Eve O'Sullivan

Subject: FW: RE: Historic Landfill Cert of Authorisations
Attachments: Summary Report Final.pdf

From: Yvonne Murray [mailto:ymurray@kildarecoco.ie]
Sent: Friday 26 October 2018 13:12
To: Magnus Amajirionwu <M.Amajirionwu@epa.ie>
Cc: Michael Holligan <mholligan@kildarecoco.ie>
Subject: RE: RE: Historic Landfill Cert of Authorisations

Magnus

Attached please find the Final Consolidated Report summarising the Environmental Risk Assessment Reports, previously submitted, that were carried out on the Carrigeen Legacy Landfill site, Clane, Co. Kildare as submitted to the EPA as part of a Certificate of Authorisation Application. This Report also includes up to date monitoring data carried out over the intervening years, including monitoring carried out in 2018.

Should you require anything further to facilitate issue of the CoA for this site, please do not hesitate to ask

Kind Regards
Yvonne

From: Magnus Amajirionwu <M.Amajirionwu@epa.ie>
To: Yvonne Murray <ymurray@kildarecoco.ie>
Date: 10/09/2018 14:45
Subject: RE: RE: Historic Landfill Cert of Authorisations

Yvonne,

Thanks for the update.

The AA screening is done in entirety with the risk assessment and remedial measures proposed. The Agency would issue a decision when all the documents have been assessed.

Thanks and kind regards

Magnus

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From: Yvonne Murray [mailto:ymurray@kildarecoco.ie]
Sent: 10 September 2018 14:40
To: Magnus Amajirionwu
Cc: Michael Holligan
Subject: RE: RE: Historic Landfill Cert of Authorisations

Magnus

Further to our previous discussions on your assessment of Kildare County Councils application for Certificate of Authorisation for a legacy landfill site in Carrigeen, you highlighted some concerns and further information that you required to fully assess the reports submitted. You had requested a suitably qualified consultant to consolidate the Tier 1, 2 and 3 reports, to reassess the risk and ensure a comprehensive Remediation Plan was submitted. KCC subsequently procured the services of OCM, who should be in a position to forward a final report in the next week or two which i will in turn forward to you for assessment.

I also subsequently forwarded the AA screening report to you, but to date have not had any feedback on it or whether the EPA accepts its conclusions. To ensure a CoA is obtained without any further delay, could you advise if you are happy with the screening, or if you request any further clarifications relating to it.

Many thanks
Yvonne

From: Magnus Amajirionwu <M.Amajirionwu@epa.ie>
To: Yvonne Murray <ymurray@kildarecoco.ie>
Date: 05/07/2018 09:35
Subject: RE: RE: Historic Landfill Cert of Authorisations

Yvonne

Received. I will forward a decision on the AA screening next week. What you've sent to me is the screening carried out by your consultant. The Agency will issue its decision as to whether it agrees (or not) with the conclusion reached by your consultant!

Thanks and kind regards

Magnus

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From: Yvonne Murray [mailto:ymurray@kildarecoco.ie]
Sent: 04 July 2018 12:05
To: Magnus Amajirionwu
Subject: Fwd: RE: Historic Landfill Cert of Authorisations

Magnus

As discussed, below is an email that Brian sent me last year. Attached to his email are copies of an acknowledgment that a Valid Application was received, the Professional Body letter, and the AA Screening Report (which screens out the need to do a full report).

Should you require anything further please let me know and I will endeavour to forward asap. As discussed we have received Department funding to remediate this site so we would very much appreciate if the application could be processed.

Kind Regards
Yvonne

From: "Brian Meaney <B.Meaney@epa.ie>" <b.meaney@epa.ie>

To: Yvonne Murray <ymurray@kildarecoco.ie>
Date: 10/02/2017 11:39
Subject: RE: Historic Landfill Cert of Authorisations

Yvonne
While I await a response to my queries about what exactly you can or should be able to see in Eden from your end, please find attached the documents that were uploaded as part of the application. I don't think these docs show your SPR linkages or the summary of your proposed remediation, but all that information will be in the quantitative risk assessment that your qualified person completed for you (but you weren't required to upload).
As regards progress, these applications are not listed in our Licensing Plan for 2017 and will not be processed this year.
Brian.

From: Brian Meaney
Sent: 10 February 2017 11:30
To: 'Yvonne Murray'
Subject: RE: Historic Landfill Cert of Authorisations

Yvonne
I'll talk to the IT people to see what can be done.
Brian.

From: Yvonne Murray [mailto:Ymurray@kildarecoco.ie]
Sent: 10 February 2017 09:44
To: Brian Meaney
Subject: Historic Landfill Cert of Authorisations

Brian

I contacted the EPA some time ago regarding getting a copy of the 2 Historic Landfill License applications made by Kildare County Council for Certificates of Authorisation.

KCC applied for Certs for 2 sites; Carrigaeen H0210 and Pollardstown Refuse Depot H0228 in early 2014 which was before my time looking after this area. Unfortunately given that the applications were made on line through EDEN I dont seem to be able to find a copy of what exactly was applied for. When i contacted the EPA previously I was advised that the software for viewing the applications had not yet been developed and therefore it was not possible to get a copy.

We will be meeting representatives from the Eastern Midlands Regional Office in the next few weeks to discuss these sites so I am wondering if there is any update on the applications, and on viewing them on Eden.

Many thanks

Yvonne

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Tier 2 and 3 Environmental Risk Assessment

Carrigeen Legacy Landfill

Clane,

County Kildare

Prepared For: -

Kildare County Council
Áras Chill Dara,
Devoy,
Naas,
Co. Kildare.

Prepared By: -

O'Callaghan Moran & Associates,
Unit 15, Melbourne Business Park,
Model Farm Road,
Cork.

October 2018

O'Callaghan Moran & Associates Registration/VAT Number: 8272844U

TABLE OF CONTENTS

LIST OF APPENDICES

1. INTRODUCTION

The Carrigeen landfill was operated by Kildare County Council (the Council) between 1977 and 1980, accepting municipal waste from the surrounding area. It covers 0.98 hectares and is located less than 1km south of Clane Village and 110m from the River Liffey.

A Tier 1 risk assessment completed by the Council in May 2010 indicated the Site was a Moderate Risk (Class B). Between 2010 and 2014 the Council commissioned the following additional assessments:

- Tier 2 Environmental Risk Assessment completed by Golder Associates;
- Tier 3 Detailed Quantitative Risk Assessment limited to assessing the geology and hydrogeology (soil, leachate, groundwater, surface water) and not addressing any change to the Tier 1 Risk ranking completed by Mulroy Environmental (2014);
- Landfill Gas Surface Emissions Survey, and GASSIM Modelling Report completed by Odour Monitoring Ireland (2011);

Separately from these assessments the Council completed surface water, groundwater and leachate monitoring in 2012, 2013, 2015 and 2017.

The Council subsequently applied to the EPA for a Certificate of Authorisation (CoA) under the Waste Management (Certificate of Historic Unlicensed Waste Disposal and Recovery Activity) Regulations, 2008. The application included the above referenced reports. The EPA has requested the preparation of a Final Report that consolidates the findings of all of the previous assessments and the Council appointed O'Callaghan Moran & Associates (OCM) to prepare this report.

1.1 Methodology

OCM reviewed the Tier 1, 2 and 3 Assessment reports and the report on the landfill gas survey. Based on the findings OCM completed the Tier 3 Assessment to determine if the findings of the Tier 2 Site Investigations results has changed the risk ranking from that established in the Tier 1 Assessment. At the Council's request OCM carried out leachate, landfill gas, groundwater and surface water monitoring in 2018.

OCM the prepared this summary report in accordance with the Code of Practice: Environmental Risk Assessment for Unregulated Waste Disposal Sites (EPA, 2007).

Mr Sean Moran MSc, P.Geol, was the OCM Project Manager with responsibility for the delivery of the project. Mr. Moran is a hydrogeologist with more than 29 years' experience in hydrogeological assessment and is certified by the IGI as qualified person in accordance with Section 2.3 of Code of Practice: Environmental Risk Assessment for Unregulated Waste Disposal Sites (EPA, 2007).

2. ENVIRONMENTAL SETTING

2.1 Site Location

The site is approximately 1km south of Clane village (Figure 2.1) and is located at the end of a cul-de-sac which provides access to one-off houses and paddocks in a residential area,

2.2 Site Layout

The landfill occupies a large portion of a former quarry (0.979 ha) as shown on Figure 2.2 which is based on the Site Lay out Plan in the Golders Tier 2 Assessment. Current land uses comprises a garden in the western section of the site, a horse paddock in the centre and scrub in the east.

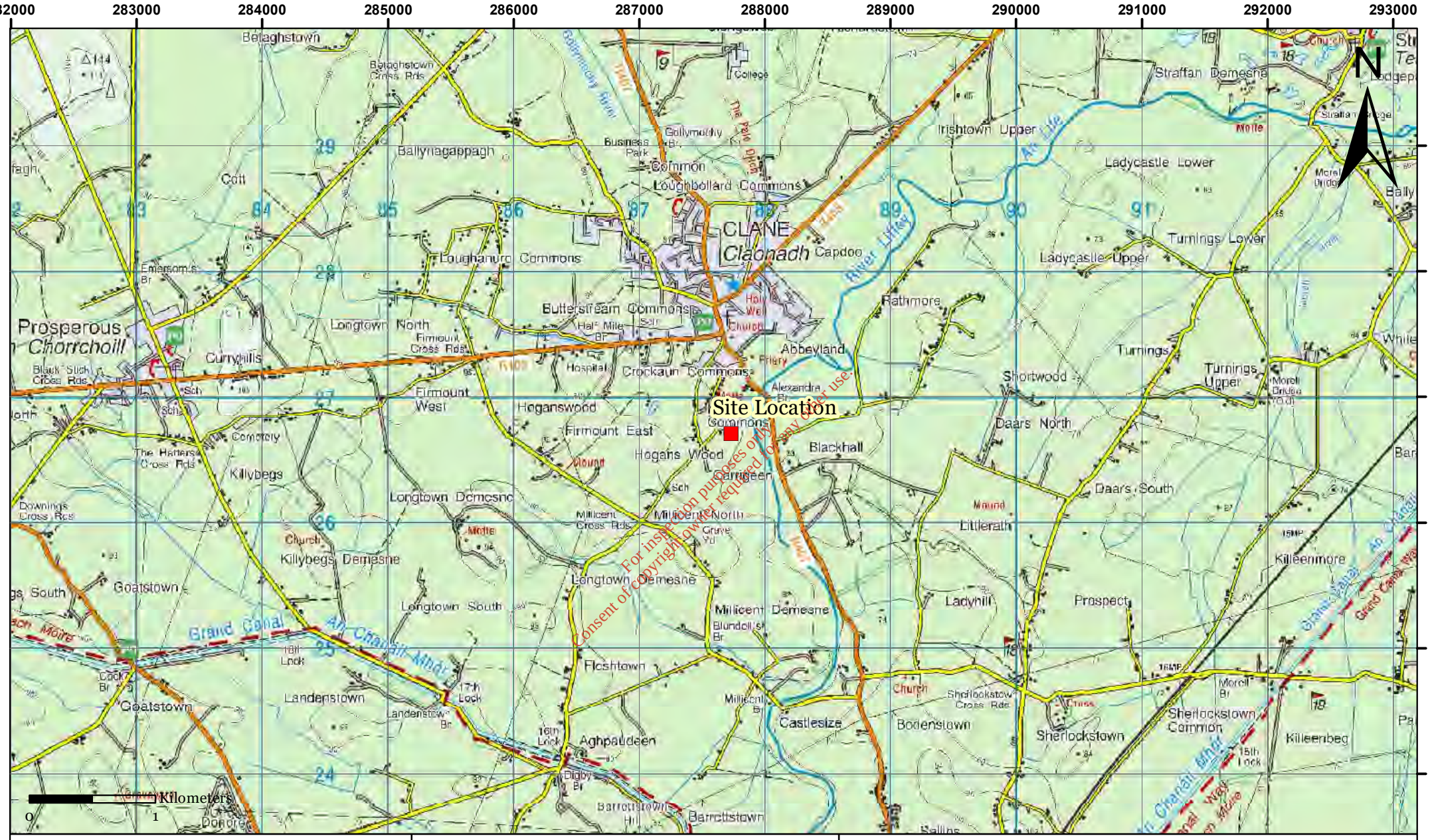
There is a steep gradient falling from south to north, with depressions evident in the east of the site where settlement has occurred. During the winter months ponding of what appears to be leachate occurs along the northern boundary. This overflows onto the road and enters a stream on the north side of the road.

2.3 Surrounding Land Use

The surrounding land use is residential and amenity, with dwellings located on individual sites of. Millicent Golf Course is immediately south of the site (Figure 2.3). The nearest dwelling is within 10m to the west of waste deposition area, with a second house 40m to the south-east. The River Liffey is 85m to the east, where it flows from south to north parallel to the eastern boundary. A tributary of the River Liffey flows from west to east within 10m of the northern north of the landfill and joins the Liffey c 85m to the north-east of the site.

2.4 Site History

The Council leased the site, which was a disused gravel and rock quarry, from the owner between 1st August 1977 and 20th June 1980. The lease agreement stipulated that the pit was to be used as a "dumping ground and central refuse dump for the disposal of all domestic, street and road refuse and such like material. The site was closed in 1980 and was capped with a minimum of 450mm of a "gravely, clayey material". Subsequent settlement of the waste has resulted in random depressions across the site.



O'Callaghan Moran & Associates,
Unit 15 Melbourne Business Park,
Model Farm Road, Cork.
Tel. (021) 4345366
email: info@ocallaghanmoran.com

CLIENT
Kildare County Council

TITLE
Site Location

Details:
Site Location

Figure 2.1

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Model Farm Road, Cork.
Tel. (021) 4345366
email: info@ocallaghanmoran.com

CLIENT
Kildare County Council

TITLE
Site Layout

Details:
- Surface Water
- Leachate Well
- Borehole
- Drain
- Site Layout

Figure 2.2

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CLIENT
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TITLE
Surrounding Landuse

Details:
- Residential
- Industrial
- Agriculture
- Recreational
- Site Layout

Figure 2.3

2.5 Hydrology

The site lies within the Liffey Lower 03 Water Body (IE_EA_09L011500). The water body has been assigned Good Status and is not at risk. The EPA has conducted biological quality monitoring at Alexandra Bridge in Clane approximately 300m downstream of the site at over a number of years. The biological quality value (Q Rating) is 4 or 'Good' overall status.

2.6 Geology & Hydrogeology

2.6.1 Soils and Subsoils

The natural ground comprises limestone derived sands and gravels. The site investigations identified a capping layer ranging in thickness from 0.3m to 1.6m. This layer comprises silty sand over the waste, with clayey sand around the boundary. The underlying waste is thinnest in the eastern section of the site due the shallow depth to bedrock.

The waste includes municipal and construction demolition (C&D) materials. The municipal waste layers comprises general plastic, rags, bottles, textiles, paper and wood. The C&D waste comprises crushed stone, brick and reworked soils. The maximum depth of waste proven was approximately 5 m below ground level (bgl) in the centre of the site.

2.6.2 Bedrock

The site is underlain by massive, unbedded lime mudstones from the Waulsortian Formation. While bedrock was encountered in the Tier 2 Site Investigation, which included the installation of 2 leachate wells (LW-01and LW-02) and groundwater wells (GW-01, 02 and 03) it is not described in the borehole logs. It was encountered in the leachate wells between 3 and 3.6m bgl and in the groundwater wells at 5m bgl in GW-02. It was not encountered in GW-03 which extended to 8m bgl. The ground conditions are not described in the borehole log for GW-01.

2.6.3 Hydrogeology

The bedrock underlying the site as a Locally Important Aquifer (Ll) which is moderately productive only in local zones. The groundwater vulnerability is classified as 'Extreme' which reflects the historical site use as a quarry.

The GSI wells database indicates that there are no wells in the aquifer within 1km of the site. Four wells were identified in the Dinantian Pure Bedded Limestone (DPBL) (i.e. Rickardstown Formation (RF) is to the south and east of the site. This is classed as a Locally Important Karstic aquifer. The wells are reported to be dug wells with poor yields. The site lies within the Dublin Groundwater Body (GWB) IE_EA_G_008. The GWB status is rated as 'Good'.

The GSI estimates that groundwater recharge in the area is 391mm per year. The GSI apply a recharge cap for this aquifer type of 200mm which means that much of the rainfall will discharge to the surface water system particularly in the winter periods when rainfall amounts are high. Groundwater flow locally is expected based on the topography and local hydrology to be from south to north/northeast toward the River Liffey.

2.7 Designated Sites

The closest Natura 2000 site is the Ballynafagh Bog Special Area of Conservation (SAC 000391), located 5.6km to the west of the site

3. TIER 2 SITE INVESTIGATIONS 2010

3.1 Objectives

The site investigation area covered four land parcels; the waste ground, the eastern paddock, the southern paddock and the private residence and gardens. The objective was to collect sufficient additional information to allow for a complete assessment of the environmental risk posed by the landfill.

3.2 Site Investigation Scope

The investigation was completed in September 2010 and comprised the following s;

- EM31 and 2D resistivity geophysical survey.
- Installation of three (3 No) 50 mm diameter groundwater monitoring wells within the site to a depth of 8 m bgl;
- Installation of two (2 No) 50 mm diameter leachate monitoring wells within the site to a depth of 6 m bgl;
- Excavation of twelve (12 No) trial pits to a maximum depth of 4.5 m bgl and the collection of soil samples from the waste body and capping materials;
- Landfill gas spike survey at 33 No locations
- Analysis of soil samples for an agreed suite of laboratory analysis;
- Analysis of a soil samples for geotechnical properties;
- Collection of one (1 No) surface water sample from the stream to the east of the Site;
- Collection of two (2 No) leachate and three (3 No) groundwater samples; and
- Topographical survey of all investigation locations.

The Site investigation locations are shown on Figure 3.1.

3.3 Site Investigation Findings

3.3.1 Geophysics

The geophysical surveys were carried out on the 13 and 14 of September 2010 and the interpretation of the results was used to subsequently locate trial pit and well locations.

The EM31 survey indicated that the area of ‘waste’ material is concentrated in the field to the west of the residential property but may extend to the front, side and rear gardens of the property as well as into the paddock to the rear of the property.

The resistivity survey indicated a waste thickness of c5m.

3.3.2 Trial Pitting Programme

Thirteen trial Pits (TP-1 to TP-14) were excavated across the site. Waste was encountered in all of the trial pits except for TP-8, 9, 10 and 13. The waste directly over lies the bedrock in TP-1 to TP-6.

The full waste thickness was proven in the eastern section of the site where bedrock was encountered. The full thickness of the waste body was not proven elsewhere.

The municipal waste layers comprised in general plastic, rags, bottles, textiles, paper and wood. A strong waste odour was observed while excavating in the waste layers at some locations.

The C&D waste layers comprised crushed stone, brick and reworked soils.

The capping material comprises gravelly silt and sand in the east of the site and a brown silty sand containing clay over the remainder of the site. The cap ranges in thickness from 0.4-0.8m.

3.4 Environmental Monitoring

Following the completion of the intrusive works Golders implemented a leachate, groundwater, surface water and landfill gas monitoring programme in 2010. The Council subsequently completed further monitoring in 2012, 2013, 2015 and 2017. OCM completed the 2018 monitoring programme in September 2018. The monitoring locations are on Figure 3.1.

3.4.1 Leachate

The two leachate wells (LW-01 and LW-02) were installed in the north east portion of the site to a depth of c6m bgl. The samples were analysed for the parameters in Table C2 of the EPA Landfill Monitoring Manual 2003. The Golders and Council laboratory results are presented in Table 3.1. LW-1 was dry during the 2018 sampling programme. The Table includes for comparative purposes, the results ranges specified in Table 7.2 EPA Landfill Site Design, 2000. The results are indicative of a weak and aged leachate with approximately 90% of the values below the mean values for a landfill that is in Stage IV of the degradation process.

Table 3.1 Leachate Results 2010 – 2017

Sample I.D.	Units	LW01						LW02							EPA Landfill Design Manual Range
Sample Date		2010	2013	09/09/2015	19/10/2016	30/11/2017	26/09/2018	2010	2012	2013	09/09/2015	19/10/2016	30/11/2017	26/09/2018	
Arsenic	µg/l	5	19	<2.5	8.3	3	NA	20.7	20.7	22	3.9	14.4	11.1	9.1	<1 - 6,700
Boron	µg/l	NA	NA	NA	NA	NA	NA	NA	624	NA	NA	NA	NA	NA	NE
Cadmium	µg/l	1	2	<0.5	2.7	0.1	NA	0.8	0.8	0.7	<0.5	2.3	0.2	<0.5	<10 - 80
Copper	µg/l	11	36	61	19	13	NA	8	8	10	38	15	2	<7	20 - 620
Mercury	µg/l	<1	<.05	<1	<1	<0.03	NA	<1	<1	<.05	<1	<1	<0.03	<1	<0.1 - 0.8
Nickel	µg/l	43	22	22	10	13	NA	18	18	4	15	9	8	7	<30 - 600
Lead	µg/l	<5	35	7	<5	7	NA	<5	<5	21	7	<5	46	<5	<40 - 1,900
Zinc	µg/l	176	1260	502	166	179.5	NA	25	25	231	88	39	63.9	<3	<30 - 6,700
Manganese	µg/l	5311	NA	NA	NA	NA	NA	1207	NA	NA	NA	NA	NA	1122	40 - 3,590
Sulphate	mg/l	86.83	NA	NA	NA	NA	NA	NA	1.59	NA	NA	NA	NA	<5	<5 - 322
Chloride	mg/l	150	153	101.4	81.7	146.4	NA	98.5	98.5	122	92.5	56.4	30.1	97.4	570 - 4,710
Fluoride	mg/l	NA	NA	NA	NA	NA	NA	NA	<.3	NA	NA	NA	NA	NA	NE
Total Cyanide	µg/l	<40	NA	NA	NA	NA	NA	<40	<40	NA	NA	NA	NA	<0.01	NE
Chromium - diss.	µg/l	32.9	17	12.3	6.2	10	NA	24.7	24.7	8	7.2	3.7	3	4.1	NE
Potassium	mg/l	117.6	12	81	63.5	93	NA	76.7	76.7	10	73.6	53	38	NA	100 - 1,580
Sodium	mg/l	130.9	20	135.8	82.8	138	NA	96.6	96.6	15	105.6	56.5	42	113.3	474 - 3,650
Ammonia	mg/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	108.02	283 -- 2,040
BOD settled	mg/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	11	110 - 1,900
COD	mg/l	302	266	148	106	207	NA	67	67	159	125	80	120	NA	622 - 8,000

NA denotes Not Analysed
NE denotes Not Established

3.4.2 Groundwater

Golders supervised the installation of three (3 No) 50 mm diameter groundwater monitoring wells on the site to a depth of 8 m below ground level (bgl). The well locations are shown on Figure 3.1. BH-1 is located in the north of the site within the footprint of the quarry. BH-2 is located in the southeast of the site and BH-3 in the southwest of the site. Both of these wells are outside the quarry footprint. BH-1 is down hydraulic gradient but within the quarry footprint. The borehole log for this well only indicates it was constructed to 8m but does not include a description of what was encountered in the drilling process.

BH-2 and BH-3 are located up hydraulic gradient of the site and the borehole logs indicate they were installed in natural ground.

Monitoring of the groundwater quality was undertaken by Golders in 2010, by the Council in 2013, 2015, 2016 and 2017 and by OCM in 2018.

The samples were analysed for a the range of parameters based on Table C2 of the EPA Manual on Landfill Monitoring (2003) and included organic and inorganic parameters that included pH and electrical conductivity, ammonia, , nitrate, orthophosphate, potassium, sodium, chloride, sulphate, heavy metals to include(arsenic, antimony, barium, cadmium, chromium, copper, fluoride, mercury, manganese, molybdenum, nickel, lead, selenium and zinc), cyanide Volatile Organic Compounds, Semi-Volatile Organic Compounds, Herbicides, Pesticides Total and Faecal Coliforms. Not all parameters were analysed during each monitoring round.

The laboratory analysis for metals between 2010 and 2017 were for total metals and not dissolved metals. The results for 2018 are for dissolved metals as the IGV and GTV limits are based on dissolved concentrations.

The results are presented in Table 3.2. The full 2018 results are in Appendix 1. The table includes Interim Guideline Values (IGV) published by the EPA and the Groundwater Threshold Values (GTV) set out in the European Communities Environmental Objectives (Groundwater) Regulations (S.I. 9 of 2010).

The IGVs are not statutory, but were developed to assist in the assessment of impacts on groundwater quality. The IGVs are based on, but are more conservative than the Drinking Water quality standards. GTVs have only been established for core indicator parameters.

Monitoring well BH-03 is upgradient of the landfill to the southwest.

The results indicate that BH-01 is impacted by leachate with persistently elevated chloride, ammonia, potassium, manganese and occasionally hydrocarbons. BH-02 may also be slightly impacted by leachate migration to the east with elevated manganese, arsenic and ammonia. BH-03 is not impacted by leachate and the most recent results indicate that the water quality meets the GTV. Previously elevated zinc and lead had been detected in this well but the detections were for total and not dissolved metals. EPH was also elevated in the past but in 2018 was not detected.

Table 3.2 Groundwater Monitoring Results 2010 – 2018

Sample I.D.	Units	BH 01						BH 02						BH 03						IGV	GTV
Sample Date		2010	2013	2015	2016	2017	2018	2010	2013	2015	2016	2017	2018	2010	2013	2015	2016	2017	2018		
Arsenic	µg/l	11.5*	10	<2.5	8	8.7	18.3	<2.5	2	<2.5	2.6	<1	10.2	4	8	22.3	95.4	6.9	3.1	10	7.5
Cadmium	µg/l	<0.5*	<.5	<0.5	0.8	<0.09	<0.5	<0.5	1	0.7	<.5	0.2	<0.5	1.1	16	3	15.9	21.9	<0.5	5	3.75
Chromium	ug/l	2.2*	3	1.7	2.2	2	5.7	<1.5	2	<1.5	<1.5	<00.93	<1.5	<1.5	27	18.2	42.9	7	<1.5	0.03	NE
Copper	µg/l	<7*	9	13	12	5	<7	<7	6	<7	<7	<1.17	<7	<7	87	52	123	32	<7	30	1500
Lead	µg/l	<5*	0.8*	<5*	<5*	3*	<5	<5*	5*	<5*	<5*	4*	<5	<5*	89*	<5*	<5*	550*	<5	10	18.75
EPH	µg/l	NA	697	330	180	NA	<10	NA	181	<10	<10	NA	<10	NA	133	<10	1550	NA	<10	10	10
Manganese	µg/l	1228*		NA	NA	NA	8899	345		NA	NA	NA	591	266	NA	NA	NA	NA	5	50	NE
Mercury	µg/l	<1*	<.05*	<1*	<1*	<0.03*	<1	<1*	<.05*	<1*	<1*	<0.03*	<1	<1*	<.05*	<1*	<1*	<0.03*	<1	1	0.75
Nickel	µg/l	10*	2	17	13	15	13	13	42	36	13	6	4	10	120	59	179	88	5	20	15
Potassium	mg/l	20.7*	7	51.2	44.2	47	NA	3.9	2	6.1	3.7	3	NA	1.6	2	3.7	5.8	2	NA	5	NE
Sodium	mg/l	42.1*	9	86.2	66.5	68	65.7	15.9	3	33	16.3	11	12.5	9.3	0.8	6.4	6.1	6	6.3	150	150
Zinc	µg/l	12*	22	6	5	23.1	<3	28	164	67	36	31.9	10	9	478	282	890	663.7	5	100	75
Chloride	mg/l	31.2*	115	95.6	74.9	64.3	66.0	30.2	72.5	55.6	32.8	22.4	25.1	13.7	10.7	13.9	20.1	17.8	22.1	30	187.5
Cyanide	µg/l	<40ug/l	NA	NA	NA	NA	<0.01	<40ug/l	NA	NA	NA	NA	<0.01	<40ug/l	NA	NA	NA	NA	<0.01	10	37.5
Orthophosphate	µg/l	1.83	<.03	<0.06	<0.06	<0.01	<0.06	1.67	0.051	<0.06	<0.06	0.064	3.16	0.11	0.034	<0.06	<0.06	<0.01	<0.06	30	NE
Sulphate	mg/l	7.09	NA	NA	NA	NA	<0.5	7.18	NA	NA	NA	NA	21.7	61.25	NA	NA	NA	NA	46.0	200	187.5
Ammonia	mg/l	18.08	72	0.32	0.24	48.59	59.02	1.92	4.36	3.9	1.56	0.81	1.52	0.1	0.039	<0.06	<0.06	0.13	0.14	0.15	0.175
BOD	mg/l	NA	<1	50	20	<2	2	NA	<1	14	<1	<2	2	NA	<1	7	<1	<2	<1	NE	NE
COD (Settled)	mg/l	NA	85	91	57	53	NA	NA	38	20	<7	<5	NA	NA	35	11	<7	<5	NA	NE	NE
TOC	mg/l	NA	22	29	4	23	<2	NA	5.12	14	<2	1.8	3	NA	1.31	7	<2	2.5	<2	NAC	NE

* Denotes dissolved concentration
NA denotes Not Analysed
NE denotes Not Established

3.4.3 Surface Water Quality

Surface water samples were collected by Golder's at SW01 downstream to the north of the Site. The drain in which the sample was collected flows from west to east discharging into the River Liffey. Golder's did not sample this drain upstream of the landfill and could not sample upstream of the site as the surface water network was either inaccessible or stagnant, therefore a representative sample could not be taken. In 2018 the drain to the north of the site was dry and samples were only collected from the River Liffey up and downstream of the site. The samples were tested for;

pH; Electrical Conductivity; Dissolved Oxygen, Total Suspended Solids; Heavy Metals (As, Ba, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se and Zn) Total alkalinity, Ammoniacal Nitrogen, Total Oxidised Nitrogen (TON), Chloride, Sulphate, Ortho-Phosphate, MR-Phosphate, Total Cyanide. Potassium, Sodium, Calcium Magnesium, Biological Oxygen Demand and Chemical Oxygen Demand.

Kildare CC sampled surface water at upstream (SW-2) and downstream (SW-1) in the River Liffey between 2013,-2017. The parameter range was more extensive including for Volatile Organic Compounds, Semi-Volatile Organic Compounds, Herbicides, Pesticides and Poly Aromatic Hydrocarbons. The sample locations are shown Figure 3.1 and the monitoring results are summarized on Table 3.3. The results have been compared to the Drinking Water Regulations 2007 and Surface Water Regulations, 2009 limits.

The 2010 monitoring results indicate the presence of elevate ammonia, manganese and phosphorous that may be associated with impacts of leachate migration from the landfill area. As no sample was collected upstream of SW-01 it is possible that impacts other than the landfill leachate may be responsible for the elevated readings for example agricultural activity in the catchment of the drain or the presence of septic tanks in dwellings adjacent to the site.

Monitoring undertaken by the Council in the River Liffey between 2013- 2017 and OCM in 2018 does not show any significant deterioration in water quality between up and downstream of the landfill. Elevated coliforms have been detected both up and downstream of the landfill and a herbicide was detected in 2017. The concentration was higher upstream compared to downstream of the landfill.

Table 3.3 Surface Water Monitoring Results

Parameter	Units	Drain	SW-1 Downstream					SW2 Upstream					Drinking Water Regulations, 2014	EQS, 2015
		2010	2013	2015	2016	2017	2018	2013	2015	2016	2017	2018		
pH	pH Units	8.39	7.5	7.42	7.95	7.9	7.92	7.5	8.07	7.87	7.8	8.02	NE	6.0<pH<9.0
Electrical Conductivity	µS/cm	507	238	436	379	-	311	238	416	384	-	338	2500	1000
Arsenic	ug/l	<2.5	1	<2.5	<2.5	1	<2.5	1	<2.5	<2.5	1	<2.5	10	25
Boron	ug/l	42	24	25	<12	<6	-	20	23	<12	<6	-	1000	NE
Cadmium	ug/l	<0.5	<0.5	<0.5	<0.5	<1	<.5	<0.5	<0.5	<0.5	<1	<0.5	5	0.9
Copper	ug/l	<7	<1	<7	<7	<1	<7	<1	<7	<7	<1	<7	2000	NE
Lead	ug/l	<5	<.5	<5	<5	2	<5	0.7	<5	<5	1	<5	5	14
Manganese	ug/l	146	23	4	34	40	<2	24	<2	10	56	<2	50	NE
Magnesium	mg/l	5.8	8	6.2	5.1	<1	-	8	6.1	5.1	<1	-	NE	NE
Mercury	ug/l	<1	<0.05	<1	<1	<0.03	<1	<0.05	<1	<1	<0.03	<1	1	0.07
Nickel	ug/l	<2	1	<2	<2	<1	<2	1	<2	<2	1	<2	NE	34
Iron	ug/l	160	47	<20	139	193	<20	45	33	63	238	<20	200	NE
Total Cyanide	ug/l	<40	<9	<10	<10	<5	<0.01	9	<10	<10	<5	<0.01	50	NE
Chromium	ug/l	<1.5	<.5	<1.5	<1.5	<1	<1.5	<.5	<1.5	<1.5	<1	<1.5	NE	32
Zinc	ug/l	6	<5	<3	3	<1	5	<5	6	4	<1	4	NE	NE
Sulphate	mg/l	27.27	11.7	14.5	10	8	15.3	11.9	14.35	10.1	6	14.8	250	NE
Chloride	mg/l	15	19.7	26.2	12	10.6	19.3	19.8	26.6	12.1	50.7	18.2	250	NE
Calcium	mg/l	122.3	117	60.6	54.8	1	-	102	59.5	55.8	1	-	NE	NE
Orthophosphate	mg/l	0.53	0.06	NA	-	0.01	<0.06	0.06	NA	-	0.01	<0.06	NE	NE
Total Oxidised Nitrogen	mg/l	3.7	1.72	2.1	1.2	0.34	-	1.77	2.1	1.1	0.5	-	NE	NAC
Total Suspended Solids	mg/l	47	<2	<10	<10	4	-	<2	<10	16	3	-	NE	NE
Total Alkalinity as CaCO3	mg/l	271	149	184	168	71	-	153	186	158	73	-	NE	NE
BOD	mg/l	2	<1	1	<1	<2	<1	<1	2	1	<2	<1	NE	5
COD	mg/l	20	16	21	9	25	-	23	13	10	22	-	NE	40
Potassium	mg/l	3.2	4	2.6	1.3	<1	-	4	2.5	1.3	<1	-	NE	NE
Sodium	mg/l	9.6	13	16.4	7.4	<0.3	13.2	13	16.1	7.4	<0.3	13	200	NE
Ammonia	mg/l	3.05	0.125	0.24	0.04	-	0.08	0.094	0.27	0.05	-	0.08	0.3	NE
2,4 – D	ug/l	-	-	<0.1	<0.01	0.112	-	-	<0.1	<0.01	0.125	-	0.1	NE
MCPA	ug/l	-	-	<0.1	<0.01	0.009	-	-	<0.1	<0.01	0.011	-	0.1	NE
MCPP	ug/l	-	-	-	-	<0.003	-	-	-	-	0.004	-	0.1	NE
Coliforms	CFU/100ml	-	3900	>150	5460	520	-	4000	>150	2980	570	-	0	NE
PAH	ug/l	-	-	ND	ND	-	<0.195	-	ND	ND	-	<0.195	NE	NAC
VOC	mg/l	-	-	ND	ND	ND	-	-	ND	ND	ND	-	NE	NE
sVOC	mg/l	-	-	ND	ND	-	-	-	ND	ND	-	-	NE	NE

ND - denotes not detected
NE - denotes not established
(-) - Not Analyzed
NAC - No Abnormal Change

O'Callaghan Moran & Associates,
Unit 15 Melbourne Business Park,
Model Farm Road, Cork.
Tel. (021) 4345366
email: info@ocallaghanmoran.com

CLIENT
Kildare County Council

TITLE
Monitoring Locations

Details:
- Surface Water
- Leachate Well
- Borehole
- Site Layout

Figure 3.1

3.5 Landfill Gas Monitoring

Landfill gas monitoring using a spike probe was carried out in thirty three (33 No) temporary landfill gas monitoring locations using a Dando Terrier Rig to advance the spike probe to a maximum depth of 4.0 mbgl and then pulled out. Monitoring was undertaken using a GA2000 Landfill Gas analyser. Methane (CH4) was observed to range between 0.0 to 39.2 % (v/v), carbon dioxide between 1.3 and 31.9 % (v/v) and Oxygen between 0.01 to 18.7%. The results are presented on Table 3.4. The monitoring locations are shown on Figure 3.1

The results indicate the presence of significant landfill gas levels in the landfill footprint and outside the landfill footprint to the west in the vicinity of the dwelling immediately to the west of the landfill.

Table 3.4 2010 Landfill Gas Spike Probe Results

Location	Depth(m)	CH4(%)	CO2(%)	O2(%)
GS-01	1.9	2.9	7.5	12.7
GS-02	2.2	3.6	15.2	3.4
GS-03	2.0	17.4	21	2.2
GS-04	3.5	14.1	13.4	3.4
GS-05	2.5	23.8	24.4	2.6
GS-06	1.0	0.1	3.8	13.6
GS-07	3.0	0.1	12.2	5.0
GS-08	2.5	28.8	28.7	2.2
GS-09	3.0	34.8	31.9	0.01
GS-10	4.0	36.7	26.1	0.4
GS-11	4.0	23.4	27.4	0.3
GS-12	2.3	21.6	20.8	2.9
GS-13	2.0	1.0	3.8	14.3
GS-14	1.7	0.1	6.4	11.0
GS-15	2.0	1.6	9.9	8.4
GS-16	2.0	0.1	3.2	14.9
GS-17	2.0	0.0	3.3	14.9
GS-18	2.5	0.0	3.7	14.8
GS-19	1.4	0.8	2.0	17.9
GS-20	1.2	0.0	1.3	18.4
GS-21	4.0	27.5	19.0	6.1
GS-22	1.2	20.4	18.3	5.3
GS-23	1.8	29.8	25.3	2.4
GS-24	4.0	30.4	25.2	1.2
GS-25	1.5	22.6	18.1	5.0
GS-26	4.0	28.1	25.1	2.8
GS-27	1.3	2.3	10.2	4.7
GS-28	2.0	2.8	10.3	3.5
GS-29	1.2	17.4	12.2	6.9
GS-30	3.0	39.2	27.7	1.9
GS-31	2.0	19.0	19.8	3.5
GS-32	3.0	25.8	23.5	2.5
GS-33	2.5	0.0	1.5	18.7

OCM completed a round of gas monitoring in September 2018 using a spike probe on the landfill and along the landfill boundaries. The probe was advanced c0.3-0.5m below ground level to assess gas migration from the waste mass. The probe did not penetrate the waste mass. Monitoring was also undertaken in the leachate and groundwater monitoring wells. The monitoring was completed using

The monitoring included the measurement of methane, carbon dioxide, oxygen and atmospheric pressure and gas flow rate using a Gas Data LSMx gas analyser. The meter was calibrated before use. The detection limit is 0.1% for methane, carbon dioxide and oxygen.

Table 3.5 2018 Gas Monitoring Results

Parameter		Pressure (mb)	Flow rate	H_2S	CH_4 (Peak)	CO_2	O_2	LEL
Location	Date / Unit		l/h	ppm	%	%	%	%
BH-1	26/09/2018	1021	0.00	0.00	0.10	0.10	21.40	0.00
BH-2	26/09/2018	1020	0.00	0.00	0.00	0.00	20.70	0.00
BH-3	26/09/2018	1020	0.00	0.00	0.00	0.00	21.10	0.00
LW-1	26/09/2018	1020	0.00	0.00	2.40	3.70	18.50	40.70
LW-2	26/09/2018	1020	0.10	0.00	16.50	27.80	3.60	>>>
Parameter		Pressure (mb)	Flow rate	H_2S	CH_4 (Peak)	CO_2	O_2	LEL
Location	Date / Unit		l/h	ppm	%	%	%	%
Point 1	26/09/2018	1020	0.00	0.00	0.00	0.00	21.40	0.00
Point 2	26/09/2018	1020	0.00	0.00	0.00	0.00	21.40	0.00
Point 3	26/09/2018	1020	0.00	0.00	0.00	0.00	21.40	0.00
Point 4	26/09/2018	1020	0.00	0.00	0.00	0.00	21.40	0.00
Point 5	26/09/2018	1020	0.00	0.00	0.00	0.00	21.40	0.00
Point 6	26/09/2018	1020	0.00	0.00	0.00	0.00	21.40	0.00
Point 7	26/09/2018	1020	0.00	0.00	0.00	0.00	21.40	0.00
Point 8	26/09/2018	1020	0.00	0.00	0.00	0.00	21.40	0.00
Point 9	26/09/2018	1020	0.00	0.00	0.00	0.00	21.40	0.00
Point 10	26/09/2018	1020	0.00	0.00	0.00	0.00	21.40	0.00
Point 11	26/09/2018	1020	0.00	0.00	0.00	0.00	21.40	0.00
Point 12	26/09/2018	1020	0.00	0.00	0.00	0.00	21.40	0.00
Point 13	26/09/2018	1020	0.00	0.00	0.00	0.00	21.40	0.00
Point 14	26/09/2018	1020	0.00	0.00	0.00	0.00	21.40	0.00
Point 15	26/09/2018	1020	0.00	0.00	0.00	0.00	21.40	0.00
Point 16	26/09/2018	1020	0.00	0.00	0.00	0.00	21.40	0.00
Point 17	26/09/2018	1020	0.00	0.00	0.00	0.00	21.40	0.00
Point 18	26/09/2018	1020	0.00	0.00	0.00	0.00	21.40	0.00
Point 19	26/09/2018	1020	0.00	0.00	0.00	0.00	21.40	0.00
Point 20	26/09/2018	1020	0.00	0.00	0.00	0.00	21.40	0.00
Point 21	26/09/2018	1020	0.00	0.00	0.00	0.00	21.40	0.00
Point 22	26/09/2018	1020	0.00	0.00	0.00	0.00	21.40	0.00
Point 23	26/09/2018	1020	0.00	0.00	0.00	0.00	21.40	0.00
Point 24	26/09/2018	1020	0.00	0.00	0.00	0.00	21.40	0.00

The monitoring results indicate that landfill gas is still being generated in the landfill based on the methane and carbon dioxide levels detected in the leachate wells LW-1 and LW-2. While no significant gas flows were recorded in the wells they were not fitted with gas valves and gas flow rates could not therefore be accurately established. The spike probe survey did not detect the presence of landfill gas close to the surface on the landfill or along the boundary. However it is possible that gas migration could be occurring below the probe penetration depth.

4. TIER 3 RISK ASSESSMENT

4.1 Conceptual Site Model

The Tier 1 Risk scores calculated by KCC are shown on Table 4.1. The KCC Risk scoring shows a Moderate Risk Site due to the potential for impact from leachate on the surface water receptor. The KCC Tier 1 Conceptual Site Model (CSM) is shown on Figure 4.1

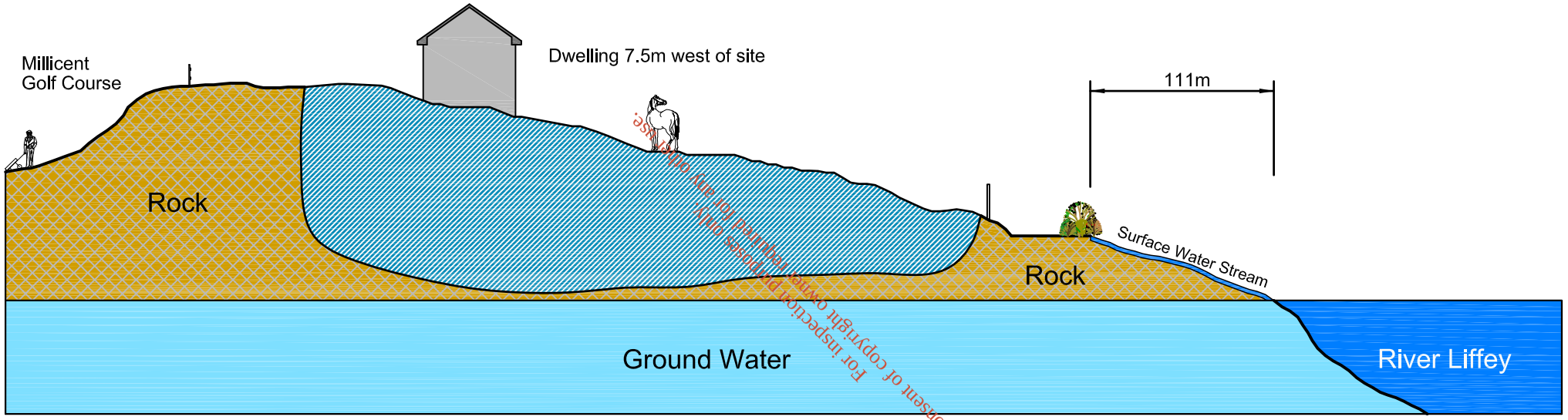
Table 4.1 Tier 2 Risk Assessment Scores

Note: The table below represents the Tier 1 risk rating for this site. SPR 1 to 9 represent the leachate risk scores. SPR 10 & 11 represent Landfill Gas risks. The migration pathways are colour coded as follows:			
Groundwater & Surface Water	Groundwater only	Surface water only	Lateral & Vertical

Calculator	SPR Values	Maximum Score	Linkages	Normalised Score
SPR 1 =	90	300	Leachate => surface water	30%
SPR 2 =	0	300	Leachate => SWDTE	0%
SPR 3 =	60	240	Leachate => human presence	25%
SPR 4 =	0	240	Leachate => GWDTE	0%
SPR 5 =	60	400	Leachate => Aquifer	15%
SPR 6 =	0	560	Leachate => Surface Water	0%
SPR 7 =	60	240	Leachate => SWDTE	25%
SPR 8 =	30	60	Leachate => Surface Water	50%
SPR 9 =	0	60	Leachate => SWDTE	0%
SPR 10 =	50	150	Landfill Gas => Human Presence	33%
SPR 11 =	0	250	Landfill Gas => Human Presence	0%

Risk Classification	Range of Risk Scores
Highest Risk (Class A)	Greater than or equal to 70% for any individual SPR lingage
Moderate Risk (Class B)	Between 40-70% for any individual SPR linkage
Lowest Risk (Class C)	Less than or equal to 40% for any individual SPR linkage

TIER 1 RATING	MODERATE



TITLE:
Environmental Risk Assessment for Unregulated Waste Disposal Sites

DRAWING NUMBER:
ERA / C / CON

KILDARE COUNTY COUNCIL
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DIRECTOR OF SERVICES: JOE BOLAND
SENIOR ENGNEER: MICHAEL HOLLIGAN

PROJECT:
Conceptual Site Model

DRAWING:
Carrigeen Refuse Depot, Clane

Scale:	Date:	Drawn by:
N.T.S.	May 2010	D.O.B.

4.2 Revised CSM

OCM refined the CSM based on a review of the Tier 2 site investigations completed by Golders in 2010, the monitoring completed by KCC between 2013 and 2017 and the monitoring completed by OCM in 2018. .

The lateral extent of the waste has been identified and it is contained within the site boundaries and the maximum depth of waste was found to be 4.5m. The quarry area is 0.98Ha with the waste footprint covering a smaller area within the quarry (c 0.70ha).

The waste is covered by a clay cap that ranges in thickness from 0.4 -0.8m of gravelly clay.

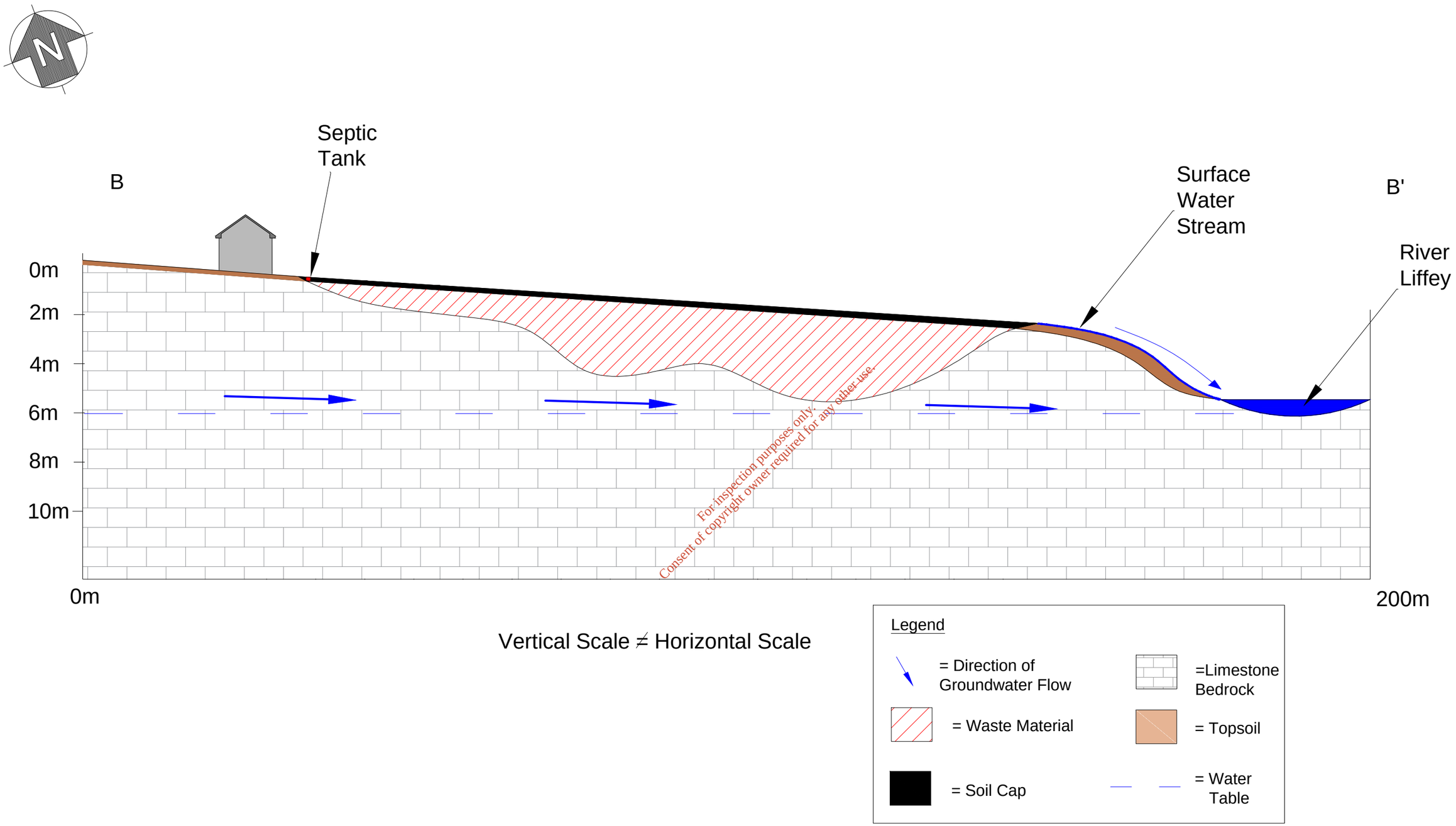
A schematic of the revised CSM is shown in Figure 4.2. The line of Section for the CSM is on Figure 4.3. The waste extends to a maximum of 4.5m bgl. The base of the waste lies directly on the bedrock in the east and south east of the site (TP-1- TP-5) but the waste thickness here is shallow (2.7m) with the exception of TP-5 where it is 4.5m. No waste is recorded in TP-8, 9 or 13 with only small amounts in TP-11 and 12. In these areas there appears to be boulder clay beneath the waste. The bulk of the waste is therefore in the east of the site. Based on the available information the waste volume is estimated at c31,500m^3. Applying the conversion ratio for municipal waste (0.4) this indicates that there is approximately 15,750 tonnes of waste on the site.

Leachate is being generated in the waste. It is likely that leachate migrates through the base of the waste into the bedrock. Because of the poorly productive nature of the bedrock aquifer (Ll) the flow paths are likely to be short with migration to the surface water primarily the River Liffey to the east of the site.

Groundwater recharge to the waste may be reduced by the clay capping layer. While some of the potential rainfall recharge runs off the site to the north it is likely that recharge does reach the waste. Leachate seepage has been observed in the north of the site toward the drain which discharges to the River Liffey. This is primarily in the winter time when rainfall levels are high and the capacity of the bedrock aquifer to accept the recharge is exceeded. The contaminated groundwater therefore overflows to the surface water pathway.

Groundwater quality in BH-1 in the north of the site indicates that it is impacted by leachate. However, surface water quality monitoring up and downstream of the site in the River Liffey shows that the leachate contamination is being attenuated and is not impacting on surface water quality in the River Liffey. During the winter time the dilution levels are likely to be higher.

The landfill gas monitoring - confirms the presence of elevated carbon dioxide and methane. If additional capping is placed in accordance with the EPA landfill restoration requirements, the potential for lateral gas migration is significant.



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Kildare County Council

FIGURE No.

4.2

TITLE

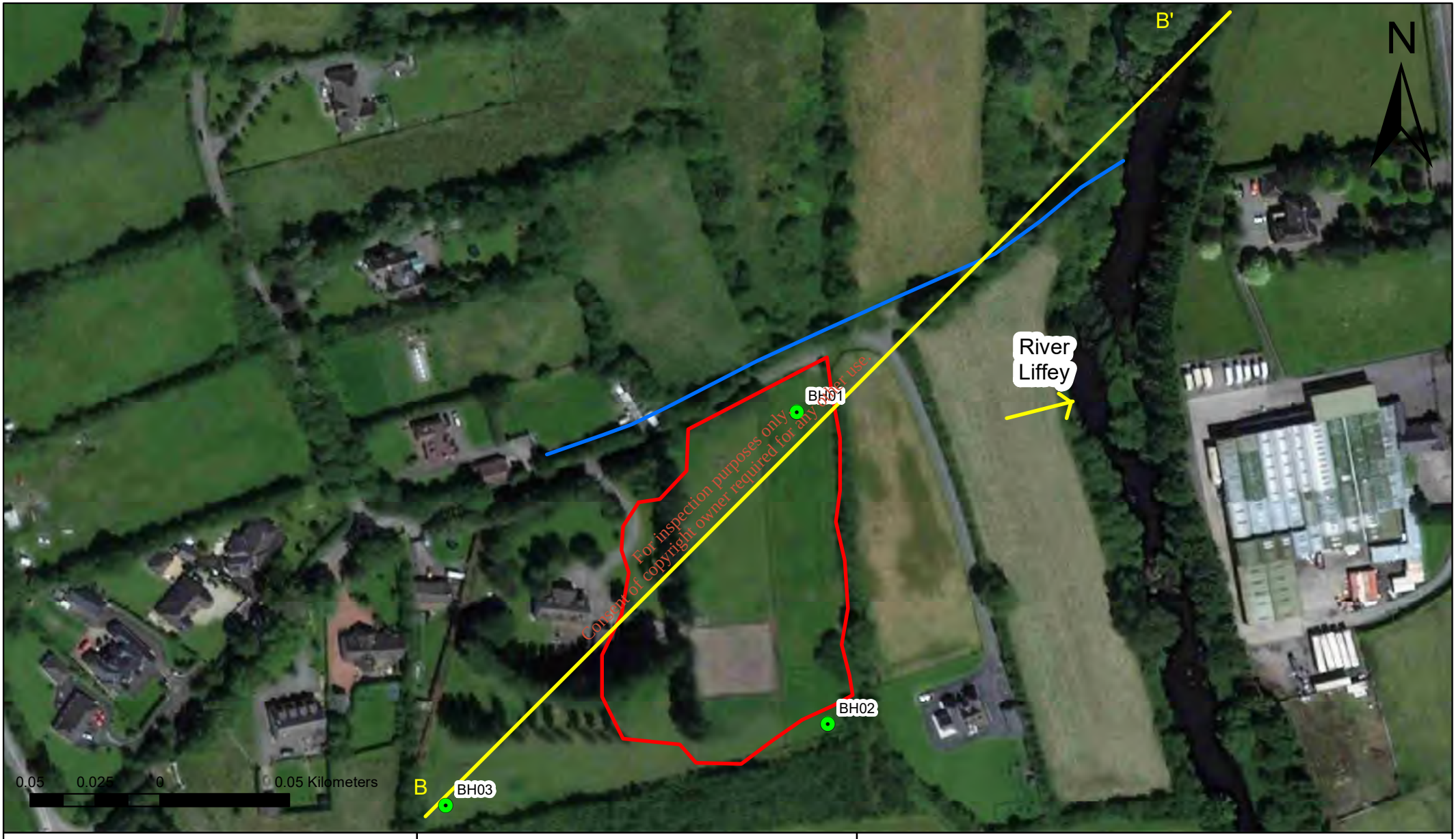
Conceptual Site Model

SCALE

NTS

REV.

B



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Kildare County Council

TITLE
Line of Section

Details:
- Borehole
- Line of Section
- Drain
- Site Layout

Figure 4.3

4.3 Source

The Source is the waste which comprises mixed domestic, commercial and construction demolition waste including bricks, metal, plastic, paper and textiles.

The waste covers an area of approximately 0.75 ha with a maximum thickness of c. 4.5 m and is estimated to amount to approximately 31,500 m^3. Assuming a density of 0.5 tonne/m^3 (to account for a predominantly municipal waste with small fractions of industrial waste) there are a maximum of c. 15,750 tonnes of waste present.

Leachate generated as a result of rainfall recharge through the waste has the potential to migrate away from the landfill. The results of the analysis of leachate samples collected at the site are indicative of an aged Stage IV (Methanogenesis Stage) or Stage V (Aerobic Stage) leachate. There is evidence of leachate break out in the north of the site during the winter period.

Landfill gas is also being generated in the body of the landfill and may be migrating laterally away from the landfill.

4.4 Pathways

4.4.1 Leachate Migration Pathways

Leachate can potentially migrate through the waste into the shallow bedrock aquifer.

The bedrock aquifer is characterised by the GSI as a Locally Important Aquifer (Ll) that is productive only in local zones. In this type of aquifer groundwater flows through the upper 10-15m of weather bedrock with short flow paths and discharge to surface water courses within 10s to 100s of metres. It is likely that the groundwater migrating beneath the site discharges to the River Liffey to the northeast of the site.

4.4.2 Landfill Gas Migration Pathways

While some landfill gas may vent to atmosphere where the clay cap is thin there is the potential for lateral gas migration. There are dwellings located immediately to the west and northwest and to the southeast of the site boundary.

4.5 Receptors

The receptors include the bedrock aquifer and groundwater body immediately beneath the site. There are no groundwater wells between the site and the River Liffey. The river is also a receptor for leachate discharges to the site.

The occupants of the dwellings located immediately to the west, northwest and southeast of the site are potential receptors for landfill gas emanating from the landfill.

4.6 Revised Risk Scores

The revised Tier 3 risk scores are summarised on Table 4.2 and are included in full in Appendix 2. The overall risk remains Moderate and is associated with leachate migration to the surface receptor and landfill gas migration to off-site receptors.

Table 4.2 Tier 3 Risk Assessment Scores

Note: The table below represents the Tier 3 risk rating for this site. SPR 1 to 9 represent the leachate risk scores. SPR 10 & 11 represent Landfill Gas risks. The migration pathways are colour coded as follows:				
Groundwater & Surface Water	Groundwater only	Surface water only	Lateral & Vertical	
Calculator	**SPR Values**	**Maximum Score**	**Linkages**	**Normalised Score**
SPR 1 =	90	300	Leachate => surface water	30%
SPR 2 =	0	300	Leachate => SWDTE	0%
SPR 3 =	60	240	Leachate => human presence	25%
SPR 4 =	0	240	Leachate => GWDTE	0%
SPR 5 =	60	400	Leachate => Aquifer	15%
SPR 6 =	0	560	Leachate => Surface Water	0%
SPR 7 =	60	240	Leachate => SWDTE	25%
SPR 8 =	30	60	Leachate => Surface Water	50%
SPR 9 =	0	60	Leachate => SWDTE	0%
SPR 10 =	75	150	Landfill Gas => Human Presence	50%
SPR 11 =	0	250	Landfill Gas => Human Presence	0%
Risk Classification		**Range of Risk Scores**		
Highest Risk (Class A)		Greater than or equal to 70% for any individual SPR lingage		
Moderate Risk (Class B)		Between 40-70% for any individual SPR linkage		
Lowest Risk (Class C)		Less than or equal to 40% for any individual SPR linkage		
TIER 3 RATING		**MODERATE**		

The site remains a moderate risk site but with the moderate risk applying to both the leachate to surface water and landfill gas to human receptor path SPR linkages.

5. REMEDIAL ACTION PLAN

The Risk Ranking for the site is Moderate and is associated with leachate migration to surface water and potential landfill gas migration to the residential dwellings to the west, northwest and southeast of the site.

Most of the site is grassland but there is a horse paddock in the southeast portion of the site.

The EPA Landfill Restoration and Aftercare Manual recommends that for Non-Inert Landfill that a minimum subsoil thickness (after placement) of 700-850m cover be placed over the landfill. Non-inert landfills should also contain a gas collection and surface water drainage system.

An outline design for the remedial works, which comprise additional capping, landfill gas collection and venting is shown in plan and cross section on Figures 5.1 – 5.4.

To minimise disruption to the grounds immediately adjacent to the dwelling to the west of the site it is proposed to install a gas collection trench running north to south on the east side of the tree as shown on Figure 5.1. At least three vertical ventilation wells should be installed to the west of the cut-off trench to ventilate gas that may be present in the quarry footprint to the west of gas collection trench.

Figure 5.2 shows the detail for the gas collection trench and vertical riser. The gas cut-off trench will extend around the perimeter of the remainder of the quarry footprint. The trench will have 100mm diameter vertical risers extending from the base of the trench to c 200mm above the top of the trench and they will be located at 20m centres along the trench. The trench should be 500mm wide and extend to c3m below ground level. The trench should be lined with a permeable membrane (terram or similar). The depth of the trench is based on the anticipated depth to groundwater which based on monitoring of groundwater well in the wells in September of 2018 is c3.5m below ground level beneath the landfill area. This was after a prolonged dry summer period and it is anticipated that the level will rise significantly in the winter. .

The trench should be backfilled to the surface with granular fill that should be no less than 25mm in diameter and of limestone origin.

Figure 5.3 shows the landfill cap area. Figure 5.4 shows the capping detail. The landfill area inside the gas collection trench footprint will be capped with 850mm of subsoil which will be compacted and graded to fall to the northeast corner. It will then be covered with c150mm of top soil and grass seeded. The horse paddock in the south of the site will be retained as requested by the site owner. A surface water collection pipe will drain the site and divert run off under the road to the north of the site to the surface water drain to the north of the site. It will be necessary to open a trench across the road to connect the stormwater pipe from the landfill area to the drain on the north side of the road.

Eight vertical gas ventilation wells will be installed in the cap to reduce the build-up of landfill gas beneath the clay cap. The wells will be of similar construction to the vertical risers in the gas collection trench.

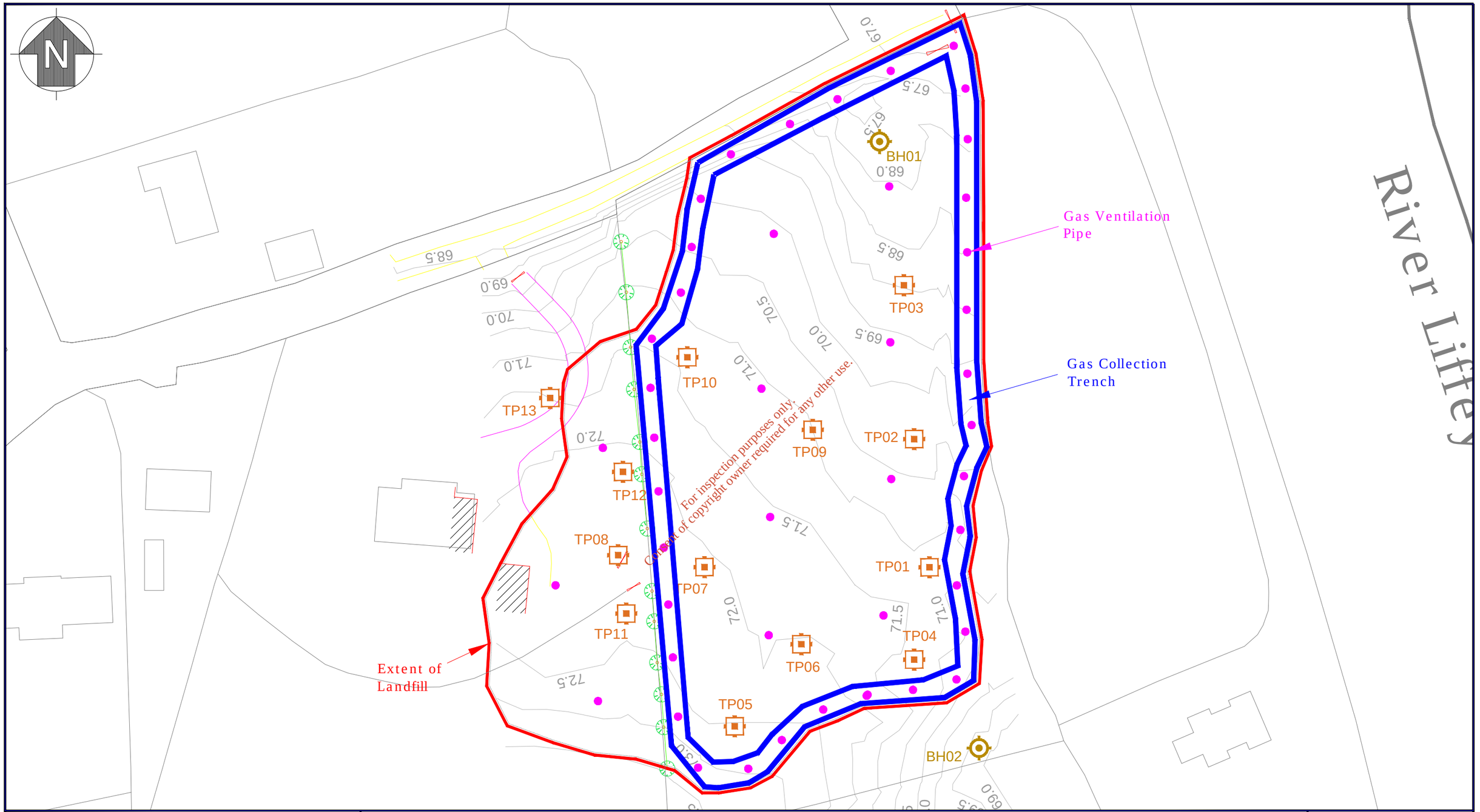

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FIGURE No.

5.1

TITLE

Gas Collection Trench

SCALE

SCALE

REV.

A

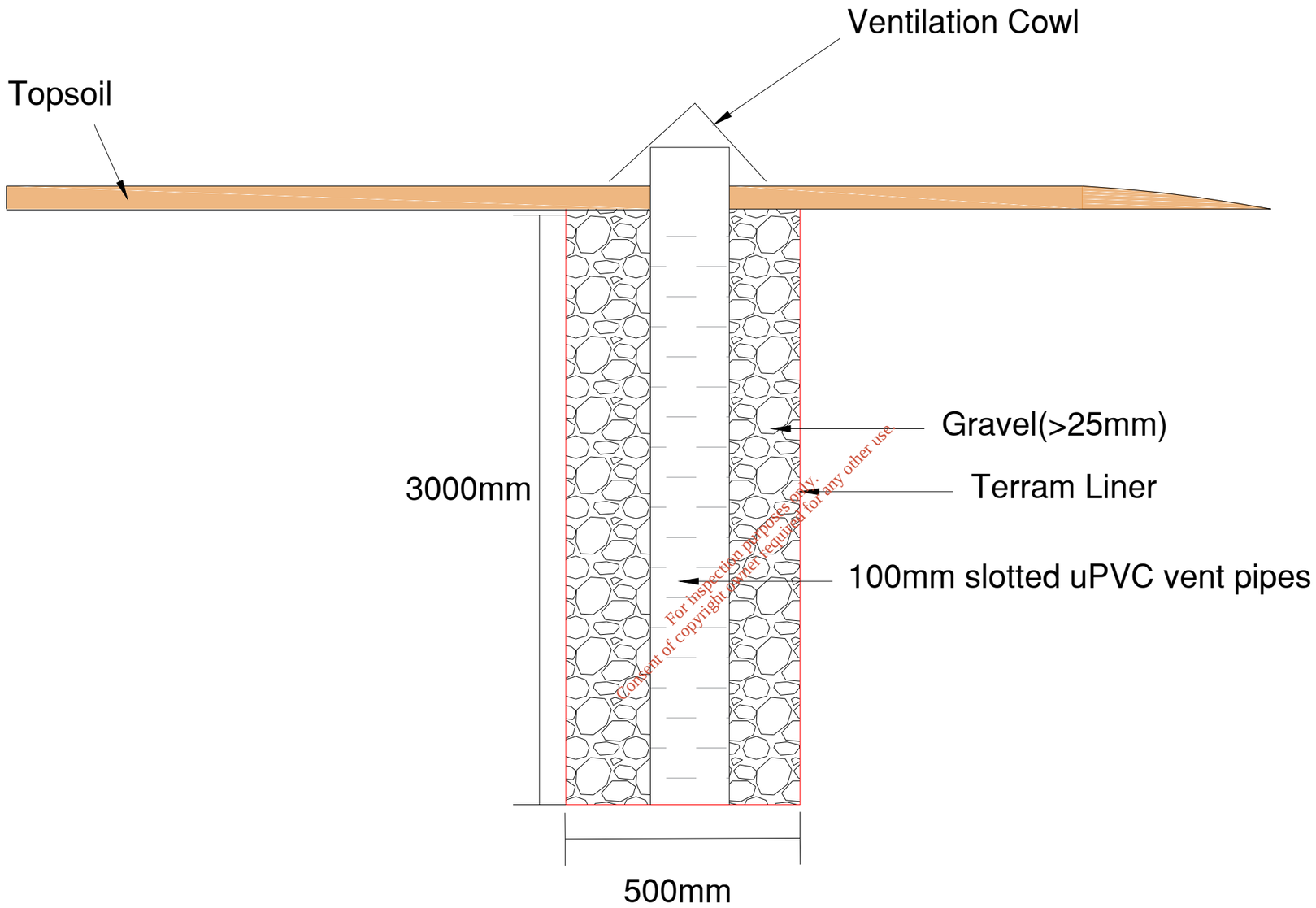

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FIGURE No.

5.2

TITLE

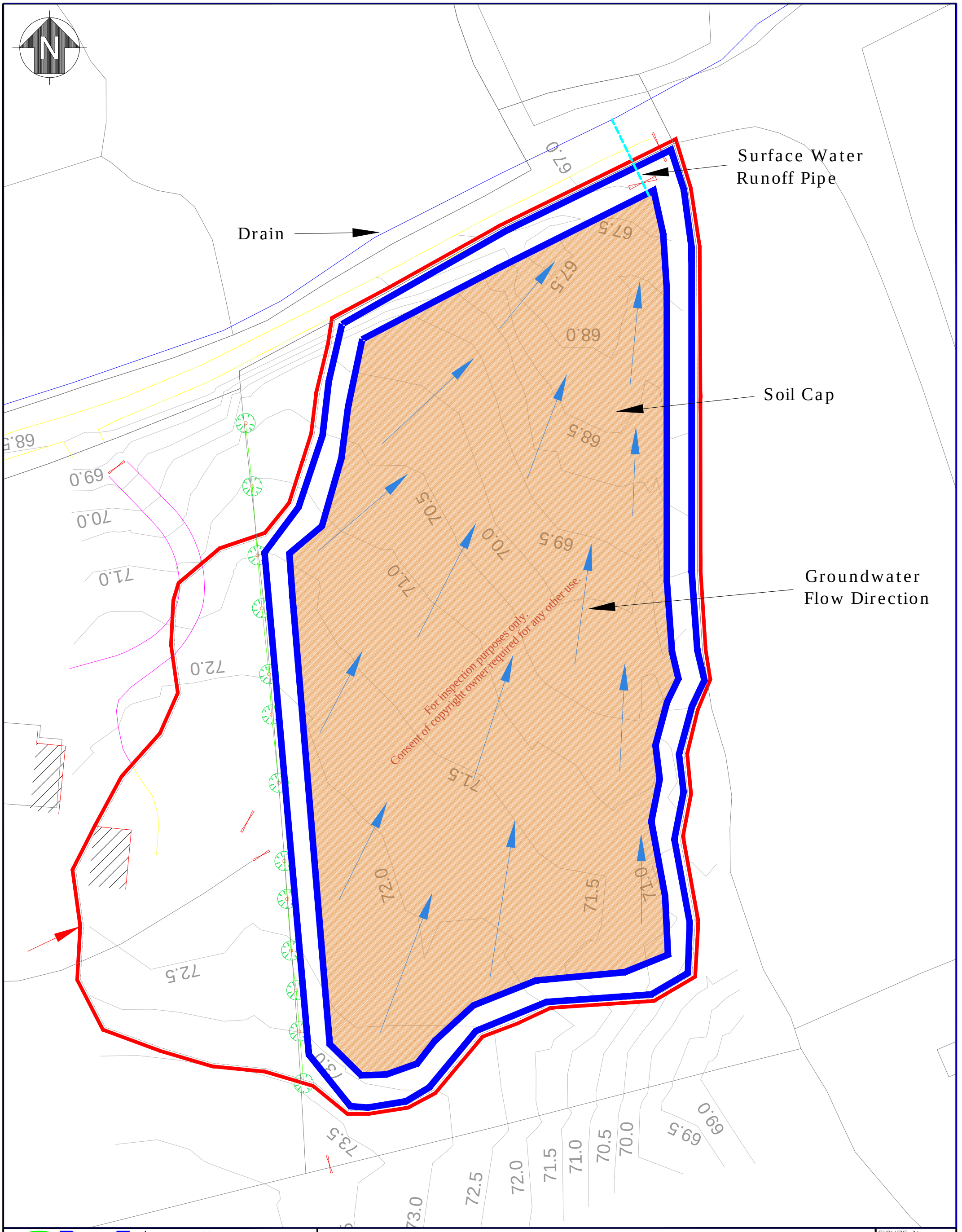
Landfill Gas Collection Trench Detail

SCALE

NTS

REV.

A



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TITLE
Topsoil Cap

FIGURE No.
FIG 5.3

SCALE
SCALE

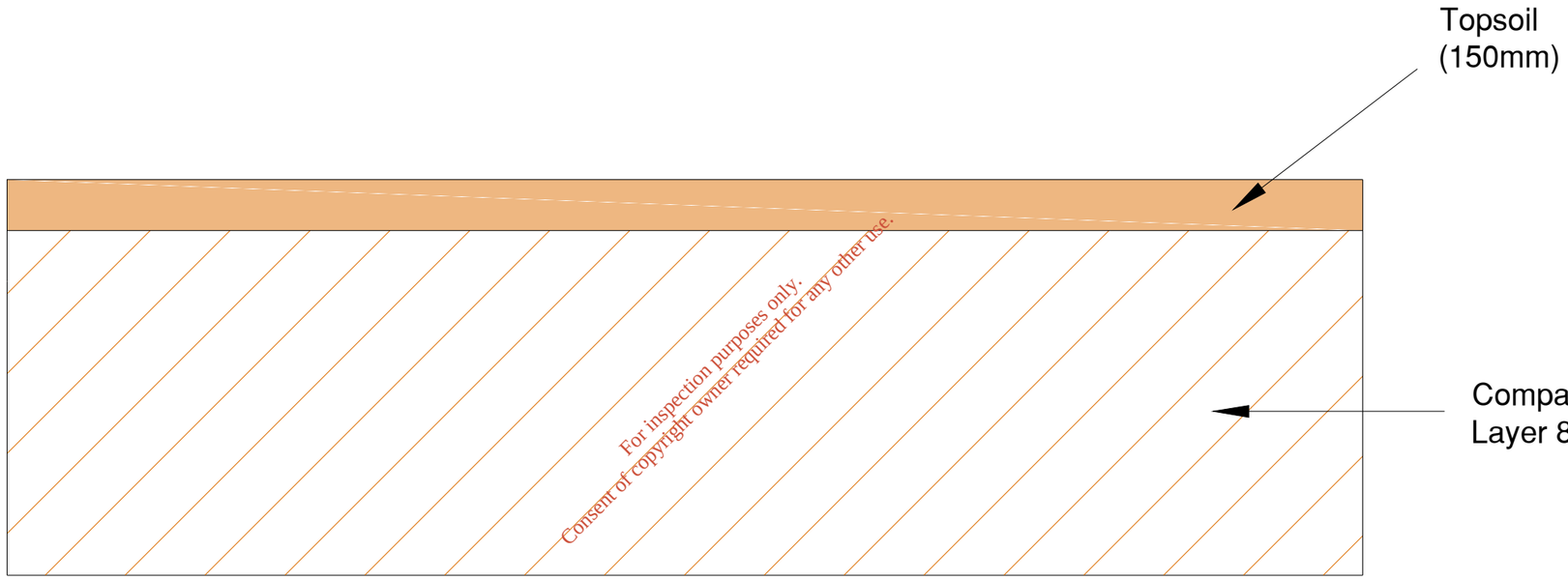

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FIGURE No.

5.4

TITLE

Landfill Capping Detail

SCALE

NTS

REV.

A

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

Risk Category

The results of the Tier 3 assessment and the refined SPR conceptual model confirm that the site remains a Class B - Moderate Risk due to the risk posed by leachate migration to surface water groundwater and landfill gas migration to offsite receptors.

Groundwater

Groundwater quality immediately down hydraulic gradient of the landfill is affected by leachate migration. The groundwater discharges to the River Liffey which is located c 40m to the east of the site. There are no groundwater supply wells between the site and the river.

Leachate

Leachate is still being generated beneath the site. The leachate is weak and indicating of an end stage degradation process in the landfill as expected given the historic nature of the site.

Landfill Gas

Landfill gas is being generated in the waste body. When the recommended capping works are complete the risk of lateral migration of landfill gas to off-site receptors will increase unless mitigation measures are undertaken.

Surface Water

In 2010 surface water in the drain to the north of the site was slightly impacted by leachate. The drain was dry during the 2018 monitoring programme. A comparison of surface water quality up and downstream of the landfill area between 2013 and 2018 shows that it is not impacted by leachate migration from the landfill. This is most likely due to high surface water dilution rates.

Redevelopment

The majority of the site is unused green area though a horse paddock is located on the south of the site. The site is not suitable for redevelopment use for construction of buildings.

6.2 Recommendations

The remedial measures described in Section 5 of the report should be implemented to mitigate the environmental risk posed by the landfill.

Groundwater monitoring should be undertaken in BH-01 – BH-03 and up and downstream of the site in the River Liffey on an annual basis to confirm that the landfill is not impacting on water quality. The parameter range should include pH, electrical conductivity dissolved oxygen, temperature ammonia, manganese, sodium, chloride, potassium, sulphate, nitrate and nitrite.

The leachate and groundwater wells should be fitted with gas caps and ground gas monitoring should also be undertaken in the monitoring and leachate wells and vertical riser pipes on the west of the trench on an annual basis to establish if lateral gas migration is occurring beyond the landfill area.

Appendix 1

Tier 1 and 3 Risk Scores

Landfill SiteName: Cloyne
Landfill Ref. No. : 08/S

Tier 1 Study

Risk Screening/ Prioritisation

Table 1a LEACHATE: SOURC/HAZARD SCORING MATRIX			
	Waste FOOTPRINT (ha)		
WASTE TYPE	≤ 1ha	> 1 ≤ 5 ha	> 5ha
C&D	0.5	1	1.5
Municipal	5	7	10
Industrial	5	7	10
Pre 1977 sites	1	2	3

1a =	5

Table 1b LANDFILL GAS: SOURC/HAZARD SCORING MATRIX			
	Waste FOOTPRINT (ha)		
WASTE TYPE	≤ 1ha	> 1 ≤ 5 ha	> 5ha
C&D	0.5	0.75	1
Municipal	5	7	10
Industrial	3	5	7
Pre 1977 sites	0.5	0.75	1

1b =	5

Table 2a : LEACHATE MIGRATION: PATHWAYS	
GROUNDWATER VULNERABILITY (Vertical Pathway)	Points
Extreme Vulnerability	3
High Vulnerability	2
Moderate Vulnerability	1
Low Vulnerability	0.5
High - Low Vulnerability (use where vulnerability not on GIS)	2

2a =	3

Table 2b : LEACHATE MIGRATION: PATHWAYS	
GROUNDWATER FLOW REGIME (Horizontal Pathway)	Points
Karstified Groundwater Bodies (Rk)	5
Productive Fissured Bedrock Groundwater Bodies (Rf & Lm)	3
Gravel Groundwater Bodies (Rg and Lg)	2
Poorly Productive Bedrock Groundwater Bodies (Ll, Pl, Pu)	1

2b =	1

Risk Screening/ Prioritisation

Table 2c : LEACHATE MIGRATION: PATHWAYS	
SURFACE WATER DRAINAGE (Surface water pathway)	**Points**
Is there a direct connection between drainage ditches associated with the waste body and adjacent surface water body? Yes	2
If no direct connection	0

2c =	**2**

Table 2d : LANDFILL GAS: PATHWAY	
LANDFILL GAS LATERAL MIGRATION POTENTIAL	**Points**
Sand and Gravel, Made ground, urban, karst	3
Bedrock	2
All other Tills (including limestone, sandstone etc - moderate permabi	1.5
All Namurian or Irish Sea Tills (low permability)	1
Clay, Alluvium, Peat	1

2d =	**3**

Table 2e : LANDFILL GAS: PATHWAY (assuming receptor located above source)	
LANDFILL GAS LATERAL MIGRATION POTENTIAL	**Points**
Sand and Gravel, Made ground, urban, karst	5
Bedrock	3
All other Tills (including limestone, standstone etc - moderate permab	2
All Namurian or Irish Sea Tills (low permability)	1
Clay, Alluvium, Peat	1

2e =	**0**

Table 3a : LEACHAGE MIGRATION: *RECEPTORS*	
HUMAN PRESENCE (presence of a house indicaates potential private wells)	**Points**
On or within 50m of the waste body	3
Greater than 50m but less than 250m	2
Greater than 250m but less than 1km from waste body	1
Greater than 1km of the waste body	0

3a =	**3**

Risk Screening/ Prioritisation

Table 3b : LEACHAGE MIGRATION: RECEPTORS PROTECTED AREAS (SWDTE or GWDTE)	Points
Within 50m of waste body	3
Greater than 50m but less than 250m of the waste body	2
Greater than 250m but less than 1km from waste body	1
Greater than 1km of the waste body	0
Undesignated sites within 50m of waste body	1
Undesignated sites greater than 50m but less than 250m	0.5
Undesignated sites greater than 250m of the waste body	0

3b =	**0**

Table 3c : LEACHAGE MIGRATION: *RECEPTORS*	
AQUIFER CATEGORY (resource potential)	**Points**
Regionally Important Aquifers (Rk, Rf, Rg)	5
Locally Important Aquifers (LI, Lm, Lg)	3
Poor Aquifers (Pl, Pu)	1

3c =	**3**

Table 3d : LEACHAGE MIGRATION: *RECEPTORS*	
PUBLIC WATER SUPPLIES (Other than private wells)	**Points**
Within 100m of site boundary	**7**
Greater than 100m but less than 300m or with in Inner SPA for GW supplies	5
Greater than 300m but less than 1km or within Outer SPA (SO) for GW supplies	3
Greater than 1km (karst aquifer)	3
Greater than 1km (no karst aquifer)	0

3d =	**0**

Table 3e : LEACHAGE MIGRATION: *RECEPTORS*	
SURFACE WATER BODIES	**Points**
Within 50m of site boundary	3
Greater than 50m but less than 250m	2
Greater than 250m but less than 1km	1
Greater than 1km	0

3e =	**3**

Landfill SiteName: Cloyne
Landfill Ref. No. : 08/S

Tier 1 Study

Risk Screening/ Prioritisation

Table 3f : LANDFILL MIGRATION: *RECEPTORS*	
HUMAN PRESENCE	**Points**
On site or within 50m of site boundary	5
Greater than 50m but less than 150m	3
Greater than 150m but less than 250m	1
Greater than 250m	0.5

3f =	**5**

Note: The table below represents the Tier 3 risk rating for this site. SPR 1 to 9 represent the leachate risk scores. SPR 10 & 11 represent Landfill Gas risks. The migration pathways are colour coded as follows:

Groundwater & Surface Water	Groundwater only	Surface water only	Lateral & Vertical

Calculator	SPR Values	Maximum Score	Linkages	Normalised Score
SPR 1 =	90	300	Leachate => surface water	30%
SPR 2 =	0	300	Leachate => SWDTE	0%
SPR 3 =	60	240	Leachate => human presence	25%
SPR 4 =	0	240	Leachate => GWDTE	0%
SPR 5 =	60	400	Leachate => Aquifer	15%
SPR 6 =	0	560	Leachate => Surface Water	0%
SPR 7 =	60	240	Leachate => SWDTE	25%
SPR 8 =	30	60	Leachate => Surface Water	50%
SPR 9 =	0	60	Leachate => SWDTE	0%
SPR 10 =	75	150	Landfill Gas => Human Presence	50%
SPR 11 =	0	250	Landfill Gas => Human Presence	0%

Risk Classification	Range of Risk Scores
Highest Risk (Class A)	Greater than or equal to 70% for any individual SPR lingage
Moderate Risk (Class B)	Between 40-70% for any individual SPR linkage
Lowest Risk (Class C)	Less than or equal to 40% for any individual SPR linkage

TIER 3 RATING	MODERATE

Appendix 2

Groundwater, Leachate and Surface Water Laboratory Results

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Unit 15
Melbourne Business Park
Model Farm
Cork
Ireland

Attention :	Conor McGrath
Date :	15th October, 2018
Your reference :	18.213
Our reference :	Test Report 18/15575 Batch 1
Location :	Carrigeen, Co. Kildare
Date samples received :	28th September, 2018
Status :	Final report
Issue :	2

Six samples were received for analysis on 28th September, 2018 of which six were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Compiled By:

Phil Sommerton BSc
Project Manager

Client Name: O'Callaghan Moran & Associates
Reference: 18.213
Location: Carrigeen, Co. Kildare
Contact: Conor McGrath
JE Job No.: 18/15575

Report : Liquid

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
H=H_2SO_4, Z=ZnAc, N=NaOH, HN=$HN0_3$

J E Sample No.	1-5	6-10	11-15	16-20	21-25	26-30					LOD/LOR	Units	Method No.
Sample ID	BH-01	BH-02	BH-03	LW-02	LIFFEY UP	LIFFEY DOWN							
Depth													
COC No / misc													
Containers	H N P BOD G	H N P BOD G	H N P BOD G	H N P BOD G	H N P BOD G	H N P BOD G							
Sample Date	26/09/2018	26/09/2018	26/09/2018	26/09/2018	26/09/2018	26/09/2018							
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water	Surface Water	Surface Water							
Batch Number	1	1	1	1	1	1							
Date of Receipt	28/09/2018	28/09/2018	28/09/2018	28/09/2018	28/09/2018	28/09/2018							
Dissolved Arsenic #	18.3	10.2	3.1	9.1	<2.5	<2.5					<2.5	ug/l	TM30/PM14
Dissolved Cadmium #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5					<0.5	ug/l	TM30/PM14
Total Dissolved Chromium #	5.7	<1.5	<1.5	4.1	<1.5	<1.5					<1.5	ug/l	TM30/PM14
Dissolved Copper #	<7	<7	<7	<7	<7	<7					<7	ug/l	TM30/PM14
Total Dissolved Iron #	57	<20	<20	83	<20	<20					<20	ug/l	TM30/PM14
Dissolved Lead #	<5	<5	<5	<5	<5	<5					<5	ug/l	TM30/PM14
Dissolved Manganese #	8899	591	5	1122	<2	<2					<2	ug/l	TM30/PM14
Dissolved Mercury #	<1	<1	<1	<1	<1	<1					<1	ug/l	TM30/PM14
Dissolved Nickel #	13	4	5	7	<2	<2					<2	ug/l	TM30/PM14
Dissolved Selenium #	<3	<3	<3	<3	<3	<3					<3	ug/l	TM30/PM14
Dissolved Sodium #	65.7	12.5	6.3	113.3	13.0	13.2					<0.1	mg/l	TM30/PM14
Dissolved Zinc #	<3	10	5	<3	4	5					<3	ug/l	TM30/PM14
PAH MS													
Naphthalene #	<0.1	<0.1	<0.1	2.2	<0.1	<0.1					<0.1	ug/l	TM4/PM30
Acenaphthylene #	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013					<0.013	ug/l	TM4/PM30
Acenaphthene #	<0.013	<0.013	<0.013	0.133	<0.013	<0.013					<0.013	ug/l	TM4/PM30
Fluorene #	<0.014	<0.014	<0.014	0.093	<0.014	<0.014					<0.014	ug/l	TM4/PM30
Phenanthrene #	<0.011	<0.011	<0.011	0.029	<0.011	<0.011					<0.011	ug/l	TM4/PM30
Anthracene #	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013					<0.013	ug/l	TM4/PM30
Fluoranthene #	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012					<0.012	ug/l	TM4/PM30
Pyrene #	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013					<0.013	ug/l	TM4/PM30
Benzo(a)anthracene #	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015					<0.015	ug/l	TM4/PM30
Chrysene #	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011					<0.011	ug/l	TM4/PM30
Benzo(bk)fluoranthene #	<0.018	<0.018	<0.018	<0.018	<0.018	<0.018					<0.018	ug/l	TM4/PM30
Benzo(a)pyrene #	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016					<0.016	ug/l	TM4/PM30
Indeno(123cd)pyrene #	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011					<0.011	ug/l	TM4/PM30
Dibenzo(ah)anthracene #	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	ug/l	TM4/PM30
Benzo(ghi)perylene #	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011					<0.011	ug/l	TM4/PM30
PAH 16 Total #	<0.195	<0.195	<0.195	2.455	<0.195	<0.195					<0.195	ug/l	TM4/PM30
Benzo(b)fluoranthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	ug/l	TM4/PM30
Benzo(k)fluoranthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	ug/l	TM4/PM30
PAH Surrogate % Recovery	79	70	79	73	85	80					<0	%	TM4/PM30
EPH (C8-C40) #	<10	<10	<10	<10	<10	<10					<10	ug/l	TM5/PM30
Sulphate as SO4 #	<0.5	21.7	46.0	<0.5	14.8	15.3					<0.5	mg/l	TM38/PM0
Chloride #	66.0	25.1	22.1	97.4	18.2	19.3					<0.3	mg/l	TM38/PM0
Nitrate as NO3 #	27.1	28.2	0.6	<0.2	4.6	4.5					<0.2	mg/l	TM38/PM0
Nitrite as NO2 #	1.00	1.56	<0.02	<0.02	<0.02	0.03					<0.02	mg/l	TM38/PM0
Ortho Phosphate as PO4 #	<0.06	3.16	<0.06	0.07	<0.06	<0.06					<0.06	mg/l	TM38/PM0
Total Cyanide #	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/l	TM89/PM0

Please see attached notes for all abbreviations and acronyms

Client Name: O'Callaghan Moran & Associates
Reference: 18.213
Location: Carrigeen, Co. Kildare
Contact: Conor McGrath
JE Job No.: 18/15575

Report : Liquid

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
$H=H_2SO_4$, Z=ZnAc, N=NaOH, $HN=HN0_3$

Please see attached notes for all abbreviations and acronyms

J E Sample No.	1-5	6-10	11-15	16-20	21-25	26-30					LOD/LOR	Units	Method No.
Sample ID	BH-01	BH-02	BH-03	LW-02	LIFFEY UP	LIFFEY DOWN							
Depth													
COC No / misc													
Containers	H N P BOD G	H N P BOD G	H N P BOD G	H N P BOD G	H N P BOD G	H N P BOD G							
Sample Date	26/09/2018	26/09/2018	26/09/2018	26/09/2018	26/09/2018	26/09/2018							
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water	Surface Water	Surface Water							
Batch Number	1	1	1	1	1	1							
Date of Receipt	28/09/2018	28/09/2018	28/09/2018	28/09/2018	28/09/2018	28/09/2018							
Ammoniacal Nitrogen as NH3 #	59.02	1.52	0.14	108.02	0.08	0.08					<0.03	mg/l	TM38/PM0
Ammoniacal Nitrogen as NH4 #	62.51	1.61	0.15	114.42	0.09	0.08					<0.03	mg/l	TM38/PM0
BOD (Settled) #	2	2	<1	11	<1	<1					<1	mg/l	TM58/PM0
Dissolved Organic Carbon #	<2	3	<2	<2	3	3					<2	mg/l	TM60/PM0
Electrical Conductivity @25C #	1564	866	876	2548	338	311					<2	uS/cm	TM76/PM0
pH #	7.24	7.46	7.27	7.06	8.02	7.92					<0.01	pH units	TM73/PM0
Total Dissolved Solids #	968	630	692	1297	238	265					<35	mg/l	TM20/PM0

Client Name: O'Callaghan Moran & Associates
Reference: 18.213
Location: Carrigeen, Co. Kildare
Contact: Conor McGrath

J E Job No.	Batch	Sample ID	Depth	J E Sample No.	Analysis	Reason
No deviating sample report results for job 18/15575						

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.
Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

JE Job No.: 18/15575

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

Samples must be received in a condition appropriate to the requested analyses. All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. If this is not the case you will be informed and any test results that may be compromised highlighted on your deviating samples report.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa.
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
*	Analysis subcontracted to an Exova Jones Environmental approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

JE Job No: 18/15575

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.				
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM5	Modified USEPA 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) with carbon banding within the range C8-C40 GC-FID.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM20	Modified BS 1377-3: 1990/USEPA 160.3 Gravimetric determination of Total Dissolved Solids/Total Solids	PM0	No preparation is required.	Yes			
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM14	Analysis of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for dissolved metals and acidified if required.	Yes			
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods 325.2 (Chloride), 375.4 (Sulphate), 365.2 (o-Phosphate), 353.1 (TON), 354.1 (Nitrite), 350.1 (NH4+) comparable to BS ISO 15923-1, 7196A (Hex Cr)	PM0	No preparation is required.	Yes			
TM58	APHA Standard Methods for the extraction of water and waste water (SMEWW) 5210B. Comparible with ISO 5815:1989. Measurement of Biochemical Oxygen Demand. When cBOD (Carbonaceous BOD) is requested a nitrification inhibitor is added which prevents the oxidation of reduced forms of nitrogen, such as ammonia, nitrite and organic nitrogen which exert a nitrogenous demand.	PM0	No preparation is required.	Yes			
TM60	TC/TOC analysis of Waters by High Temperature Combustion followed by NDIR detection. Based on the following modified standard methods: USEPA 9060, APHA Standard Methods for Examination of Water and Wastewater 5310B, ASTM D 7573, and USEPA 415.1.	PM0	No preparation is required.	Yes			
TM73	Modified US EPA methods 150.1 and 9045D and BS1377:1990. Determination of pH by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			
TM76	Modified US EPA method 120.1. Determination of Specific Conductance by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			

JE Job No: 18/15575

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM89	Modified USEPA method OIA-1667. Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis.	PM0	No preparation is required.	Yes			