1,0.3)
	Data are spot measurements of Leachate Quality
Naphthalene	LOGUNIFORM(0.001,0.01)
	Substance to be treated as List 1

Justification for Species Concentration in Leachate

Ammoniacal nitrogen concentration distribution based upon Golder judgement, waste descriptions, and duration since waste facility closed (1972). Chloride concentration range used based upon site specific data derived from CEN leachate test results. Maximum naphthalene concentration used derived from total pollutant analysis of site specific wastes. Minimum naphthalene concentration take as an order of magnitude less than this.

Drainage Information

Fixed Head.

Head on EBS is given as (m): SINGLE(0.1)

Justification for Specified Head

No leachate containment control; minimal value (0.1 m) leachate head taken at base of cell

Barrier Information

There is no barrier

Justification for Engineered Barrier Type

No engineered barrier present

Clays, sands and gravels pathway parameters

Modelled as unsaturated pathway

Pathway length (m):	UNIFORM(6,12)
Flow Model:	porous medium
Pathway moisture content (fraction):	UNIFORM(0.1,0.25)
Pathway Density (kg/l):	UNIFORM(1.75,2)

Justification for Unsat Zone Geometry

Unsaturated zone thickness based upon topographic elevation range across Site minus water table elevation across Site footprint minus maximum waste thickness.

Pathway hydraulic conductivity values (m/s):	SINGLE(0.001)

Justification for Unsat Zone Hydraulics Properties

Hydraulic cond. based on maximum value for unconsolidated silty sand (Table 2.2 Freeze R.A. & Cherry J.A., 1979 'Groundwater' Prentice Hall), moisture content based on conservative judgement.

Pathway longitudinal dispersivity (m):	UNIFORM(0.6,1.2)

Justification for Unsat Zone Dispersion Properties

Longitudinal dispersivity taken as 10% of unsaturated zone thickness

Retardation parameters for Clays, sands and gravels pathway

Modelled as unsaturated pathway

Uncertainty in Kd (l/kg):

Ammoniacal_N	TRIANGULAR(0.5,1,2)
Chloride	SINGLE(0)
Naphthalene: Calculated kd	
Partition to Organic Carbon ml/g	SINGLE(1288)
Fraction of Organic Carbon (fraction)	LOGUNIFORM(0.00021,0.073)

Justification for Kd Values by Species

Contaminant specific and soil specific values used from ConSim Help Files.

Aquifer Pathway Dimensions for Phase

Pathway length (m):	UNIFORM(20,160)
Pathway width (m):	SINGLE(250)

pathway parameters

No Vertical Pathway

Clays, sands and gravels pathway parameters

Modelled as aquifer pathway.

Mixing zone (m):	UNIFORM(5,10)

Justification for Aquifer Geometry

Pathway width measured from east to west across Site and perpendicular to groundwater flow.

Pathway regional gradient (-):	UNIFORM(0.025,0.03)
Pathway hydraulic conductivity values (m/s):	LOGUNIFORM(1e-006,0.0001)
Pathway porosity (fraction):	UNIFORM(0.1,0.33)

Justification for Aquifer Hydraulics Properties

Effective porosity based on value for silty sand in Figure 2.2 Hiscock K.M., 2005. 'Hydrogeology: Principles and Practice' Blackwell Science Ltd.

Pathway longitudinal dispersivity (m):	UNIFORM(2,16)
Pathway transverse dispersivity (m):	UNIFORM(0.6,4.8)

Justification for Aquifer Dispersion Details

Based on LandSim manual, Longitudinal dispersivity taken as 10% of pathway length (downgradient distance to receptor); Lateral dispersivity taken as 3% of pathway length.

Retardation parameters for Clays, sands and gravels pathway

Modelled as aquifer pathway.

Uncertainty in Kd (l/kg):

Ammoniacal_N	TRIANGULAR(0.5,1,2)
Chloride	SINGLE(0)
Naphthalene: Calculated kd	
Partition to Organic Carbon ml/g	SINGLE(1288)
Fraction of Organic Carbon (fraction)	LOGUNIFORM(0.00021,0.073)

Justification for Aquifer Kd Values by Species

Contaminant specific and soil specific values used from ConSim Help Files.

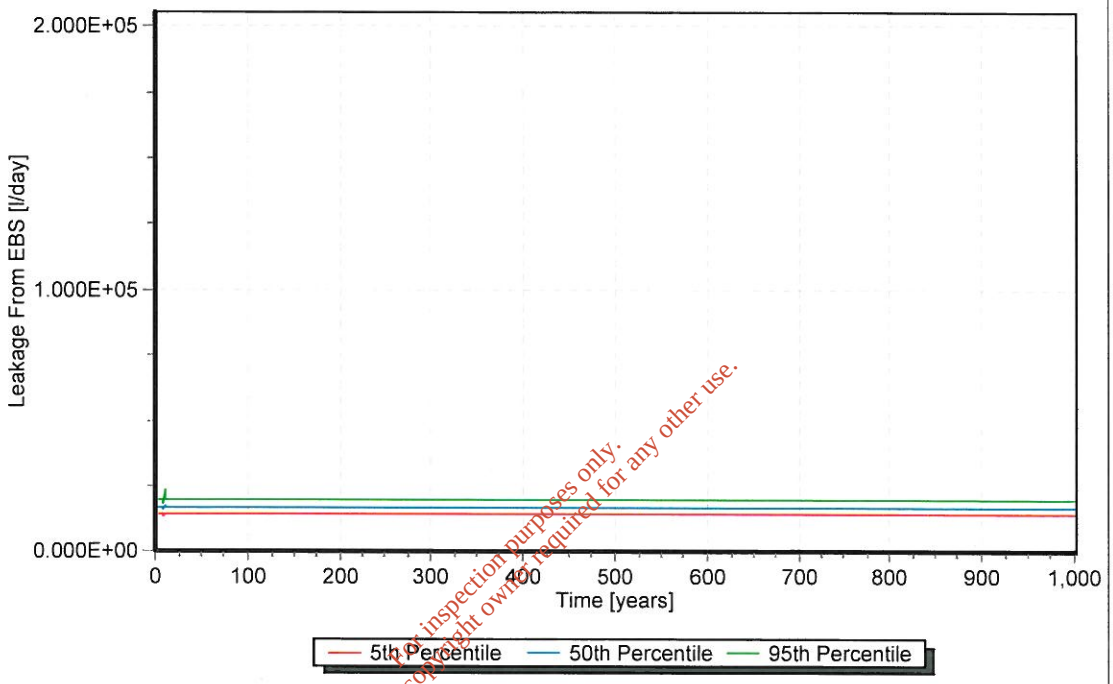
Pathway Density (kg/l):	UNIFORM(1.75,2)

LandSim Version 2.5

Project Name: Pollardstown

Customer:Golder Associates Ireland Ltd

Results: Pollardstown, Leakage From EBS [l/day]



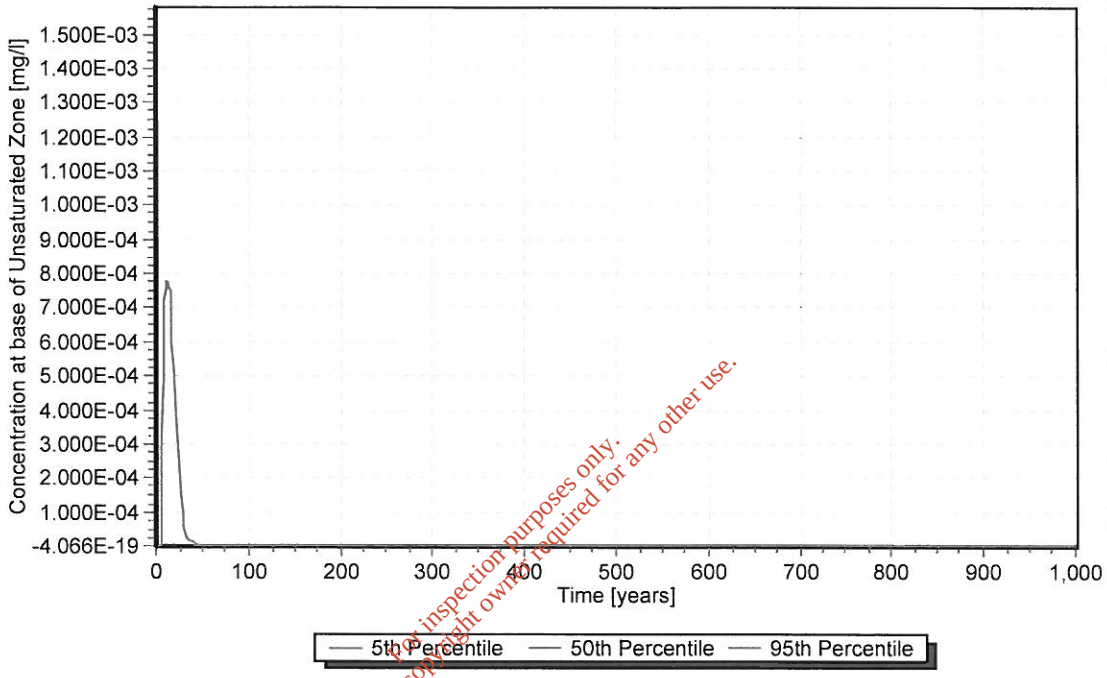
\Current.sim 20/03/2012 15:42:15

LandSim Version 2.5

Project Name: Pollardstown

Customer:Golder Associates Ireland Ltd

Results: Pollardstown, Naphthalene Concentration at base of Unsaturated Zone [mg/l]



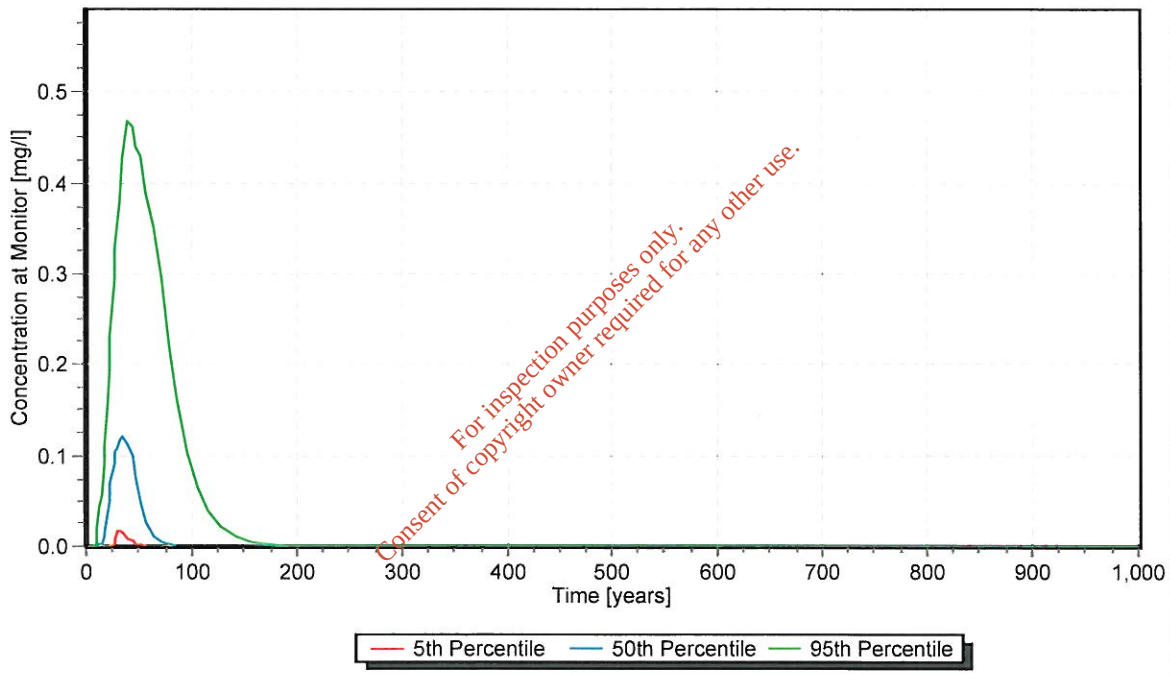
\Current.sim 20/03/2012 15:42:15

LandSim Version 2.5

Project Name: Pollardstown

Customer:Golder Associates Ireland Ltd

Results: Pollardstown, Ammoniacal_N Concentration at Monitor [mg/l]



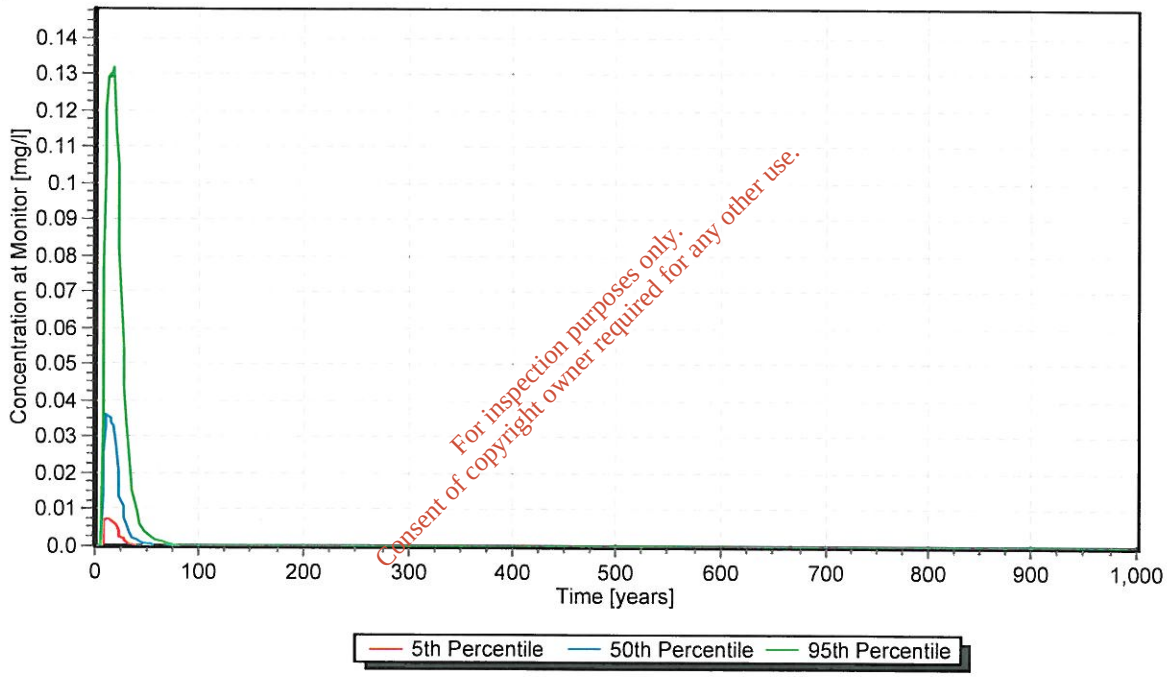
\Current.sim 20/03/2012 15:42:15

LandSim Version 2.5

Project Name: Pollardstown

Customer:Golder Associates Ireland Ltd

Results: Pollardstown, Chloride Concentration at Monitor [mg/l]



\Current.sim

20/03/2012 15:42:15

APPENDIX D

Appropriate Assessment

November 2012

APPROPRIATE ASSESSMENT OF POLLARDSTOWN FEN DEPOT

Natura Impact Statement

Submitted to:
Ciara Corrigan
Environment Section
Kildare County Council
Aras Chill Dara
Devoy Park
Naas
Co. Kildare

REPORT

Report Number. 11507190200.R1.V0

Distribution:

Kildare County Council - 1 copy (pdf)
Golder Associates Ireland Limited - 1 copy

Golder Associates

Table of Contents

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

Golder Associates were retained by Kildare County Council (KCC) to carry out an Appropriate Assessment Stage 2 of the remediation plan of Pollardstown Depot.

Pollardstown Depot is located on the western edge of Newbridge town in County Kildare and within the Curragh Ground Water Body (GWB), which feeds Pollardstown Fen SAC.

This report forms the Natura Impact Statement (NIS) required for Appropriate Assessment Stage 2 and examines the potential for impacts on Pollardstown Fen SAC due to the presence of contaminated land at Pollardstown Depot, in combination with other plans and projects, and proposes the necessary mitigation required. The terms of reference of this report are set out below. This NIS is based upon the conclusions of the Tier 3 Risk Assessment and Conceptual Site Model (Golder, 2012).

1.1 Terms of Reference

Directive 92/43/EEC on the Conservation of Natural Habitats and Wild Fauna and Flora – the 'Habitats Directive' - provides legal protection for habitats and species of European importance. Article 2 of the Directive requires the maintenance or restoration of habitats and species of European Community interest, at a favourable conservation status. Articles 3 - 9 provide the legislative means to protect habitats and species of Community interest through the establishment and conservation of an EU-wide network of sites known as *Natura 2000*. Natura 2000 sites are Special Areas of Conservation (SACs) designated under the Habitats Directive and Special Protection Areas (SPAs) designated under the Conservation of Wild Birds Directive (79/409/EEC).

Articles 6(3) and 6(4) of the Habitats Directive set out the decision-making tests for plans or projects affecting Natura 2000 sites. Article 6(3) establishes the requirement for Appropriate Assessment:

"Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public."

Article 6(4) deals with the steps that should be taken when it is determined, as a result of Appropriate Assessment, that a plan/project will adversely affect a European site. Issues dealing with alternative solutions, imperative reasons of overriding public interest and compensatory measures need to be addressed in this case.

Article 6(4) states:

"If, in spite of a negative assessment of the implications for the site and in the absence of alternative solutions, a plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature, the Member States shall take all compensatory measures necessary to ensure that the overall coherence of Natura 2000 is protected. It shall inform the Commission of the compensatory measures adopted.

Where the site concerned hosts a priority natural habitat type and/or a priority species, the only considerations which may be raised are those relating to human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest."

The requirements of Articles 6(3) and 6(4) of the Habitats Directive have been transposed into Irish legislation by means of the Habitats Regulations, 1997 (S.I. No. 94 of 1997) and the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477/2011).

1.2 Appropriate Assessment

There are four Appropriate Assessment stages which are described as follows:

1.2.1 Stage 1 - Screening

This initial stage aims to identify the likely impacts of a project or plan on a Natura 2000 site, either alone or in combination with other projects or plans. The impacts are examined to establish whether these impacts are likely to be significant. Assessment of the significance of effects is carried out in consultation with the relevant nature agencies.

1.2.2 Stage 2 - Appropriate Assessment

The aim of this stage is to identify the conservation objectives of the site and to assess whether or not the project or plan, either alone or in combination with other projects or plans, will result in adverse effects on the integrity of the site, as defined by the conservation objectives and status of the site. Stage 2 is carried out in consultation with the relevant nature agencies. Where it cannot be demonstrated that there will be no adverse effects on the site, it is necessary to devise mitigation measures to avoid, where possible, any adverse effects.

Assessment of the effects of the project on the integrity of the site incorporates the following steps:

- Description of the proposed plan/project;
- Collation of Information about the Natura 2000 Site including setting out the conservation objectives of the site;
- Description of how the project or plan, in combination with other projects/plans, will affect the Natura 2000 Site, its key species and habitats, and how the overall integrity of the site is likely to be affected; and
- Description of what mitigation measures are to be introduced to avoid or reduce the adverse effects on the integrity of the site, acknowledging uncertainties and any gaps in information.

1.2.3 Stage 3 - Assessment of Alternative Solutions

This stage examines alternative ways of implementing the project or plan that, where possible, avoid any adverse impacts on the integrity of the Natura 2000 site. If alternative solutions have been identified that will either avoid any adverse impacts or result in less severe impacts on the site, it will be necessary to assess their potential impact by recommencing the assessment at Stage One or Stage Two as appropriate. However, if it can be reasonably and objectively concluded that there is an absence of alternatives, it will be necessary to proceed to Stage Four of this assessment methodology.

1.2.4 Stage 4 - Assessment where Adverse Impacts Remain

For sites that host priority habitats and species, it is necessary to consider whether or not there are human health or safety considerations or environmental benefits flowing from the project or plan. If such considerations do exist, then it will be necessary to carry out the Stage Four assessments of compensatory measures. If no such considerations exist, then it is necessary to establish whether there are other Imperative Reasons of Overriding Public Interest (IROPI) before carrying out the Stage Four assessments. Where IROPI exist, an assessment to consider whether compensatory measures will or will not effectively offset the damage to the site will be necessary before the project or plan can proceed.

Given the potential for significant impacts on Pollardstown Fen SAC, from Pollardstown Depot, a Stage 2 Appropriate Assessment was carried out. This report is for Stage 2 only.

1.3 Study Limitations

Cumulative impact assessment is based upon available information. There is insufficient information on all discharges within the study area to make a quantitative cumulative impact assessment, therefore cumulative impacts are discussed in qualitative terms, based on available information, in this report.

2.0 STAGE 2 APPROPRIATE ASSESSMENT METHODS

2.1 Desktop Review, Data Collation and Consultation

A desktop review was conducted of available published and unpublished information, together with consultation with National Parks and Wildlife Services (NPWS) local staff, Inland Fisheries Ireland (IFI), and a review of data available on the NPWS http://www.npws.ie/en/ and National Biodiversity (NBDC) http://maps.biodiversityireland.ie/ web-based databases. Consultation also highlighted existing or proposed developments, and other possible sources of pollution, which should be considered in the assessment.

Desktop Review and Data Collation

Pollardstown Fen SAC is fed by the Curragh groundwater body. The desktop study reviewed information relating to the hydrogeology of the Curragh groundwater body, existing information on the groundwater quality, features of Pollardstown Fen SAC and potential pressures on the groundwater body.

Existing reports which were reviewed as part of the desk study include the following:

- South Eastern River Basin Management Plan (2009-2015);
- South Eastern River Basin District Characterisation Report;
- Water Framework Directive Annex IV Protected Areas: Water Dependent Habitat and Species, and High Status Sites (Mayes, 2008);
- Water Quality in Ireland 2001-2003 (EPA, 2005);
- Kildare – County Geological Site Report (Geological Survey of Ireland);
- The Curragh GWB: Summary of Initial Characterisation (Geological Survey of Ireland); and
- Water Framework Directive Full Report for the Curragh Groundwater Body.

Consultation

NPWS local staff highlighted the potential for cumulative impacts to groundwater and that these should be assessed.

2.2 Appropriate Assessment Methodology

Appropriate Assessment has been carried out with reference to the following documents:

- Assessment of plans and projects significantly affecting Natura 2000 sites: Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC (European Communities, 2002);
- Waste Water Discharge Licensing. Note on Appropriate Assessments for the purposes of the Waste Water Discharge (Authorisation) Regulations, 2007 (S.I. No. 684 of 2007) (Environmental Protection Agency);
- Managing Natura 2000 sites: the provisions of Article 6 of the 'Habitats Directive' 92/43/EC (European Communities, 2000);
- Appropriate Assessment of Plans and Projects in Ireland: Guidance for Planning Authorities (Dept. Environment Heritage and Local Government, December 2009);
- Guidelines for Ecological Impact Assessment (Institute of Ecology and Environmental Management, 2006);
- Guidelines for Assessment of Ecological Impacts of National Roads Schemes (NRA, Revision 2, 1st June, 2009); and

- Appropriate Assessment is carried out in stages, as recommended by the above-referenced guidance documents.

3.0 DESCRIPTION OF THE PROJECT

3.1 Location

Pollardstown Depot is located on the south eastern edge of the railway track within 500m of Pollardstown Fen SAC (Figure 1). Golder Ecologist, Anne Murray, visited the depot on Feb 29th 2012.

The depot comprises a mix of stockpiles vegetated and unvegetated, hardstanding areas with bays to hold gravel and rock, berms to prevent accidental fall from steep ridges, a stockpile of county council bins and some grassed sandy verges towards the railway side with rabbit warrens.

The vegetated stockpiles contain species including, creeping cinquefoil *Potentilla reptans*, creeping bent *Agrostis stolonifera*, common bent *Agrostis cappillaris*, false-oat grass *Arrhenatherum elatius*, cocksfoot *Dactylis glomerata*, red fescue *Festuca rubra*, white clover *Trifolium repens*, red clover *Trifolium pratense*, ribwort plantain *Plantago lanceolata*,, tufted vetch *Vicia cracca*, nettles *Urtica dioica*, creeping thistle *Cirsium arvense*, silverweed *Potentilla anserina,* dandelion *Taraxacum* agg. and bramble *Rubus fruticosus* agg..

The grassy verges have rabbit grazed slopes with a large number of rabbit burrows throughout and contain species of calcareous grassland including species such as; false-oat grass *Arrhenatherum elatius*, cocksfoot *Dactylis glomerata*, red fescue *Festuca rubra*, mouse-ear hawkweed *Pilosella vulgaris* and carline thistle *Carlina vulgaris.*

The hedgerows that edge the site comprise mainly Hawthorn and Ash.

It is understood that the Site was a former limestone ballast quarry owned by CIE (Coras Iompair Eireann). It is also understood that sand and gravel was extracted at the Site. Records indicate that KCC leased the Site from CIE to use as a waste disposal Site for municipal and industrial waste generated in the Newbridge area. Moreover it is understood that KCC ceased to use the Site as a waste facility in 1972 and it was used by KCC's Roads Section as a depot to store materials, dispose of street sweepings and to dispose of construction and demolition waste associated with road works. Dumping of this waste and other unknown waste classified as 'municipal' waste has ceased since 2009.

The depot is used as a storage depot by the KCC Roads Section. Kildare County Council Environment Section state that there will be no disposal of any waste material at the site in the future.

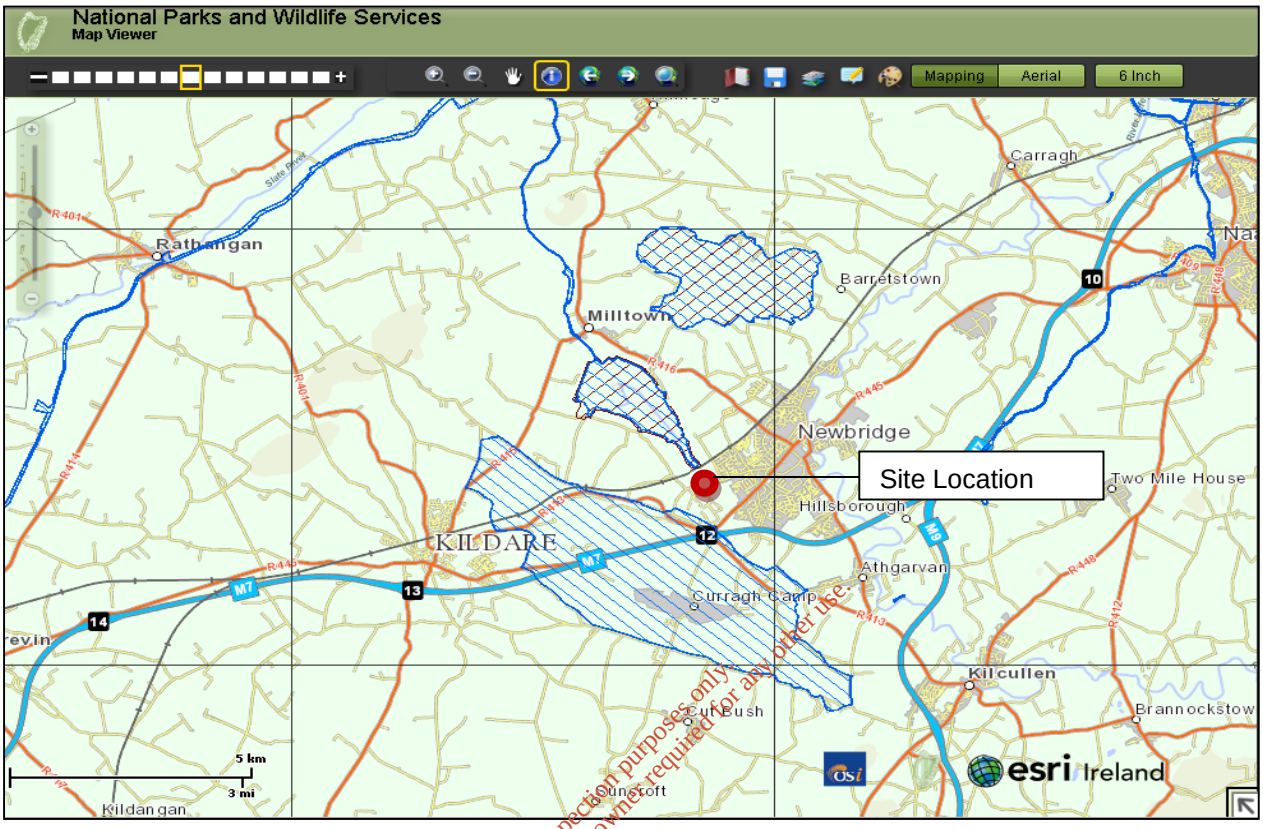


Figure 1: Pollardstown Fen SAC and Site Location

4.0 DESCRIPTION OF THE NATURA 2000 SITE: POLLARDSTOWN FEN SAC (SITE CODE: 000396)

4.1 Generic Conservation Objectives

NPWS provided generic conservation objectives for Pollardstown Fen SAC, (NPWS, 2012). These are outlined as follows:

Objective: To maintain or restore the favourable conservation condition of the Annex I habitat(s) and /or the Annex II species for which the SAC has been selected:

- Vertigo geyeri [1013];
- Vertigo angustior [1014];
- Vertigo moulinsiana [1016];
- * Calcareous fens with *Cladium mariscus* and species of the Caricion davallianae [7210];
- * Petrifying springs with tufa formation (Cratoneurion) [7220]; and
- Alkaline fens [7230].

4.2 General Description

Pollardstown Fen is situated on the northern margin of the Curragh of Kildare, approximately 3km west-north-west of Newbridge. It lies in a shallow depression, running in a northwest/southeast direction. About 40 springs provide a continuous supply of water to the fen, rising chiefly at its margins, along distinct seepage areas of mineral ground above the fen level. The continual inflow of calcium-rich water from the Curragh, and from the limestone ground to the north, creates waterlogged conditions which lead to peat formation. There are layers of calcareous marl in this peat, reflecting inundation by calcium-rich water. This peat-marl deposit reaches some 6 m at its deepest point and is underlain by clay.

Pollardstown Fen is unusual in Ireland as it is an extensive area of primary and secondary fen peat, lacking scrub vegetation on its surface. The vegetation is quite varied and species-rich with numerous well-defined plant communities and several rare or scarce floral species. Species and communities characteristic of more nutrient-rich conditions occur on the fen margins where the water first emerges from the ground, while the central fen area is dominated by more uniform and less nutrient-demanding vegetation types. Damp pastures occur on wet mineral soils and partly-drained peats on the fen margins, which are reasonably species-rich, with particularly good displays of orchids in some areas.

The fen has ornithological importance for both breeding and wintering birds. An area of reclaimed land was re-flooded in 1983 and has now reverted to open water, swamp and regenerating fen. Since the re-flooding of the fen and the development of the shallow lake, wintering waterfowl have been attracted in increased numbers.

Otter and Brook Lamprey (*Lampetra planeri*), two species listed in Annex II of the EU Habitats Directive, occur at Pollardstown. Various groups of the invertebrate fauna have been studied and the system has been shown to support a true fen fauna. The species complexes represented are often rare in Ireland, with the sub-aquatic organisms particularly well represented. A number of internationally important invertebrates (mostly Order Diptera, i.e. two-winged flies) have been recorded from the site. Of particular conservation importance, however, is the occurrence of all three of the Whorl Snails (*Vertigo* spp.) that are listed on Annex II of the EU Habitats Directive. Pollardstown is the only known site in Ireland (or Europe) to support all three species (*Vertigo geyeri*, *V. angustior*, *V. moulinsiana*) (NPWS, 2003).

The full NPWS Site Synopsis for Pollardstown Fen SAC is provided in Appendix 1.

4.3 Designated Features

The following features of Pollardstown Fen SAC are considered in this assessment:

Alkaline Fen (7230), Cladium Fen (7210) and Petrifying Springs (7220)

Pollardstown Fen contains the EU Annex II Habitats Alkaline fen, *Cladium* fen and Petrifying springs, as a result of the distinct hydrogeological conditions in the locality.

The alkaline fen habitat arises from the alkaline water draining from the adjacent Curragh gravel aquifer. *Cladium* fen often occurs in association with alkaline fen, but is generally slightly wetter with the water table at or above the surface, though fluctuations in the water table are less (NPWS, 2008). Petrifying springs, rising chiefly at the fens margins, provide a continuous supply of calcium-rich water to the fen, promoting the development of a characteristic vegetation community including hook moss *Palustriella commutata*, marsh bryum *Bryum pseudotriquetrum* and yellow saxifrage *Saxifraga aizoides* (NPWS, 2008).

Threats to these habitats include land reclamation, drainage and subsequent changes in hydrogeological regimes, and nutrient enrichment and subsequent eutrophication (NPWS, 2008).

Whorl Snails (Vertigo geyeri, Vertigo angustior, Vertigo moulinsiana)

There are eight species of whorl snail in Ireland, and three, *Vertigo geyeri, Vertigo angustior* and *Vertigo moulinsiana*, are protected under Annex II of the Habitats Directive. These species are all dependant on stable and specific ground water conditions, and as they only live for just over a year, they are vulnerable to

the effects of fluctuations in hydrology and have been lost from many sites both in Ireland and across the EU.

Vertigo geyeri has specific requirements of saturated water conditions in calcareous, ground water fed flushes that are often limited in size to a few metres square. These habitats are generally found in mosaics of suitable patches within wider fen macro-habitats. Such habitats are generally scarce and fragmented in Ireland, and suitable *Vertigo geyeri* habitat within sites is often very small in area and localized (NPWS 2008). A basic requirement for *V. geyeri* is maintenance of the existing hydrological regime, so management practices that alter site hydrology or hydrogeology can be very damaging to it, whether carried out on-site or elsewhere in the catchment supporting the hydrology of the site. Nutrient enrichment, whether from agricultural run-off, use of fertilisers or slurry spreading, can also be damaging (Moorkens, 2007).

Vertigo angustior lives in the more open-structured moss and decaying vegetation towards the top of the litter layer (Killeen, 2003), or in damp moss, in open unshaded habitats. The species requires friable and permanently moist litter, shaded by moderately tall herbaceous or grassy vegetation, and normally occurs in association with permanently moist but free-draining soil, not subject to inundation. In Ireland, the main decline of *V. angustior* sites appears to be a result of loss of riverside and canal-side habitat, particularly from drainage of marshy areas in the midlands and south east[*].

Vertigo moulinsiana is a climbing species in emergent vegetation at the margins of rivers, streams, ponds and lakes, living over a large vertical range at different times of year. This species requires tall vegetation structure and also requires a stable hydrogeology, where the water-table is at, or slightly above, the ground surface for much of the year and any seasonal flooding is of very low amplitude (OPW, 2009). In Ireland, the greatest loss of *V. moulinsiana* sites has been through drainage of wetlands, and riparian management of the Grand and Royal Canals, and further pressure on habitats through spread of urban development is likely.

The Republic of Ireland has 14 SACs for *V. geyeri*, 12 for *V. angustior*, and 7 for *V. moulinsiana*, with just one SAC (Pollardstown Fen) hosting all three species.

Brook Lamprey

Brook lamprey completes its life cycle in freshwater, spawning in gravels in the upper reaches of rivers, with larval development occurring in burrows in soft sediments in slower flowing waters downstream, in substrate that contains a relatively high organic content and is composed of mud and silt (Maitland, 2003). The river lamprey grows to 30 cm and has a similar life history to the sea lamprey. Species distribution maps to date are almost exclusively based on adult records (Igoe, 2004) as difficulties arise with the identification of juveniles to species level. Brook Lamprey is a noted feature of Pollardstown fen and Kurtz & Costello (1999) noted that brook lamprey is found throughout Hydrometric Area 14 – River Barrow catchment, within which Pollardstown Fen lies.

Otter

The NPWS Site Synopsis indicates that otter is present within Pollardstown Fen SAC, and otter spraints have been observed at the fen in the past year (NPWS Ranger *pers. comm*.). There are further records for otter in the 10km square N71, within which Milltown Millview WWTP and Pollardstown Fen and Mouds Bog SAC occur, on the NBDC database, with the most recent (2008) record located 2km north of Newbridge originating from the National Roadkill Survey (biology.ie), and further records originating from the Badger and Habitats Survey of Ireland 1991.

The Irish otter population has shown a decline of 20-25% between 1980 and 2006 (Bailey and Rochford, 2006), and although the cause of the decline is unclear, it is partly attributable to declines in preferred prey species numbers, particularly eel (Marnell et al., 2009), as a result of pollution and habitat destruction, amongst other reasons.

[*] OPW (2009): *EcIA of the effects of OPW drainage maintenance on fens, mires and whorl snails*

5.0 GROUNDWATER QUALITY

Pollardstown Fen lies in a shallow depression, and is maintained by groundwater which continuously flows into the fen from approximately 40 springs and seepage zones. Most of the springs arise around the margins of the depression above the level of the fen and are fed groundwater from the Curragh Groundwater Body. The following is a summary of the GSI's Initial Characterisation of the Curragh Groundwater Body, and the mid-Kildare Aquifer.

5.1 Curragh Groundwater Body (mid-Kildare Aquifer)

The Mid-Kildare Aquifer extends below and beyond the Curragh Plains, lying in a shallow trough oriented NE-SW, in the surface of the limestone bedrock. The sand and gravel aquifer is of regional importance. The Curragh itself is a proposed Natural Heritage Area (pNHA), consisting of a unique semi-natural, acidic grassland on shallow soils over an extensive glacial outwash plain. The gravels of the plain reach depths of 70m in places, with the areas of greatest thickness to the northeast along the drainage divide. This thickness reduces away from this area of higher elevation.

The Curragh groundwater body (GWB) is recharged from rainwater percolating through the topsoil and unsaturated sand and gravel deposits. The main discharge mechanisms present are baseflow discharge to rivers, seepages at the extremities of the body and discharge via springs. The interaction between groundwater and surface water is complex and the quantification of the volume of groundwater that contributes to surface water flow and its chemical composition is often difficult to calculate. Groundwater contributions to surface water flow vary; however in the more productive aquifers such as the sand and gravel aquifer of the Curragh GWB, the contribution may be up to 80 or 90 percent (Toner et al., 2005).

The Curragh GWB is a feeder for the Grand Canal and an important source of baseflow for the major river catchments in Kildare, namely the Liffey, the Barrow and the Boyne. This is supported by the estimated flow from the aquifer to the Milltown Feeder at Pollardstown Fen, which is approximately 25,000 m^3/day.

The Curragh GWB has a large catchment area. Its hydrogeology is significant as it is an important source of baseflow for rivers and streams, it influences the ecology of a number of interesting habitats and it is the source of water for Pollardstown Fen.

5.1.1 Water Framework Directive Status

The Water Framework Directive Status of the Curragh ground water body, which is linked to Pollardstown Fen SAC, is rated as Poor (Figure 2). The *Poor* status is largely due to abstraction pressures rather than water quality issues (Matthew Craig EPA, *pers. comm.*). As the Curragh GWB is a sand and gravel aquifer, it is highly vulnerable (www.gsi.ie). Therefore, discharges to the ground are likely to give rise to impacts to the ground water body and the habitats and species that rely on ground water.

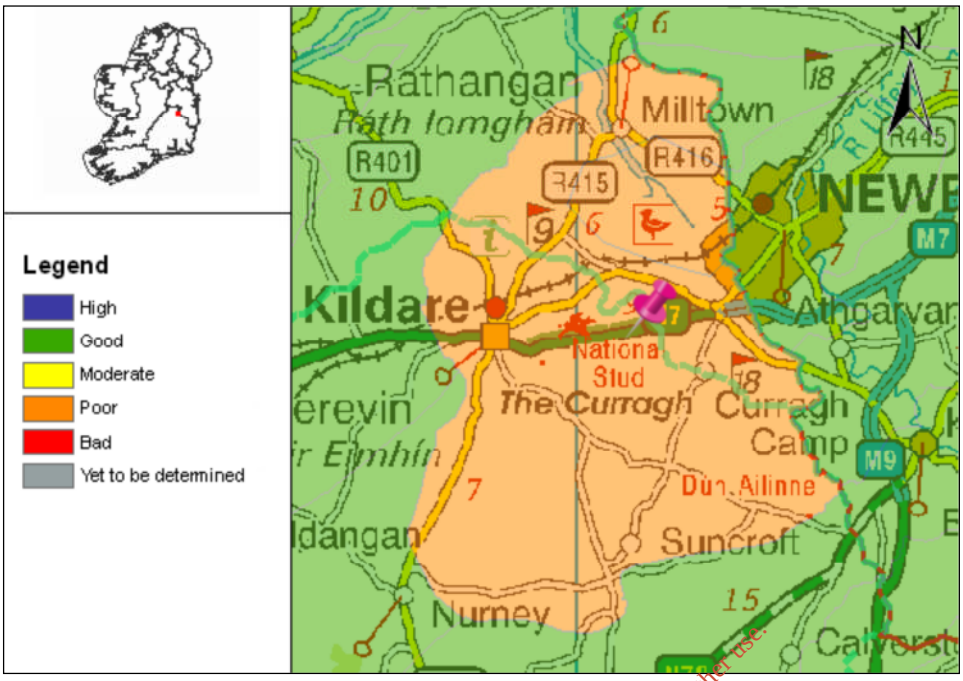


Figure 2: Groundwater Status (WFD report on the Curragh Groundwater Body)

In terms of groundwater dependant terrestrial ecosystems, two in the SERBD (Pollardstown Fen and The Curragh GWB) are in Poor Status due to Drainage pressures[†].

A summary of E.U. Annex II Habitats and EU Annex IV Species sensitivity to changes in groundwater is provided in Appendix 2.

6.0 IMPACT ASSESSMENT

6.1 Assessment Methods

The evaluation, impact and significance criteria used in this Impact Assessment are given below:

Habitats were assessed in accordance with the guidance contained in the document *Guidelines for Ecological Impact Assessment in the United Kingdom* (IEEM, 2006), with reference to *Guidelines for Assessment of Ecological Impacts of National Roads Schemes* (NRA, 2009).

The evaluation, impact and significance criteria used in this Impact Assessment are given below:

Evaluation Criteria

Table 1: Criteria for Establishing Receptor Sensitivity/Importance

Importance	Ecological Valuation
International	Sites, habitats or species protected under international legislation e.g. Habitats and Birds Directive. These include, amongst others: SAC's, SPA's, Ramsar Sites, Biosphere Reserves, including sites proposed for designation, plus undesignated sites that support populations of internationally important species.

[†] SERBD Groundwater Action Plan (March 2010)

Importance	Ecological Valuation
National	Sites, habitats or species protected under national legislation e.g. Wildlife Act 1976 and amendments. Sites include designated and proposed NHAs, Statutory Nature Reserves, National Parks, plus areas supporting resident or regularly occurring populations of species of national importance (e.g. 1% national population) protected under the Wildlife Acts, and rare (Red Data List) species.
Regional	Sites, habitats or species which may have regional importance, but which are not protected under legislation (although Local Plans may specifically identify them) e.g. viable areas or populations of Regional Biodiversity Action Plan habitats or species.
High Local/County	Areas supporting resident or regularly occurring populations of protected and red data listed-species of county importance (e.g. 1% of county population), Areas containing Annex I or II habitats or species not of international/national importance, County important populations of species or habitats identified in county plans, Areas of special amenity or subject to a Tree Preservation Order.
Moderate Local	Areas supporting resident or regularly occurring populations of protected and red data listed-species of local importance (e.g. 1% of local population), Undesignated sites or features which enhance or enrich the local area, Sites containing viable area or populations of local Biodiversity Plan habitats or species, local Red Data List species etc.
Low Local	Undesignated sites or features, which enhance or enrich the wildlife resource at a Parish or neighbourhood level.

6.1.1 Significance Criteria

An impact's significance is measured bearing in mind the site's evaluation for nature conservation. An impact of severe significance is one which is likely to cause a considerable drop in the biodiversity value of a site that is extremely important for nature conservation. An impact of major significance will also impinge on an important nature conservation site or species but the impact will be less marked. An impact of moderate significance will cause a significant loss in biodiversity on a site but is unlikely to impinge on statutory sites or species. A minor impact will have only a very limited impact on biodiversity whereas an impact that is termed negligible/not significant is one that is most unlikely to impact in any way on biodiversity.

IEEM (2006) define an ecologically significant impact as an impact (negative or positive) on the integrity of a defined site or ecosystem and/or the conservation status of habitats or species within a given geographic area. The integrity of a site is the coherence of its ecological structure and function, across its whole area, which enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which it was classified (IEEM, 2006).

Best scientific professional judgement has been used in some cases, to assess the significance of predicted effects. The significance criteria are expressed on a six point scale, including both adverse and beneficial effects, as described in Table 2.

Table 2: Criteria for Assessing Significance of Predicted Impacts

Impact Level	Description
Severe Impact	Ecological effects of a scale or magnitude which would result in permanent, total loss of an irreplaceable species or habitat of international or national importance (occasionally of local importance), or which would result in the substantial loss of a protected/rare habitat or a population of a protected/rare species. They represent key factors in the decision-making process. Typically, mitigation measures would be unlikely to remove such effects.
Major Impact	These effects are likely to relate to permanent impacts at a regional or local level, or temporary impacts at an international or national level, and could be potential concerns to the project depending upon the relative importance attached to the issue during the decision making process. The effects are likely to be large in scale or magnitude, and result in substantial medium term loss of protected/rare species or habitats. Mitigation and detailed design work are unlikely to entirely eliminate all ecological effects.
Moderate Impact	These effects are usually only at local or regional level, and may be short or medium term only, or temporary impacts on a small part of an international site. However, the cumulative effects of such issues may lead to an increase in the overall effect on ecological features. They represent issues where effects will be experienced, but mitigation measures and detailed design work may ameliorate/enhance some of the consequences upon affected interests, but some residual effects will still arise.
Minor Impact	These effects are likely to be local issues only; or small magnitude impacts at the regional and national level, they are usually temporary, and are unlikely to be of importance in the decision making process. However, they are of relevance in enhancing the subsequent design of the development and consideration of mitigation measures.
Not Significant/No Impact	No perceivable impacts on ecological features (habitat or species). Impacts may be beneath levels of perception, within normal bounds of variation, within the margin of forecasting error, or impacting on exceptionally poor baseline conditions.
Beneficial/Positive Impact	These effects are those, which through implementation, would be anticipated to benefit the ecology of the site. They may advance the objectives of local, national or international species or habitats.

6.1.2 Impact Characteristics

Direct and Indirect Impacts - An impact can be caused either as a direct or as an indirect consequence of a proposed development.

Magnitude - Magnitude measures the size of an impact, which is described as high, medium, low or very low.

Extent - The area of which the impact occurs, where the receptor is a habitat, magnitude and extent may become synonymous.

Level - An impact is assessed based on whether it is of international, national, regional or local importance (Refer to Table 1). This has a direct bearing on its magnitude and significance.

Duration - The time for which the impact is expected to last prior to recovery or replacement of the resource or feature.

- Short Term: The effects would be of short duration and would not last more than 2-5 years from the commencement of development;
- Medium Term: The effects would take 5-15 years to be mitigated; and
- Long Term: The effects would be reasonably mitigated over a long period of time (15 years or more).

Reversibility – An irreversible/permanent impact is one from which recovery is not possible within a reasonable timescale, while a reversible/temporary impact is one from which spontaneous recovery is possible.

Likelihood

- Near Certain: >95% chance of occurring as predicted;
- Probable: 50-95% chance as occurring as predicted;
- Unlikely: 5-50% chance as occurring as predicted; and
- Extremely Unlikely: <5% chance as occurring as predicted.

6.2 Site Evaluation

Pollardstown Depot lies within the GWB catchment of Pollardstown Fen SAC. It has the potential to affect the groundwater quality of the Curragh GWB which feeds the fen, and subsequently affect species present in the fen. The site is of 'International' ecological value according to the criteria outlined in Table 1.

6.3 Potential Impacts

The main impact under consideration in this report – is that of contamination to groundwater in close proximity to Pollardstown Fen which could result in a deterioration of water quality in the groundwater and subsequent impacts on Habitats Directive protected species of Pollardstown Fen, i.e. brook lamprey, otter and whorl snails *Vertigo* spp. and their habitats. Potential impacts of water quality deterioration on the habitats, for which Pollardstown Fen is designated, are also considered.

Potential direct and indirect impacts of the discharge are as follows:

- Direct effect on SAC habitats due to groundwater quality deterioration of groundwater, resulting in changes in the vegetation community of Pollardstown Fen SAC;
- Direct effect on SAC species due to groundwater quality deterioration of Pollardstown Fen and alterations to sensitive habitats and species – whorl snails *Vertigo* spp. are highly sensitive to any changes in groundwater quantity and quality; and
- Otter prey species have specific water quality requirements and any decline in water quality in the fen could have significant indirect impacts on the otter populations using Pollardstown Fen.

6.3.1 Sensitivity of Features

Alkaline Fen (7230), Cladium Fen (7210) and Petrifying Springs (7220)

Threats to these habitats include land reclamation, drainage and subsequent changes in hydrogeological regimes, nutrient enrichment and subsequent eutrophication (NPWS, 2008). The sensitivity of these habitats to changes in water quantity and quality are considered to be extreme and high-extreme respectively (Appendix 2).

Eutrophication is one of the biggest threats to water quality and sensitive fen habitats in Pollardstown Fen (NPWS, 2008), mainly due to the release of nutrients from point sources of pollution such as sewage

treatment plant discharges and diffuse sources of pollution such as run-off from fields or seepage of nutrients from soil into ground water. Diffuse sources are often individually minor, but collectively significant.

Potential impacts from seepage of contaminants from Pollardstown Depot into the groundwater system may arise. Low summertime water levels and abstraction pressures may also impact groundwater by effectively increasing the concentration of pollutant loads and nutrient enrichment, which may then percolate into the groundwater system.

Whorl Snails *Vertigo spp.*

Whorl snails may be vulnerable to pollution, and are also vulnerable to poor water quality if it results in changes to the plant community upon which they rely. The sensitivity of these species to changes in water quantity and quality are considered to be high-extreme (Appendix 2).

Elevated levels of nutrients in groundwater, particularly phosphates and nitrates, are likely to be significant if changes result in the vegetation community, which is particularly relevant to snail habitat if the vegetation is likely to become rank (Killeen, 2003).

Lamprey

The impact of water quality, although recognised as a threat to all fishes, has not been quantified for lamprey. However, deterioration of water quality in areas supporting lamprey will inevitably reduce lamprey survival (Igoe *et al*, 2004).

Otter

An indirect impact on otter is possible were its prey species to be affected by poor water quality. Otter prey species largely comprise slow-moving, bottom-living species including eels, salmonids, crustaceans including white-clawed crayfish, and amphibians (Harris & Yalden, 2008).

6.3.2 Assessment of Groundwater Quality Information

6.3.2.1 Groundwater Monitoring

For this Tier 3 assessment groundwater quality data was assessed from four (4 No) on site and two (2 No) further off Site locations. The following Table 3 depicts details of these groundwater monitoring wells.

Table 3: Details of On and Off Site Groundwater Monitoring Locations

ID	Depth of Well (in meters)	Groundwater Level (in m OD)	Relative to the Site
BH01	17.8	90.26	Upstream & On Site
BH02	13.6	91.44	Upstream & On Site
BH03	14.1	88.81	Upstream & On Site
BH04	16.3	87.49	Cross gradient & On Site
BH204	15.0	85.73	Downstream & Off Site
MW2	16.0	88.88	Downstream & Off Site

6.3.2.2 On-Site Locations

The most recent groundwater monitoring occasions for on-Site groundwater monitoring locations BH01, BH02 and BH03 were 4 October 2010 (by Golder) and 29 November 2011 (by KCC), and for BH04 29 November 2011 (by KCC).

The following Table 4 depicts observed elevated concentrations within above mentioned groundwater monitoring locations when compared against the IGV values (EPA, 2003) and SI No 9 of 2010.

Table 4: Groundwater Monitoring Results – Exceedances within On-Site Locations

Parameter	Unit	BH01		BH02		BH03		BH04	Guideline Values	
		4/10/10	29/11/11	4/10/10	29/11/11	4/10/10	29/11/11	29/11/11	IGV 1)	SI No 9 2)
Sulphate	mg/l	-	-	190.31	220.25	-	-	-	200	187.5
Ammonium	mg/l	-	-	0.28	-	-	-	-	0.15	0.065 – 0.175
Potassium	mg/l	-	-	9.8	8	-	-	-	5	n/a
Chloride	mg/l	-	-	34.6	-	-	-	30	30	24 – 187.5
Ortho Phosphate	mg/l	12.07	-	1.5	-	22.38	-	-	0.03	n/a

1) *Environmental Protection Agency 2003. Towards Setting Guideline Values for the Protection of Groundwater in Ireland, Interim Report*
2) *Statutory Instruments. S.I. No.9 of 2010. European Communities Environmental Objectives (Groundwater) Regulations, 2010.*

Reference should be made to the conceptual Site model for locations.

From the above data summary, chloride concentrations from BH04 only have been identified as having the potential to exceed the relevant IGV threshold downstream of the Site. The 30mg/l chloride concentration noted is considered to be well below any relevant drinking water quality standard and within the range of what can be observed elsewhere naturally in Ireland.

6.4 Cumulative Impacts

The Water Framework Directive groundwater risk assessment report identifies a number of key threats and pressures to groundwater systems in the SERBD. Threats and pressures which may cumulatively impact on eutrophication of the Curragh GWB and subsequently Pollardstown Fen GWB and Pollardstown Fen SAC include the following:

- Abstraction:
  - municipal and private water supplies; and
  - known IPPC-licensed industrial abstractions
- Diffuse pollution sources:
  - One-off Housing: septic tanks discharging to groundwater;
  - Agriculture:
    - Mobile inorganics (nutrients); and
    - Mobile organics (pesticides, polyaromatic hydrocarbons).
  - Onsite clustered and leaking urban sewer systems (nutrients.).
- Point Pollution sources:
  - Quarries;
  - Landfill sites and waste dumps;
  - Trade effluent discharges (e.g., IPPC licensed facilities);

- Licensed wastewater discharges to groundwater; and
- Contaminated lands.

6.4.1 Abstraction

Abstraction pressures could increase the concentration of any nutrient load present in the groundwater supply. Known abstractions include those for municipal water supplies; Curragh Camp Supply Boreholes - McDonagh (800 m^3/day) and Hare Park (1100 m^3/day); and numerous private water supplies (GSI, Curragh East GWB Summary of Initial Characterisation). The IPPC-licensed Kildare Chilling Company also abstracts water from the Curragh GWB (700 m^3/day). These abstractions could thus cumulatively contribute to eutrophication of the groundwater body and consequent effects on Pollardstown Fen SAC.

6.4.2 Diffuse Pollution Sources

One-off Housing: Septic Tanks discharging to Groundwater

Numerous one-off housing exists in the vicinity of Pollardstown Fen SAC, many of which are not connected to the mains municipal sewerage system and rely upon septic tank and percolation area systems for waste water treatment. New housing planning applications are subject to specific planning conditions to ensure that wastewater discharge from one-off properties are within acceptable limits; however it is likely that many older properties with old wastewater treatment systems may be exceeding such limits. Therefore cumulative impacts from wastewater discharge from un-sewered properties on Pollardstown Fen are possible.

Urban Areas

Newbridge occurs adjacent to the Curragh GWB and Kildare towns occurs within the Curragh GWB catchment. These urban areas are a source of urban stormwater runoff and pollutant loads and may contribute to the cumulative impacts on Pollardstown Fen.

Agriculture

Agricultural land in the vicinity of Pollardstown Fen and the Curragh is used predominantly for livestock grazing. The extent of the use of the herbicides, Atrazine and Simazine, in the area is unknown but the potential input of these dangerous substances from the agricultural sector is being addressed during the farm surveys undertaken by Kildare County Council (ref. KCC discharge license application, Table 2.1), and will be further investigated through their Dangerous Substances monitoring programme.

Water quality monitoring has so far not suggested that the agricultural sector is contributing Dangerous Substances, in particular Atrazine and Simazine, in sufficient quantities to be harmful to the aquatic environment (KCC discharge license application, Section 2).

The cultivation of pasture for livestock grazing typically involves the application of organic and artificial fertilisers to promote sufficient grass growth. Runoff from agricultural land is likely to be high in nitrates and phosphates, and could potentially contribute to eutrophication of the groundwater underlying Pollardstown Fen. The Kildare County Development Plan 2011-2017 contains policies which require that the use of intensive agricultural waste for land-spreading must be carried out under an accepted Nutrient Management Plan which must demonstrate nutrient uptake and capacity in lands where manures are to be spread. Although this should reduce the contribution of agricultural run-off to cumulative eutrophic impacts on Pollardstown Fen, the potential for cumulative impacts cannot be ruled out in this regard.

Recreation

The application of fertiliser to improve grassland on the Curragh Golf Course, the Pitch and Putt Course and the Curragh Race Course may contribute to the cumulative eutrophic impacts on the Curragh GWB and subsequently Pollardstown Fen.

6.4.3 Point Pollution Sources

Quarries

There are a number of disused quarries beyond the south western and south eastern boundary of Pollardstown Fen SAC. The stripping of surface soils and vegetation, and extraction of sand/gravel/rock from these quarries may increase the susceptibility of the underlying groundwater system in this area to potential pollution pressure arising from e.g. surface water runoff from surrounding lands, accidental spillages etc. and subsequent percolation into the groundwater. The quarries may therefore contribute to cumulative impacts on the groundwater of Pollardstown Fen.

Landfills and Waste Dumps

There is a disused landfill filling an old sand/gravel pit at the Curragh Camp at Hare Park. Curragh Camp staff estimated that tipping had ceased in the mid 1990's. The staff also indicated that the fill mostly comprised builder's rubble and that tipping was carried out for at least twenty years. Other local people have commented that domestic waste was regularly tipped to this landfill.

Landfill discharges could therefore contribute to cumulative effects on the groundwater supply and Pollardstown Fen SAC.

IPPC Licensed Facilities

IPPC Licensed facilities located over the Curragh Groundwater Body or within 5km of Pollardstown Fen include Wyeth Medica Ltd., Curragh Tintawn Carpets Ltd., Schloetter Ireland Ltd., Procter and Gamble (Manufacturing) Ireland Ltd., and Kildare Chilling Company. These are described in the respective EPA Inspectors report as follows and are shown in Figure 3:

- Wyeth Medica Ltd.: Process wastewater on the site comprises wash waters from the four production sectors namely OC, HRT, Tranquillisers and Lederle Areas with some boiler/cooling tower blow-down. The wastewater together with domestic sewage undergoes pH treatment and is discharged to Kildare County Council Sewer and ultimately to Osberstown Waste Water Treatment Plant. There is no emission to ground from the Wyeth Medica site, and the company is required to monitor groundwater on a biannual basis in accordance with their license;

- Curragh Tintawn Carpets Ltd.: there are no activities taking place (or which have occurred in the past) at this facility which are likely to impact on the quality of the groundwater beneath the site. Most of the process is essentially dry with a small amount (2.8 m^3 per week) of effluent generated which is appropriately treated in the treatment plant;

- Schloetter Ireland Ltd.: the chemical composition of the liquid effluent from the process is dilute quantities of heavy metals, residues of mineral acids and trace amounts of other chemicals listed in the application. Treatment consists of mixing, two stage pH adjustment, flocculation, sedimentation, sludge consolidation, sampling and discharge to the local authority sewer;

- Procter and Gamble (Manufacturing) Ireland Ltd.: Discharge of trade effluent is to an IDA-owned sewer which flows into the Kildare County Council sewer; and

- Kildare Chilling Company: Wastewaters arising at the site are treated in the facility's wastewater treatment plant (WWTP) and include contaminated surface water (run-off from designated areas of access roads and yards which are used by 'dirty' vehicles i.e. livestock delivery vehicles); domestic sewage and process effluent (washwaters from the normal washing of the process areas, lairage area, transport vehicle wash etc.). The WWTP consists of screening, grease/fat removal, balancing tank, 2 No. bio-towers, 2 No. interstage clarifiers, activated sludge aeration, final clarifier and a sludge holding tank. The treated effluent combines with surface water from the site and is then discharged to sewer. The pipe conveying the company's combined treated effluent/surface water connects with the Sanitary Authority sewer which conveys treated effluent from the Kildare town treatment plant i.e. effluent from Kildare Chilling does not undergo any treatment in the Sanitary Authority's WWTP. This sewer then discharges to the River Tully (stream) which flows in a southwesterly direction (away from Pollardstown

Fen) to its confluence with the River Barrow. The Tully Stream is not connected to the Cloncumber stream and River Slate surface water catchments.

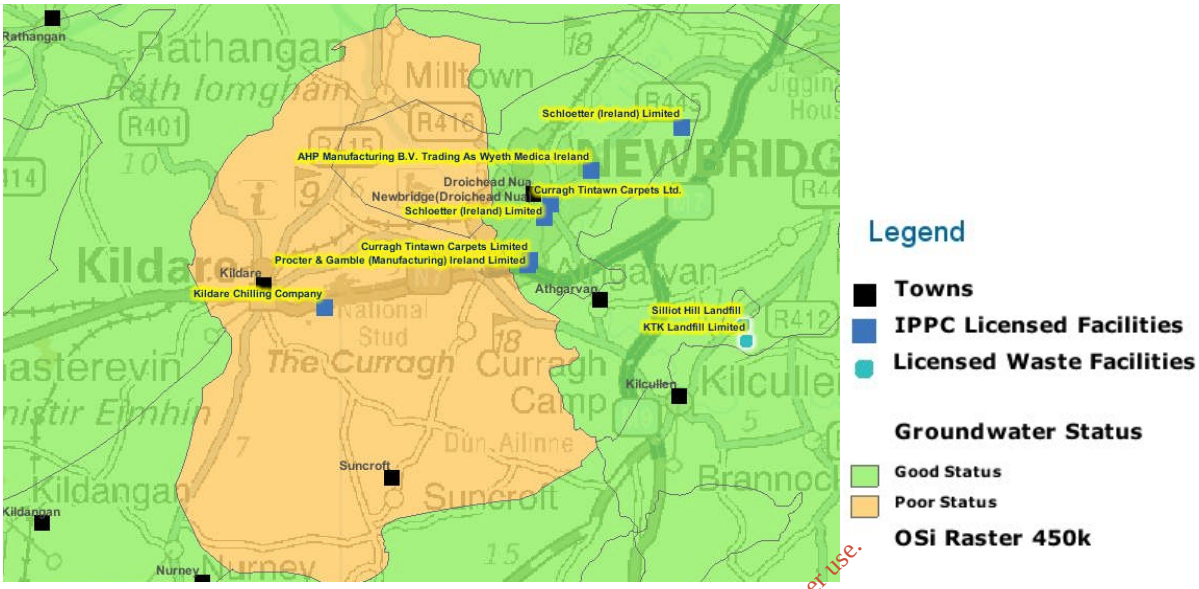


Figure 3: Licensed IPPC and Waste Facilities (EPA Data)

As outlined above, these licensed facilities discharge trade effluent to the local authority sewerage system, and several facilities incorporate their own wastewater treatment system. The local authority sewerage waste treatment system subsequently treats the wastewater influent, before discharging to surface water systems. None of the licensed facilities are discharging trade effluent to groundwater, instead discharging into either the municipal sewer and wastewater treatment system, or in the case of Kildare Chilling, directly to the Tully stream, which arises over 7km southeast of Pollardstown Fen, and flows in a south easterly direction from there.

As the above-mentioned licensed facilities are not discharging to ground, and all except Kildare Chilling are located outside of the extent of the Curragh GWB, it is not anticipated that these would contribute significantly to cumulative eutrophic impacts on the quality of the Curragh GWB feeding Pollardstown Fen SAC.

WWTPs

Milltown Millview WWTP discharges to the Curragh groundwater body via an adjacent percolation area. Milltown Fenview WWTP is located <500m west of Milltown Millview WWTP, and discharges to the Cloncumber stream via a network of drains ca. 3km downstream of Pollardstown Fen SAC. Athgarvan WWTP, located ca. 5km southeast of Milltown Millview WWTP, discharges into the Curragh (East) groundwater body. These WWTPs have been subject to AA Stage II Assessments. Cumulative impacts on Pollardstown Fen from Milltown Fenview WWTP in combination with Milltown Millview WWTP are possible.

6.5 Assessment of Impacts

Impacts that may be caused by Pollardstown Depot are summarised in Table 5.

This Tier 3 Assessment (Section 1 of the Tier 3 report (Golder, 2012) has not established any material evidence that Pollardstown Fen is receiving significant contamination via groundwater drainage from beneath the Site. Leach tests carried out on selected wastes largely produced concentrations below comparative thresholds, and a LandSim model simulation of the Site performance predicted that concentrations would likely be below any perceptible threshold at the perimeter monitoring points.

Hazardous substance screening in accordance with UK EA Guidance document (Hydrogeological Risk Assessment for Landfills, UK EA) was carried out at the Site and at locations directly downstream of the Site

during May 2012. In summary, Mercury was observed at a detectable concentration downstream of the Site, but not within the Site. Triphenyltin was detected at several locations both upstream and downstream of the Site. A further two rounds of analysis of groundwater's in September/October 2012 for mercury and Organotin compounds have return all parameters below the detection limit. Continued monitoring is recommended in the short term to confirm these findings.

Table 5: Possbile Impacts from Pollardstown Depot

Description of Impact	Direct/Indirect	Magnitude	Level	Duration & Reversibility	Likelihood	Significance
Changes in water quality within the fen (caused by contaminants to groundwater body from Pollardstown Depot) resulting in: Changes in community composition of fen flora (*Calcareous fens with Cladium mariscus and species of the Caricion davallianae [7210], Petrifying springs with tufa formation (Cratoneurion) [7220], Alkaline fens [7230]*) causing reductions in habitat extent, and reductions in associated faunal species (*Vertigo* spp.) due to changes in water quality. Reduction in numbers of otter and brook lamprey due to loss of prey species on which these species feed.	Direct Impacts on the fen habitats and Vertigo spp. may occur as a result of groundwater contamination. Indirect Impacts on otter and brook lamprey may occur due to reduced prey availability	Low - Monitoring of groundwater indicates no significant impacts.	The impact is considered at the International level of importance as caladium fens and petrifying springs are priority habitats within Pollardstown SAC, and the SAC is also designated for *Vertigo* spp.	At least short-term temporary impact.	Possible as the depot is located in the groundwater body (Curragh Groundwater body) that feeds Pollardstown Fen	Moderate to Minor Potential for Negative Impact following groundwater monitoring and modelling which indicate no likely significant impacts.

7.0 MITIGATION

Measures to reduce further the infiltration of rainwater and surface water through the Site should be implemented through the planting of native trees similar to those that occur in the surrounding area and that are typical of Kildare. This may require some re-profiling of the current Site e.g. removal or use of stockpiles. Tree selection and planting design should be carried out in consultation with Kildare County Council Parks Section, Heritage Officer and a suitably qualified ecologist.

8.0 RESIDUAL

Residual impacts once mitigation measures are implemented would be Minor.

9.0 MONITORING

Hazardous substance screening was carried out at the Site and at locations directly downstream of the Site during May 2012. In summary, Mercury was observed at a detectable concentration downstream of the Site, but not within the Site. Triphenyltin was detected at several locations both upstream and downstream of the Site. Further two rounds of analysis of groundwater's in September/October 2012 for mercury and Organotin compounds have returned all parameters below detection limit. Continued monitoring is recommended in the short term to confirm these findings.

10.0 CONCLUSION

The conceptual model and Tier 3 Risk assessment indicate that potential *significant* impacts from Pollardstown Depot on Pollardstown Fen SAC are unlikely.

The proposed mitigation measures should be undertaken by KCC as a matter of priority at the earliest possible opportunity, and a monitoring programme should continue in the short term to confirm that all parameters are in compliance with the Groundwater Directive and therefore help to protect groundwater dependent receptors of Pollardstown Fen SAC.

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Report Signature Page

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APPENDIX 1

NPWS Site Synopsis

SITE NAME: POLLARDSTOWN FEN (SITE CODE: 000396)

Pollardstown Fen is situated on the northern margin of the Curragh of Kildare, approximately 3km west-north-west of Newbridge. It lies in a shallow depression, running in a north-west/south-east direction. About 40 springs provide a continuous supply of water to the fen. These rise chiefly at its margins, along distinct seepage areas of mineral ground above the fen level. The continual inflow of calcium-rich water from the Curragh, and from the limestone ground to the north, creates waterlogged conditions which lead to peat formation. There are layers of calcareous marl in this peat, reflecting inundation by calcium-rich water. This peat-marl deposit reaches some 6 m at its deepest point and is underlain by clay.

Pollardstown Fen is unusual in Ireland as it is an extensive area of primary and secondary fen peat, lacking scrub vegetation on its surface. The fen vegetation is generally from 0.5 - 1.5 m high and consists mainly of Saw Sedge *(Cladium mariscus),* Reed *(Phragmites australis),* Blunt-flowered Rush *(Juncus subnodulosus)* and a variety of Sedges *(Carex* spp.). The vegetation is quite varied and species-rich with numerous well-defined plant communities and several rare or scarce species, including Narrow-leaved Marsh Orchid *(Dactylorhiza traunsteineri),* Fly Orchid *(Ophrys insectifera)* and Broad-leaved Bog Cotton *(Eriophorum latifolium).* Of particular interest is the occurrence of the moss, *Homalothecium nitens* - a boreal relict species which is rare in Ireland. Species and communities characteristic of more nutrient-rich conditions occur on the fen margins where the water first emerges from the ground, while the central fen area is dominated by more uniform and less nutrient-demanding vegetation types.

Damp pastures occur on wet mineral soils and partly-drained peats on the fen margins. These are reasonably species-rich, with particularly good displays of orchids in some areas.

The fen has ornithological importance for both breeding and wintering birds. Little Grebe, Coot, Moorhen, Teal, Mallard, Mute Swan, Water Rail, Snipe, Sedge Warbler and Reed Bunting all breed annually within the fen vegetation. Reed Warbler and Garganey, both rare breeding species in Ireland, have been recorded at Pollardstown and may have bred. In recent years two very specialised bird species associated with fens, Marsh Harrier and Savi's Warbler, have been seen at Pollardstown.

An area of reclaimed land was reflooded in 1983 and has now reverted to open water, swamp and regenerating fen. Since the reflooding of the fen and the development of the shallow lake, wintering waterfowl have been attracted in increased numbers. Maximum counts during winter 1984/85 were as follows: Little Grebe 24; Teal 161; Mallard 220; Coot 81; Snipe 68.

Otter and Brook Lamprey *(Lampetra planeri),* two species listed in Annex II of the EU Habitats Directive, occur at Pollardstown.

Various groups of the invertebrate fauna have been studied and the system has been shown to support a true fen fauna. The species complexes represented are often rare in Ireland, with the sub-aquatic organisms particularly well represented. A number of internationally important invertebrates (mostly Order Diptera, i.e. two-winged flies) have been recorded from the site. Of particular conservation importance, however, is the occurrence of all three of the Whorl Snails *(Vertigo* spp.) that are listed on Annex II of the EU Habitats Directive. Pollardstown is the only known site in Ireland (or Europe) to support all three species *(Vertigo geyeri, V. angustior, V. moulinsiana)* and thus provides a unique opportunity to study their different habitat and hydrological requirements.

Much of the fen vegetation is now owned by the Office of Public Works and is a Statutory Nature Reserve.

Pollardstown fen is the largest spring-fed fen in Ireland and has a well developed flora and fauna. Owing to the rarity of this habitat and the numbers of rare organisms found there, the site is rated as of international importance.

APPENDIX 2

EU Annex I Habitats and EU Annex II Species Sensitivity to changes in Groundwater

Table 6: Surface water ecosystems and terrestrial ecosystems directly dependent on groundwater. * Indicates priority habitats (after Mayes, 2008)

EU Habitat Code	EU Annex I Habitat	Number of SACs	Type	Sensitivity to changes in Groundwater Quantity	Sensitivity to changes in Groundwater Quality
1150	* Coastal lagoons	25	SW	low - high	Moderate - high
1330	Atlantic salt meadows *(Glauco-Puccinelietalia maritimae)*	38	GWDTE	low - moderate	low
1410	Mediterranean salt meadows *(Juncetalia maritimi)*	33	GWDTE	low - moderate	low
2170	Dunes with *Salix repens* ssp. *argentea (Salicion arenariae)*	11	GWDTE	high	high
2190	Humid dune slacks	15	GWDTE	high - extreme	high - extreme
21A0	Machairs (* in Ireland)	19	GWDTE	high - extreme	moderate - high
3110	Oligotrophic waters containing very few minerals of sandy plains *(Littoreletalia uniflorae)*	32	SW	moderate	extreme
3130	Oligotrophic to mesotrophic standing waters with vegetation of the *Littoreletea uniflorae* and/or of the *Isoëto-Nanojuncetea*	9	SW	moderate	high
3140	Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.	18	SW	high	high-extreme
3150	Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition*-type	9	SW	moderate	moderate
3160	Natural dystrophic lakes and ponds	10	SW	low	extreme
3180	* Turloughs	43	GWDTE	high	moderate - extreme
3260	Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Calitricho-Batrachion* vegetation	21	SW	moderate	moderate
3270	Rivers with muddy banks with *Chenopodion rubri* p.p. and *Bidention* p.p.	1	GWDTE	moderate	low
4010	Northern Atlantic wet heaths with *Erica tetralix*	37	GWDTE	low - (extreme)	high
6410	*Molinia* meadows on calcareous, peaty or clayey-silt-laden soils *(Molinion*	13	GWDTE	low - moderate	low - moderate
6430	Hydrophilous tall herb fringe communities of plains and of the montane to	3	GWDTE	moderate	moderate
7110	* Active raised bogs	51	GWDTE	low - (extreme)**	low -(high)**
7120	Degraded raised bogs still capable of natural regeneration	53	GWDTE	low - (extreme)**	low -(high)**
7130	Blanket bog (* if active bog)	50	GWDTE	low - (extreme)**	low -(high)**
7140	Transition mires and quaking bogs	16	GWDTE	extreme	moderate

EU Habitat Code	EU Annex I Habitat	Number of SACs	Type	Sensitivity to changes in Groundwater Quantity	Sensitivity to changes in Groundwater Quality
7150	Depressions on peat substrates of the *Rhynchosporion*	62	GWDTE	low	moderate
7210	* Calcareous fens with *Cladium mariscus* and species of *Caricion*	17	GWDTE	extreme	high
7220	* Petrifying springs with tufa formation *(Cratoneurion)*	19	GWDTE	extreme	extreme
7230	Alkaline fens	39	GWDTE	extreme	high
8310	Caves not open to the public	9	GWDTE	extreme	high
91D0	* Bog woodland	11	GWDTE	extreme	low
91E0	*Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior (Alno-padion, Alnion incanae, Salicion*	23	GWDTE	moderate	low - high

Table 1: Species directly Dependent on Groundwater (after Mayes, 2008)

EU Species Code	EU Annex II Species	Number of SACs	Sensitivity to changes in Groundwater Quantity	Sensitivity to changes in Groundwater Quality
1013	*Vertigo geyeri*	10	extreme	extreme
1014	*Vertigo angustior*	11	high	high
1016	*Vertigo moulinsiana*	7	high	high
1092	*Austropotamobius palipes*	13	high	moderate
1393	*Drepanocladus vernicosus*	7	extreme	extreme
1528	*Saxifraga hirculus*	4	extreme	extreme

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