

ATTACHMENT D1

Tier 1 Environmental Risk Assessment

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BARNAGEERAGH UNREGULATED WASTE DISPOSAL SITE

TIER 1 ENVIRONMENTAL RISK ASSESSMENT



MDR1552Rp0001
Barnageeragh
Tier 1 Environmental Risk
Assessment
F01
13 August 2019

REPORT

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Approval for issue

Gareth McElhinney

12 August 2019

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Contents

1	INTRODUCTION	1
1.1	Environmental Risk Assessment.....	1
1.2	Project Objective	3
1.3	Scope of Works	3
1.4	Limitations	4
1.5	Competent and Qualified Persons	4
2	SITE BACKGROUND	5
2.1	Site Location.....	5
2.2	Site History	5
2.3	Planning	8
2.4	Previous Environmental Site Investigation.....	10
2.4.1	Investigations at the Hamilton Hill Development Site	10
2.4.2	Investigations connected to the Wastewater Treatment Plant Development.....	13
2.5	Existing Landfill Policy.....	13
3	SITE DESCRIPTION	14
3.1	Site Setting	14
3.1.1	Walkover Survey.....	14
3.1.2	Area 1: The waste area	14
3.1.3	Area 2: Residential and grass area	14
3.1.4	Area 3: North of the identified waste area	14
3.2	Geology.....	14
3.2.1	Soils and Subsoils	14
3.2.2	Bedrock.....	14
3.2.3	Structural Geology	18
3.3	Hydrogeology and Hydrology.....	18
3.3.1	Hydrogeology.....	18
3.3.2	Hydrology.....	18
3.3.3	Groundwater Wells and Springs.....	18
3.4	Protected Sites	20
4	INITIAL CONCEPTUAL SITE MODEL (CSM)	23
5	TIER 1 – RISK ASSESSMENT	24
5.1	Risk Assessment Process.....	24
5.2	Matrices.....	24
5.2.1	Source.....	24
5.2.2	Pathways	25
5.2.3	Receptors.....	26
5.2.4	Summary of Matrix Scores	27
5.3	Tier 1 Source-Pathway-Receptor Linkages	27
6	CONCLUSIONS AND RECOMMENDATIONS	29
6.1	Conclusions.....	29
6.2	Recommendations	29
7	REFERENCES	31

Tables

Table 1: Risk Category Prioritisation from EPA Code of Practice	1
Table 2: Summary of Planning Applications on the Subject Site	8
Table 3: Previous Risk Rating for the Subject Site	13
Table 4: Wells and Springs within a 5km Radius of the Subject Site	20
Table 5: Protected Sites within 15km Radius of the Subject Site	21
Table 6: Leachate: Source/ Hazard Scoring Matrix 1a	24
Table 7: Landfill Gas: Source/ Hazard Scoring Matrix 1b	24
Table 8: Leachate Migration: Pathways Scoring Matrix 2a	25
Table 9: Leachate Migration: Pathways Scoring Matrix 2b	25
Table 10: Leachate Migration: Pathways Scoring Matrix 2c	25
Table 11: Landfill Gas: Pathways Scoring Matrix 2d (receptor within 250m)	25
Table 12: Landfill Gas: Pathways Scoring Matrix 2e (receptor above source)	25
Table 13: Leachate Migration: Receptors Scoring Matrix 3a	26
Table 14: Leachate Migration: Receptors Scoring Matrix 3b	26
Table 15: Leachate Migration: Receptors Scoring Matrix 3c	26
Table 16: Leachate Migration: Receptors Scoring Matrix 3d	26
Table 17: Leachate Migration: Receptors Scoring Matrix 3e	26
Table 18: Landfill Gas: Receptors Scoring Matrix 3f	27
Table 19: Summary of Matrix Scores	27
Table 20: Barnageeragh Risk Category and Prioritisation Class	28
Table 21: Tier 2 Exploratory Investigations and Sampling	30

Figures

Figure 1.1 - Site Location	2
Figure 2.1 - Map of site entrances	6
Figure 2.2 - Historical Aerial maps	7
Figure 2.3 – Existing Monitoring Locations	12
Figure 3.1 - Map outlining breakdown of site areas	15
Figure 3.2 - GSI map of Subsoils	16
Figure 3.3 - GSI map of Bedrock Geology	17
Figure 3.4 - GIS map of Hydrogeology	19
Figure 3.5 - Protected Sites within 15km	22
Figure 4.1 Initial CSM for Barnageeragh Landfill	23

Appendices

Appendix A Site Walkover Checklist	32
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1 INTRODUCTION

RPS was commissioned by Fingal County Council (FCC) to undertake a Tier 1 Environmental Risk Assessment (ERA) for an unregulated waste disposal site in Barnageeragh to the north of the town of Skerries, Co. Dublin.

The site is bounded to the north by Barnageeragh Road, to the east by Barnageeragh waste water treatment plan (WWTP), to the south by the Dublin-Belfast rail line and to the west by the Hamilton Hill housing estate (refer **Figure 1.1**). This subject site is approximately 1.4 hectares in area with the waste deposition area at approx. 0.8 hectares.

Under the Waste Management (Certification of Historic Unlicensed Waste Disposal and Recovery Activity) Regulations 2008, S.I. No. 524 of 2008, an application to the Environmental Protection Agency (EPA) for a Certificate of Authorisation must be submitted to regularise the site.

The application for a Certificate can only be made by the relevant local authority (in this case FCC) and must be supported by an environmental risk assessment carried out in accordance with the “Code of Practice: Environmental Risk Assessment for Unregulated Waste Disposal Sites”, (EPA, 2007), hereafter the CoP.

The ERA will be completed in a phased approach in accordance with the CoP and the initial step in this assessment is the Tier 1 Preliminary Site Investigation which is documented in this ERA report.

1.1 Environmental Risk Assessment

This environmental risk assessment has been completed in accordance with the CoP. The environmental risk assessment examines the various Source-Pathway-Receptor (SPR) linkages. The range of risk rankings are summarised in **Table 1**.

Table 1: Risk Category Prioritisation from EPA Code of Practice

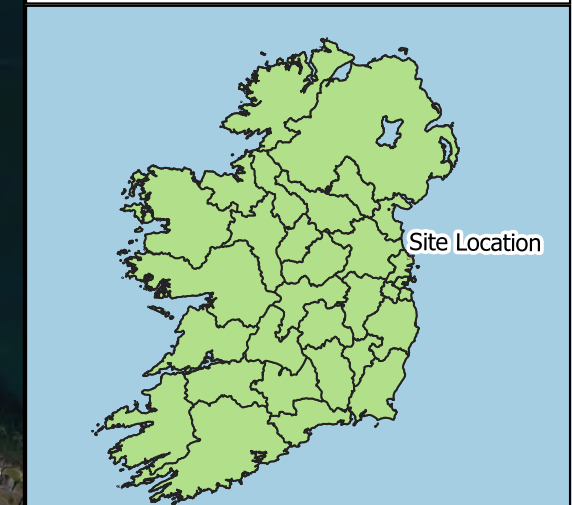
Score	Priority Class	Risk Category	Definition
> 70%	A	High	High risk/high uncertainty sites. Further investigation required to confirm status. Presents potentially high risk to environment in current condition. Remediation / mitigation will be necessary. Highest priority with Regulating Authority.
40% to 70%	B	Moderate	Moderate risk/moderate uncertainty sites. Further investigation required to confirm status. Presents potentially moderate risk to environment in current condition. Remediation / mitigation may be required.
< 40%	C	Low	Low risk sites. Not considered to present risk to environment in current condition however further investigation may be required in case of change of land use.



Legend

- Site Location
- Railway
- ↑ Site Entrance
- 400m
- County Boundary
- Sea Background

Map showing a larger area surrounding the site. Identifying site entrance points, railway and distance to Irish Sea.



Title:	Site Entrance and Area Map
Project:	Barnageeragh Landfill
Client:	Fingal County Council
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Issue Details

Drawn by: Scott Graydon	Project No: MDR1552
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Approved by: GMcE	MDR1552QGIS0001F01
Scale: 1:15,000@A3	Figure 1.1
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The EPA *Code of Practice* outlines a six-step process to be followed in undertaking an assessment of an unregulated waste disposal site. The six steps are summarised below:

- Step 1: Notification of the EPA that historical waste has been identified at the site;
- Step 2: TIER 1 Assessment including development of a conceptual site model with risk screening and prioritisation;
- Step 3: TIER 2 Assessment including detailed site investigations and verification of the site's classification;
- Step 4: TIER 3 Assessment including the refinement of the conceptual site model based on the information from the Tier 2 Assessment. A quantitative risk assessment shall be carried out on all high and moderate risk sites;
- Step 5: Site remediation proposals are to be made, if considered necessary; and
- Step 6: The Local Authority is to ensure that all reporting requirements as set out in the *Code of Practice* have been satisfied.

Step 1 has already been completed.

This report completes Step 2 in the above sequence and will be used to identify SPR linkages that must be assessed as part of the Tier 2 process.

1.2 Project Objective

The objective of this report is to identify any environmental or human health risks resulting from the waste site in its current condition and to prioritise these risks to guide future site investigations.

1.3 Scope of Works

For the purpose of this Tier 1 ERA, RPS undertook the following scope of work:

- Desk based study involving a review of public sources of information and available historical information on the site;
- Site walkover survey to inspect the current site conditions; and
- Development of the initial Conceptual Site Model.

This Tier 1 ERA was completed in accordance with the CoP and the following sources of information were consulted in the compilation of this report:

- EPA online datasets;
- Geological Survey of Ireland (GSI) online datasets;
- Aerial Photography;
- National Parks and Wildlife Service (NPWS) online maps and data;
- Eastern Midlands Region Waste Management Plan 2015-2021;
- Fingal County Council Planning <http://www.fingalcoco.ie/planning>;
- EPA catchments <https://www.catchments.ie/>;
- Review of pertinent historical reports;
- Water Maps interactive tool on the Irish National Water Framework Directive website;
- Discovery Series Maps (1:50,000) and Orthophotography available from the Ordnance Survey Ireland (OSI); and
- Previous site investigation reports.

1.4 Limitations

The following notes should be read in conjunction with this report:

- This report contains only the available factual data for the site obtained from the sources described in the text;
- The review of the site is based on documentation and information provided by FCC;
- Where data have been supplied by FCC or other sources it has been assumed that the information is correct, but no warranty is given to that effect. While reasonable care and skill has been applied in review of this data no responsibility can be accepted by RPS for inaccuracies in the data supplied;
- During the site walkover (28th March 2019) areas where the Health and Safety of RPS personnel would have been jeopardised were not accessed;
- Two of the 21 No. previous site investigation installations were damaged (namely BH10 and BH13) and could not be accessed.

The conclusions presented in this report represent RPS's best professional judgement based on a review of site conditions observed during the site visit and the relevant information available at the time of drafting. The opinions and conclusions presented are valid only to the extent that the information provided was accurate and complete.

1.5 Competent and Qualified Persons

This report has been prepared by Dr Blathnaid McPoilin under the direction of Gareth McElhinney.

Dr Blathnaid McPolin is a Senior Project Scientist with 9 years' experience in contaminated land and remediation. She holds a PhD in Environmental Microbiology and Contaminated Land from Queen's University Belfast (2014). She is a Chartered Member of Institute of Environmental Sciences (IES) and a Member of the Irish Environmental Law Association (IELA).

Gareth McElhinney is a Technical Director in Environment and Marine and has 20 years' postgraduate experience with significant experience in landfill engineering, contaminated land and remediation projects. He holds a bachelors degree in Civil Engineering and a masters degree in Business Studies. Gareth is a Chartered Engineer with Engineers Ireland, and is on their Register of Chartered Engineers: Historic Landfills¹ in accordance with Section 2.3 of the EPA Code of Practice.

¹ <https://www.engineersireland.ie/services/landfill-register.aspx>

2 SITE BACKGROUND

2.1 Site Location

The site is located in the Barnageeragh Cove area to the north of the town of Skerries, Co. Dublin (Figure 2.1). The site is bounded to the north by Barnageeragh Road and access to the site is via the Hamilton Hill housing estate to the east or via a gate at the roundabout opposite Fulmar housing estate. New residential housing has been constructed to the north and west of the site as Hamilton Hill. To the east is the Irish Water WWTP separated from site by a dense treeline and boundary fence. To the south of the site is the Belfast to Dublin rail line and beyond are agricultural fields. The Irish Sea is approximately 400m north of the site.

2.2 Site History

The following is a brief description of the history of the site and surrounding area. **Figure 2.2** shows selected historical aerial views of the site and the full maps described below can be accessed through the [GeoHive](#) website (June 2019).

- Historic map 6 inch colour (1837 – 1842):
 - Map shows Dublin to Drogheda (as it was at that point) railway in progress.
 - The site in question was agricultural land at this point in time.
- Historic map 25 inch (1888 – 1913):
 - Map shows the completed railway line, now named Great Northern Railway (Ireland).
- Aerial map 1995 (black and white):
 - Farm houses and buildings appear near the coast to the north and west of the site.
 - Outward expansion of the town of Skerries.
 - An access road has been constructed west to east approaching the subject site, with a turning area constructed at the end of the road.
 - The site appears to be no longer being used for agricultural purposes with some of the ground appearing to be overgrown. There is some evidence of human disturbance of the ground in the area immediately south of the eastern extent of the access road.
- Aerial map 2000 (colour):
 - Site identified as an irregular mound (suggesting waste activity), with access road directly to the site from the west.
 - Expansion of residential housing estates associated with Skerries toward the subject site. These are connected by a link road from the R127 Dublin Road.
- Aerial map 2005:
 - The access road was extended to the north of site to the field boundary and subsequently runs due east-southeast towards the town of Skerries.
 - Expansion of residential housing estates associated with Skerries toward the subject site. These are connected by a link road from the R127 Dublin Road.
- Aerial map 2005 – 2012:
 - Identifies an expansion of the vegetation to the north and north east of the site.
 - Removal of vegetation along the southern part of the site.
 - Wastewater treatment facility constructed to the east of the subject site. The road from the wastewater treatment plant runs east, south of Skerries, where it joins the previously constructed road associated with the residential housing estates and eventually re-joins the R127 Dublin Road.
 - Signs of further residential housing development to the north and north-east.



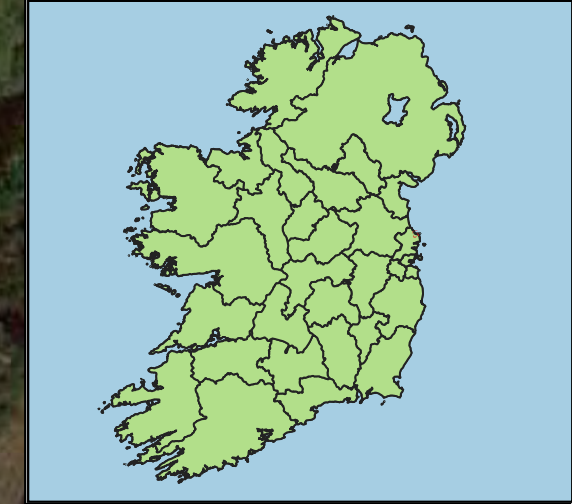
Site Location

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- Site Location
 - County Boundary
 - Sea_Background
- Google Map

Map showing the location boundary for the Barnageeragh Landfill Site.



Title: **Site Location Map**

Project: Barnageeragh Historic Landfill

Client: Fingal County Council

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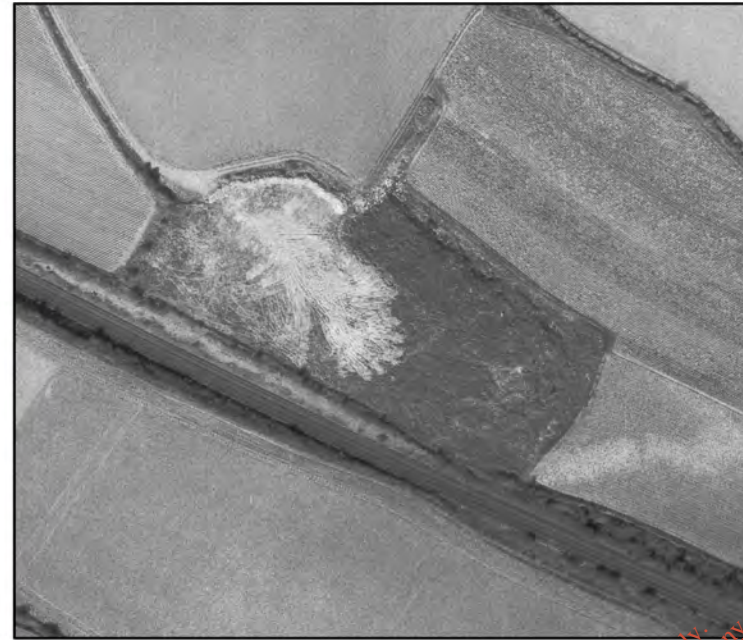
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ESRI Aerial Background

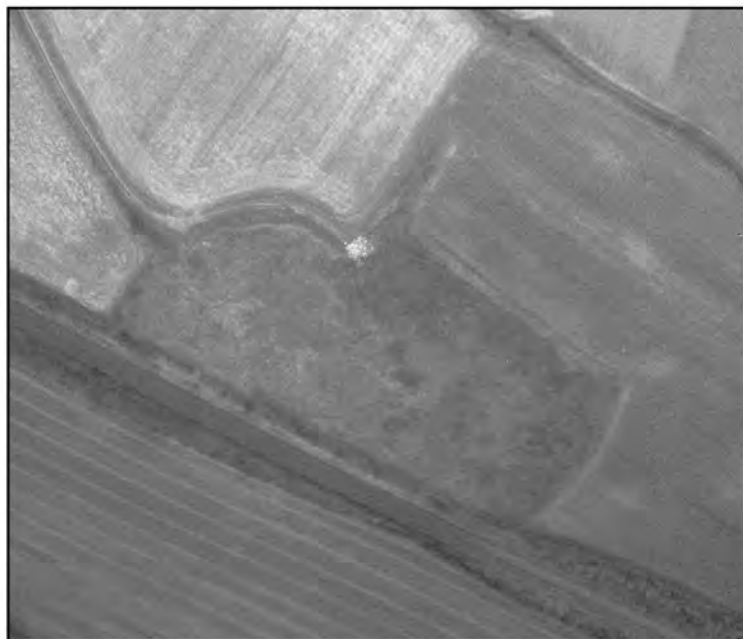


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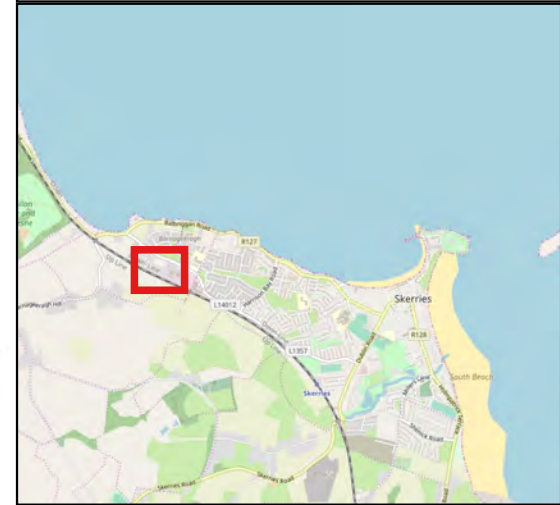


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Legend

Aerial view of site location
Street Map
Site Location

6 No. historical aerial views showing the site location identifying the landfill area.



Title: **Historical Aerial Views**

Project: **Barnageeragh Landfill**

Client: **Fingal County Council**



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- Current/premium aerial maps:
 - The Barnageeragh Road has been constructed west to east across the northern boundary of the subject site connecting the R127 Balbriggan Road with the wastewater treatment plant. This road now links all the way to the R127 Dublin Road to the east of Skerries.
 - Shows the near completion of the residential housing estates to the north of the subject site with construction commencing on the Hamilton Hill estate.
 - Landscape of waste site has changed with vegetation now removed.
 - Site used as a compound during construction of new houses with storage facilities and vehicle movements evident from tracks.
 - Building materials and excavated material deposited in the south east of the site.
 - Deposited building materials observed around the site including to the immediate north, between waste area and new road.

There is limited information available on the uses of the land, particularly between 1913 and 1995. However, a 1988 survey, undertaken by Dublin County Council, recorded that tipping of household and commercial waste (which included material tipped by the Council) began at this site sometime around the mid-1950s and ended in 1983. An extract from this report states the following:

“Situating about 2¼ km North West of Skerries, on the northern side of the railway, this site became available to the Council in 1954, but most of the tipping occurred between 1963 and 1983. It is believed that trade waste as well as domestic refuse was tipped here.”

A Tier 1 Risk Assessment was carried out by Fingal County Council’s Environment Department in 2009/2010 and classified the site as “Low” risk. Subsequently the site was entered by the Council into the EPA Section 22 Register (Ref: S22-02655) and classified as a C (Low) risk.

2.3 Planning

The FCC planning website indicates that there have been several planning applications at the site and in the surrounding area. **Table 2** presents a summary of the relevant planning applications.

Table 2: Summary of Planning Applications on the Subject Site

Reference	Applicant and Submission Type	Application Description	Outcome and FCC Decision Date
F05A/1818	Winsac Ltd Permission	A residential development and local services. The proposed development consists of 544 dwellings. An urban centre over two and three stories. The development also includes a crèche (284 sq.m.), a reserved school site, landscaped open space, playing fields, children's playground, pedestrian and cycle routes, access roads, the provision of a distributor road linking the Townparks Distributor Road and the Skerries/Balbriggan Road (R127). The application site includes a Protected Structure (RPS No. 502 - Mound Site Barnageeragh). This structure will not be affected by the proposed development.	Granted, July 2006
F05a/1818/E1	Winsac Ltd	Permission is sought for a residential development and local services centre on lands adjacent to and west of the Kelly's Bay development. The proposed	Granted, Sept 2013

REPORT

Reference	Applicant and Submission Type	Application Description	Outcome and FCC Decision Date
	Extension of duration of development permission	consists of the following: 544 dwellings, an urban centre over two and three (5535 sq.m.). A total of 962 car parking spaces. The development also includes a crèche (284 sq.m.), a reserved school site, landscaped open space, playing fields, children's playground, pedestrian and cycle routes, access roads, the provision of a distributor road linking the Townparks Distributor Road and the Skerries/Balbriggan Road (R127), foul and surface water drainage development, along with ESB substations, landscaping, boundary treatments and lighting. All works in accordance with the Barnageeragh Local Area Plan. The application site includes a Protected Structure (RPS No. 502 - Mound Site Barnageeragh). This structure will not be affected by the proposed development. In addition, feasibility drawings have been provided of road realignment and improvement works to the R127 outside the application site boundary. The applicant proposes to cede this area of land to Fingal County Council to facilitate future improvements to the R127 Skerries-Balbriggan Road. Significant Further Information and revised plans have been furnished to the Planning Authority.	
F16A/0519	Winsac Ltd Permission	This application seeks to make alterations to the previously approved link road (Barnageeragh Road) between Kelly's Bay and Balbriggan Road (R127). The changes in summary are as follows: Amendment of the Barnageeragh Road vertical alignment from CH-15 to CH250; Omission of the permitted Commercial south/Residential North Signal Controlled junction at CH 400; Provision of a Signalised Pedestrian crossing at CH 380; Provision of a new 28m ICD Roundabout provided at CH480 to provide access to Commercial North/South sites; Provision of a new turning head provided at the newly created Fulmar Cul-de-Sac; Provision of a permanent link to Residential North at the location of the existing temporary link at the School Access Link Roadway, and the realignment of same; Other associated works. The development was previously approved under Planning Reg. Ref. No. F05A/1818.	Granted, Jan 2017
F16A/0602	Winsac Ltd	Development of a petrol filling station on a site of 0.68ha. with vehicular and pedestrian	Withdrawn,

Reference	Applicant and Submission Type	Application Description	Outcome and FCC Decision Date
	Permission	access at previously approved link road (Barnageeragh Road) between Kelly's Bay and Balbriggan Road (R127) previously approved under Planning Reg Ref. No. F05A/1818) with access off proposed roundabout subject to current application F16A/0519. The proposed development will consist of a single storey building (506 sq.m). Forecourt area to provide petrol/diesel dispensing pumps and forecourt canopy 6.8m high with structural supports at 9.3m high. A covered car wash facility (665 sq.m.) with three underground fuel storage tanks, 47 car parking spaces. Works to include a hard and soft landscaping including boundary treatments, signage (including totem sign 5.5m high and signage to unit's facades), retail unit, canopy, car wash etc.); and all associated engineering and site works necessary to facilitate the development.	May 2017
F19A/0196	Winsac Ltd Permission	For the development of an area of open space at Barnageeragh Cove, Skerries which will consist of a 37m x 18.5m Multi Use Games Area (MUGA) including fencing, tarmac surfacing, provision of 10 No. car parking spaces, grading of earth, mown path, wild meadow grassed area, pathway including ramp and steps to facilitate pedestrian / cycleway access to Hamilton Hill, stone surfacing, stone wall / railings with gate access, tree planting and all associated site development works to facilitate the establishment of the open space area.	Pending, May 2019

2.4 Previous Environmental Site Investigation

2.4.1 Investigations at the Hamilton Hill Development Site

Winsac Ltd. under the permissions granted by FCC began constructing residential development in the Barnageeragh area back in 2008. During groundworks for the Hamilton Hill development to the immediate north, historical waste material was encountered in May 2017.

Subsequently, a site investigation was undertaken by Mulroy Environmental in May to July 2017 on behalf of Winsac involving the following:

- Excavation of 50 No. trial pits in accordance with BS 10175:2011 with laboratory analysis of 40 soil samples for a suite of parameters;
- Installation of 14 No. groundwater monitoring wells with three rounds of groundwater monitoring undertaken;

REPORT

- Installation of 3 No. deep gas monitoring wells; and
- Installation of 4 No. shallow gas monitoring wells.
- Apex Geoservices were also contracted to carry out a geophysical survey of the site.

A series of groundwater monitoring, surface water sampling and gas monitoring was carried out by Mulroy Environmental and has been accounted for in this analysis. The location of the monitoring points installed and tested are shown in **Figure 2.3**. A summary of the findings of the investigations as carried out by Mulroy Environmental is provided below:

- Of the 40 No. soil samples from the trial pits screened for asbestos, none of the samples tested positive for asbestos fibres;
- 13 No. of the 40 No. samples had one or more exceedances in the metal determinands within the leachate analysis for inert waste acceptance criteria (WAC). The metals that exceeded the criteria included antimony, arsenic, barium, cadmium, copper, lead and zinc;
- Sulphate was elevated above inert WAC in 22 No. of the 40 No. samples;
- Total dissolved solids (TDS) were detected in 14 No. of the samples above the inert WAC value;
- Mineral oil was detected above the Inert WAC limit in 4 No. soil samples;
- Polycyclic aromatic hydrocarbons (PAH) were detected above the method detection limit in 10 No. samples but none above the inert WAC limit;
- Total Organic Carbon (TOC) was detected above the inert WAC limit in 14 No. in any of the 40 No. soil samples;
- Volatile Organic Compound (VOC) analysis was conducted on 5 No. of the 40 No. samples and only one sample detected VOCs (namely vinyl chloride and 1,2-dichloroethene);

The results of the soil analysis indicates that 13 No. of the 40 No. samples would be classed as inert, 17 non-hazardous and 10 samples would be hazardous.

In relation to groundwater, the most notable findings are listed as follows:

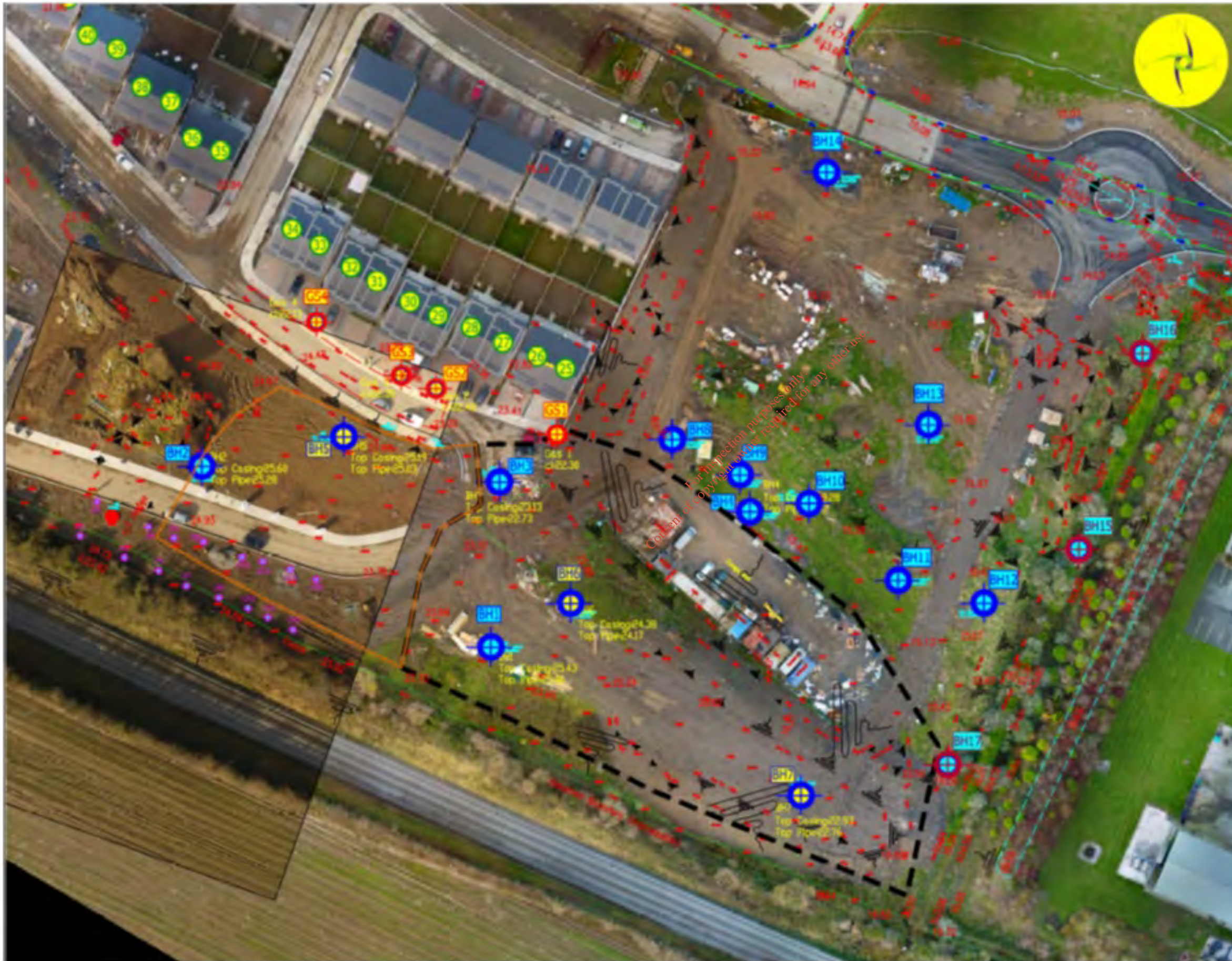
- The results obtained within all 14 No. boreholes on the three sampling occasions for ammoniacal nitrogen exceeded the Groundwater Regulations threshold value;
- There are several exceedances of major anions and cations (such as sulphate and phosphate) for all wells at various sample events;
- All metals tested were within the GAC with the exception of arsenic, barium, boron, iron, manganese, mercury and selenium; and
- No VOCs were detected within the groundwater above the method detection limit in any of these samples.

The ammonia, sulphate, mercury, phosphate, iron and manganese results are typical of groundwater which has been impacted by leachate from waste.

Surface water monitoring undertaken suggests that the main source of pollution to the stream is agricultural practices within the catchment and levels are unrelated to the waste body.

50 rounds of landfill gas monitoring have been carried out and the potential risk from landfill gas has been assessed as very low risk in pathway boreholes. Elevated levels of methane have been detected at a number of wells, in particular BH4 and BH17. As a consequence, five passive gas venting wells have been installed at the site in May 2018 by Winsac.

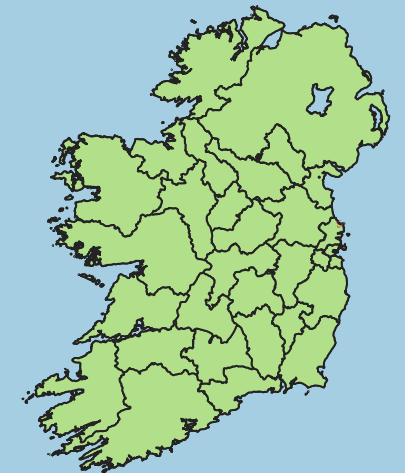
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Legend

Historic Landfill Outline
 BH Locations
 Residential housing

Map showing the location of monitoring BH's for the Barnageeragh Landfill Site, and the landfill outline identified by the dashed black line.



Title: **Monitoring BH Location Map**

Project: Barnageeragh Historic Landfill

Client: Fingal County Council

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2.4.2 Investigations connected to the Wastewater Treatment Plant Development

It is also noted that as part of the WWTP works a 600mm rising foul sewer main was constructed by FCC to transfer sewage from Balbriggan to the newly constructed WWTP on the eastern boundary of the site. It is understood that the pipeline was installed on site in 2006 and that the installation involved the excavation and pulling back of historical waste within the waste body, the installation of the pipework and the re-instatement of the waste.

To support this development, a geotechnical/ environmental borehole site investigation was carried out in October 2005 to January 2006 and involved the following:

- Four boreholes were installed and waste was found at circa 6 – 9 m below ground level (bgl);
- Soil sampling indicated elevated levels of arsenic at one borehole;
- Elevated levels of PAH were detected at a number of the boreholes but at levels below the Soil Guideline Values;
- No groundwater monitoring was undertaken;
- No methane was detected.

2.5 Existing Landfill Policy

The waste management plans, including the Eastern Midlands Region Waste Management Plan 2015-2021, have recognised the need to address legacy and historic unregulated landfills within the respective regions. Policy G2 of the Plan states:

“Roll-out the plan for remediating historic closed landfills prioritising actions to those sites which are the highest risk to the environment and human health.”

This policy has been agreed by the relevant Local Authorities and discussed at departmental level. In order to prioritise the high-risk sites, the plan programme proposes to complete the investigation, authorisation and remediation of the remaining Class A sites in accordance with the following priority order:

- Sites with a gas source-pathway-receptor linkage containing hazardous waste;
- Sites with a gas source-pathway-receptor linkage;
- Sites with a groundwater vulnerability source-pathway-receptor linkage; and
- Sites with a surface water vulnerability source-pathway-receptor linkage.

From a review of the register compiled in accordance with the Waste Management Act 1996 as amended (the Act) and presented in the Eastern Midlands Region Waste Management Plan 2015-2021, the site was previously classified as a Risk Rating C (Low Risk) site as noted in **Table 3**.

Table 3: Previous Risk Rating for the Subject Site

Site ID	Local Authority	Site Name	Risk Rating
S22-02655	Fingal County Council	Barnageeragh	C

Source: Eastern Midlands Region Waste Management Plan 2015-2021

Site is classified as municipal (post-1977).

3 SITE DESCRIPTION

3.1 Site Setting

3.1.1 Walkover Survey

RPS completed a site walkover survey of the site and surrounding area on the 28th March 2019. A walkover survey checklist (EPA, 2007) is included in **Appendix A**. For description purposes the site is split into three areas as outlined in the following sections and illustrated in **Figure 3.1**.

3.1.2 Area 1: The waste area

The southern section of the site is the historic unregulated waste site. The area is mainly mounded at a higher elevation than the northern area of the site, with the residential housing and grassed area to the west at a similar level to the mounded waste body. The surface is mostly barren with uneven ground, with some residual construction waste deposited around the site. Trees and hedgerow run along the south and east of the site separating it from the railway line and the Irish Water WWTP respectively. The site is currently prohibited for public use or passage, however there is an tarmac pathway in the northwest of the site along the houses leading to the back of the estate, suggesting a potential, future walkway through the waste site from the housing estate to the road. There were no obvious olfactory or visual signs of contamination (other than the discarded building material) noted at the site.

3.1.3 Area 2: Residential and grass area

This area is to the west of the waste body and covers the residential area of Row 3 Hamilton Hill (10 properties in total). This is an area of importance as it is currently in public and residential use as a road and grassed play area for residents.

3.1.4 Area 3: North of the identified waste area

This is the area directly east of the houses in Hamilton Hill and north of the waste body, separating the waste body from the Barnageeragh Road. RPS understands that this part of the site has not been used for waste deposition. It is predominately flat unvegetated land with boggy and waterlogged portions in the centre of the site which may have been due to recent rainfall in the area. Some waste from construction works have been left on the surface in this area.

3.2 Geology

3.2.1 Soils and Subsoils

The soil on the surface is classed as made ground as the site was used as a waste site and reworked material has been deposited on the surface in the general area of the site.

According to the GSI the subsoils beneath the site and associated area are classified as hummocky sands and gravels derived from lower Palaeozoic sandstones and shales. There is a thinning out band of alluvium to the north, east and south of the site, encircling the waste body like a horse-shoe formation (**Figure 3.2**). Much of the surrounding area is a till type quaternary sediment.

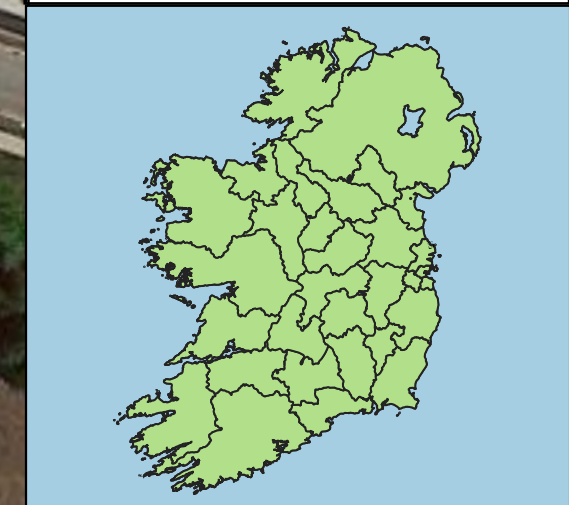
3.2.2 Bedrock

The area is underlain by the Skerries Formation which consists of Laminated blue grey siltstone and sandstone, greywacke sandstone of Wenlock age or younger can also be in this formation (**Figure 3.3**). The bedrock age is from the Silurian and can be up to 480m in thickness.



Legend	
	Site Location
	Historic Landfill Area
	1. Landfill
	2. Residential and Grass
	3. North of Site
	County Boundary
	Sea Background

Map is to identify the different areas within the site.

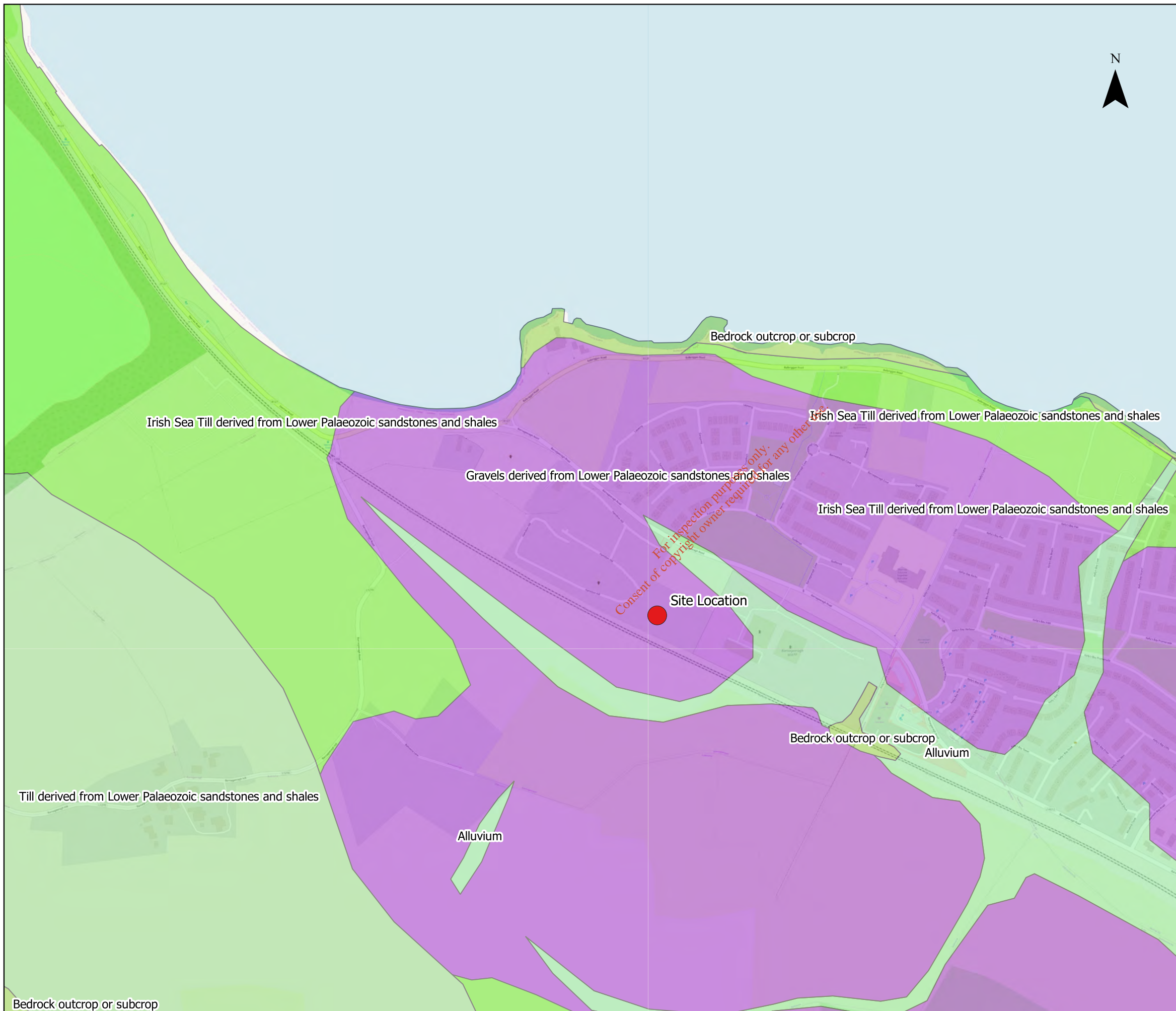


Title:	Breakdown of Site Areas
Project:	Barnageeragh Landfill
Client:	Fingal County Council

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Legend

- Location
- QUATERNARY SEDIMENT**
- Alluvium
- Bedrock outcrop or subcrop
- Gravels
- Irish Sea Till
- Till

OpenStreetMap

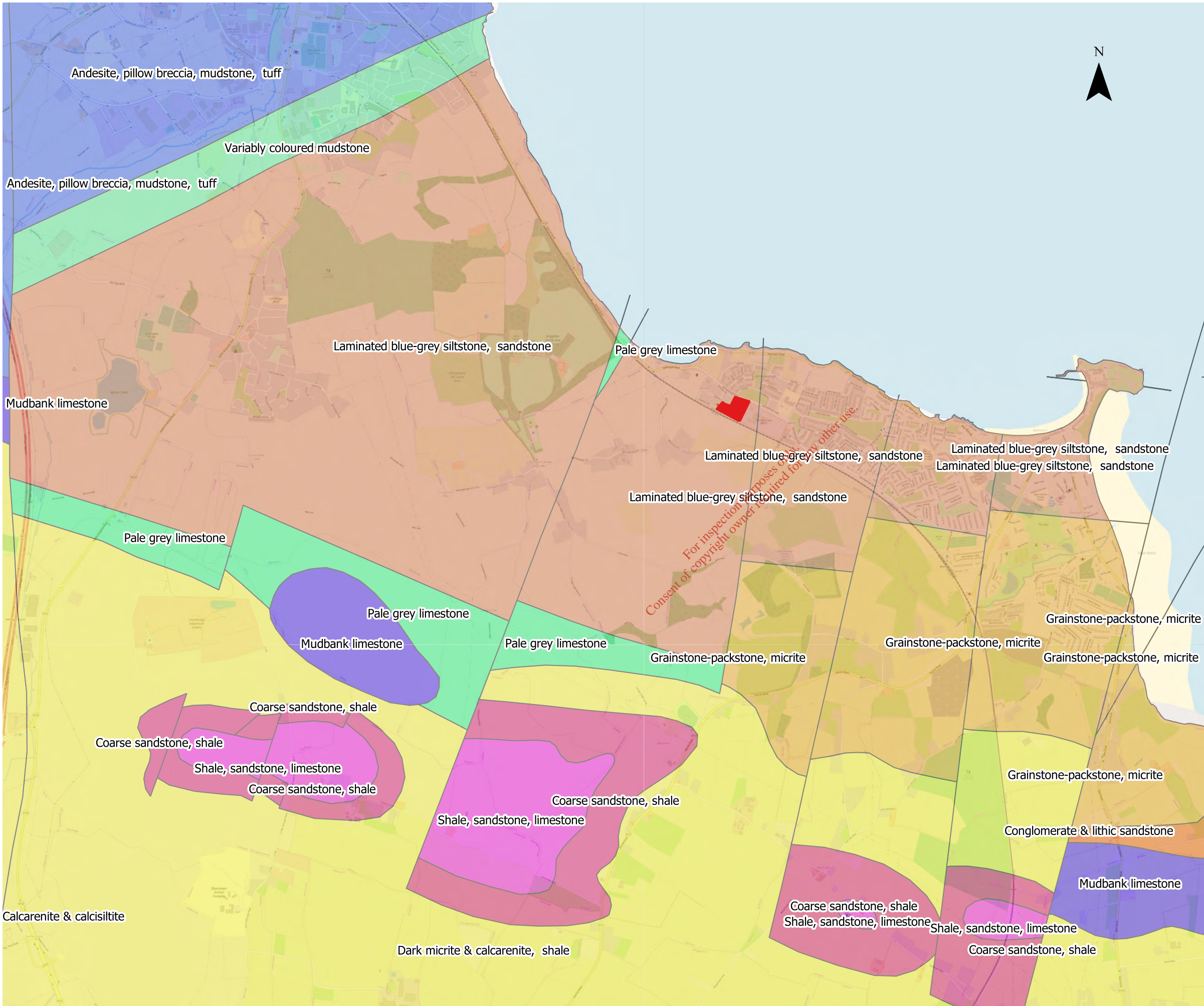


Title:	Sub Soil Geology
Project:	Barnageeragh Landfill
Client:	Fingal County Council
RPS	West Pier Business Campus, Dun Laoghaire, Co. Dublin, Ireland
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Legend

- Site Location
- Bedrock_Seamless_ITM_100k
- Andesite, pillow breccia, mudstone, tuff
- Calcarenite & calcisiltite
- Coarse sandstone, shale
- Conglomerate & lithic sandstone
- Dark limestone & shale (calp)
- Dark micrite & calcarenite, shale
- Grainstone-packstone, micrite
- Laminated blue-grey siltstone, sand
- Mudbank limestone
- Pale grey limestone
- Shale, sandstone, limestone
- Variably coloured mudstone
- Strat_Struct_lines_ITM_2016

OpenStreetMap

Site Location

Geological map of site and surrounding area.

Title: **Geological Bedrock Map**

Project: Barnageeragh Landfill

Client: Fingal County Council

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3.2.3 Structural Geology

The area has multiple faults trending in a north-south direction. The closest fault is located in the field to the east of the site where the WWTP is located. Further to the south of the site there is an older fault trending in an east-west direction, being displaced further north by younger faults. Note that the geology changes on the south of the east-west trending fault to Holmpatrick Formation (**Figure 3.3**).

3.3 Hydrogeology and Hydrology

3.3.1 Hydrogeology

The aquifer beneath the site and surrounding area is classified as a poor aquifer in bedrock which is generally unproductive, except for local zones and covering an area of 15km². The subsoil which has been described by GSI as glaciofluvial sands and gravels has a high permeability with an 85% recharge coefficient overlain by well-drained soil. The vulnerability level of this aquifer is classified as high. In the zone of alluvium subsoil (**Figure 3.4**) the permeability is low and has a moderate level of vulnerability, which would be expected.

Close to the site between approximately 0.8km and 1km to the WNW and SSW respectively there is a locally important aquifer classified as a karstified aquifer, which has zones of erosion, often in limestone rock, that has produced fissures, sinkholes and underground streams allowing for flow of groundwater.

According to the EPA, the status of the groundwater within the Dublin GWB located beneath the site and the surrounding area is classified as "Good Status" (EPA Catchments 2019).

There are no groundwater wells on the site (other than those from previous site investigations). According to GSI there are multiple wells/springs within the vicinity of the site. There are no Public Supply Source Protection Areas within the site, however the nearest is located approximately 2km south west of the site, called 'Bog of the Ring' covering an area of approx. 19.5km.

3.3.2 Hydrology

There is no surface water directly on or going through the site. The GSI map shows a stream starting in the WWTP (Barnageeragh EPA code 08B39) east of the subject site, flowing eastward to Margaretstown (EPA code 08M17) and discharging via the Mill Stream (Skerries) (EPA code 08M03) into the Irish Sea.

3.3.3 Groundwater Wells and Springs

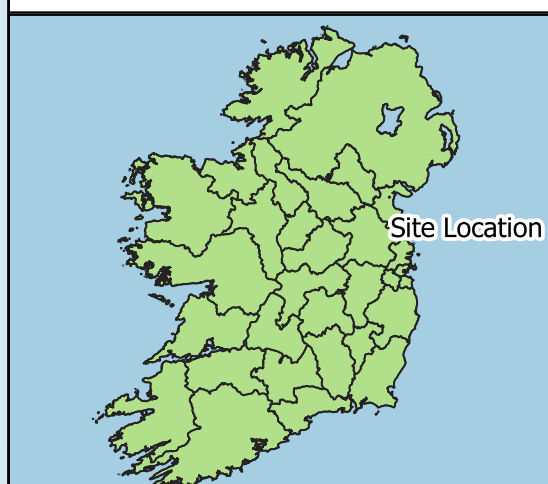
The list of wells within a 5km radius from the site are presented in **Table 4**.



Legend

- Site Location
- AquiferBed**
- Locally Important Aquifer - Bed
- Locally Important Aquifer - Kars
- Poor Aquifer - Bedrock which is

OpenStreetMap



Title: **Hydrogeological Map**

Project: Barnageeragh Landfill

Client: Fingal County Council



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Table 4: Wells and Springs within a 5km Radius of the Subject Site

GSI Name	Well Type	Drill Date (mm/yyyy)	Depth (m)	Approx. Distance from Site(km)	Direction from Site	Yield Class	Well Use
3225NWW005	Spring	Dec 1899	20	2.3	ESE	-	-
3225SWW015	BH	June 1986	91	2.6	SE	Excellent	Dunnes Ltd
3225SWW002	BH	Aug 1971	43.6	2.5	SE	Good	Agri & domestic
3225SWW016	BH	Mar 1997	91.4	3.4	SE	Excellent	Unknown
3225SWW001	BH	Aug 1971	31.4	3.5	SSE	Excellent	Agri & domestic
3225SWW036	BH	Dec 1899	104	2.7	S	-	Agri & domestic
3225SWW034	BH	Aug 1971	38.1	3.6	SSW	Good	Agri & domestic
3225SWW030	Spring	Dec 1899	-	4.4	SSW	-	-
3225SWW029	Spring	Dec 1899	-	5.0	S	-	-
3225SWW033	BH	Dec 1899	57	2.3	SSW	Excellent	Public supply
3225SWW035	BH	Dec 1899	85	3.5	SSW	-	Agri & domestic
3225SWW037	BH	Dec 1899	91	3.8	SSW	-	Agri & domestic
2925SEW017	BH	Apr 1993	91	5.1	SW	Good	Other
2925SEW019	BH	Dec 1993	38	4.8	WSW	Excellent	Other
2925NEW082	BH	Dec 1993	38	4.7	WSW	Excellent	Other
2925NEW086	BH	Mar 1994	24	5.0	W	Good	Other
3225NWW006	Spring	Dec 1899	-	3.0	W	-	-
3225NWW007	BH	Aug 1971	25.6	3.4	WNW	Good	Agri & domestic
3225NWW004	BH	May 1997	121.9	3.1	WNW	Good	Agri & domestic
2925NEW087	BH	Nov 1984	51.8	4.0	WNW	Excellent	Other
3225NWW001	BH	May 1986	62.5	3.6	NW	Excellent	Industrial
3225NWW002	BH	June 1996	74.6	3.7	NW	Excellent	Industrial
3225NWW003	BH	Jan 1997	104.5	3.8	NW	Excellent	Industrial

(Note: The Dec 1899 wells are most likely before this date, labelled as a holding date, i.e. well completed but no official records were kept at the time of instillation.)

3.4 Protected Sites

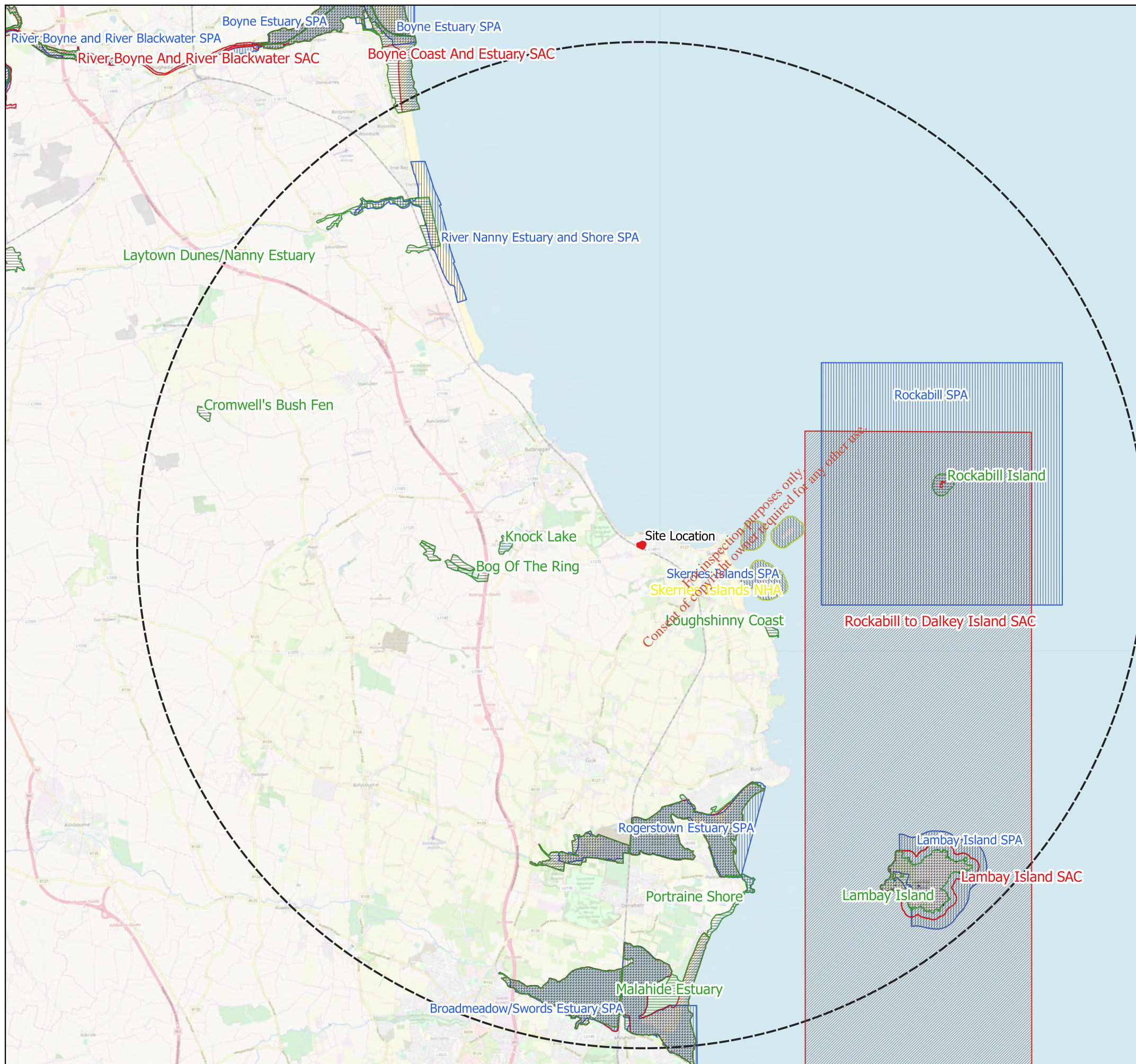
Although there are no identifiable areas of protection on site, there are various locations nearby to be noted that are designated under national and European law (e.g. SACs and SPAs under the Habitats Directive).

Table 5 outlines all protected sites within a 15km radius according to the NPWS website (NPWS, June 2019) and these are also shown in **Figure 3.5**.

REPORT

Table 5: Protected Sites within 15km Radius of the Subject Site

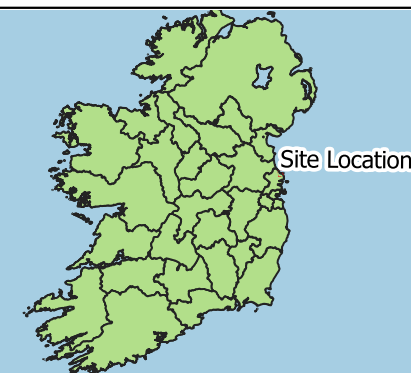
Location	NPWS ID	Protection Type
Skerries Islands	001218	NHA
	004122	SPA
Rockabill Island	000207	pNHA
	004014	SPA
Rockabill to Dalkey	003000	SAC
Lambay Island	000204	pNHA and SAC
	004069	SPA
Portraine Shore	001215	pNHA
Rogerstown Estuary	000208	pNHA and SAC
	004015	SPA
Loughshinny Coast	002000	pNHA
Bog of Ring	001204	pNHA
Knock Lake	001203	pNHA
Cromwells Bush Fen	001576	pNHA
Laytown Dunes / Nanny Estuary	000554	pNHA
River Nanny Estuary and shore	004158	SPA
Malahide Estuary	000205	pNHA and SAC
	004025	SPA
Notes:	NHA	Natural Heritage Area
	pNHA	Proposed Natural Heritage Area
	SAC	Special Area of Conservation
	SPA	Special Protected Area



Legend

- NHA_ITM_2015_11
- pNHA_ITM_2015_01
- SAC_ITM_2016_03
- SPA_ITM_2015_11
- 15km Buffer
- Site Location
- County Boundary
- Sea Background

The Special Area of Conservation (SAC), the Special Protection Area (SPA), the Natural Heritage Areas (NHA) and the Proposed Natural Heritage Areas (pNHA) are downloaded from the National Parks and Wildlife Services (NPWS) website (www.npws.ie).



Title: **Protected Sites within 15km**

Project: Barnageeragh Landfill

Client: Fingal County Council

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4 INITIAL CONCEPTUAL SITE MODEL (CSM)

The initial conceptual site model (CSM) was developed on the basis of the information collected as summarised in **Section 3** and is illustrated in **Figure 4.1**. The CSM indicates that there is the potential for landfill gas to be the main concern with regard to the proximity to receptors (the houses) with some likelihood of leachate also posing a risk to receptors if there is a pathway to groundwater or surface waters.

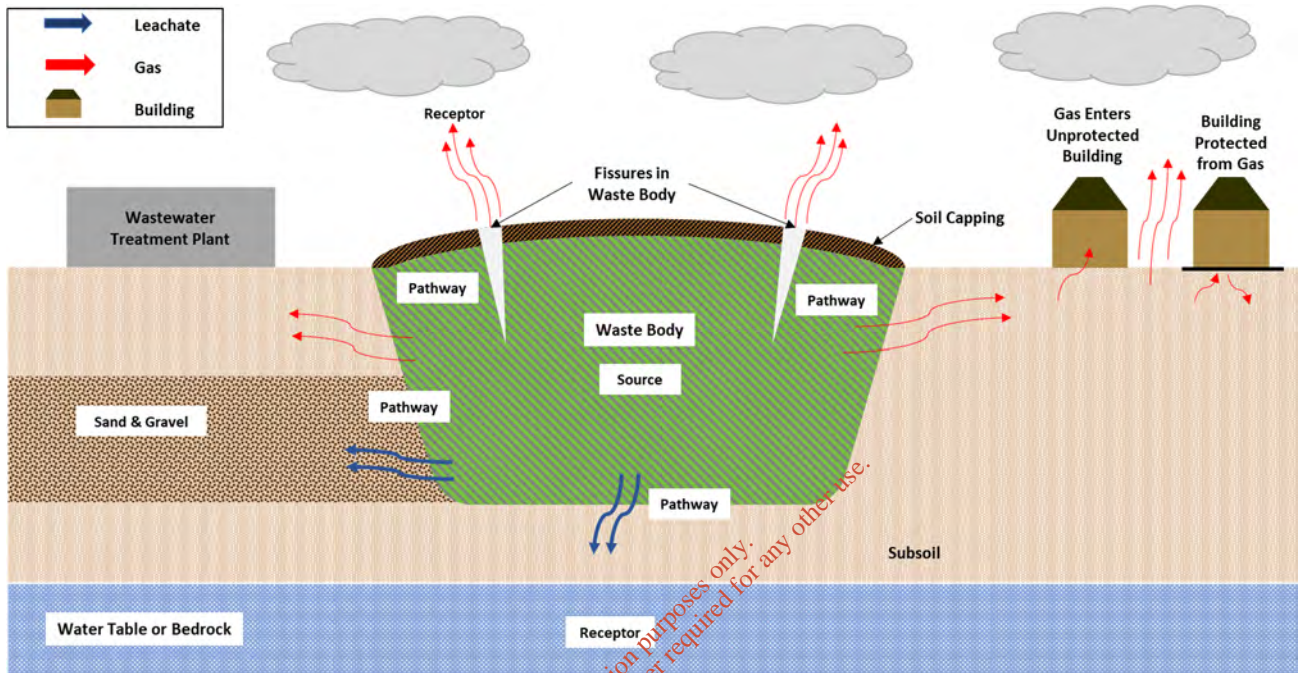


Figure 4.1 Initial CSM for Barnageeragh Landfill

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5 TIER 1 – RISK ASSESSMENT

5.1 Risk Assessment Process

The EPA CoP identifies eleven Source-Pathway-Receptor (SPR) linkages that are to be considered within the conceptual model and assessed as part of the Tier 1 Risk Assessment. Each of these linkages can be scored using the schema provided in the EPA CoP to provide an overall risk categorisation for the site.

The CoP uses a separate scoring matrix for each aspect of an SPR linkage, which are defined within Tables 1a to 3f of the CoP. Where an individual aspect is not present or not relevant within the context of the conceptual model it is given a score of 0.

The score of each linkage is normalised with respect to 100 by dividing the score for each linkage by the maximum available points for that linkage, expressed as a percentage. The overall score for the site is taken as the maximum of the individual normalised scores. The site can then be placed in a prioritisation category depending upon the potential level of risk identified. Sites with a higher score represent those with either a higher level of risk, which may require remediation, or a high level of uncertainty, which requires further intrusive investigation. If a high score is due to a high level of uncertainty, then the assessment should proceed to Tier 2 (Site Investigation and Testing) to refine the risk assessment.

5.2 Matrices

5.2.1 Source

The following tables outline the scoring matrixes for the source of contamination based on the knowledge of the site. Cells highlighted in green are the relevant scores.

Although waste material is understood to have been deposited at the site from the pre-1977 era, it is understood that landfilling continued up to 1983. Recent records from landfill gas monitoring on-site would also indicate more recent waste deposition. Therefore, the “Municipal” category has been chosen. The area of waste is less than 1 hectare.

Table 6: Leachate: Source/ Hazard Scoring Matrix 1a

Waste Type	Waste Footprint (ha) Matrix Score		
	≤1ha	> 1 ≤ 5ha	> 5ha
C&D	0.5	1	1.5
Municipal	5	7	10
Industrial	5	7	10
Pre-1977 sites	1	2	3

Table 7: Landfill Gas: Source/ Hazard Scoring Matrix 1b

Waste Type	Waste Footprint (ha) Matrix Score		
	≤1ha	> 1 ≤ 5ha	> 5ha
C&D	0.5	0.75	1
Municipal	5	7	10
Industrial	3	5	7
Pre-1977 sites	0.5	0.75	1

5.2.2 Pathways

The following tables outline the scoring matrixes for the pathways of contamination based on the knowledge of the site.

Table 8: Leachate Migration: Pathways Scoring Matrix 2a

Groundwater Vulnerability (Vertical Pathway)	Matrix Score
Extreme Vulnerability	3
High Vulnerability	2
Moderate Vulnerability	1
Low Vulnerability	0.5
High - Low Vulnerability	2

Table 9: Leachate Migration: Pathways Scoring Matrix 2b

Groundwater Flow Regime (Horizontal Pathway)	Matrix Score
Karstified Groundwater Bodies (Rk) Vulnerability	5
Productive Fissured Bedrock Groundwater Bodies (Rf and Lm)	3
Gravel Groundwater Bodies (Rg and Lg)	2
Poorly Productive Bedrock Groundwater Bodies (LI, PI, Pu)	1

Table 10: Leachate Migration: Pathways Scoring Matrix 2c

Surface Water Drainage (Surface Water Pathway)	Matrix Score
Is there direct connection between drainage ditches associated with the waste body and adjacent surface water body? Yes	2
If no direct connection	0

Table 11: Landfill Gas: Pathways Scoring Matrix 2d (receptor within 250m)

Landfill Gas Lateral Migration Potential	Matrix Score
Sand and Gravel, made ground, urban, karst	3
Bedrock	2
All other Tills (including limestone, sandstone etc. – moderate permeability)	1.5
All Numerian or Irish Sea Tills (low permeability)	1
Clay, Alluvium, Peat	1

Table 12: Landfill Gas: Pathways Scoring Matrix 2e (receptor above source)

Landfill Gas Vertical Migration Potential	Matrix Score
Sand and Gravel, made ground, urban, karst	5
Bedrock	3
All other Tills (including limestone, sandstone etc. – moderate permeability)	2
All Numerian or Irish Sea Tills (low permeability)	1
Clay, Alluvium, Peat	1

5.2.3 Receptors

This section deals specifically with the location of the contamination on or close to residential dwellings or industrial facilities. The nearest building is less than 50m to the west of the waste body.

Table 13: Leachate Migration: Receptors Scoring Matrix 3a

Human Presence (presence of a house indicates potential private wells)	Matrix Score
On or within 50m of the waste body	3
Greater than 50m but less than 250m of the waste body	2
Greater than 250m but less than 1km of the waste body	1
Greater than 1km of the waste body	0

Table 14: Leachate Migration: Receptors Scoring Matrix 3b

Protected Areas (SWDTE or GWDTE)	Matrix Score
Within 50m of the waste body	3
Greater than 50m but less than 250m of the waste body	2
Greater than 250m but less than 1km of the waste body	1
Greater than 1km of the waste body	0
Undesignated sites within 50m of the waste body	1
Undesignated sites greater than 50m but less than 250m of the waste body	0.5
Undesignated sites greater than 1km of the waste body	0

Table 15: Leachate Migration: Receptors Scoring Matrix 3c

Aquifer Category (resource potential)	Matrix Score
Regionally Important Aquifers (Rk, Rf, Rg)	5
Locally important aquifers (Ll, Lm, Lg)	3
Poor Aquifers (Pl, Pu)	1

Table 16: Leachate Migration: Receptors Scoring Matrix 3d

Public Water Supplies (other than private wells)	Matrix Score
Within 100m of the site boundary	7
Greater than 100m but less than 300m or within Inner SPA(SI) for SW 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

Table 17: Leachate Migration: Receptors Scoring Matrix 3e

Surface Water Bodies	Matrix Score
Within 50m of the site boundary	3
Greater than 50m but less than 250m	2
Greater than 250m but less than 1km	1
Greater than 1km	0

Table 18: Landfill Gas: Receptors Scoring Matrix 3f

Human Presence	Matrix Score
On site or within 50m of the site boundary	5
Greater than 50m but less than 150m	3
Greater than 150m but less than 250m	1
Greater than 250m	0.5

5.2.4 Summary of Matrix Scores

Table 19 provides a summary of the matrix scores for each of the Source Pathway Receptor matrices discussed in the foregoing sections.

Table 19: Summary of Matrix Scores

Matrix No.	Category	Score	Max. Score possible
1a	Municipal, <1ha	5	10
1b	Municipal, <1ha	5	0
2a	High Vulnerability	2	3
2b	Poorly Productive Bedrock Groundwater Bodies (LI, PI, Pu)	1	5
2c	No direct connection	0	2
2d	Sand and Gravel, made ground, urban, karst	3	3
2e	Sand and Gravel, made ground, urban, karst	5	5
3a	On or within 50m of the waste body	3	3
3b	Greater than 1km of the waste body	0	3
3c	Poor Aquifers (PI, Pu)	1	5
3d	Greater than 1km (karst aquifer)	3	7
3e	Greater than 50m but less than 250m	2	3
3f	On site or within 50m of the site boundary	5	5

5.3 Tier 1 Source-Pathway-Receptor Linkages

The results from each of **Table 6** (Matrix 1a) through to **Table 18** (Matrix 3f) have been collated to calculate the respective Source-Pathway-Receptor (SPR) linkages using the equations from Figure 9 to Figure 12 of the EPA *Code of Practice*. The results of the SPR linkage are summarised in **Table 20**.

Table 20: Barnageeragh Risk Category and Prioritisation Class

SPR No.	Equation	SPR Linkage Score	% Score	Risk Classification	Max Score
Leachate migration through combined surface water and groundwater pathways					
SPR1 Surface Water Body	$1a \times (2a+2b+2c) \times 3e$	30	10%	Low – Class C	300
	$5 \times (2+1+0) \times 2$				
SPR 2 Protected Area (SWDTE)	$1a \times (2a+2b+2c) \times 3b$	0	0%	Low – Class C	300
	$5 \times (2+1+0) \times 0$				
Leachate migration through groundwater pathway					
SPR 3 Human Presence (Private well)	$1a \times (2a+2b) \times 3a$	45	19%	Low – Class C	240
	$5 \times (2+1) \times 3$				
SPR 4 Protected Area (GWPTe)	$1a \times (2a+2b) \times 3b$	0	0%	Low – Class C	240
	$5 \times (2+1) \times 0$				
SPR 5 Aquifer Category	$1a \times (2a+2b) \times 3c$	15	4%	Low – Class C	400
	$5 \times (2+1) \times 1$				
SPR 6 Public Supply (well)	$1a \times (2a+2b) \times 3d$	45	8%	Low – Class C	560
	$5 \times (2+1) \times 3$				
SPR 7 Surface Water Body	$1a \times (2a+2b) \times 3e$	30	13%	Low – Class C	240
	$5 \times (2+1) \times 2$				
Leachate migration through surface water pathways only					
SPR 8 Surface Water Body	$1a \times 2c \times 3e$	0	0%	Low – Class C	60
	$5 \times 0 \times 2$				
SPR 9 Protected Area (SWDTE)	$1a \times 2c \times 3b$	0	0%	Low – Class C	60
	$5 \times 0 \times 0$				
Landfill gas migration pathways					
SPR 10 Lateral Migration to Human Presence	$1b \times 2d \times 3f$	75	50%	Moderate – Class B	150
	$5 \times 3 \times 5$				
SPR 11 Vertical Migration to Human Presence	$1b \times 2e \times 3f$	125	50%	Moderate – Class B	250
	$5 \times 5 \times 5$				

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

In conclusion, eight of the SPR linkages have a low risk (SPR 1 to 9) while none have a high-risk categorisation.

There are two SPR linkages with a moderate risk:

- SPR 10 - relates to the potential for lateral gas migration which should be investigated further due to the presence of residential housing within 50m of the site boundary.
- SPR 11 - relates to the potential for vertical gas migration which should be investigated further due to the presence of residential housing within 50m of the site boundary.

Due to the presence of moderate risk categorisation SPR linkages in accordance with the EPA CoP the site is classified as moderate risk site (Class B) as a result of the Tier 1 assessment. This reflects the uncertainty with regard to the pathways for landfill gas to reach receptors. In line with the EPA CoP, further site investigations are required to verify the moderate risk status.

6.2 Recommendations

Based on the outcome of the Tier 1 environmental risk assessment, it is recommended that the project proceed to Tier 2 assessment in order to verify the moderate risk status for SPR linkages SPR 10 and SPR 11.

Table 21 is taken from the EPA CoP and highlights what investigations are mandatory, recommended or should be considered as part of the Tier 2 process.

A significant amount of site investigations have already been undertaken by the developer of the site. As part of this Tier 1 assessment, this information has not been considered. It will be fully considered in the Tier 2 assessment. Subsequently, any gaps in the available information will be identified and additional investigations undertaken if deemed necessary.

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REPORT

Table 21: Tier 2 Exploratory Investigations and Sampling

SPR LINKAGE	SOURCE	PATHWAY	RECEPTOR	TRIAL PITS & TRENCHES	WASTE TYPE	WASTE SAMPLING	LEACHATE SAMPLING	SOIL SAMPLING	Surface or Groundwater Sampling	Topographic & GPS SURVEY
SPR 10	LANDFILL GAS	Lateral Migration (Subsoil)	Human Presence	M	M	R	R	R	R/S	R/S
SPR 11	LANDFILL GAS	Vertical Migration (Subsoil)	Human Presence	M	M	R	R	R	R/S	R/S

M = Mandatory and should be completed as thoroughly as possible for each site.
 R = Recommended technique assuming site conditions allow.
 S = Should be considered but is dependent on site suitability for that methodology.

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7 REFERENCES

- Code of Practice: Environmental Risk Assessment for Unregulated Waste Disposal Sites (EPA, 2007);
- EPA online datasets;
- Geological Survey of Ireland (GSI) online datasets;
- Aerial Photography;
- Geohive website (for historical maps) (2019);
- National Parks and Wildlife Service (NPWS) online maps and data;
- Eastern Midlands Region Waste Management Plan 2015-2021;
- Fingal County Council Planning <http://www.fingalcoco.ie/planning>;
- EPA catchments <https://www.catchments.ie/>;
- Winsac Ltd – Environmental Risk Assessment – Barnageeragh Cove, Skerries, Mulroy Environmental, 2019;
- Water Maps interactive tool on the Irish National Water Framework Directive website;
- Discovery Series Maps (1:50,000) and Orthophotography available from the Ordnance Survey Ireland (OSI);

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Appendix A

Site Walkover Checklist

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EPA CoP Walkover Survey Checklist		
Walkover Survey Checklist	Project:	MDR1552 Barnageeragh Historic Landfill
Information	Checked	Comment (include distance from site boundary)
1. What is current land use?	x	Not in use, previously used as a construction site compound during housing development.
2. What are the neighbouring Land Use?	x	Residential housing to the north and west. Irish Water, wastewater treatment plant to the east. Railway and then agricultural fields to the south.
3. What is the size of the Site?	x	1.42 ha (3.5 acres), the waste area is approximate 0.81 ha (2 acres).
4. What is the topography?	x	Flat to the north and northeast. Raised mound in the northwest and the southern half of site (that being the waste body).
5. Are there potential receptors (if yes, give details)?	x	Yes.
Houses	x	Housing estate immediately to the west of the site and to the north.
Surface Water features (if yes, distance and direction of flow)	x	Irish sea, North 400m and WNW 450m, tidal. A small stream about 180m east of the site.
Any wetland or protected areas	x	Any protected areas are greater than 1km away.
Public Water Supplies	x	-
Private Wells	x	Closest known well is greater than 2km.
Services	x	Large wastewater main going through middle of waste body. Railway line just south of the site. Smaller services for residential housing.
Other Buildings	x	Irish water wastewater treatment plant to the east of the site.
Other	x	Residential grass area on western part of waste body.
6. Are there any potential sources of contamination (if yes, give details)?	x	Yes, unregulated waste disposal site.
Surface Waste (if yes, What type?)	x	Most surface waste is from most recent construction activities.
Surface ponding of leachate	x	-
Leachate seepage	x	-
Landfill Odours	x	-
7. Are there any outfalls to surface water? (if yes, are there discharges and what is the nature of the discharge?)	x	The stream to the east flows east and then north linking with the Mill stream, flowing to the Irish sea. There is no direct pathway or connection from the waste body to this stream. No observed evidence of discharge.
8. Are there any signs of impact on the environment? (if yes, take photographic evidence)	x	No, vegetation is known to grown in the area, the current lack of vegetation is mainly due to the most recent construction work in the area.
Vegetation die off, bare ground	x	Lack of vegetation is mainly due to the most recent construction work.
Leachate seepages	x	None observed.
Odours	x	None observed.

REPORT

EPA CoP Walkover Survey Checklist		
Walkover Survey Checklist	Project:	MDR1552 Barnageeragh Historic Landfill
Information	Checked	Comment (include distance from site boundary)
Litter	x	Only from recent site works.
Gas bubbling through water	x	-
Signs of settlement, subsidence, water logged areas	x	Small area in the north part of site near BH13 is wet / very soft ground.
Drainage or hydraulic issues	x	-
Downstream water quality appears poorer than upstream water quality		-
9. Are there any indications of remedial measures? (provide details)	x	Yes
Capping	x	Waste body is covered with Made Ground (sand, gravel, clay)
Landfill gas collection	x	21 Monitoring wells are located in and around the site area.
Leachate Collection	x	-
10. Describe fences and security feature (if any)	x	Hedgerow and trees to the south and east. Secure fencing to the north. Temporary wire mesh fencing to the west.
Any other relevant information?	x	A few pipes with cowls on top found on the landfill, presumed to be the gas vents installed by the developer.

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