



Environmental Impact Assessment Report (EIAR)

Volume 6 of 6: Appendices

(Appendix 10.3) Petrol Station Assessment

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Memorandum



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Date: 22/06/2021
To: Pat Murphy
From: Jacobs/TOBIN
Ref: 32105801 - 6909-05-01072021-A01
Re: **Water Supply Project Eastern and Midlands Region: Petrol Station Assessment**

As part of the Water Supply Project, TOBIN conducted a contamination assessment for the former petrol station at Greenhills, Birdhill, Co. Tipperary ('the site'). The site is a disused petrol station by the side of the R445. It is proposed to develop a site entrance to the west of the former petrol station. The former petrol station at Greenhills, Birdhill, Co. Tipperary does not appear to be in operation for over 30 years. This risk assessment has been conducted in accordance with latest Best Practice in Ireland and uses nationally and internationally accepted human health and environmental risk assessment protocols.

1 Site Location and Description

The former petrol station is located at Greenhills, Birdhill, Co. Tipperary. The site is located 1.5km to the east of Birdhill village and 25m east of the proposed access track. The site is bordered to the west by farm buildings/farmyard and the Kilmastulla River, to the south and east by the R445 and by the Knockadromin Stream (EPA segment code 25_783) to the north. The site and surrounding areas are flat with little variation in topography. No access to the tank is available due to locked cover. The area slopes gently to the north and west, towards the Knockadromin Stream and Kilmastulla River (25_3881) – see Figure 1.

1.1 Site Investigations

Site investigations were conducted at the site in May 2021 – See Figure 2. The Tier 1 risk assessment was undertaken on the former petrol station to determine if potential soil and water contaminants are present in excess of screening (or generic) guidelines. If contaminants are in excess of these screening guidelines, a detailed quantitative risk assessment (DQRA) could be required. The contaminants selected for analysis are considered appropriate for the site and likely contaminants.

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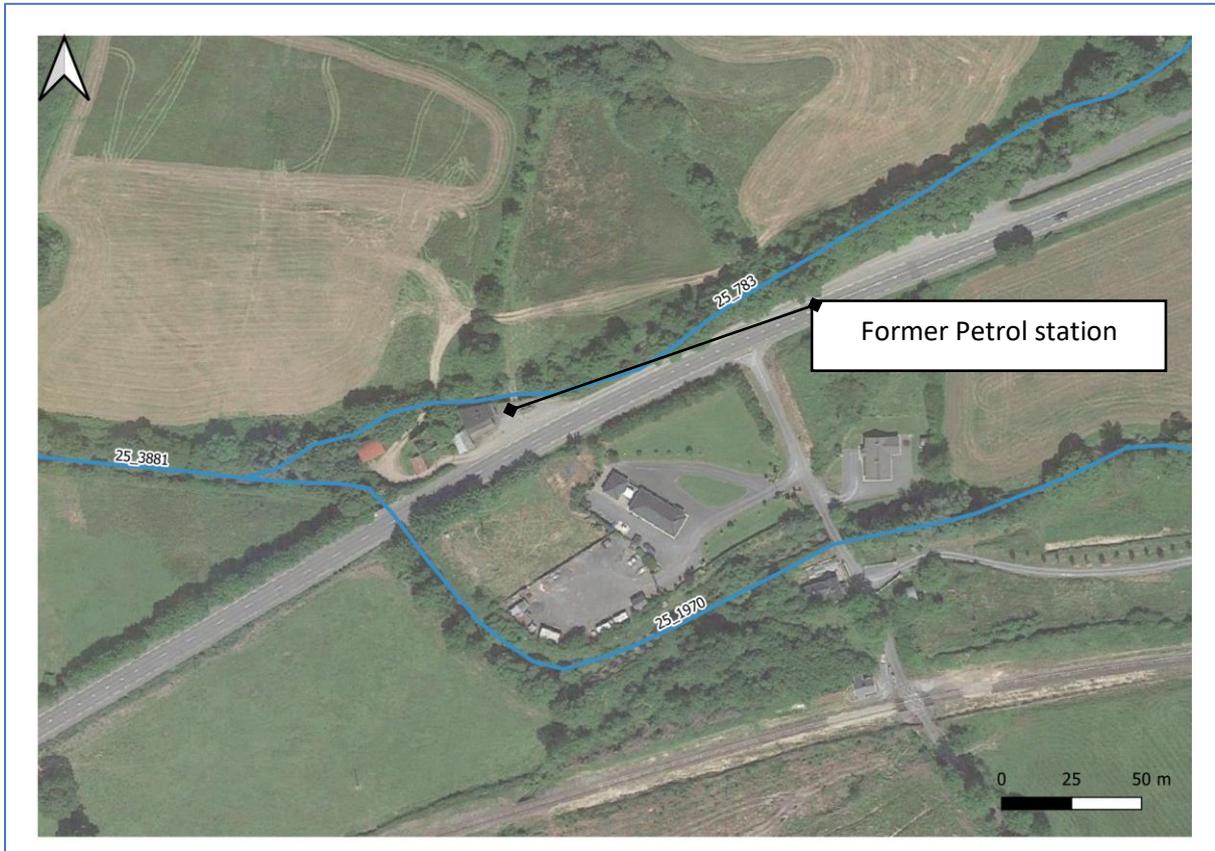


Figure 1 Site Location Map

The soil samples are detailed in Table 1 and shown on Figure 2.

Table 1 Soil samples

Sample	Location
P211	Immediately Upgradient of the Petrol Station on bank of the Knockadromin
P212	Downgradient of the Petrol Station – near proposed river crossing
P213	Downgradient of the Petrol Station – on banks of the Kilmastulla River

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The water samples are detailed in Table 2 and shown on Figure 2.

Table 2 Water Samples

Sample	Location	EPA River Segment Code
K1	Upgradient of the Petrol Station on Knockadromin Stream	25_783
K2	Downgradient of the Petrol Station on Knockadromin Stream – near proposed river crossing	25_783
K3	Downgradient of the Petrol Station – upgradient of Kilmastulla and Knockadromin Stream	25_1970

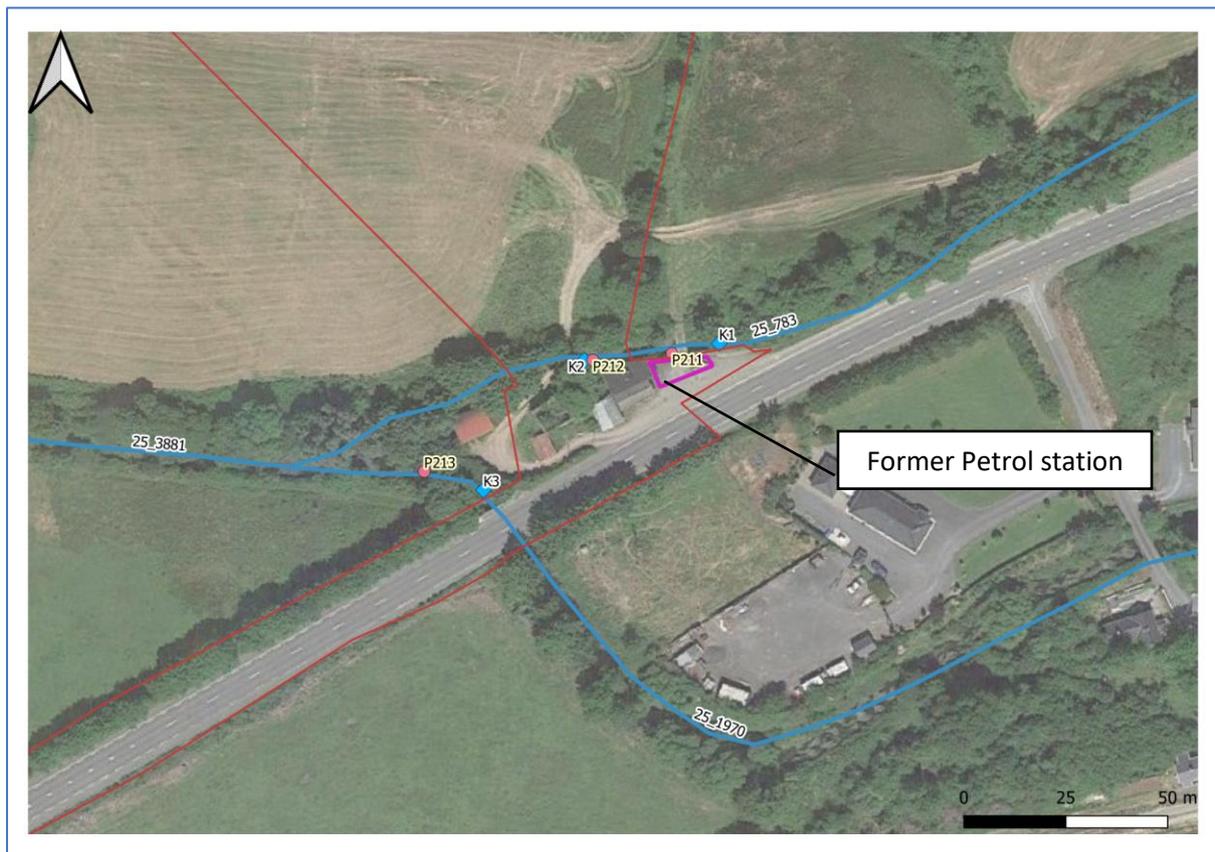


Figure 2 Soil and Water Sample Locations

For soils, all analytical results were compared with UK-based published human-health generic soil assessment criteria (GAC) in order to identify any possible contaminant sources on the site and the chemicals of potential concern (COPCs).

The soil results have been compared to GAC for:

- Phytotoxic impact (environmental); and
- Human Health Risk Assessment criteria - S4ULs derived by LQM/CIEH (2015)).

The GAC used is considered a conservative land setting for the former petrol station end use.

1.1. Geology and Hydrogeology

The geology across the former petrol station can be summarised as follows:

- 0 to 0.1m Brown Topsoil.
- Alluvium soils and sandstone till (0.2 to 1 mbgl). Soils encountered at the site comprise of mottled orange/yellow sandy silts with occasional gravel lens. Soil thickness greater than 1 m were noted in river banks. The GSI geological maps indicate the presence of till derived from sandstone and alluvium mapped in the area.
- Dinantian (early) Sandstones, Shales and Limestones. The mapped bedrock geology is Dinantian (early) Sandstones, Shales and Limestones. No evidence of bedrock was noted on the site or in the surrounding area.

The underlying bedrock is a poorly productive aquifer.

1.2. Risk Screening

1.2.1. Soils

For soils, all analytical results from the 2021 site investigation were compared with UK-based published S4ULs human-health GAC in order to compare the soil geochemistry of the site to the generic limit values for appropriate land use. In addition, the soils were also compared to phytotoxic screening values.

The criteria routinely used by TOBIN as soil screening values for the protection of human health are:

- Phytotoxic screening values (DOE,2006¹);
- Category 4 Screening Levels (C4SLs) published in 2014 which adopt a “low level of toxicological concern” (LLTC) as the toxicological benchmark; and
- Suitable 4 Use Levels (S4ULs) published in 2015 which adopt a minimal or tolerable risk as described in SR2 (EA 2009c).

The growth of produce/ potential growth of produce, is covered under the phytotoxic criteria. Phytotoxic screening values are set for agricultural land and protective of human health. Phytotoxic screening values are utilised as detailed in Section 1.2.2 phytotoxic screening values.

¹ UK Department Of Environment 2006 Code of Practice for Agricultural Use of Sewage Sludge. Second Edition.

The S4UL criteria have been generated using the Contaminated Land Exposure Assessment model (CLEA) and supporting technical guidance (EA, 2009a², 2009b³, 2009c⁴).

1.2.2. Phytotoxic Screening Values

The natural background level of heavy metals depends strongly on the origin of the soil and soil characteristics, since metals occur naturally in the earth's crust. Anthropogenic contamination of soils with heavy metals is caused by atmospheric deposition or by direct disposal on the soil.

Several heavy metal compounds can inhibit plant growth in Irish soils, thus the DoE Code of Practice and Generic Assessment Criteria (GAC) can be applied to assess and to promote healthy plant growth. In the absence of other published GAC, the GAC have been obtained from legislation (UK and European) and guidance related to the use of sewage sludge on agricultural lands.

The Council of European Communities Sewage Sludge Directive (86/278/EEC) and the UK Department of the Environment produced a Code of Practice (CoP) (Updated 2nd Edition) in 2006 provided guidance on the application of sewage sludge on agricultural land. The Directive requires that the use of sludge takes into consideration the nutrient requirements of plants and does not negatively affect the quality of the soil and of the surface water and groundwater.

The specified threshold values of selected metals in soil are listed in Table 3 and 4 of the updated 2nd Edition of the DoE Code of Practice and are designed to protect plant growth. It is noted that these values are more stringent than the values set in current UK Regulations. The GAC are presented in Table 3.

1.2.3. Suitable 4 Use Levels (S4ULs)

The CLEA model is based on the fate and transport of chemicals in the environment and a generic conceptual model for site conditions and human behaviour to estimate child and adult exposures to soil contaminants for those potentially living, working, and/or playing on contaminated sites over long time periods (EA, 2009b).

The CLEA model uses ten exposure pathways (Ingestion (outdoor soil, indoor dust, homegrown vegetables and soil attached to homegrown vegetables), Dermal Contact (outdoor soil and indoor dust) and Inhalation (outdoor dust, indoor dust, outdoor vapours and indoor vapours)).

² EA (2009a) Using Soil Guideline Values. Science Report SC050021/SGV Introduction.

UK Environment Agency.

³ EA (2009b) Updated Technical Background to the CLEA model. Science Report SC050021/SR3

Introduction. UK Environment Agency.

⁴ EA (2009c) Human health toxicological assessment of contaminants in soil. Science Report SC050021/SR2. Environment Agency.

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The presence and/or significance of each of the potential exposure pathways is dependent on the land use being considered. The model uses standard land use scenarios. In 2015, updated GACs for various substances were published by the Chartered Institute of Environmental Health (CIEH) (LQM and CIEH, 2015) using the current version of the CLEA software.

The GAC apply to the potential land use that is perceived as potentially the greatest risk to human health. The potential risk factors for individual metals varies depending on the potential exposure scenarios associated with that potential land use, thus the potential exposure factors drive the underlying science behind the science utilised to generate the LQM/CIEH S4ULs - Generic Assessment Limit Values.

The proposed GACs used include a very conservative Land Use Scenario for the proposed development. Soil screening values (S4ULs) are detailed below in Table 3 and 4.

2 Results

2.1 Soil Results

Table 3 and 4 contains the S4UL guideline values used in the Tier 1 assessment. All measured hydrocarbon and inorganic concentrations were below the GAC values upgradient and downgradient of the former petrol station.

In accordance with the CLEA and S4ULs, Table 3 and 4 summarises data from the site investigation maximum value, and various GACs for each of these contaminants.

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Table 3 Soil Metal Results

Determinands	Units	Generic Assessment Criteria (S4UL)		P211 - Upgradient P212 Downgradient P213 Kilmastulla River			Above Screening values?
		(6.0% SOM) with Home Grown Produce Residential	Allotment (6.0% SOM)				
Arsenic	mg/kg	37	43	4.76	4.82	19.5	No
Cadmium	mg/kg	11	1.9	<0.40	<0.40	10.2	YES
Copper	mg/kg	2400	520	30.1	14.8	54.3	No
Lead	mg/kg		80	59.4	62	893	Yes
Zinc	mg/kg	NA	NA	85.9	92.7	2310	No

Table 4 BTEX Screening Values (mg/kg of soil)

Determinants	Generic Assessment Criteria (S4UL)		P211 - Upgradient	P212 Downgradient	P213 Kilmastulla	Above Screening values
	Allotment (1%/ 2.5%/ 6%)	RWHP (1%/ 2.5%/ 6%)				
BTEX Compounds (SOM 1%/ 2.5%/ 6%) mg/kg						
Benzene	0.017/0.034/ 0.075	0.087/0.17/ 0.37	<0.016	<0.016	<0.016	No
Toluene	22 / 51 / 120	130 / 290 / 660	<0.050	<0.050	<0.050	No

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Determinants	Generic Assessment Criteria (S4UL)		P211 Upgradient	P212 Downgradient	P213 Kilmastulla	Above Screening values
	Allotment (1%/ 2.5%/ 6%)	RWHP				
Ethylbenzene	16 / 39 / 91	47 / 110 / 260	<0.033	<0.033	<0.033	No
O – Xylene	28 / 67 / 160	60 / 140 / 330	<0.016	<0.016	<0.016	No
M – Xylene	31 / 74 / 170	59 / 140 / 320	<0.033	<0.033	<0.033	No
P – Xylene	29 / 69 / 160	56 / 130 / 310	<0.033	<0.033	<0.033	No

Concentrations of metal on the banks of the Kilmastulla River are elevated. The elevated metal concentrations are likely to be as a result of historical mining at the upgradient Silvermines area (*Inter-Agency Group, 2004*).

2.1.1 Phytotoxic Screening values

Several heavy metal compounds can inhibit plant growth in Irish soils; thus, the DoE Code of Practice and Generic Assessment Criteria (GAC) can be applied to assess and to promote healthy plant growth. In the absence of other published GAC, the GAC have been obtained from legislation (UK and European) and guidance related to the use of sewage sludge on agricultural lands – see Table 5.

Table 5 Phytotoxic screening levels

PARAMETER	Phytotoxic Generic Assessment Criteria			Above Phytotoxic GAC
	Units	Max site value		
Arsenic	mg/kg	50	19.5	No
Cadmium	mg/kg	3	10.9	YES (P213 - Kilmastulla)
Copper	mg/kg	135	54.3	No
Lead	mg/kg	300	893	YES (P213 - Kilmastulla)
Zinc	mg/kg	200	2310	YES (P213 - Kilmastulla)

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The concentration of soils located upgradient and downgradient of the petrol station are comparable to natural background metal concentrations and below the phytotoxic criteria threshold values. All metals at the petrol station are below the Phytotoxic screening guidelines. Metal and hydrocarbon concentrations at the former petrol station reflect the natural soil metal concentrations in the area and the proposed land use.

Cadmium, Lead and Zinc are above the Phytotoxic screening values on the banks of the Kilmastulla River.

The above values indicate that the soils at both upgradient and downgradient of the former petrol station did not indicate contamination. No soils concentrations exceed the Phytotoxic screening levels. The Phytotoxic levels are set at a level that does not impact on agriculture or the environment.

No soil concentration exceeded the S4ULs for hydrocarbons on the Kilmastulla River. Concentrations of some metals are above the EPA trigger values.

2.2 Surface water results

A combination of the Drinking water regulations (SI122 of 2014) and the surface water regulations (SI 77/2019) was used as screening values for the petrol station assessment. The most conservative of the values has been used for the assessment criteria at this site.

Where no screening values are published in Ireland, the WHO drinking water guideline values have been used as assessment criteria due the absence of Irish-based criteria.

Table 6 Water Sample Results

Parameter	Units	K1 Upgradient - Knockadromin	K2 Downgradient - Knockadromin	K3 Kilmastulla River	STANDARDS		ABOVE LIMITS Y/N
					Surface water standards SI 77 of 2019	Drinking Water / WHO guidelin es	
Arsenic, total as As (ug/l)	ug/l	1.6	1.4	2.4	-	10	N
Selenium, total as Se (ug/l)	ug/l	<0.60	<0.60	<0.60	-	100	N
Cadmium , Total as Cd	mg/l	<0.0006	<0.0006	<0.0006	0.08	0.005	N
Copper, Total as Cu	mg/l	<0.009	<0.009	<0.009	-	0.03	N
Lead , Total as Pb	mg/l	<0.006	<0.006	<0.006	-	10	N
Mercury, Total as Hg	ug/l	<0.01	<0.01	<0.01	0.07	1	N
Nickel, Total as Ni	mg/l	<0.003	<0.003	<0.003	-	0.02	N
Tin , Total as Sn	ug/l	<7.00	<7.00	<7.00	-	na	N
Zinc, Total as Zn	mg/l	<0.018	<0.018	0.03	-	0.1	N
Aliphatic VPH >C5 -	ug/l	<10	<10	<10	-	-	NA

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Parameter	Units	K1 Upgradient - Knockadromin	K2 Downgradient - Knockadromin	K3 Kilmastulla River	STANDARDS		ABOVE LIMITS Y/N
					Surface water standards SI 77 of 2019	Drinking Water / WHO guidelin es	
C6							
Aliphatic VPH >C6 - C8	ug/l	<10	<10	<10	-	-	NA
Aliphatic VPH >C8 - 10	ug/l	<10	<10	<10	-	-	NA
Aliphatic VPH >C5 - C10	ug/l	<10	<10	<10	-	-	NA
Aromatic VPH >C5 - C7	ug/l	<10	<10	<10	-	-	NA
Aromatic VPH >C7 - C8	ug/l	<10	<10	<10	-	-	NA
Aromatic VPH >C8 - C10	ug/l	<10	<10	<10	-	-	NA
Aromatic VPH >C5 - C10	ug/l	<10	<10	<10	-	-	NA
VPH >C5 - C10	ug/l	<10	<10	<10	-	-	NA
Aliphatic EPH >C10 - C12	ug/l	<10	<10	<10	-	-	NA
Aliphatic EPH >C12 - C16	ug/l	<10	<10	<10	-	-	NA
Aliphatic EPH >C16 - C35	ug/l	<10	<10	<10	-	-	NA
Aliphatic EPH >C35 - C44	ug/l	<10	<10	<10	-	-	NA
Aliphatic EPH >C10 - C44	ug/l	<10	<10	<10	-	-	NA
Aromatic EPH >C10 - C12	ug/l	<10	<10	<10	-	-	NA
Aromatic EPH >C12 - C16	ug/l	<10	<10	<10	-	-	NA
Aromatic EPH >C16 - C21	ug/l	<10	<10	<10	-	10	N
Aromatic EPH >C21 - C35	ug/l	<10	<10	<10	-	10	N
Aromatic EPH >C35 - C44	ug/l	<10	<10	<10	-	10	N
Aromatic EPH >C10 - C44	ug/l	<10	<10	<10	-	10	N
EPH >C10 - C44	ug/l	<10	<10	<10	-	10	N
Aliphatic VPH/EPH >C5 - C44	ug/l	<10	<10	<10	-	10	N

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Parameter	Units	K1 Upgradient - Knockadromin	K2 Downgradient - Knockadromin	K3 Kilmastulla River	STANDARDS		ABOVE LIMITS Y/N
					Surface water standards SI 77 of 2019	Drinking Water / WHO guidelin es	
Aromatic VPH/EPH >C5 - C44	ug/l	<10	<10	<10	-	10	N
VPH/EPH >C5 - C44	ug/l	<10	<10	<10	-	10	N
Naphthalene	ug/l	<0.010	<0.010	<0.010	-	0.1	N
Acenaphthylene	ug/l	<0.010	<0.010	<0.010	-	0.1	N
Acenaphthene	ug/l	<0.010	<0.010	<0.010	-	0.1	N
Fluorene	ug/l	<0.010	<0.010	<0.010	-	0.1	N
Phenanthrene	ug/l	<0.010	<0.010	<0.010	-	0.1	N
Anthracene	ug/l	<0.010	<0.010	<0.010	-	0.1	N
Fluoranthene	ug/l	<0.010	<0.010	<0.010	-	0.1	N
Pyrene	ug/l	<0.010	<0.010	<0.010	-	0.1	N
Benzo(a)anthracene	ug/l	<0.010	<0.010	<0.010	-	0.1	N
Chrysene	ug/l	<0.010	<0.010	<0.010	-	0.1	N
Benzo(b)fluoranthene	ug/l	<0.010	<0.010	<0.010	0.017	0.1	N
Benzo(k)fluoranthene	ug/l	<0.010	<0.010	<0.010	0.017	0.1	N
Benzo(a)pyrene	ug/l	<0.010	<0.010	<0.010	0.27	0.01	N
Indeno(123cd)pyrene	ug/l	<0.010	<0.010	<0.010	-	0.1	N
Dibenzo(ah)anthracene	ug/l	<0.010	<0.010	<0.010	-	0.1	N
Benzo(ghi)perylene	ug/l	<0.010	<0.010	<0.010	0.0082	0.1	N
PAH, Total of 16	0	<0.010	<0.010	<0.010			

No hydrocarbon contamination was detected or observed in any of the surface water samples. All of the reported metal concentrations are within the corresponding guideline values. No visual or olfactory evidence of contamination was noted on site during the sampling of the surface water features. While the soil metal concentrations at the Kilmastulla are elevated, the surface water quality has not been influenced by the sediment metal concentrations.

3 Conclusions

Quantitative risk assessment techniques have been used to determine whether any of the pollutant S_P_R linkages identified in Section 2 are indicative of significant risk. The findings of this assessment are as follows:

1. No measured soil metal and hydrocarbon concentrations exceeded the S4ULs or Phytotoxic criteria for the future use of the former petrol station. Samples were taken upgradient and downgradient of the former petrol station. P212 was taken near the proposed river crossing. The soils are comparable to natural background metal and hydrocarbon concentrations.
2. Elevated soil metal concentrations were detected in the soil sample on the banks of the Kilmastulla River. Metal concentrations are elevated as a likely result of historic mining in the Silvermines hills which form the upper catchment of the Kilmastulla River. While the soil metal concentrations are high, no evidence of elevated metals were detected in the Kilmastulla River.
3. Soil removal, where required along the banks of the Kilmastulla River, will require disposal in accordance with the Waste Management Act 1996 as amended.
4. No measured surface water concentrations in the Knockadromin River or Kilmastulla River exceeded the screening values.
5. Notwithstanding the above, should any excavation or removal of soil proximal to the former fuel tanks be proposed (which is not currently the case) this would require further site investigation.

Memorandum

References

BSI (2011) BS10175:2011 +A1:2013 Investigation of contaminated sites – code of practice. British Standards Institute, London.

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EA (2009e) CLEA Software (Version 1.05) Handbook Science Report SC050021/SR4

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S.I. No. 122 of 2014, European Union (Drinking Water) Regulations

S.I. No. 77 of 2021 European Communities Environmental Objective (Surface Water) Regulations, (2021)

SRK (2005) Management and Rehabilitation of the Silvermines Area, Phase IV report: Conceptual Design



Unit 7-8 Hawarden Business Park
Manor Road (off Manor Lane)
Hawarden
Deeside
CH5 3US

Tel: (01244) 528700

Fax: (01244) 528701

email: hawardencustomerservices@alsglobal.com

Website: www.alsenvironmental.co.uk

Irish Drilling Limited
Old Galway Road
Loughrea
Co. Galway

Attention: Dympna Darcy

CERTIFICATE OF ANALYSIS

Date: 06 September 2017
Customer: D_DRILL_LGA
Sample Delivery Group (SDG): 170826-86
Your Reference: 17T101
Location: WSP
Report No: 423139

We received 3 samples on Saturday August 26, 2017 and 3 of these samples were scheduled for analysis which was completed on Wednesday September 06, 2017. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

Chemical testing (unless subcontracted) performed at ALS Environmental Hawarden (Method codes TM) or ALS Environmental Aberdeen (Method codes S).

Approved By:

Sonia McWhan

Operations Manager





CERTIFICATE OF ANALYSIS

Validated

SDG: 170826-86
Location: WSP

Client Reference: 17T101
Order Number: 4894

Report Number: 423139
Superseded Report:

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
16082456	RC45	EW1	5.00 - 5.00	23/08/2017
16082463	RC46	EW1	4.00 - 4.00	23/08/2017
16082470	RC231	EW1	7.00 - 7.00	23/08/2017

Maximum Sample/Coolbox Temperature (°C) :

18

ISO5667-3 Water quality - Sampling - Part3 -

During Transportation samples shall be stored in a cooling device capable of maintaining a temperature of (5±3)°C.

ALS have data which show that a cool box with 4 frozen icepacks is capable of maintaining pre-chilled samples at a temperature of (5±3)°C for a period of up to 24hrs.

Only received samples which have had analysis scheduled will be shown on the following pages.



CERTIFICATE OF ANALYSIS

Validated

SDG: 170826-86
Location: WSP

Client Reference: 17T101
Order Number: 4894

Report Number: 423139
Superseded Report:

Results Legend		Customer Sample Ref.	RC45	RC46	RC231		
#	ISO17025 accredited.						
M	mCERTS accredited.						
aq	Aqueous / settled sample.	Depth (m)	5.00 - 5.00	4.00 - 4.00	7.00 - 7.00		
diss.filt	Dissolved / filtered sample.	Sample Type	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)		
tot.unfilt	Total / unfiltered sample.	Date Sampled	23/08/2017	23/08/2017	23/08/2017		
*	Subcontracted test.	Sample Time					
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery	Date Received	26/08/2017	26/08/2017	26/08/2017		
(F)	Trigger breach confirmed	SDG Ref	170826-86	170826-86	170826-86		
1-5&*\$@	Sample deviation (see appendix)	Lab Sample No.(s)	16082456	16082463	16082470		
		AGS Reference	EW1	EW1	EW1		
Component	LOD/Units	Method					
Alkalinity, Total as CaCO3	<2 mg/l	TM043	230	380	335		
			#	#	#		
Silica	<0.5 mg/l	TM044	6.6	8.1	<0.5		
Organic Carbon, Total	<3 mg/l	TM090	6.23	<3	16.8		
			#	#	#		
Ammoniacal Nitrogen as NH4	<0.3 mg/l	TM099	0.903	<0.3	0.409		
			#	#	#		
Fluoride	<0.5 mg/l	TM104	0.525	<0.5	<0.5		
			#	#	#		
Conductivity @ 20 deg.C	<0.005 mS/cm	TM120	0.36	0.664	0.571		
			#	#	#		
Aluminium (diss.filt)	<2 µg/l	TM152	36	<2	<2		
			#	#	#		
Antimony (diss.filt)	<0.1 µg/l	TM152	2.6	<0.1	0.189		
Arsenic (diss.filt)	<0.5 µg/l	TM152	1.07	0.774	1.56		
			#	#	#		
Barium (diss.filt)	<0.2 µg/l	TM152	27.3	62.8	319		
			#	#	#		
Boron (diss.filt)	<5 µg/l	TM152	84.1	26.4	30.3		
			#	#	#		
Cadmium (diss.filt)	<0.08 µg/l	TM152	<0.08	<0.08	0.173		
			#	#	#		
Chromium (diss.filt)	<1 µg/l	TM152	4.52	1.85	<1		
			#	#	#		
Cobalt (diss.filt)	<0.15 µg/l	TM152	0.171	0.209	4.96		
			#	#	#		
Copper (diss.filt)	<0.3 µg/l	TM152	2.87	0.709	5.29		
			#	#	#		
Lead (diss.filt)	<0.2 µg/l	TM152	<0.2	<0.2	<0.2		
			#	#	#		
Manganese (diss.filt)	<1 µg/l	TM152	32.9	26.7	2070		
			#	#	#		
Molybdenum (diss.filt)	<0.5 µg/l	TM152	<0.5	<0.5	<0.5		
			#	#	#		
Nickel (diss.filt)	<0.4 µg/l	TM152	4.43	1.61	28.8		
			#	#	#		
Zinc (diss.filt)	<1 µg/l	TM152	144	11.4	500		
			#	#	#		
Mercury (diss.filt)	<0.01 µg/l	TM183	<0.01	<0.01	<0.01		
			#	#	#		
Nitrite as NO2	<0.05 mg/l	TM184	0.325	<0.05	0.052		
			#	#	#		
Sulphate	<2 mg/l	TM184	10.7	17.4	18.6		
			#	#	#		
Chloride	<2 mg/l	TM184	13.8	26	25.5		
			#	#	#		
Nitrate as NO3	<0.3 mg/l	TM184	6.2	23.1	<0.3		
Nitrate as N	<0.0677 mg/l	TM184	1.4	5.21	<0.0677		
Phosphorus (tot.unfilt)	<20 µg/l	TM191	<20	<20	<20		
PCB congener 28	<0.015 µg/l	TM197	<0.015	<0.015	<0.015		
PCB congener 52	<0.015 µg/l	TM197	<0.015	<0.015	<0.015		
PCB congener 101	<0.015 µg/l	TM197	<0.015	<0.015	<0.015		
PCB congener 118	<0.015 µg/l	TM197	<0.015	<0.015	<0.015		
PCB congener 138	<0.015 µg/l	TM197	<0.015	<0.015	<0.015		
PCB congener 153	<0.015 µg/l	TM197	<0.015	<0.015	<0.015		



CERTIFICATE OF ANALYSIS

Validated

SDG: 170826-86
Location: WSP

Client Reference: 17T101
Order Number: 4894

Report Number: 423139
Superseded Report:

Table of Results - Appendix

Method No	Reference	Description	Wet/Dry Sample ¹	Surrogate Corrected
TM043	Method 2320B, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part109 1984	Determination of alkalinity in aqueous samples		
TM044	MEWAM Phosphorous and silica in waters, effluent and sludges HMSO 1992	Determination of silica in water using the Palintest test kit		
TM061	Method for the Determination of EPH,Massachusetts Dept.of EP, 1998	Determination of Extractable Petroleum Hydrocarbons by GC-FID (C10-C40)		
TM090	Method 5310, AWWA/APHA, 20th Ed., 1999 / Modified: US EPA Method 415.1 & 9060	Determination of Total Organic Carbon/Total Inorganic Carbon in Water and Waste Water		
TM099	BS 2690: Part 7:1968 / BS 6068: Part2.11:1984	Determination of Ammonium in Water Samples using the Kone Analyser		
TM104	Method 4500F, AWWA/APHA, 20th Ed., 1999	Determination of Fluoride using the Kone Analyser		
TM120	Method 2510B, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part 9:1970	Determination of Electrical Conductivity using a Conductivity Meter		
TM152	Method 3125B, AWWA/APHA, 20th Ed., 1999	Analysis of Aqueous Samples by ICP-MS		
TM183	BS EN 23506:2002, (BS 6068-2.74:2002) ISBN 0 580 38924 3	Determination of Trace Level Mercury in Waters and Leachates by PSA Cold Vapour Atomic Fluorescence Spectrometry		
TM184	EPA Methods 325.1 & 325.2,	The Determination of Anions in Aqueous Matrices using the Kone Spectrophotometric Analysers		
TM191	Standard Methods for the examination of waters and wastewaters 16th Edition, ALPHA, Washington DC, USA. ISBN 0-87553-131-8.	Determination of Unfiltered Metals in Water Matrices by ICP-MS		
TM197	Modified: US EPA Method 8082.EA Method 174 and 5109631	Determination of WHO12 and EC7 Polychlorinated Biphenyl Congeners by GC-MS in Waters		
TM228	US EPA Method 6010B	Determination of Major Cations in Water by iCap 6500 Duo ICP-OES		
TM256	The measurement of Electrical Conductivity and the Laboratory determination of pH Value of Natural, Treated and Wastewaters. HMSO, 1978. ISBN 011 751428 4.	Determination of pH in Water and Leachate using the GLpH pH Meter		

¹ Applies to Solid samples only. DRY indicates samples have been dried at 35°C. NA = not applicable.

Chemical testing (unless subcontracted) performed at ALS Environmental Hawarden (Method codes TM) or ALS Environmental Aberdeen (Method codes S).



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Test Completion Dates

Lab Sample No(s)	16082456	16082463	16082470
Customer Sample Ref.	RC45	RC46	RC231
AGS Ref.	EW1	EW1	EW1
Depth	5.00 - 5.00	4.00 - 4.00	7.00 - 7.00
Type	Ground Water	Ground Water	Ground Water

Alkalinity as CaCO3	04-Sep-2017	04-Sep-2017	04-Sep-2017
Ammoniacal Nitrogen	29-Aug-2017	29-Aug-2017	29-Aug-2017
Anions by Kone (w)	05-Sep-2017	06-Sep-2017	05-Sep-2017
Conductivity (at 20 deg.C)	01-Sep-2017	01-Sep-2017	01-Sep-2017
Dissolved Metals by ICP-MS	05-Sep-2017	05-Sep-2017	05-Sep-2017
Fluoride	31-Aug-2017	31-Aug-2017	31-Aug-2017
Mercury Dissolved	04-Sep-2017	04-Sep-2017	04-Sep-2017
Metals by iCap-OES Dissolved (W)	05-Sep-2017	05-Sep-2017	05-Sep-2017
Nitrite by Kone (w)	30-Aug-2017	31-Aug-2017	31-Aug-2017
PCB Congeners - Aqueous (W)	01-Sep-2017	01-Sep-2017	01-Sep-2017
pH Value	30-Aug-2017	30-Aug-2017	30-Aug-2017
Silica	29-Aug-2017	29-Aug-2017	29-Aug-2017
Total Metals by ICP-MS	30-Aug-2017	30-Aug-2017	30-Aug-2017
Total Organic and Inorganic Carbon	31-Aug-2017	31-Aug-2017	31-Aug-2017



CERTIFICATE OF ANALYSIS

SDG: 170826-86	Client Reference: 17T101	Report Number: 423139
Location: WSP	Order Number: 4894	Superseded Report:

Appendix

General

1. Results are expressed on a dry weight basis (dried at 35°C) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH4 by the BRE method, VOC TICs and SVOC TICs.

2. Samples will be run in duplicate upon request, but an additional charge may be incurred.

3. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALS reserve the right to charge for samples received and stored but not analysed.

4. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

5. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

6. When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as "Not detected". If no asbestos fibre types are found all will be reported as "Not detected" and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of asbestos present is not determined unless specifically requested.

7. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

8. If appropriate preserved bottles are not received preservation will take place on receipt. However, the integrity of the data may be compromised.

9. NDP - No determination possible due to insufficient/unsuitable sample.

10. Metals in water are performed on a filtered sample, and therefore represent dissolved metals - total metals must be requested separately.

11. Results relate only to the items tested.

12. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

13. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%, they are generally wider for volatiles analysis, 50-150%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

14. **Product analyses** - Organic analyses on products can only be semi-quantitative due to the matrix effects and high dilution factors employed.

15. Phenols monohydric by HPLC include phenol, cresols (2-Methylphenol, 3-Methylphenol and 4-Methylphenol) and Xylenols (2,3 Dimethylphenol, 2,4 Dimethylphenol, 2,5 Dimethylphenol, 2,6 Dimethylphenol, 3,4 Dimethylphenol, 3,5 Dimethylphenol).

16. Total of 5 speciated phenols by HPLC includes Phenol, 2,3,5-Trimethyl Phenol, 2-Isopropylphenol, Cresols and Xylenols (as detailed in 15).

17. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

18. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

19. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

20. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

21. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

22. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

23. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

24. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as "mixed hydrocarbons". Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

Sample Deviations

If a sample is classed as deviated then the associated results may be compromised.

1	Container with Headspace provided for volatiles analysis
2	Incorrect container received
3	Deviation from method
4	Holding time exceeded before sample received
5	Samples exceeded holding time before preservation was performed
§	Sampled on date not provided
◆	Sample holding time exceeded in laboratory
@	Sample holding time exceeded due to sampled on date
&	Sample Holding Time exceeded - Late arrival of instructions.

Asbestos

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

Astestost Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Coisidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than: - Trace - Where only one or two asbestos fibres were identified.

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.