TIER 1 ENVIRONMENTAL RISK ASSESSMENT

HISTORIC LANDFILL AT SCOTCH CORNER LANDFILL CO. MONAGHAN

MAY 2018

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Abstract: This report represents the findings of a Tier 1 risk assessment conducted at the historic landfill at Scotch Corner Landfill, Co. Monaghan in accordance with the EPA Code of Practice on Environmental Risk Assessment for Unregulated Waste Disposal Sites.

TABLE OF CONTENTS

PAGE

LIST OF APPENDICES

LIST OF TABLES

PAGE

LIST OF FIGURES

PREAMBLE

Fehily Timoney & Co. (FT) was appointed by Monaghan County Council (MCC) to complete a Tier 1 environmental risk assessment (ERA) of the existing environment in the historical landfill located to the south of the licenced facility at Scotch Corner. This ERA was carried out in accordance with the EPA Code of Practice (CoP) on ERA for Unregulated Waste Disposal Sites (2007).

The historic landfill is located to the south of the existing Licenced landfill (W0020-02) opposite the landfill entrance. The historic site covers approximately 4.5 hectares.

A Tier 1 assessment was conducted by FT which included a detailed desk study and site walkover. This concluded that a **moderate risk classification (Class B) can be assigned to the site**.

For a moderate risk site, the CoP directs that the site will have to apply for a certificate of registration.

A Tier 2 quantitative risk assessment is required for a site which is classified as moderate risk. FT recommend further intrusive site investigations and sampling as part of the Tier 2 assessment.

1. INTRODUCTION

1.1. Background

Scotch Corner historic landfill is located approximately 4km south-west of Clontibret off the R184 in Co. Monaghan. The 4.5-hectare historic landfill is located to the south of the licenced site on the opposite side of the local access road.

The historic landfill ceased operation in 1991. Information from existing borehole records indicates that waste in this historic landfill is mainly deposited directly over the bedrock. Leachate within the historic landfill is collected via a concrete pipe system and directed to a holding sump (Old G1) and recirculated back to the historic landfill.

MCC requested that an ERA be carried out for the site in accordance with the EPA CoP on ERA for Unregulated Waste Disposal Sites.

1.2. Scope of Works and Project Objectives

The scope of work was to undertake a Tier 1 assessment of the site based on the risk assessment methodology approach, in accordance with the EPA CoP. This approach requires the carrying out of a:

- Desktop Study
- Detailed Site Walkover
- Environmental Risk Assessment (ERA)
- Development of Conceptual Site Model (CSM)

1.2.1. Project Objectives

As part of the initial desk study a preliminary assessment of available information was undertaken. This was followed-up with a site walkover. The desk study and site walk-over were used to inform the development of both the preliminary conceptual site model (CSM) and the ERA.

This report presents the findings of the assessment.

2. METHODOLOGY

2.1. Introduction

A desktop review of available documentation for the site was conducted and a visit was undertaken to carry out a detailed site walkover on 25th April 2018.

The documentation made available to FT for the desktop review included:

- RPS – Environmental Impact of Historic Landfill (2004)
- Glovers Site Investigation Report No. 4824 (January 2003)
- Monaghan County Council Site Plans and Drawings

2.2. Desk Study

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

2.2.1. Site Description and On-Site Conditions

The landfill is located in a primarily rural setting in an area of rolling topography dominated by drumlins. Areas between the drumlins are often boggy at elevations between 95-115mOD, while more free-draining ground is found on the drumlins themselves which rise to between 140mOD and 150mOD. There is a hill located to the north of the site with a peak elevation of 157mOD. The land use in the area is primarily agricultural with the land used for pasture. The site is bounded to the north by agricultural land, to the west by bog land to the east by forestry and to the south by agricultural land and bogs.

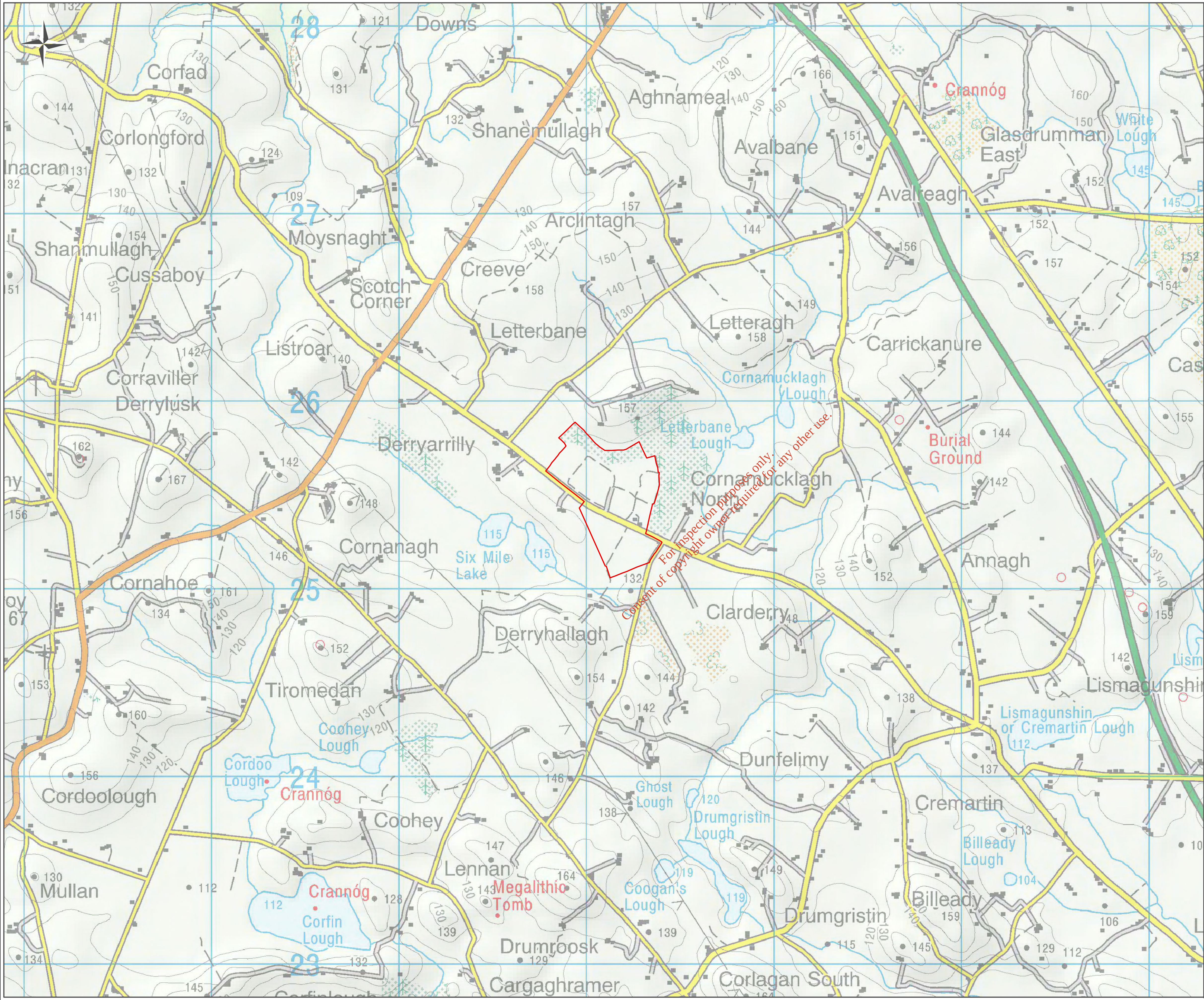
2.2.2 Existing Bedrock Geology

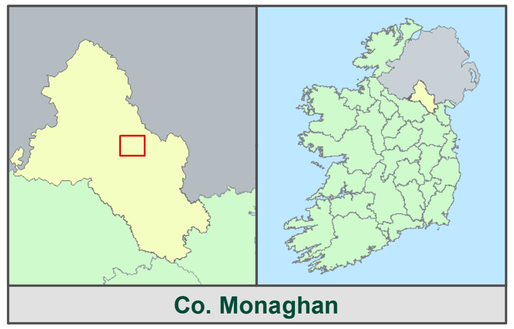
According to the GSI the site and surrounding area is underlain by the Silurian Lough Avaghon formation (LA) which is generally made up of *'grey, fine to coarse grained, massive greywacke sandstones, micro-conglomerates and amalgamated beds'*.

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

2.2.3 Existing Overburden Geology

The landfill site is underlain by relatively thin subsoil overlying a poorly productive bedrock aquifer. The subsoils are typically of glacial till comprising sandy gravelly clay. According to the GSI, the glacial overburden is mapped as *'Till derived from Low Palaeozoic Sandstone and shales'* (TLPSS), as shown in Figure 2.3. The north-eastern portion of the site and surrounding area is underlain by cutaway blanket peat.





Legend

Perimeter Boundary

Figure Title	Site Location
Figure No.	2.1
Project	Tier I Scotch Corner Historic Landfill
Client	Monaghan County Council
Scale 1:20,000	**Page Size** A3
Revision A	**Date** 28/04/2018

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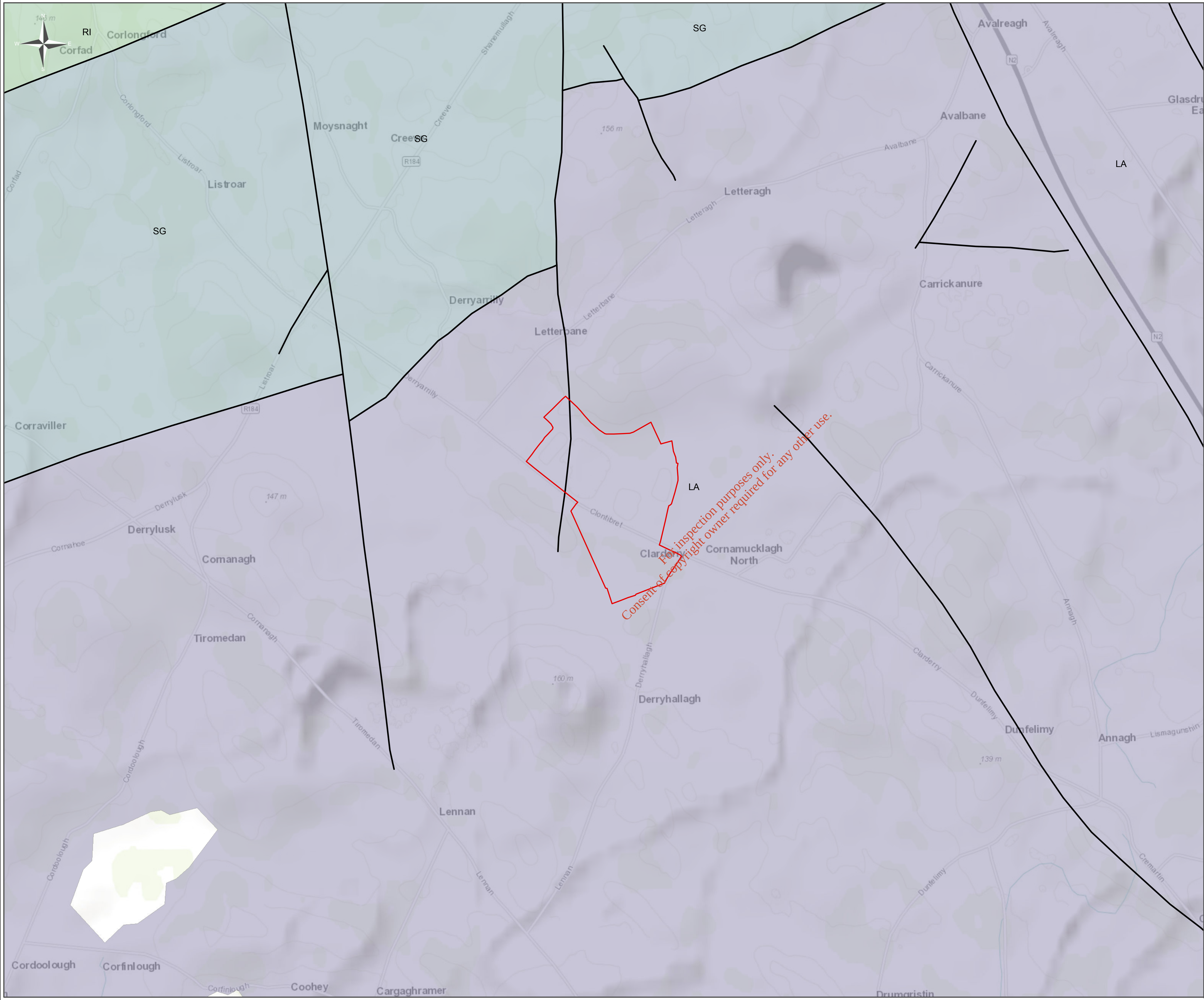

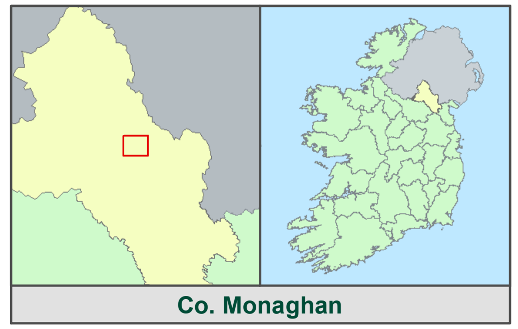

Legend

- Perimeter Boundary
- Dip of Bedding in Degrees
- Stratigraphical Linework
- Structural Linework

Bedrock Geology

- LA: Lough Avaghon Formation
- RI: Red Island Formation
- SG: Slieve Glah Formation

Figure Title	Bedrock Geology
Figure No.	2.2
Project	Tier I Scotch Corner Historic Landfill
Client	Monaghan County Council
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0 0.25 0.5 1 Kilometers

Map Path: R:\Map Production\2018\P1530\Workspace\P1530_Fig2-3_QuaternaryGeology_A3.mxd

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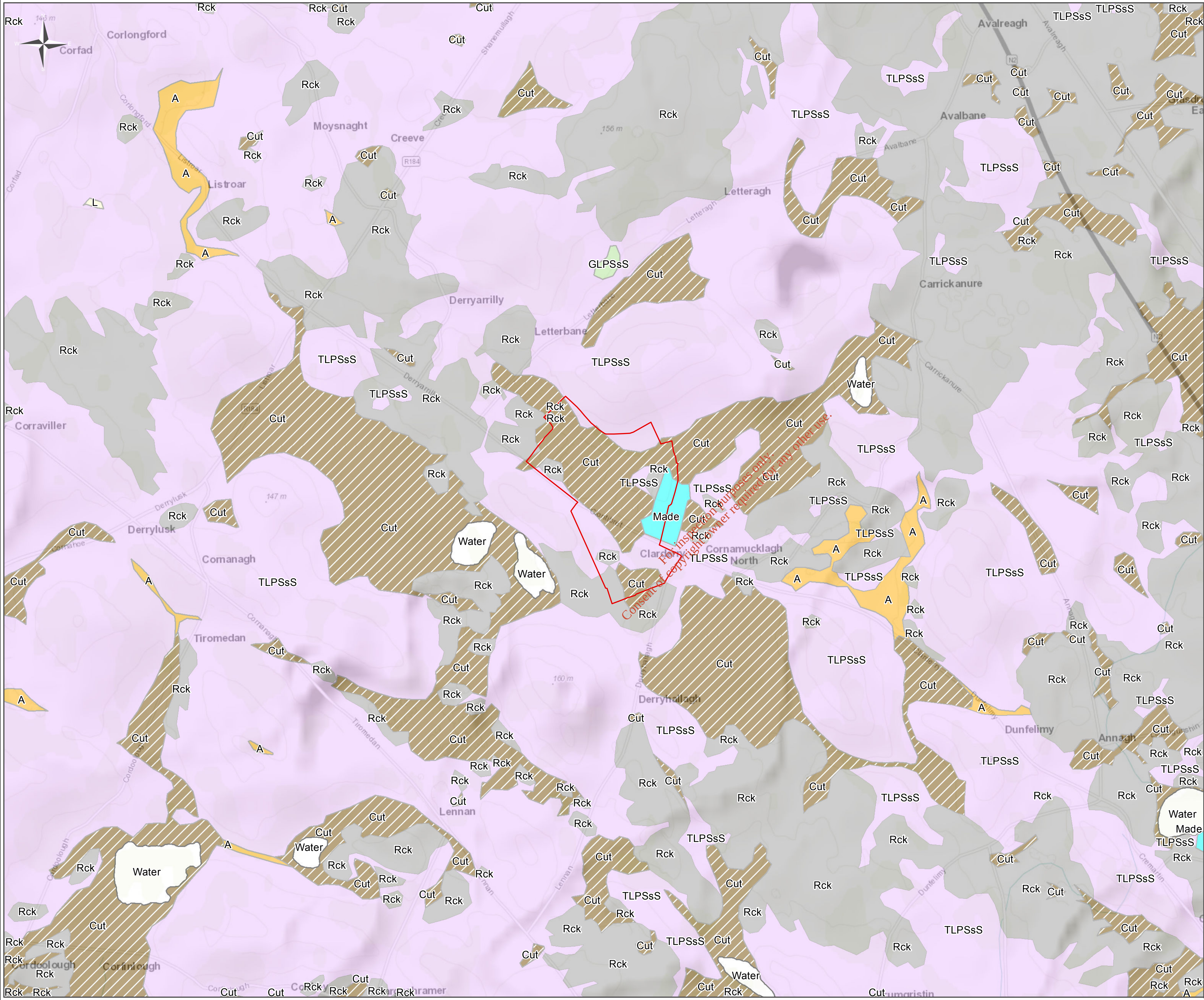

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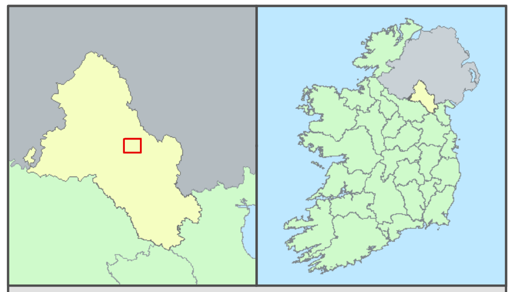

Legend

- Perimeter Boundary

Subsoils Data

- A, alluvium
- Cut, cutover peat
- GLPSsS, sandstone & shale sands and gravels
- L, lake sediment
- Made, made ground
- Rck, bedrock at surface
- TLPSsS, sanstone and shales till - Lower Paleozoic
- Water, water

Figure Title	Quaternary Geology
Figure No.	2.3
Project	Tier I Scotch Corner Historic Landfill
Client	Monaghan County Council
Scale 1:15,000	**Page Size** A3
Revision A	**Date** 28/04/2018

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2.2.4 Hydrogeology

The site lies within the Clarderry Groundwater Body (GWB No. IENBG026) which is a small groundwater body defined around the area of the landfill and surrounding lands and 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 spring named St. Catherine's Well, approximately 1.1km north of the site boundary. The spring lithology is muddy limestone.

The GSI national recharge map defined the annual recharge as 100mm/yr. The effective rainfall for the area is 683mm/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 a number of springs in the surrounding area. Some of these springs are located at the base of the drumlins and may represent groundwater discharging from the drumlin sediments where these spread out at the base of the drumlins. Other springs are mapped along the edge of the Six Mile Lakes and may represent local groundwater discharges to the lake.

There are no public groundwater supplies and no groundwater dependent ecosystems in the area. Private groundwater supplies within 250m of the site have been monitored and only one of these now remain active (W7), the other sites have become inactive. 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
2631NEW016	Poor	15.3	--	3.1	0.9	0.35	1971
2631NWW097	Poor	10.9	--	4.0	1.2	0.5	1965
2631NWW117	Poor	17.5	--	4.9	1.2	0.5	1971
2631NWW054	Poor	13.1	--	3.1	--	0.7	1971
2631NEW012	Poor	10.9	--	21.3	4.9	0.6	1968
2631NEW010	Poor	26.2	--	45.7	--	0.85	1972

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 10km north-west of the site boundary. The outer protection area is 3.76 km^2.

2.2.5 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 Lough Avaghon formation is classified as a Poor Aquifer (Pl) that is generally unproductive except in local zones. The aquifer vulnerability is mainly extreme in the inter-drumlin areas. The vulnerability at the drumlins themselves is lower due to the thicker subsoils comprising the drumlins.

The groundwater vulnerability for the site is presented in Table 2.2. This table outlines the standard ratings of vulnerability used by the GSI, with the existing site conditions highlighted based on the findings of the site investigations.

Table 2.2: Groundwater Vulnerability

Vulnerability Rating	Hydrogeological Conditions		
	Subsoil Permeability (Type) and Thickness		
	High Permeability (sand/gravel)	Moderate Permeability (sandy soil)	Low Permeability (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: 1. N/A = not applicable.
2. Precise permeability values cannot be given at present.

2.2.6 Hydrology

The site is located within the catchment of the River Fane which flows towards the southeast. The streams flowing along the northern boundary of the site are tributaries to the River Fane. There is a catchment boundary to the south of the site defined by a low rise in topography to the south of the old landfill. This catchment drains to the north west to the Six Mile Lake stream, which is a tributary of the River Cor.

There are a number of small lakes located in the vicinity of the site. Two small lakes to the south of the old landfill termed Six Mile Lakes drain towards the north west. Letterbane Lough lies along the course of the River Fane to the north east of the site.

Historical Mapping for the area illustrates a small lake called Little Lough which was positioned in the central area of the site. This lake was drained during the expansion of the site.

2.2.7 Existing Geological Heritage

The GSI holds no records of areas of Geological Heritage within the site boundary or in the immediate vicinity of the site.

The nearest recorded of geological heritage held by the GSI is approximately 3.8km north-east of the site boundary at Tassan. Tassan is described as *"the largest and most productive of the Monaghan district lead mines, from c. 1840-1866"* and the geological feature of note is a *"good mixture of extant mine features, including mine buildings and solid waste".*

2.2.8 Existing Geotechnical Stability

The GSI landslides database indicates that the nearest recorded geo-hazard was at Carrowmaculla, Lisnaskea Co. Fermanagh (ITM 643496 835192) in 1979, approximately 25 km north-west of the site boundary.

According to the GSI, the site and surrounding area is underlain by cutaway blanket peat.

2.2.9 Site History

OSI Historic Map (1888-1913 and 1837-1842) identifies that the land within the site boundary and the surrounding area was previously arable land.

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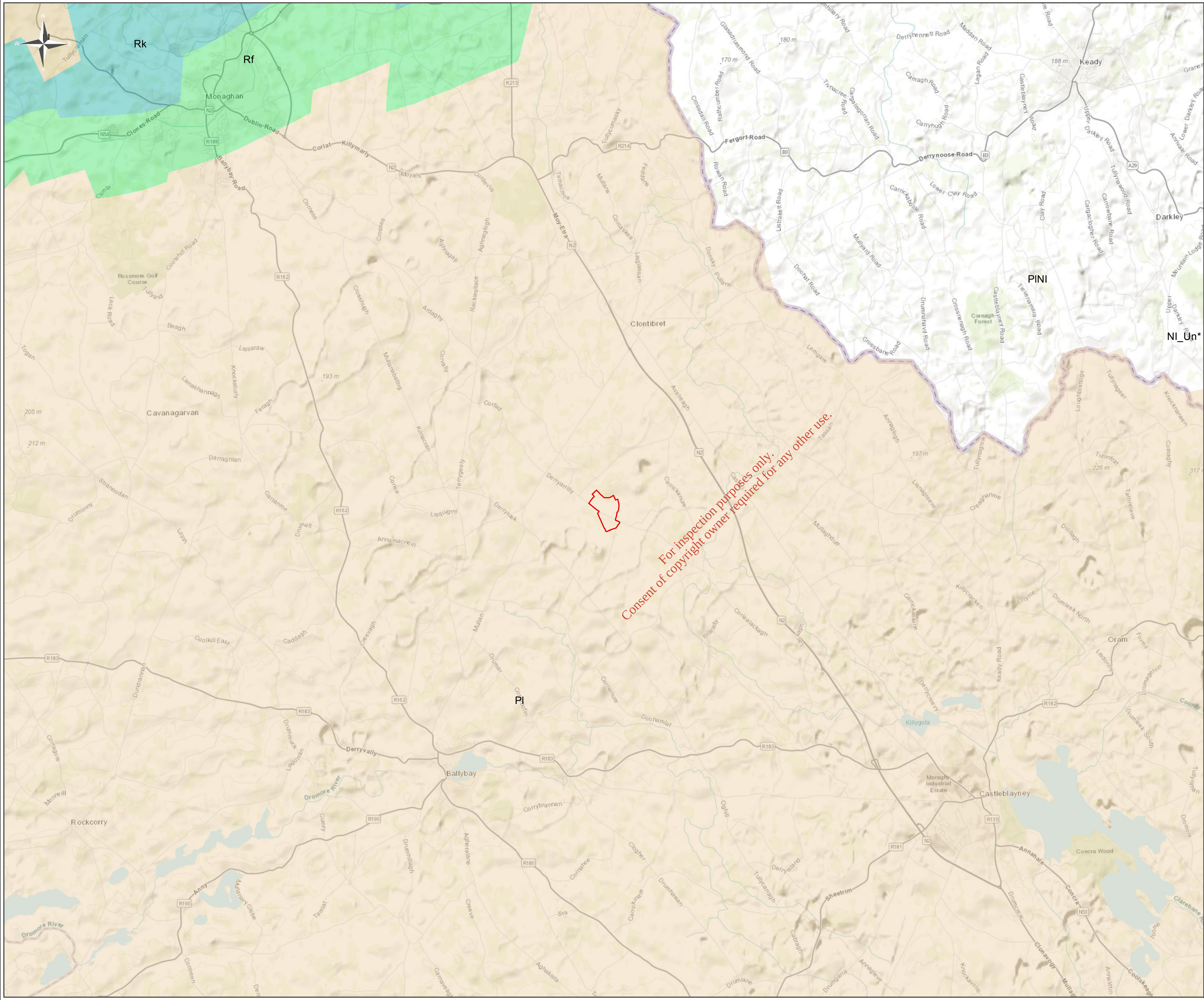

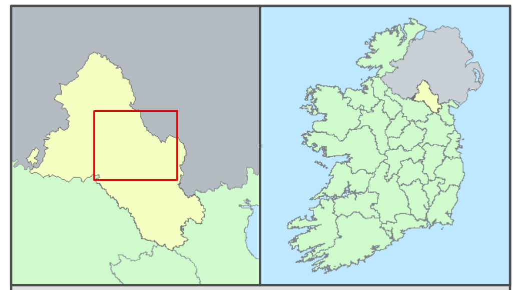

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Legend

- Perimeter Boundary
- LI: Locally Important Aquifer - Bedrock Mod Productive Locally
- PI: Poor Aquifer Bedrock Generally Unproductive Except Locally
- Rf: Regionally Important Aquifer - Fissured Bedrock
- Rk: Regionally Important Aquifer - Karstified

0 0.5 1 2 Kilometers

Figure Title	Aquifer Classification
Figure No.	2.4
Project	Tier I Scotch Corner Historic Landfill
Client	Monaghan County Council
Scale 1:75,000	**Page Size** A3
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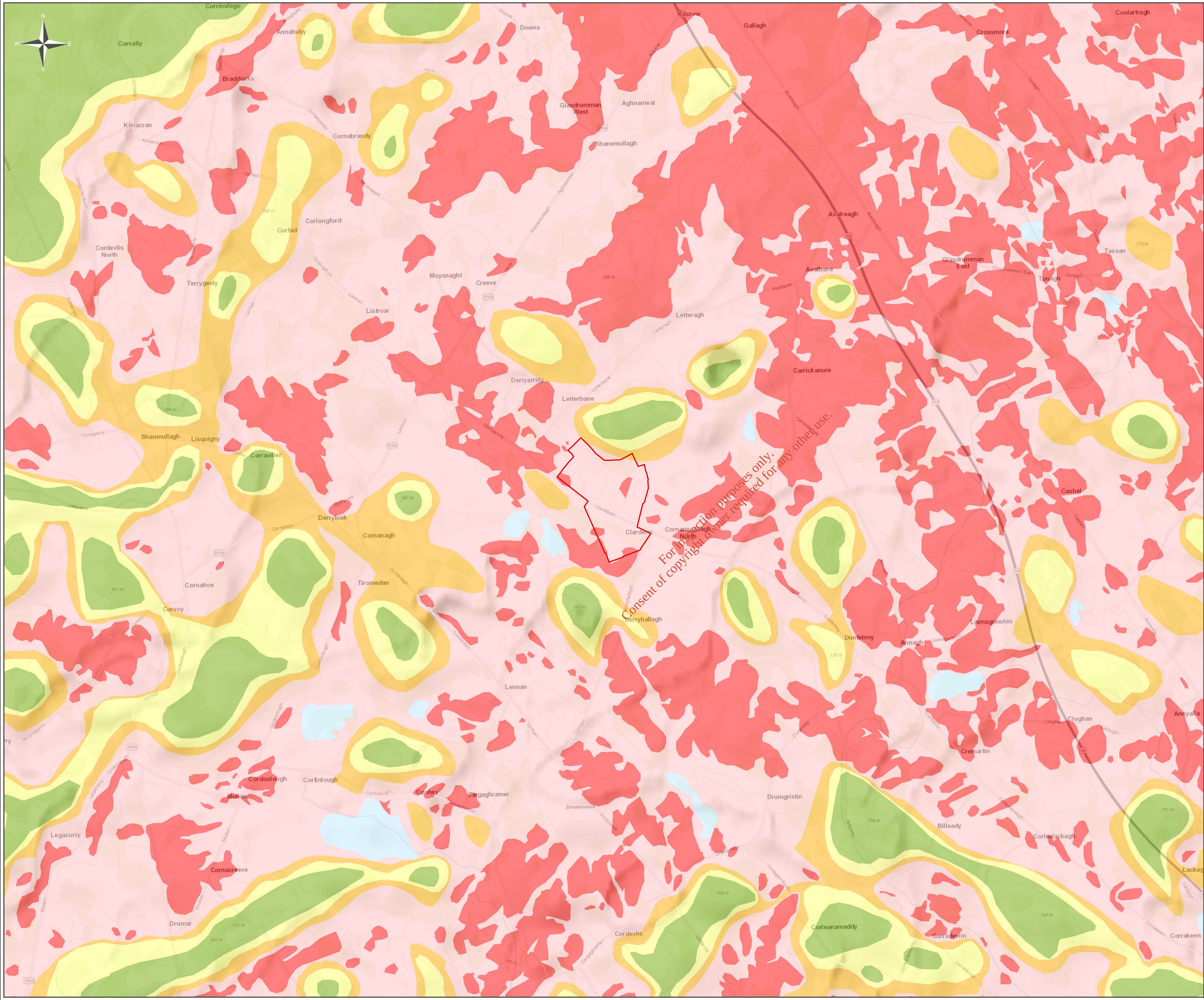
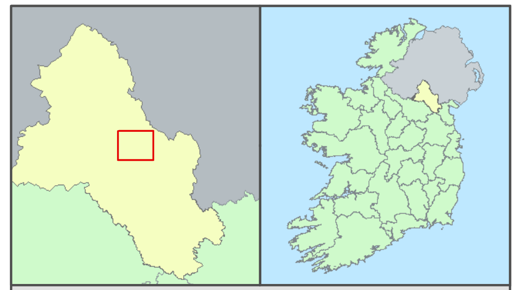
Map Path: R:\Map Production\2018\P1530\Workspace\P1530_Fig2-5_GroundwaterVulnerability_A3.mxd





Co. Monaghan

Legend

Perimeter Boundary

Groundwater Vulnerability

- E - Extreme
- H - High
- M - Moderate
- L - Low
- Water
- X (Rock Near Surface or Karst)

Figure Title	Groundwater Vulnerability
Figure No.	2.5
Project	Tier I Scotch Corner Historic Landfill
Client	Monaghan County Council
Scale 1:25,000	**Page Size** A3
Revision A	**Date** 28/04/2018

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0 0.5 1 2 Kilometers

Map Path: R:\Map Production\2018\P1530\Workspace\P1530_Fig2-6_WellsAndSprings_A3.mxd

Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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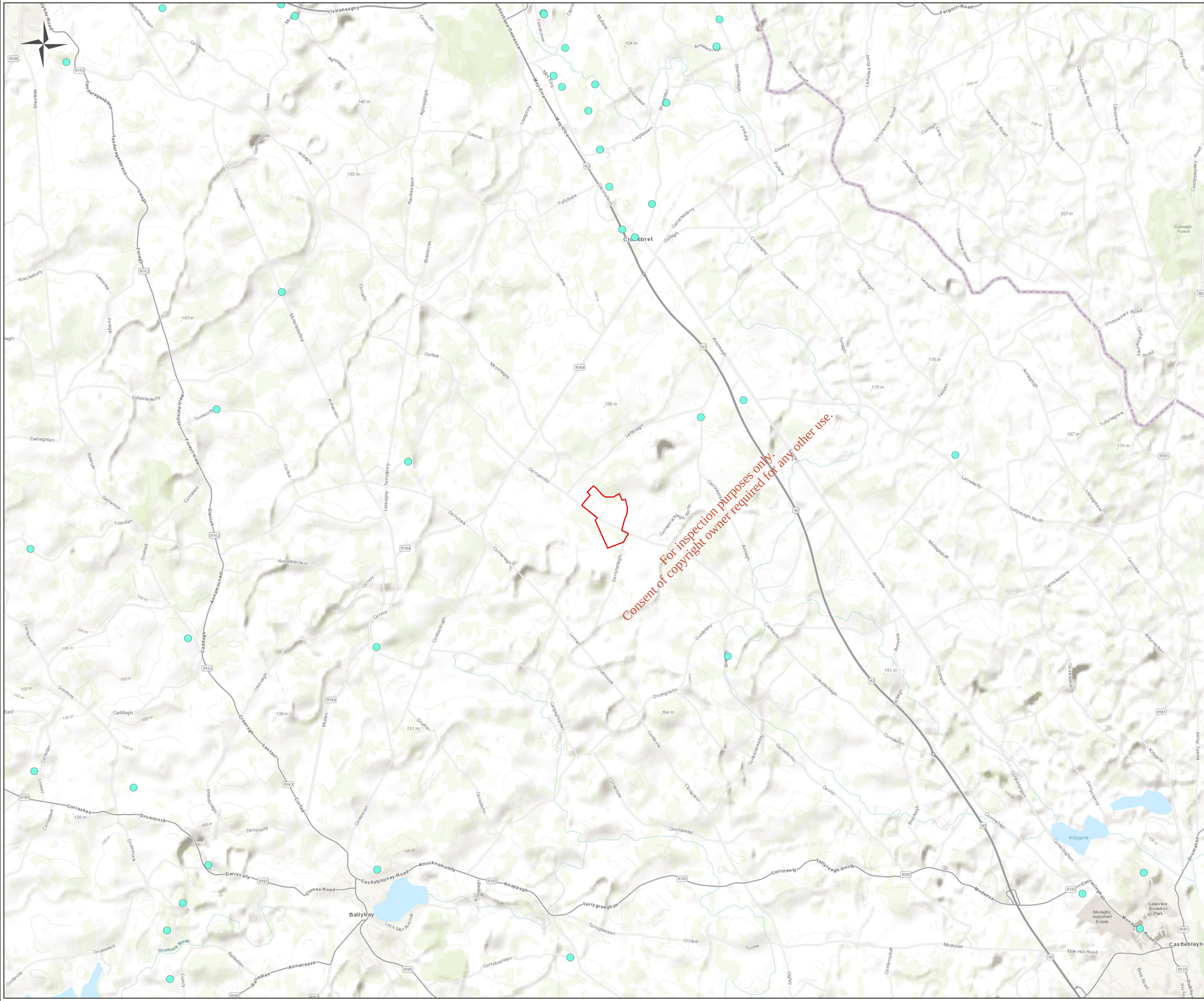

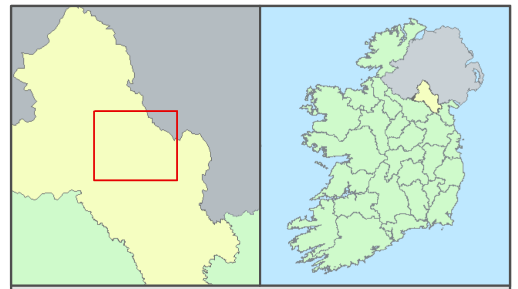

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Legend

- Perimeter Boundary
- Groundwater Well (10-50m

Figure Title	Wells and Springs
Figure No.	2.6
Project	Tier I Scotch Corner Historic Landfill
Client	Monaghan County Council
Scale 1:50,000	**Page Size** A3
Revision A	**Date** 28/04/2018

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0 0.5 1 2 Kilometers

2.3. Site Investigation

The site investigation comprised of a detailed site walkover by an FT Project Engineer. The site walkover was conducted on the 25th April 2018. The completed site walkover checklist, in accordance with the EPA CoP, is included in Appendix II.

2.3.1. Site Walkover

The FT Project Engineer noted that the site is currently very overgrown, particularly at the western end of the site, and that the ground level is undulating. The walkover paid considerable attention to the surface water drainage network surrounding the site along the perimeter (G3, G4, G5, G8, G9, G10, G11, G13) and the leachate collection system in place (Old G1 Sump).

The perimeter drainage is installed to direct all surface water runoff towards the G5 sump along the northern boundary as illustrated in Figure 2.7. Surface water is pumped from the G5 sump back to a central location in the western portion of the site to percolate down through the stockpiled fill material. The infiltrated surface water is then collected at sump 'recirculated G5' at the foot of an embankment and directed north towards G6 and ultimately the surface water stream within the licenced facility.

Since September 2017, MCC have altered the leachate collection from the historic site which previously was directed to the leachate lagoon within the licenced facility. Any leachate collected at the site is pumped from the Old G1 sump and directed to a manifold system consisting of 4 no. distribution valves and spread across the surface in the eastern portion of the historic site (see Figure 2.7).

The following infrastructural services are also present at the site:

- A concrete drainage culvert which runs underneath local road R184 to the boundary fence with the licenced facility.
- Overhead electricity lines along the northern boundary adjacent to local road R184.

The photos presented in Appendix III show the site itself and the type of materials encountered during the site walkover.

2.3.2. Previous Site Investigations

In October 2002, a site investigation was undertaken at the site of the historic landfill and in the area of the existing facility. Boreholes were drilled and trial pits were excavated, the location of which are shown in Appendix IV.

Outside of the historic landfill, six borehole pairs (B1/B1a, B2/B2a; B3/3a; BH4/4a; BH5/5 and Bh6/6a) were drilled: each pair comprised one shallow borehole through the overburden to the top of the bedrock and one deep borehole into bedrock. B1/B1a was drilled up gradient of the historic landfill while the remaining boreholes were drilled around the perimeter of the existing facility i.e. down gradient of the historic landfill.

Within the historic landfill, boreholes SI1, SI2, SI3 and SI6 were drilled through overburden of fill/made ground, waste and boulder clay and into bedrock.

Seven trial pits (TP1 to TP7) were also excavated in the area of the historic landfill.

Standpipes were installed within the boreholes to enable groundwater level monitoring and sampling for water quality analysis both within the overburden and the bedrock. The site investigation data is reported in Glovers Site Investigation Report No. 4824 dated January 2003.

In March 2015, shallow and deep dual boreholes were installed along the eastern boundary of the historic landfill (B7/B7a) and south-eastern corner of the licenced boundary (B8/B8a) at the site entrance.

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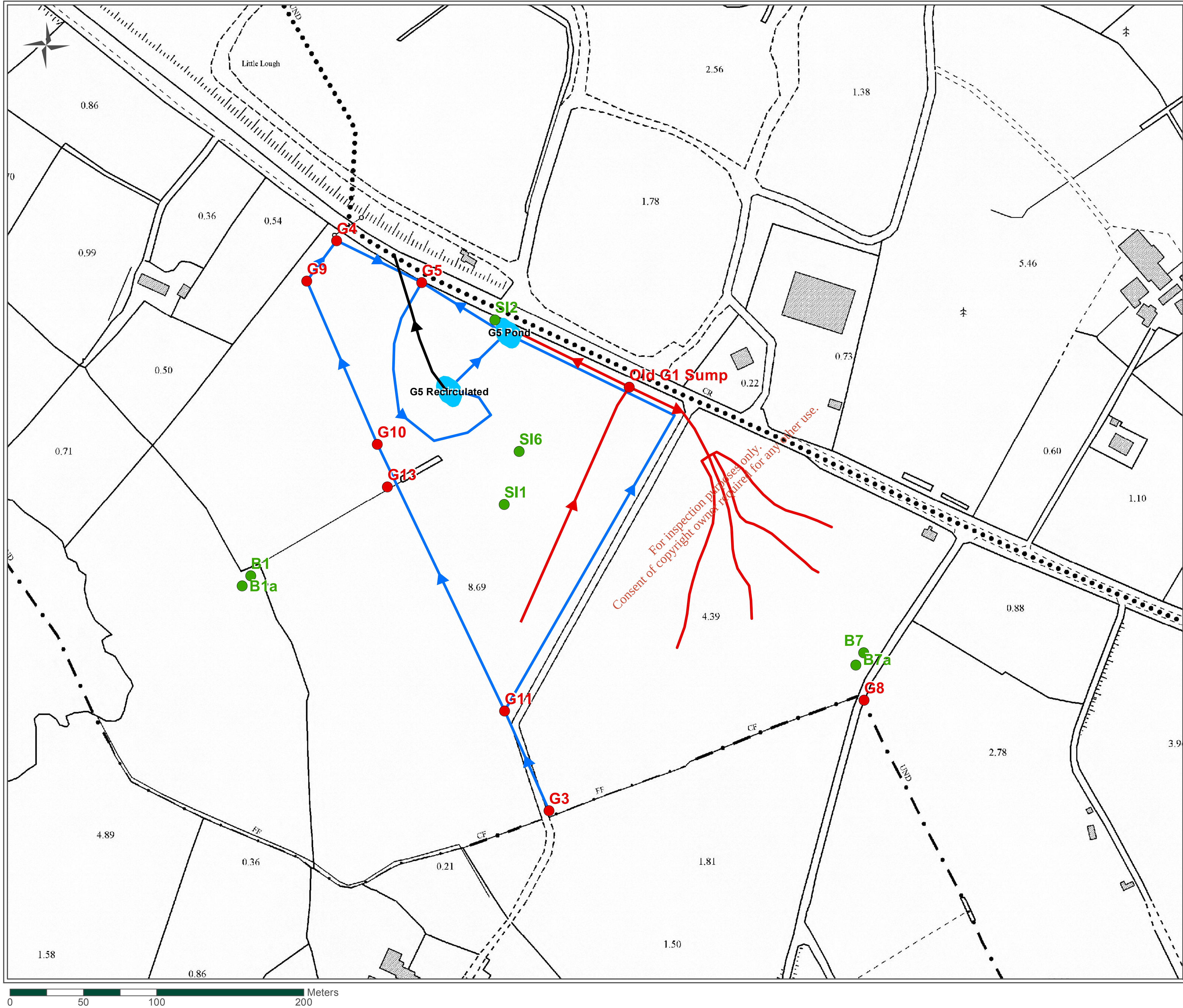

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Legend

- Ground Water Monitoring Points
- Surface Water Monitoring Points
- Redirected Surface Water Pipeline Directed to G6 (existing landfill)
- Leachate Pipework
- Surface Water Pipework
- Surface Water Ponds

Figure Title	Existing Site Layout
Figure No.	2.7
Project	Tier I Scotch Corner Historic Landfill
Client	Monaghan County Council
Scale 1:2,500	**Page Size** A3
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3. RISK ASSESSMENT

3.1. Introduction

Risk assessment considers the likelihood of occurrence and the consequence of occurrence of an event (Royal Society, 1992[1]). ERA is based on the development of a Conceptual Site Model (CSM) which is used to determine the potential exposure of a vulnerable receptor to a contaminant. The CSM is used as the basis for the risk assessment. It is used to identify all possible sources (S), pathways (P) and receptors (R) as well as the processes that are likely to occur along each of the source-pathway-receptor (S-P-R) linkages and uncertainties.

Based on the desktop investigation and site walkover undertaken, this CSM takes the source of the contamination to be the interred waste material deposited over bedrock in the historic landfill, the pathway to involve the surface water and groundwater and the ultimate receptors to be the groundwater and River Fane tributary stream located downgradient of the historic landfill to the north.

3.2. Potential Pathways and Receptors

A pathway is a mechanism or route by which a contaminant comes into contact with, or otherwise affects, a receptor. Contaminants associated with deposited waste may include leachate generated from groundwater/rainwater infiltration into the waste material and/or the generation of landfill gas from the degradation of the biodegradable fraction of deposited waste.

The unlined waste body at the historic landfill was designed as 'dilute and disperse' and lies directly on saturated bedrock. Leachate from the waste represents a direct discharge to groundwater. Therefore, the potential pathways associated with the site are:

- direct seepage into the underlying bedrock aquifer;
- contaminant migration through the bedrock aquifer to the adjacent stream to the north;
- transfer of diluted leachate to the stream via recirculated interceptor drainage system.

3.2.1. Groundwater/Leachate Migration

The three main pathways for leachate migration are.

- Vertically to the water table or top of an aquifer, where groundwater is the receptor
- Vertically to an aquifer and then horizontally in the aquifer to a receptor such as a well, spring, stream or in this case, the adjacent coastline
- Horizontally at the ground surface or at shallow depth to a surface receptor

The migration and attenuation of leachate from the site depends on the permeability and thickness of subsoil and on both the bedrock permeability value and type. These elements are encompassed in groundwater vulnerability, groundwater flow regime and surface water drainage. The main receptors to leachate migration from this site are:

- Aquifer; and,
- Surface water bodies

[1] Royal Society 1992, Risk: Analysis, Perception and Management. The Royal Society, London (ISBN 0-85403-467-6).

Leachate Results: January 2017 – March 2018

Following a review of the latest leachate monitoring data (January 2017 – March 2018) for the historic landfill (Old G1 sump) provided by MCC, it has been established that leachate is present at the site. Leachate results when compared against the published minimum and maximum observed ranges for acetogenic and methanogenic leachates (EPA Landfill Manual, Landfill Site Design, 2000) show parameters are within the published guideline values for acetogenic and methanogenic leachate composition.

3.2.2. Landfill Gas Migration

The two main pathways for landfill gas migration are

- Lateral migration via subsoil
- Vertical migration via subsoil

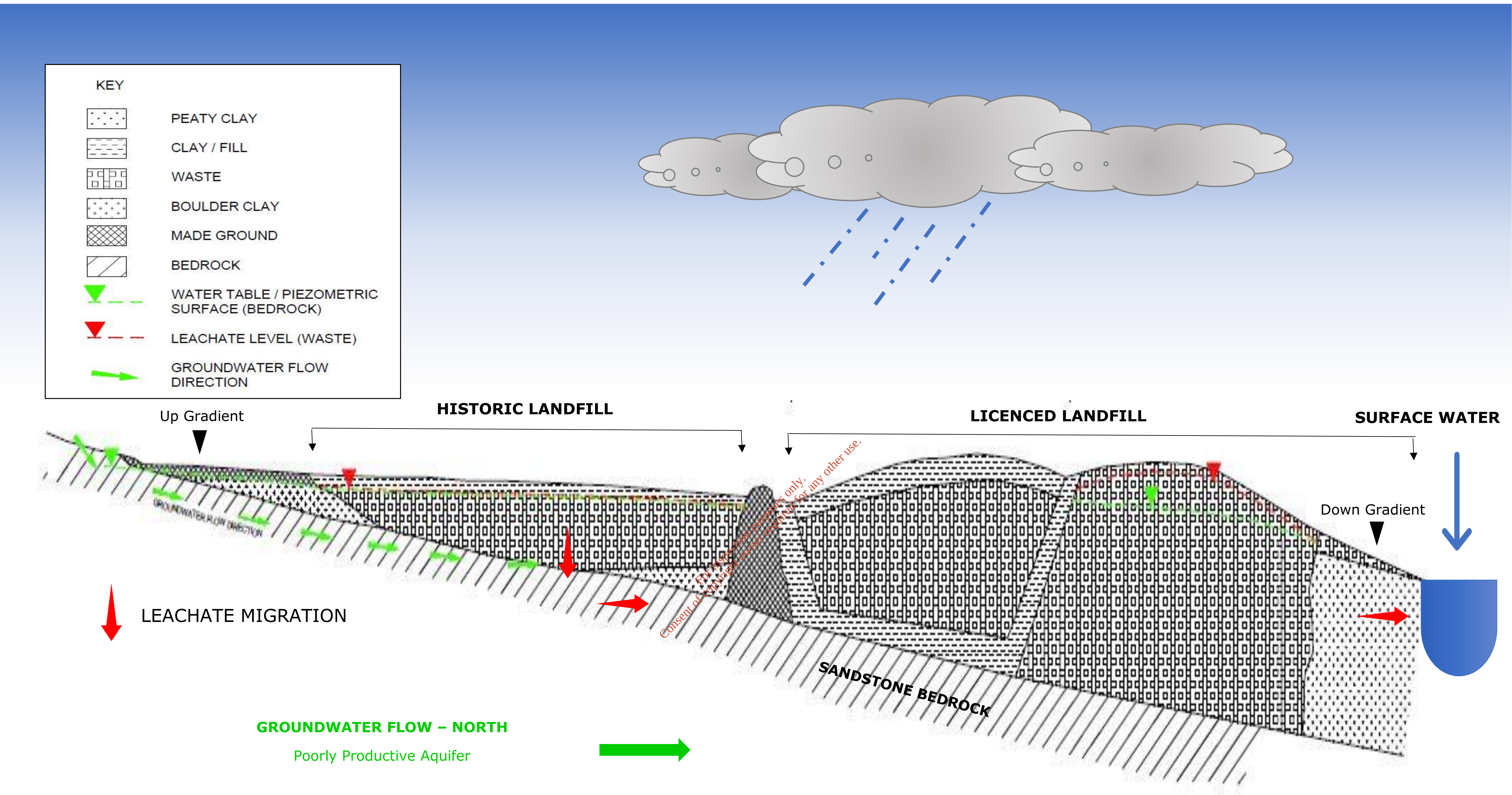
The migration of landfill gas from the site depends on the nature of the material deposited and the nature, permeability and thickness of the surrounding subsoil or bedrock. The main receptors to potential landfill gas migration from this site are:

- Human Presence/Buildings nearby the waste body

Landfill gas has the potential to collect in confined spaces such as ducts, chambers, and manholes. As a result, the small industrial complex located to the south of the site is an area that may be at particular risk from landfill gas produced at the site.

3.3. Conceptual Site Model

Based on the desktop investigation and site walkover undertaken, an assessment of the risk is made to confirm the source – pathway – receptor (S-P-R) linkages identified in the preliminary investigation. The results and analysis of the investigation has enabled a basic conceptual model to be produced, which is presented in Figure 3.1, overleaf.



CROSS SECTION SOUTH WEST – NORTH EAST

FIGURE 3.1 SCOTCH CORNER HISTORIC LANDFILL
CONCEPTUAL SITE MODEL

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3.4. Risk Prioritisation

Risk prioritisation enables resources to be prioritised on the highest risk facilities and on the highest source – pathway – receptor linkage potential.

The risk prioritisation process assigns a score to each linkage and the overall score is the maximum of the individual linkages for the site. The higher the score a site/linkage receives the higher the risk.

To classify the risk, scores will be applied to the information obtained during the site investigation. Where there is insufficient information available (i.e. where there is a high degree of uncertainty) the highest score is assumed.

The scoring matrixes are as follows:

- Leachate; Source/hazard scoring matrix, based on waste footprint
- Landfill gas: Source/hazard scoring matrix based on waste footprint
- Leachate migration: Pathway (Vertical)
- Leachate migration: Pathway (Horizontal)
- Leachate migration: Pathway (Surface water drainage)
- Landfill gas: Pathway (Lateral migration potential)
- Landfill gas: Pathway (Upwards migration potential)
- Leachate migration: Receptor (Surface water drainage)
- Leachate migration: Receptor (Human presence)
- Leachate migration: Receptor (Protected areas – SWDTE or GWDTE) (Surface water/groundwater dependent terrestrial ecosystems)
- Leachate migration: Receptor (Aquifer category – Resource potential)
- Leachate migration: Receptor (Public water supplies – other than private wells)
- Leachate migration: Receptor (Surface water bodies)
- Landfill gas: Receptor (Human presence)

Table 3.1 calculates the points awarded to each of the headings listed above.

Table 3.1: Risk Classification Calculation

EPA Ref	Risk	Points	Rationale
1a	Leachate; source/hazard scoring matrix, based on waste footprint.	7	Based on a waste footprint of >1 and ≤5 ha and a site that operated as a landfill post 1980.
1b	Landfill gas; source/hazard scoring matrix, based on waste footprint.	7	Based on a municipal waste footprint of >1 and ≤5 ha.
2a	Leachate migration: Pathway (Vertical)	3	GSI describes the groundwater vulnerability as Extreme.
2b	Leachate migration: Pathway (Horizontal)	1	The bedrock is classified by the GSI as a Poorly Productive Aquifer (PI) – bedrock which is unproductive except in Local Zones.
2c	Leachate migration: Pathway (Surface water drainage)	2	Connection between the waste body and surface water
2d	Landfill gas: Pathway (Lateral migration potential)	3	Made ground (as per GSI online mapping)
2e	Landfill gas: Pathway (Upwards migration potential)	0	No buildings or enclosed spaces above waste body

EPA Ref	Risk	Points	Rationale
3a	Leachate migration: Receptor (Human presence)	1	Private groundwater supplies within 1km of the historic site are monitored at borehole W7.
3b	Leachate migration: Receptor (Protected areas – SWDTE or GWDTE) (Surface water/ groundwater dependent terrestrial ecosystems)	0	The nearest SAC/pNHA is located greater than 1 km from the waste body
3c	Leachate migration: Receptor (Aquifer category – Resource potential)	1	The bedrock is classified by the GSI as a Poorly Productive Aquifer (PI) – bedrock which is unproductive except in Local Zones.
3d	Leachate migration: Receptor (Public water supplies – other than private wells)	0	No known public water supply within 1 km.
3e	Leachate migration: Receptor (Surface water bodies)	2	Surface water within 250 m of site boundary.
3f	Landfill Gas: Receptor (Human presence)	3	Local Authority offices and small industrial complex greater than 50 m but less than 150 m from the site boundary.

Table 3.2: Normalised Score of S-P-R Linkage

Calculator		S-P-R Values	Maximum Score	Linkage	Normalised Score
Leachate migration through combined groundwater and surface water pathways					
SPR1	1a x (2a + 2b + 2c) x 3e	7 x (3+1+2) x 2 = **84**	300	Leachate => surface water	28%
SPR2	1a x (2a + 2b + 2c) x 3b	7 x (3+1+2) x 0 = **0**	300	Leachate => SWDTE	0%
Leachate migration through groundwater pathway					
SPR3	1a x (2a + 2b) x 3a	7 x (3+1) x 1 = **28**	240	Leachate => human presence	11.6%
SPR4	1a x (2a + 2b) x 3b	7 x (3+1) x 0 = **0**	240	Leachate => GWDTE	0%
SPR5	1a x (2a + 2b) x 3c	7 x (3+1) x 1 = **28**	400	Leachate => Aquifer	7%
SPR6	1a x (2a + 2b) x 3d	7 x (3+1) x 0 = **0**	560	Leachate => Surface Water	0%
SPR7	1a x (2a + 2b) x 3e	7 x (3+1) x 2 = **56**	240	Leachate => SWDTE	23%
Leachate migration through surface water pathway					
SPR8	1a x 2c x 3e	7 x 2 x 2 = **28**	60	Leachate => Surface Water	46%
SPR9	1a x 2c x 3b	7 x 2 x 0 = **0**	60	Leachate => SWDTE	0%
Landfill gas migration pathway (lateral & vertical)					
SPR10	1b x 2d x 3f	7 x 3 x 3 = **6.75**	150	Landfill Gas => Human Presence	**63%**
SPR11	1b x 2e x 3f	7 x 0 x 3 = **0**	250	Landfill Gas => Human Presence	0%
Site maximum S-P-R Score					**63%**
Risk Classification					**B - Moderate**

Table 3.2 shows the maximum S-P-R scoring for the site is **63%** based on the potential for landfill gas production at the site.

The following are the risk classifications applied:

- Highest Risk (Class A) — Greater than 70 for any individual SPR linkage
- Moderate Risk (Class B) — 41-69 for any individual SPR linkage
- Lowest Risk (Class C) — Less than 40 for any individual SPR linkage

Based on this, the site can be classified as a **moderate risk classification (Class B)**. The EPA describes these sites as a "moderate risk posed to the environment or human health". Detailed site investigations are required to be carried out on all high and moderate risk sites.

4. CONCLUSIONS & RECOMMENDATIONS

A Tier 1 study was conducted by FT. The study consisted of a desktop study and a detailed site walkover. These works informed the development of the CSM and risk screening model.

The results of the Tier 1 assessment and risk model indicate that the site is a **Class B - moderate risk**. The EPA describes these sites as a "moderate risk posed to the environment or human health". Detailed site investigations are required to be carried out on all high and moderate risk sites.

Given that there is no landfill liner or capping present there remains a pathway between the leachate and the groundwater body beneath. There is also believed to be a direct pathway between the leachate and surface water seepage from the landfill.

A Tier 2 quantitative risk assessment is required for a site which is classified as moderate risk. FT recommend further intrusive site investigations and sampling as part of the Tier 2 assessment.

For a moderate risk site, the CoP directs that the site will have to apply for a certificate of registration which will be established in the context of Section 22 of the Waste Management Acts, 1996 to 2005.

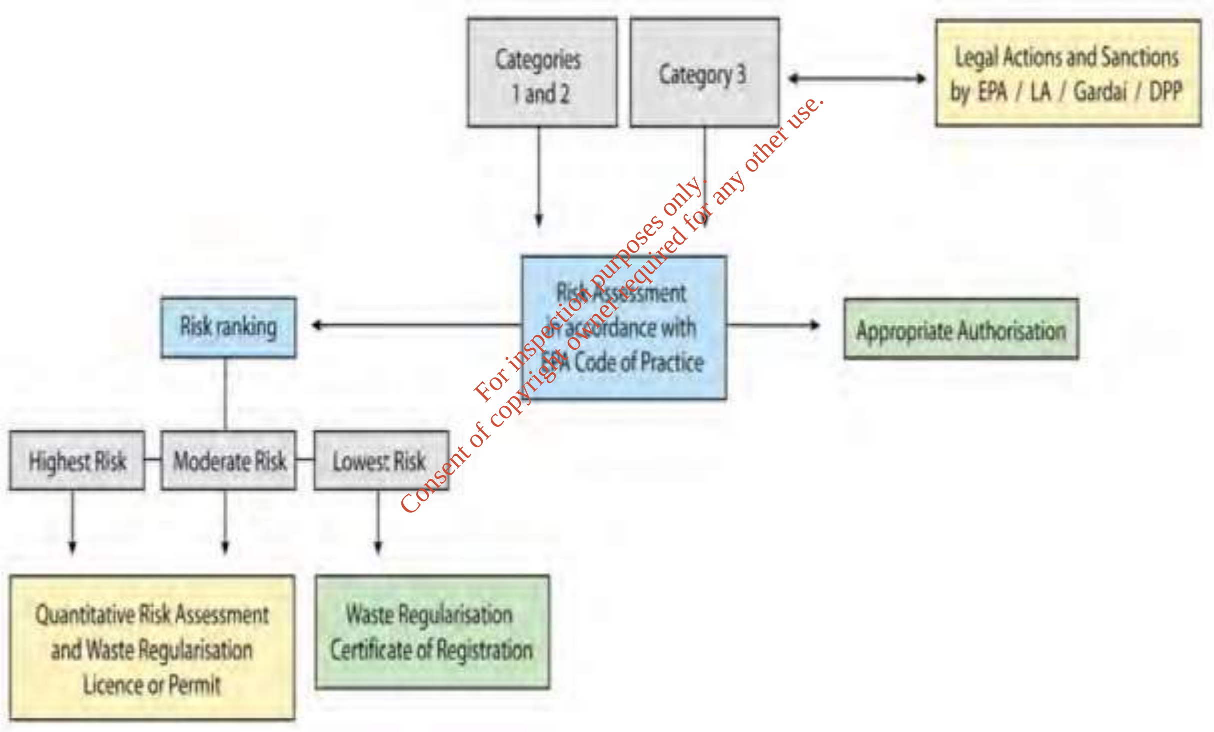

Figure 4.1: Extract from Section 1.3 of the EPA CoP

4.1. Recommendations

Notwithstanding the previous 2002 site investigation, intrusive site investigations will be required, using trial pits, boreholes and slit trenches to confirm waste volumes, footprint and depths, and to assess and characterise waste types and compositions.

The scope of the site investigation required is detailed in the following section.

4.1.1. S.I. Design

FT envisage the site investigation should consist of the following items:

- 3 x Cable Percussion with Rotary Follow-on Boreholes to 10m in the eastern portion of the site to function as leachate boreholes
- 16 x Trial Pits
- In-situ testing
- Groundwater Monitoring & Sampling
- Laboratory testing
- Factual reporting

The following sections outline the overall approach that should be adopted.

Geophysics Survey

It is recommended that a geophysical survey is undertaken to determine the extent of waste and the ground conditions beneath the waste. Procurement of a suitably qualified surveyor will be required to undertake a geophysical survey of the site using EM31 conductivity, 2D resistivity profiling and seismic refraction.

Trial Pitting

The trial pits are recommended across the site to investigate the nature, vertical and horizontal extent of the interred waste material. FT have allowed for the excavation of 16 No. trial pits across the target site to a maximum depth of 4.0m, or until natural ground is confirmed beyond the base of the interred waste body. The number and location of trial pits will depend on site access and location of existing services. All trial pits should be logged in accordance with BS5930.

Waste Quantification, Sampling and Analysis

Wastes encountered during trial pitting shall be subject to descriptive logging and bulk sampling at appropriate intervals. A proportion of the waste samples collected during trial pitting shall be subject to Waste Acceptance Criteria analysis for the purposes of classification into inert, non-hazardous or hazardous criteria.

Groundwater / Leachate / Landfill Gas Monitoring Boreholes

As per previous site investigations at the site, it is likely that landfill leachate is directly impacting the groundwater receptor. FT propose to install 3 No. monitoring wells to a maximum depth of 10m in the eastern portion of the site to be used for monitoring and sampling within the site boundary. The borehole installations will be multi-purpose and allow for sampling of groundwater, landfill gas and leachate as required. The existing offsite upgradient (B1a/B1), downgradient (B2a/B2, B5a/B5) and cross-gradient (B7a/B7) monitoring locations are proposed to be used for this assessment following agreement with MCC.

In-situ Falling/Rising head tests are recommended to assess the permeability of the underlying strata.

GPS way finders and physical markers should be used to record proposed SI locations allowing for accurate mapping and setting out of actual works.

Groundwater / Leachate / Landfill Gas Sampling and Potentiometric Mapping

The borehole installations should be multi-purpose and allow for sampling of groundwater and landfill leachate as required. Post installation and development of the wells, a minimum of two rounds of groundwater sampling should be undertaken from each of the well locations and analysed for the parameters listed in Table C3 of the EPA Landfill Monitoring Manual (2003).

Groundwater: groundwater sampling should be designed to assess the overall groundwater quality versus the published Groundwater Regulations (2010) (SI No. 9 of 2010) groundwater threshold values (GTVs), and to allow for the detection of key leachate indicators i.e. ammonia, heavy metals etc.

Leachate Sampling: any leachate or contaminated groundwater encountered during the excavations of the waste body should be sampled and subjected to Leachate Indicator analysis and compared to reference values to assess the type and strength of the leachate encountered.

Landfill Gas: borehole installations will be subject to regular monitoring as part of the proposed schedule. Landfill Gas sampling will be conducted and recorded using a GEM5000 landfill gas analyser. The GEM5000 will allow for the measurement of the following parameters:

- CH4
- CO2
- O2
- N
- H2S
- Barometric Pressure (mB)
- Flow
- Balance Gases

The groundwater flow gradient on site should be determined from the groundwater depth/head information collected at the site. A standard dip meter should be used to measure the natural level of groundwater / leachate. The potentiometric groundwater head measurements should be combined to map the groundwater flow direction beneath the site. The potentiometric mapping will allow the upstream and downstream groundwater locations to be identified which will aid conceptualising the flow direction of any contaminated leachate plumes exiting the site.

Surface Water Sampling

The perimeter drainage is installed to direct all surface water runoff from the landfill towards the G5 sump along the northern boundary as illustrated in Figure 2.7. The monitoring schedule adopted should allow for the sampling of the access chambers (i.e. G3, G4, G5, G8, G9, G10, G11, G13) and nearby open surface water drainage channels upstream and downstream of the historic landfill waste body to assess the impact (if any) of the landfill on local surface water quality.

It is envisaged to sample the upstream and downstream surface water sampling locations set out in in Table 2.1.

Table 4.1: Surface water sampling locations

Site	Receiving Watercourse	Upstream Location	Onsite Location	Downstream Location
Scotch Corner Historic Landfill	River Fane tributary stream.	G3, G8	G11, G13	G4, G5, G6 (licenced site)
Scotch Corner Historic Landfill	River Fane tributary stream.	N/A	Eastern perimeter drainage channel	Eastern perimeter drainage channel

A minimum of two rounds of surface water sampling should be undertaken from each of the 5 no. identified locations and analysed for the parameters listed in Table C3 of the EPA Landfill Monitoring Manual (2003). The results of the surface water monitoring will be assessed against the current published surface water standards (S.I. No. 272 of 2009).

The surface water monitoring should be supported with the completion of a CCTV survey of the interceptor drainage networks to assess the integrity of the system surrounding the waste body and inspect the need for repair (if required).