

Eve O'Sullivan

Subject: FW: Killycard Landfill H0364-01 E-Mail 3 of 3

From: Kieran Duffy
Sent: 16 April 2020 10:11
To: 'Ewa Babiarczyk' <E.Babiarczyk@epa.ie>
Subject: FW: Killycard Landfill H0364-01 E-Mail 2 of 3

Eva
Tier 2 report. This is the largest of the 3 files.
Kieran

From: Kieran Duffy
Sent: 16 April 2020 10:07
To: 'Ewa Babiarczyk' <E.Babiarczyk@epa.ie>
Subject: Killycard Landfill H0364-01 E-Mail 1 of 3

Hi Eva

Further to our conversation yesterday afternoon find updated Tier 1 report for Killycard landfill site following our reply to the notice. Our Tier 1, 2, and 3 reports have been all updated to reflect the notice.

I will try forwarding you on the updated Tier 2 and Tier 3 reports in subsequent emails. They are large files and I have been unable to compress them to date.

If you are unable to receive these because of their size we will have to consider an alternative approach subsequently.

Regards

Kieran Duffy

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ENVIRONMENTAL BALANCE IN DESIGN AND CONSTRUCTION

TIER 2 RISK ASSESSMENT

HISTORIC LANDFILL AT KILLYCARD, CO. MONAGHAN

APRIL 2020



TIER 2 RISK ASSESSMENT

HISTORIC LANDFILL AT KILLYCARD, CO. MONAGHAN

User is Responsible for Checking the Revision Status of this Document

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Abstract: This report represents the findings of a Tier 2 site investigation carried out at Killycard Historic Landfill, Castleblayney, Co. Monaghan, and conducted in accordance with the EPA Code of Practice for unregulated landfill sites. The site investigation was undertaken to determine the extent of the historic landfilling at the site.

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EXECUTIVE SUMMARY

Fehily Timoney & Company (FT) was appointed by Monaghan County Council (MCC) to complete a Tier 2 environmental risk assessment (ERA) of Killycard Historic Landfill in accordance with the Environmental Protection Agency (EPA) Code of Practice (CoP) (2007): *Environmental Risk Assessment for Unregulated Waste Disposal Sites*.

The site is located approximately 8km North-East of Clones town circa 1km off the N54 national road, close to the village of Smithborough. It was previously reported by MCC that the landfill accepted waste from approximately 1980 to 1987.

A Tier 1 study conducted by FT in June 2018 determined the site to be a high-risk classification (Class A). The primary risks identified related to the risk of leachate runoff entering the Corrinshigo Lough and the risk of leachate migration into the groundwater aquifer. The completed Tier I study is included as an Appendix 1.

The Tier 2 study, presented herein, consisted of a desktop study, geophysical survey, intrusive site investigation works, environmental monitoring (waste, surface water, landfill gas and groundwater sampling) and laboratory analysis. The results of these works informed the development of the CSM (conceptual site model) and risk screening model.

The following site investigation works were undertaken at the site:

- 13 No. Trial pit excavations
- Installation and monitoring of 3 No. groundwater boreholes
- 1 No. Geophysical survey (2D resistivity and seismic refraction profiling)
- Environmental Sampling: surface water, groundwater and landfill gas
- Topographical Survey
- Factual reporting

The findings of the site investigation work and geophysical surveying suggest the waste material is deposited in a single infill area tending west to east in the centre of the site and between approximately 140m in length and 120m in width. The geophysical survey delineated the survey area into zones based on an interpretation of the ground conditions across the site. The following 2 No. zones were identified:

- Zone A: made ground/waste (predominantly organic) over very soft Peat/Clay with Leachate
- Zone B: made ground/waste (mixed with Clay/Silt) over very soft Peat/Clay

The maximum waste footprint including Zone A and Zone B is calculated to be approximately 1.15 hectares.

A volume calculation based on the surveyed surface profiles for the existing ground level and the base of waste as interpreted, estimates an interred waste volume of approximately 29,700 m³ at the site. This is in line with MCCs initial estimate which was in the region of 30,000 cubic meters.

Analysis of waste samples from the trial pits excavated, when assessed against the Waste Acceptance Criteria indicated that much of the waste material within the site can be classified as typically inert. The waste classification is considered to reflect the level of degradation over time since landfilling ceased.

Analysis of groundwater samples recovered from the three monitoring wells GW01 to GW03 have reported ammonia concentrations which exceed guideline threshold values. Given that all monitoring wells were installed within the waste body, as confirmed by the trial pit and geophysical findings, the landfill is contributing to a deterioration in groundwater quality locally. The monitoring boreholes were installed within the waste body due to the restricted space available within the site.

Based on the presence of elevated ammonia concentrations typical of landfill leachate, the shallow soil cap is not considered suitable at preventing rainfall infiltration into the waste body. The groundwater table also appears to be intersecting the waste body and contributing to leachate migration from the landfill.

The presence of peat underlying the waste body across the site may also be contributing to the elevated ammonia concentrations detected in the groundwater locally. The combined presence of elevated ammonia and coliform concentrations in all monitoring wells GW01 to GW03 may also be evidence of localised contamination due to agricultural land spreading or poorly functioning septic tanks in the area.

Landfill gas monitoring from perimeter wells GW01 to GW03 at the site indicates gas concentrations detected are within the range typical of inert waste with the exception of a slightly elevated methane concentration detected at upgradient sampling location GW01. Based on the detection of slightly elevated gas concentrations and the proximity of the industrial buildings to the eastern boundary of the waste body, additional gas monitoring should be considered as part of future works.

Analysis of surface water samples recovered from the watercourses surrounding the site indicated 2 No. exceedances of the EQS (2009) guideline limit values for ammonia and BOD. Given that the determined groundwater flow direction is west-south-west from the waste body, the detected ammonia and BOD at these levels may be evidence of impact from the landfill. However, the presence of ammonia and BOD at these levels may also be an indication of slurry spreading runoff from the surrounding agricultural fields in the area, rather than solely from the landfill.

Based on the results of the Tier 2 site assessment, the site can be classified as a **High Risk Classification (Class A)**. The principal risks identified on the site are the risk to Corrinshigo Lough from the migration of leachate from the landfill into the surface water receptor, the shallow permeable soil cap across the site contributing to leachate generation and the risk to the adjacent industrial building receptor from the migration of landfill gas from the waste material encountered at the site.

It is recommended by FT that a Tier 3 DQRA be undertaken. As part of the Tier 3 assessment, further groundwater, surface water monitoring and landfill gas monitoring and analysis is being recommended at each monitoring location GW01 to GW03, SW1 and SW2 inclusive. The results of this analysis should be used to confirm the conclusion of the Tier 3 report and inform works.

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1 INTRODUCTION

1.1 Background

Killycard historic landfill is located approximately 1.7km to the North-West of Castleblayney town on the R183 Castleblayney to Ballybay Regional Road. According to information provided by Monaghan County Council (MCC), the landfill ceased operations in 1987.

Since its closure the site has been covered with a soil cap, no other remediation works have been carried out. The exact quantity of waste deposited on site is unknown however MCC have estimated the quantity to be in the region of 30,000 cubic metres.

MCC is required to complete a tiered risk assessment of unregulated waste disposal sites in accordance with the Environmental Protection Agency (EPA) Code of Practice for unregulated waste disposal sites.

A Tier 1 Assessment completed by Fehily Timoney & Co. (FT) in June 2018 determined the site has a risk classification of High (Class A) based on risk of leachate runoff entering Corrinshigo Lough and the risk of landfill gas migration to nearby human receptors.

1.2 Scope of Works

FT's scope of work was to undertake a Tier 2 assessment of the site in accordance with the EPA Code of Practice (CoP) 2007: *Environmental Risk Assessment for Unregulated Waste Disposal Sites*. This approach required the completion of the following:

- Desk Study
- Site Walkover
- Intrusive Site Investigation
- Surface water, groundwater and landfill gas monitoring
- Environmental Risk Assessment (ERA)
- Geophysical and surveying to estimate extents and depths of waste
- Development of a conceptual site model (CSM)

As part of the initial desk study, a review of available information was undertaken. This was followed-up with a site walkover by FT personnel. The desk study and site walkover were used to determine the locations for the intrusive site investigation.

FT appointed Causeway Geotech Limited (CGL) to conduct the intrusive site investigation which included; excavation of trial pits and the installation of three onsite groundwater monitoring boreholes. APEX Geoservices were also appointed by FT to undertake geophysical surveying of the site.

The purpose of the geophysical study was to attempt to define the vertical and lateral extents of any waste body. Trial pits were excavated to provide a preliminary assessment of the volume, extent and type of waste infilled at the site. The groundwater monitoring boreholes were installed to assess the impact, if any, of the onsite groundwater.

Laboratory analysis of waste samples, surface water and groundwater were conducted to assess and quantify any potential or ongoing environmental impacts.

The information gathered from the desk study, intrusive site investigation and geophysical survey were used to inform the development of both the CSM and the Environmental Risk Assessment (ERA). This report presents the findings of the assessment.

2 DESK STUDY

2.1 Introduction

The desk study included the review of the following literature sources and websites:

- Geological Survey of Ireland, Groundwater Web Mapping: www.gsi.ie
- Environmental Protection Agency Maps: <http://gis.epa.ie/Envision>
- National Parks and Wildlife Service Map Viewer: www.npws.ie
- Water Maps, <http://watermaps.wfdireland.ie>
- Monaghan County Council Site Plans and Drawings
- BS 5930: 1999, Code of Practice for Site Investigations
- BS 10175: 2000, Investigation of Potentially Contaminated Sites – Code of Practice
- EPA's Historic Mine Sites - Inventory and Risk Classification (2009)
- EPA - Assessing and Developing Natural Background Levels for Chemical Parameters in Irish Groundwater (2017)

A desktop review of available documentation for the site was conducted followed by a site walkover.

2.2 Desk Study

This section of the report presents the findings of the desk study.

2.2.1 Site Description & On-Site Conditions

The site is located approximately 1.7km to the North-West of Castleblayney town on the R183 Castleblayney to Ballybay Regional Road. The site covers approximately 2.0 hectares in size.

There are 3 No. dwelling houses within 150 metres of the site boundary. Commercial developments have been constructed on site including mushroom houses (now derelict) and an operational industrial building in the eastern portion of the site. The western portion of the site shares a boundary with Corrinshigo lake. A steeply sloped agricultural field is located to the north of the site. The land use in the area is primarily agricultural with this site currently used for general agricultural purposes, principally animal grazing.

The location of the site is shown in Figure 2.1, overleaf.

2.2.2 Previous Studies

A Tier 1 Risk Assessment completed by FT on 22nd June 2018 which comprised the following:

- Development of a conceptual site model (CSM);
- Identification of contaminant sources, pathways of contaminant migration and potential receptors which may be vulnerable if exposed to those contaminants; i.e. the identification of Source- Pathway-Receptor (SPR) linkages; and
- The prioritisation of sites and SPR linkages based on their perceived risk.

Based on the available information, the Tier 1 Assessment determined that the overall risk score for Killycard Landfill was 70%, resulting in a risk classification of High (Class A).

A copy of this assessment is included in Appendix 1.

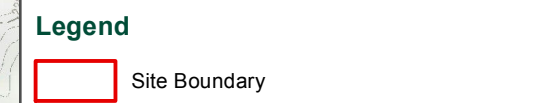
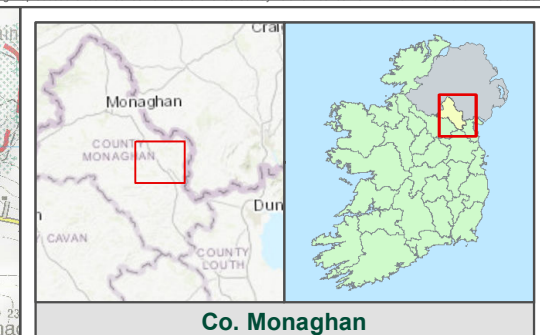
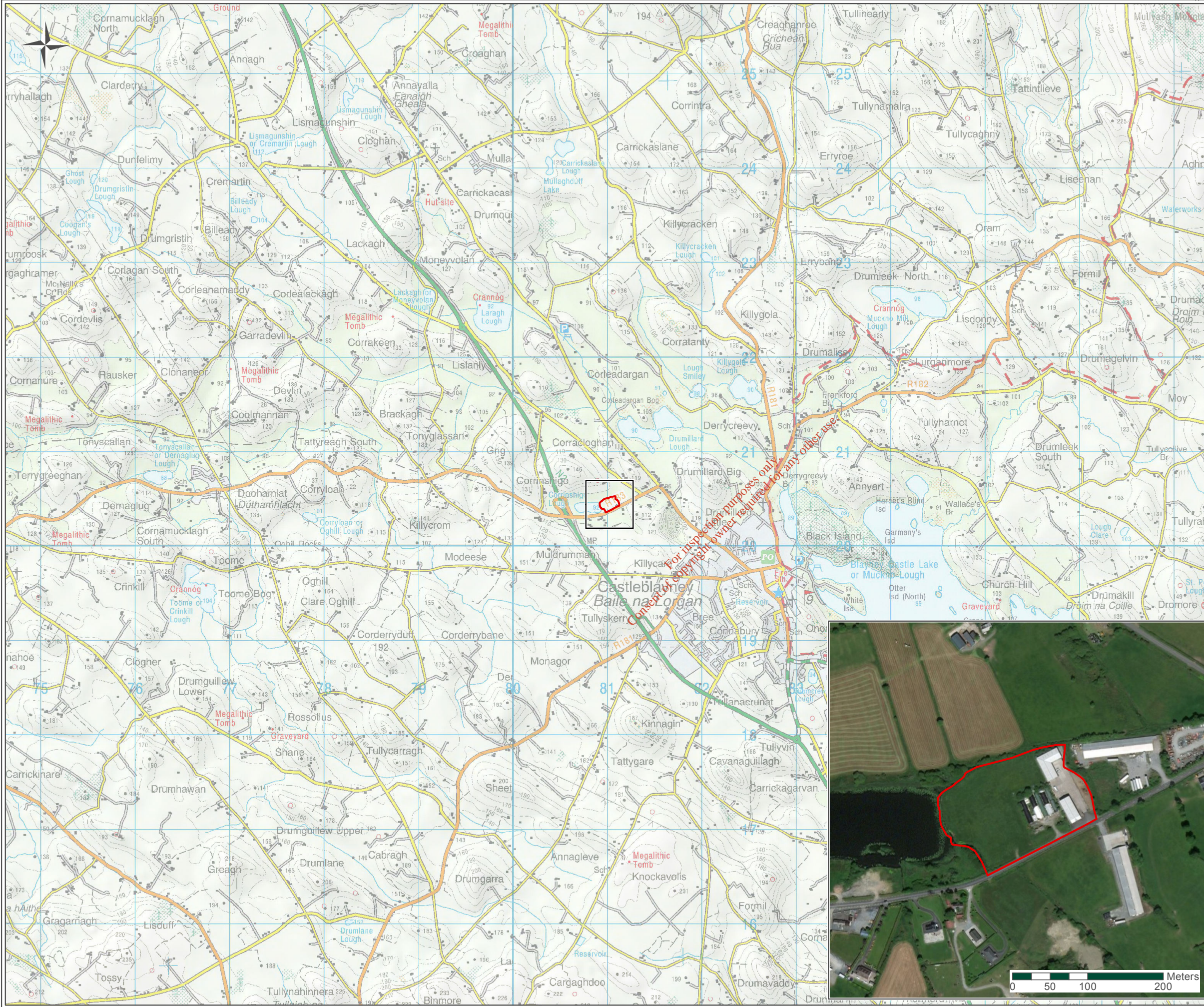


Figure Title	Site Location
Figure No.	2.1
Project	ERA of Historic Landfill at Killicard, Co. Monaghan
Client	Monaghan County Council
Scale	1:40,000
Page Size	A3
Revision	A
Date	17/10/2018

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2.2.3 Topography

The landfill is located in a low-lying valley within a primarily rural setting in an area of rolling topography. The site is generally described as flat with a hill rising from the northern boundary of the site. The low-lying valley gives rise to the Corrinshigo lake which defines the western boundary of the site.

The site is at an elevation of between 93 m and 95 m above Ordnance Datum (OD).

The completed topographical surveys for the site is provided in Appendix 6.

2.2.4 Geology

Drift/Quaternary Geology

The Quaternary Map provided by GSI Online identifies the quaternary sediments at the site as 'cut-over raised peat'. The landfill site is underlain by cut over raised peat overlying a poorly productive bedrock aquifer. The subsoils are typically of cutover/cutaway peat.

Beyond the northern and southern site boundaries the superficial geology is made up of glacial tills derived from 'Lower Palaeozoic sandstones and shales.'

During the installation of boreholes during the site investigation, the presence of peat is described in the drillers logs to a depth ranging from of 4.0m to 4.8m BGL at boreholes GW01 to GW03, as referenced in the CGL borehole logs, Appendix 2.

The quaternary geology is presented in Figure 2.2.

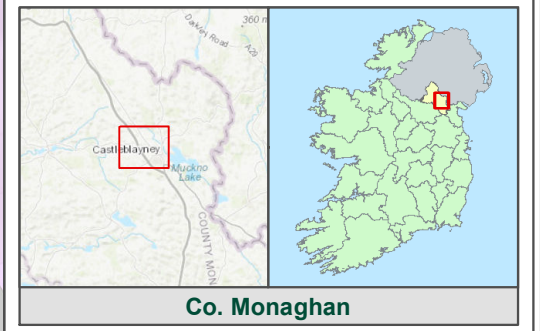
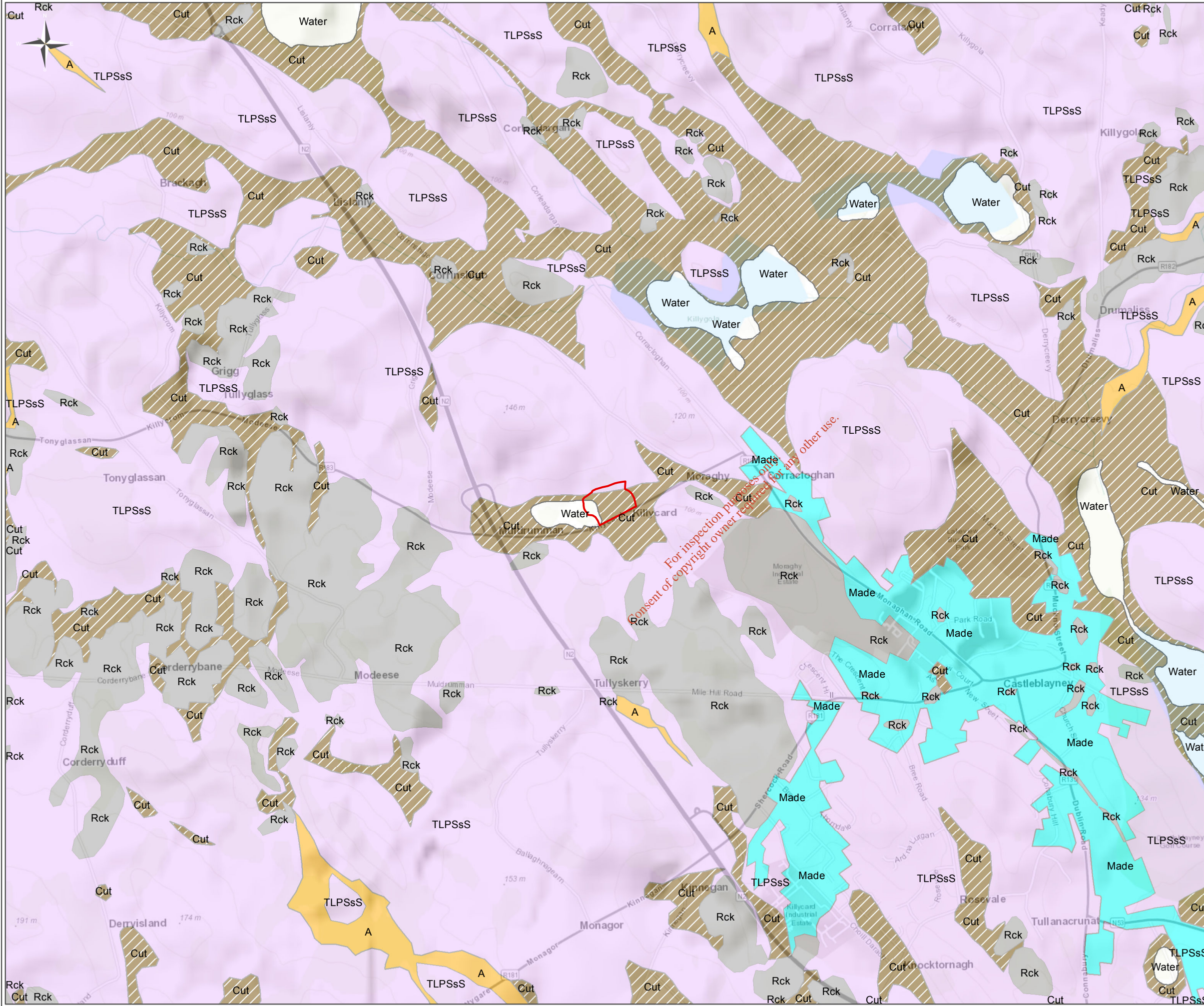
Solid or Bedrock Geology

The GSI online 1:100,000 scale bedrock geology map, the site and surrounding area is underlain by the Silurian Oghill formation (OL) which is generally made up of

'grey to grey-green massive sandstone (greywacke), microconglomerate and amalgamated beds with subordinate thin to thick-bedded greywacke and locally, at least partly, unfaulted dark grey or black pyritic, occasionally graptolitic shale-mudstone'.

The GSI bedrock geology map shows a fault travelling north-south across the eastern area of the site.

The nearest bedrock outcrop to the site has been mapped approximately 80m from the southern site boundary just off the R183 roadway. The bedrock geology is presented in Figure 2.3.



Co. Monaghan

Legend

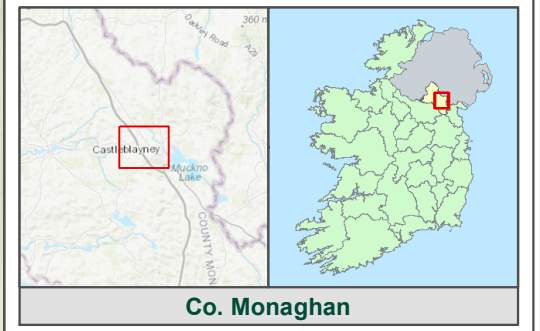
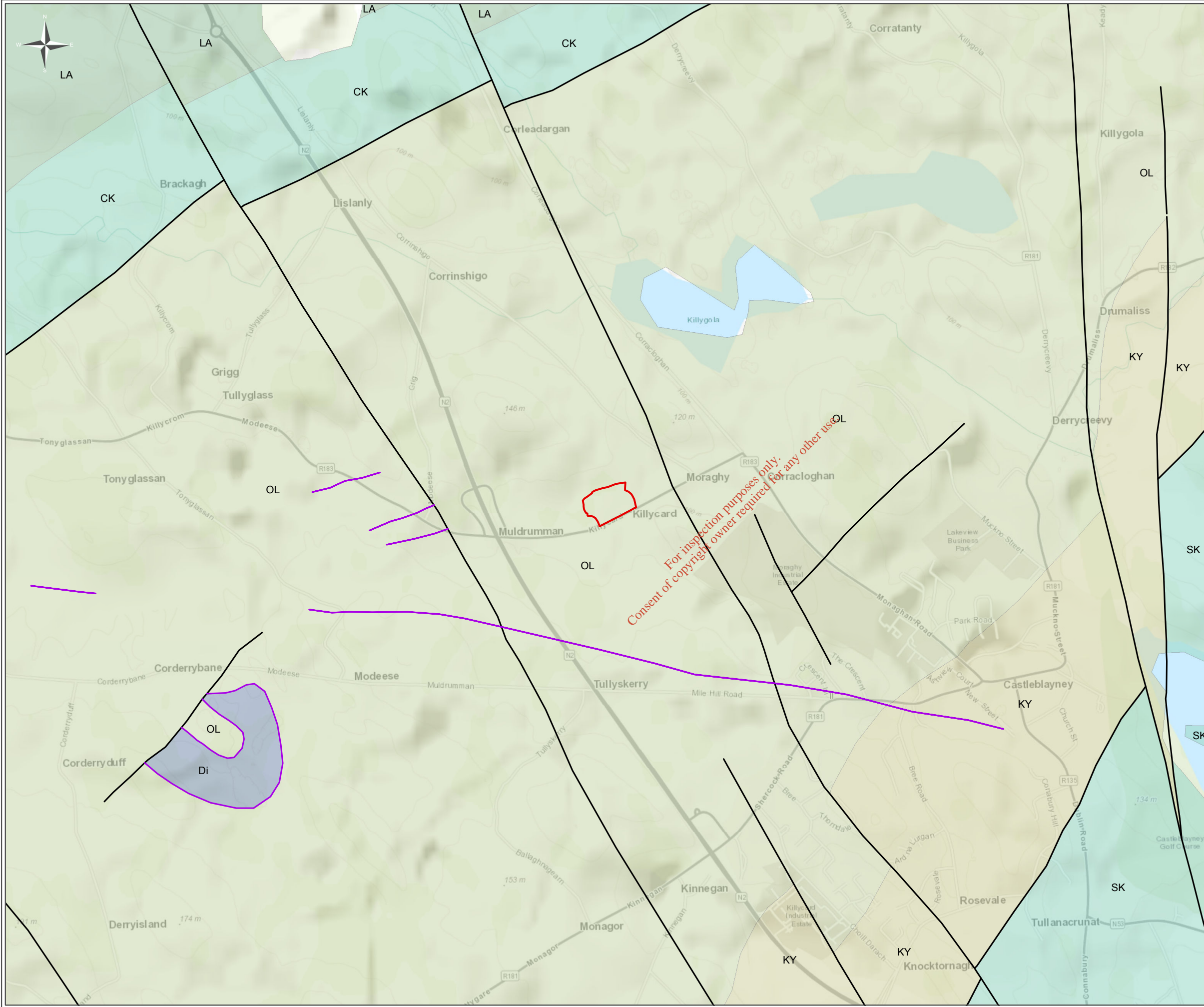
- Site Boundary
- Subsoils Data**
 - A, alluvium
 - Cut, cutover peat
 - Made, made ground
 - Rck, bedrock at surface
 - TLPSSs, sanstone and shales till - Lower Paleozoic
 - Water, water

Figure Title	Quaternary Geology
Figure No.	2.2
Project	ERA of Historic Landfill at Killicard, Co. Monaghan
Client	Monaghan County Council
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- Site Boundary
- Stratigraphical Linework
- Structural Linework

Bedrock Geology

- CK: Carrickatee Formation
- Di: Diorite
- KY: Kehernaghkilly Formation
- LA: Lough Avaghon
- OL: Oghill Formation
- SK: Shercock Formation

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Figure Title	Bedrock Geology
Figure No.	2.3
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2.2.5 Hydrogeology

An examination of the national bedrock aquifer map on the GSI online mapping classifies the Silurian Oghill formation as a Poor Aquifer (PI) – bedrock which is generally unproductive except for local zones. The bedrock aquifer mapping is presented in Figure 2.4.

The site lies within the Louth Groundwater Body (GWB No. IEGBNI_NB_G_019) which is defined as being at *Good Status* under the Water Framework Directive.

There are no karst landforms within the site boundary. The nearest karst landform is a series of enclosed depressions approximately 10.8km south of the site boundary.

The GSI national recharge map defined the annual recharge as 100mm/yr. The effective rainfall for the area is 654mm/yr, indicating the recharge coefficient is 22.5%, which implies the majority of available recharge runs off due to a shallow water table in the subsoil that results from the low permeability of the bedrock aquifer. This will result in flashy streams with reduced baseflow.

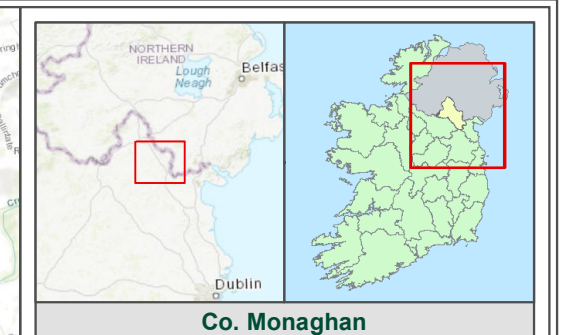
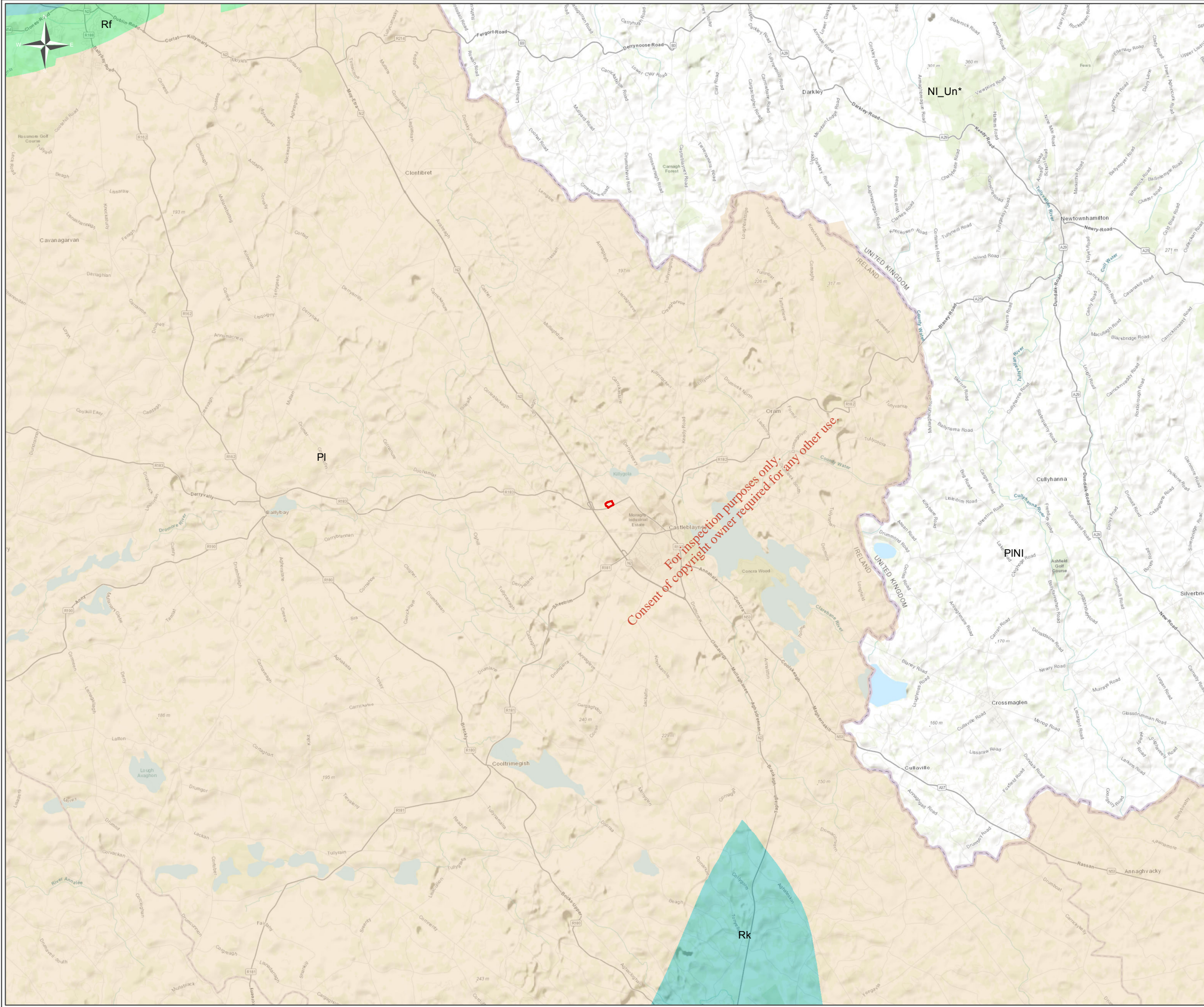
Historical mapping for the area shows several springs in the surrounding area. There are no public groundwater supplies and no groundwater dependent ecosystems in the area. The site walkover confirmed the presence of public supply water mains outside the entrances to the residential housing within 250m of the landfill and outside the industrial units adjacent to the site.

Locations of wells and springs are presented in Figure 2.5.

Table 2-1: Distance of wells and springs from the Site

BH/Spring	Yield class	Yield	Use	Depth (m)	Depth to Rock confidence (m)	Distance from site (km)	Date
2631NEW002	Poor	34.6		28.0	6.0	0.32	1899
2631NEW091	Poor	13.1		4.3	1.2	<1	1899
2631NEW078	Poor	10.9	--	6.1	1.2	<1	1969
2631NEW084	Poor	9.8	--	2.4	0.3	<1	1971
2631NEW087	Poor	10.9	--	4.6	1.2	<1	1970
2631SEW009	Poor	16.4	--	7.3	--	<1	1899
2631NEW040	Poor	32.7	--	16.2	3.1	<1	1970

There are no Groundwater Drinking Water Protection Areas within the site boundaries, according to GSI. The closest groundwater protection area to the sites is the Monaghan Town outer protection areas, approximately 18km north-west of the site boundary. The outer protection area is 3.76km².



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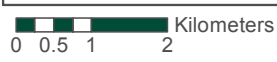
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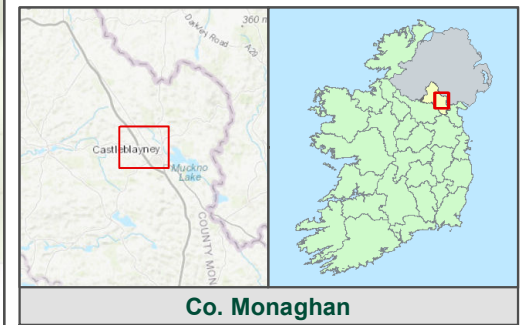
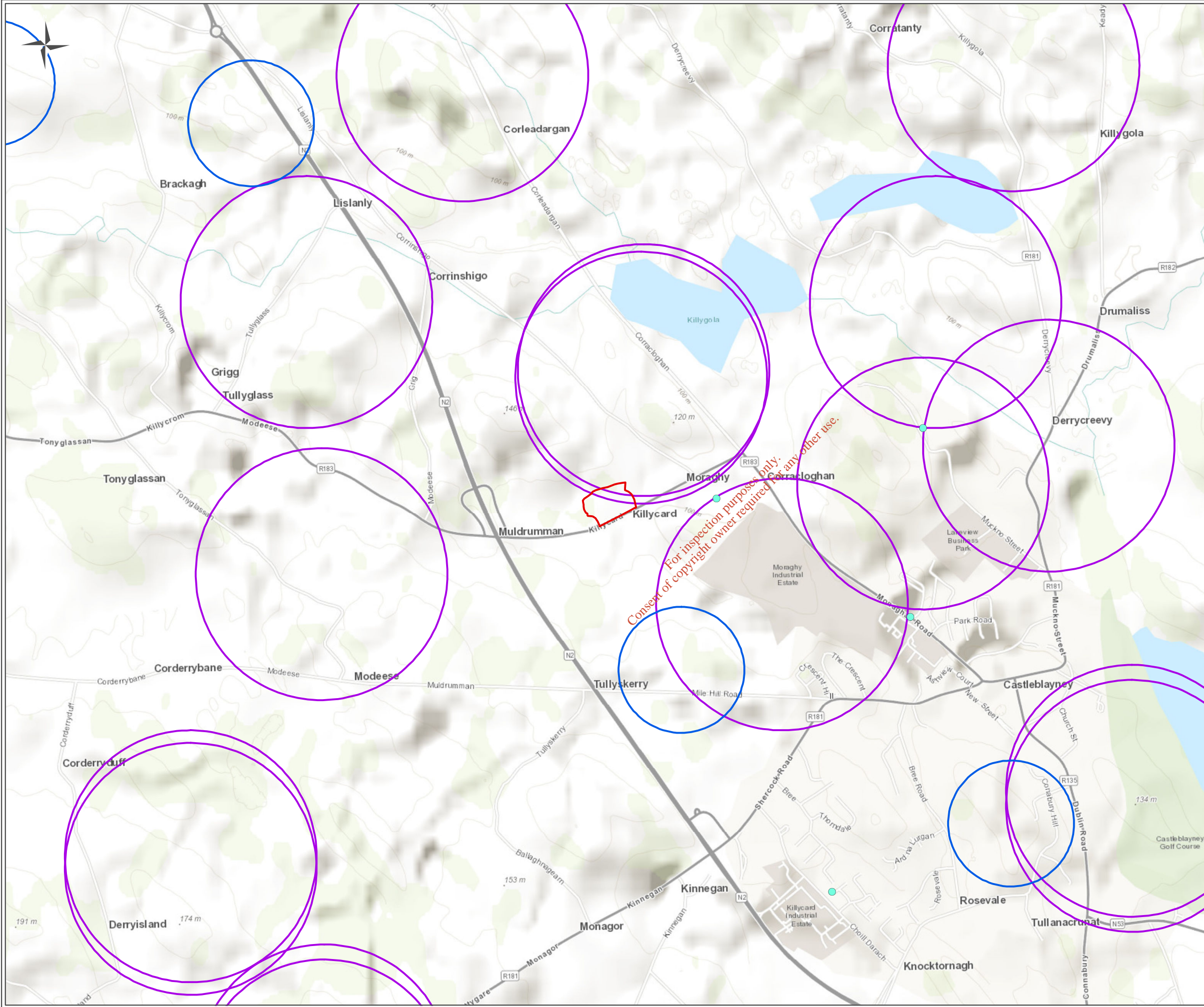
- Site Boundary
- PI: Poor Aquifer Bedrock Generally Unproductive Except Locally
- Rf: Regionally Important Aquifer - Fissured Bedrock
- Rk: Regionally Important Aquifer - Karstified

Figure Title	Aquifer Classification
Figure No.	2.4
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Legend

- Site Boundary
- Groundwater Well (10-50m Accuracy)
- Groundwater Well (200-500m Accuracy)
- Groundwater Well (500m-1km Accuracy)

Figure Title	Wells and Springs	
Figure No.	2.5	
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2.2.6 Groundwater Vulnerability

Groundwater vulnerability, as defined by the GSI, is the term used to represent the intrinsic geological and hydrogeological characteristics that determine the ease with which groundwater could be contaminated by human activities.

The vulnerability of an aquifer to contamination is influenced by the leaching characteristics of the topsoil, the permeability and thickness of the subsoil, the presence of an unsaturated zone, the type of aquifer, and the amount and form of recharge (the hydrologic process where water moves downward from surface water to groundwater).

Groundwater vulnerability is determined mainly according to the thickness and permeability of the subsoil that underlies the topsoil, as both properties strongly influence the travel times and attenuation processes of contaminants that could be released into the subsurface from below the topsoil.

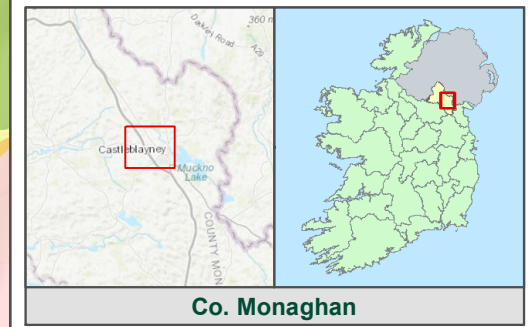
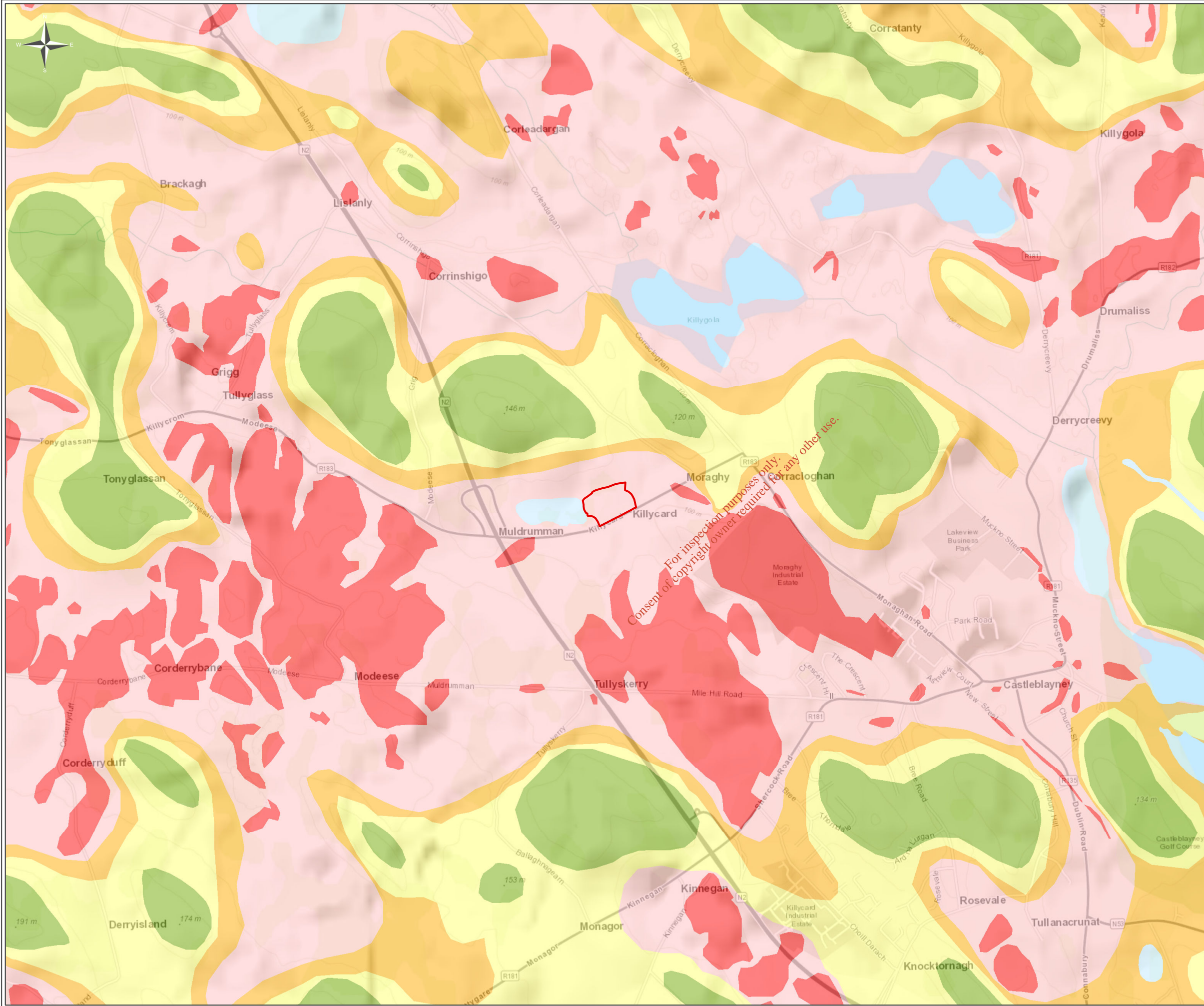
The Oghill formation is classified as a Poor Aquifer (PI) that is generally unproductive except in local zones. The aquifer vulnerability of the site is Extreme. The recharge coefficient associated with the western section of the site is 22.5% and the recharge rate is 100mm/year.

The Groundwater Vulnerability mapping is presented in Figure 2.6.

Table 2-2: GSI Guidelines – Aquifer Vulnerability Mapping

Vulnerability Rating	Hydrogeological Conditions		
	Subsoil Permeability (Type) and Thickness		
	High Permeability (Shallow Bedrock)	Moderate Permeability (e.g. Sandy soil)	Low Permeability (e.g. Clayey subsoil, clay, peat)
Extreme (E)	0 - 3.0 m	0 - 3.0 m	0 - 3.0 m
High (H)	>3.0 m	3.0 -10.0 m	3.0 - 5.0 m
Moderate (M)	N/A	>10.0 m	5.0 - 10.0 m
Low (L)	N/A	N/A	>10 m

Notes:
N/A = Not Applicable
Precise permeability values cannot be given at present



Legend

- Site Boundary
- Groundwater Vulnerability**
- E - Extreme
- H - High
- M - Moderate
- L - Low
- Water
- X (Rock Near Surface or Karst)

Figure Title
Groundwater Vulnerability

Figure No. 2.6

Project
ERA of Historic Landfill at Killicard, Co. Monaghan

Client
Monaghan County Council

Scale 1:15,000 **Page Size** A3

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