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GALWAY HISTORIC LANDFILLS

TIER 2 RISK ASSESSMENT HISTORIC LANDFILL AT NEW INN, CO. GALWAY

Prepared for: Galway County Council

Comhairle Chontae na Gaillimhe
Galway County Council

Date: November 2020

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TIER 2 RISK ASSESSMENT HISTORIC LANDFILL AT NEW INN, CO. GALWAY

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Abstract: This report represents the findings of a Tier 2 site investigation carried out at New Inn Historic Landfill, Co. Galway 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

New Inn historical landfill site covers an area of c.1.5 ha and is located adjacent to the R348, Athenry to Ballinasloe Road, to the west of New Inn town. The site is owned by Galway County Council.

A Tier 2 study was conducted by Fehily Timoney (FT) in accordance with the EPA Code of Practice - Environmental Risk Assessment for Unregulated Waste Disposal Sites for New Inn Historic Landfill.

The study consisted of a desktop study, site walkover, topographical survey, geophysical survey, intrusive site investigation and environmental monitoring. These works informed the development of the CSM and risk screening model.

The findings of the site investigation work and geophysical surveying suggest the waste material is deposited in a single infill area with the footprint of the historic landfill estimated at 2,600 m^2. 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 10,400 m^3.

Analysis of waste samples from the trial pits advanced at the site, when assessed against 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 biological degradation that has taken place since waste placement commenced. Trial pitting and site walkovers have confirmed the waste material is near the surface with a minimal soil cover present across the site.

Landfill gas monitoring from monitoring wells existing wells BH01, BH02, BH04 and new monitoring wells GW01 and GW02 at the site indicates gas concentrations detected are below threshold levels set by the EPA Landfill Manuals - Landfill Monitoring, with the exception of well BH02 which is located within the waste body.

Analysis of groundwater samples recovered from the monitoring wells BH01, BH04, GW01 and GW02 contain elevated concentrations of ammoniacal nitrogen and chloride at GW02 and BH04. Ammoniacal nitrogen and chloride constituents of leachate which commonly occur in high concentrations in leachate. However, EPA groundwater monitoring at New Inn has historically recorded elevated concentrations of chloride, therefore the elevated concentrations observed at GW02 and BH04 may not be directly attributed to leachate migration from the site.

The shallow soil cap is not suitable at preventing rainfall infiltration into the waste body which will continue to contribute to leachate generation.

Static groundwater level measurements indicate that the groundwater flow direction is south to north. Groundwater level measurements also indicated that groundwater table was slightly below the base of waste material at the time of monitoring, however it is noted that groundwater levels fluctuate seasonally and the water table may transect the waste material at various times of the year.

The leachate monitoring results from BH02 show the presence of pollutants and at elevated concentrations typical of MSW landfill leachate i.e. ammoniacal nitrogen, chloride and COD.

Analysis results for surface water samples recovered from the Raford River located to the north of the site, at locations upstream and downstream of the historic landfill show only one exceedance of EQS limit values. Nickel concentrations were marginally above the EQS limit at upstream location SW1 for one monitoring round. The results indicate that the site is not having a negative impact on the water quality of this river.

Based on the results of the Tier 2 site assessment, the site can be classified as a **Low Risk Classification (Class C)**.

1. INTRODUCTION

1.1 Background

Galway County Council (GCC) appointed Fehily Timoney and Company (FT) to prepare a Tier 2 risk assessment on a historical landfill near New Inn, Co. Galway.

New Inn historical landfill covers an area of c.1.5 ha and is located adjacent to the R348, Athenry to Ballinasloe Road, to the west of New Inn. The site is owned by Galway County Council.

The topography of the site is generally relatively flat, with a gentle slope towards south-west. The surroundings area primarily comprises agricultural land with residential areas found to the south-east.

The landfill area was initially estimated to be approximately 1.5Ha. Available evidence suggests the site was operated between 1970's to 1989. It was originally part of a quarry operated by Galway County Council which was later infilled. The Raford River is located c.60m north of the site boundary, flowing in an east-west direction.

No remediation measures are known have been carried out with the exception of fencing the site however the fencing is now mostly removed or damaged. Groundwater monitoring wells were also previously installed within the site and offsite, some of these wells have been utilised as part of the Tier 2 assessment. For groundwater, leachate and landfill gas monitoring.

A Tier 1 Risk Assessment was previously completed by GCC. Based on the available information, the Tier 1 Assessment determined that the overall risk score for New Inn Landfill was 70%, resulting in a risk classification of **High (Class A)**. The highest score of 70% was calculated for source-pathway-receptor (SPR) 8, referring to the risk of leachate migration to surface water via surface water pathways.

A copy of GCC's Tier 1 assessment risk scoring results are included in Appendix 1.

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
- Topographical Survey
- Geophysical and surveying to estimate extents and depths of waste
- Intrusive Site Investigation
- Groundwater and Surface Water Sampling
- Development of a conceptual site model (CSM)
- Environmental Risk Assessment (ERA).

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 scope of the site investigation.

The site walkover checklist and accompanying photolog are included in Appendix 2 to this report.

Minerex were appointed by FT to undertake a geophysical survey of the site. Geophysical surveying including Electro Conductivity, Electro Resistivity and Seismic Refraction surveying methods. The full geophysical survey report is included in Appendix 3 to this document.

The purpose of the geophysical study was to attempt to define the vertical and lateral extents of any waste body.

FT appointed Causeway Geotech Limited (CGL) to conduct the intrusive site investigation which included the installation of two groundwater monitoring wells and eight trial pits excavations. Sampling and geotechnical analysis of capping material was also conducted.

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.

A full geotechnical report is included in Appendix 4 to this document.

Laboratory analysis of waste, surface water and groundwater samples were conducted to assess and quantify any potential or ongoing environmental impacts. Results of waste sampling are included in Appendix G of Causeway Geotechnical Report (Appendix 3 of this report) with

Laboratory analytical reports for surface and groundwater monitoring are presented in Appendix 5.

The information gathered from the desk study, intrusive site investigation and geophysical survey were used to inform the development of 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
- DoHPLG/EPA/Local Authority maps: www.catchments.ie
- BS 5930: 1999, Code of Practice for Site Investigations
- BS 10175: 2000, Investigation of Potentially Contaminated Sites – Code of Practice
- 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 on the 20th of May 2020.

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 area was originally estimated by GCC to be approximately 1.5Ha and is in the ownership of Galway Co Co. Based on land folio mapping provided by GCC additional lands adjacent to the site have also been considered in this Tier 2 assessment to confirm if waste deposition occurred beyond the site boundary originally identified by GCC. Investigation in these lands comprised the excavation of four trial pits and geophysical survey.

The site is located adjacent to the R348, Athenry to Ballinasloe Road. The Raford River is located north of the site and New Inn town is located east of the site. There are no dwellings located within the site, however there is a housing development located less than 50m south-east of the site.

The site was a former quarry and was subsequently filled. The ground at the site is undulating, with small, localised dips and mounds throughout the site. Generally, however elevations are decreasing in a south to north direction from the R348 road. The surroundings area is mainly agricultural land, residential areas can be found to the south-east and Raford River to the North.

An existing leachate monitoring well (BH2) located within the known historic landfill area was identified and was utilised for this Tier 2 assessment.

The location of the site is shown in Figure 2.1.

2.2.2 Previous Studies

A Tier 1 Risk Assessment and risk scoring was completed by GCC (Appendix 1). The Tier 1 assessment comprised the following:

- 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 maximum risk score for New Inn Landfill was 70%, resulting in a risk classification of **High (Class A)**.

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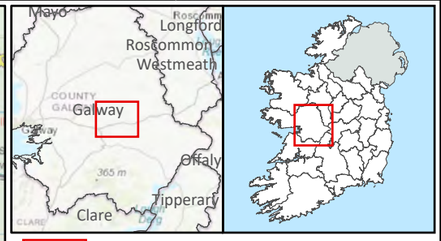

Site Boundary

N
W E
S
0 0.5 1 2 Kilometers

TITLE: Site Location			
PROJECT: New Inn Historic Landfill ERA			
FIGURE NO:	2.1		
CLIENT:	Galway County Council		
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2.2.3 Topography

The historic landfill site covers an area of c.1.5 ha is located adjacent to the R348, Athenry to Ballinasloe Road. Topography of the surrounding environment is characterised by land gently sloping upwards the hills to the east of the site and New Inn. The historical landfill site is a former quarry and is characterised by an undulating surface, mounds and steep slopes along the R348, but with elevations generally decreasing from the roadside in a northerly direction. Review of the OSI Discovery series map indicate that site elevations range from 70 – 80 m AOD.

2.2.4 Geology

Geological and hydrogeological information on the site and surrounding area was obtained from the online GSI spatial mapping and database.

Drift/Quaternary Geology

The quaternary sediments at site comprise Gravels derived from Limestones. Drift/quaternary geology is shown in Figure 2.2.

During the installation of boreholes, the presence of made ground, sand, gravel, clay and limestone was recorded and are described in the driller's logs (see Appendix 4).

Solid or Bedrock Geology

The underlying bedrock at the site comprises the of Lucan Formation (LU), described as dark limestone and shale. GSI mapping did not indicate the presence of bedrock outcrop within the site or immediate vicinity. Bedrock geology is presented in Figure 2.3.

Bedrock was encountered at 5.90m (73.12 mAOD) and 4.40m bgl (73.92 mAOD) during the installation of boreholes GW01 and GW02 as referenced in the CGL borehole logs, Appendix 4.

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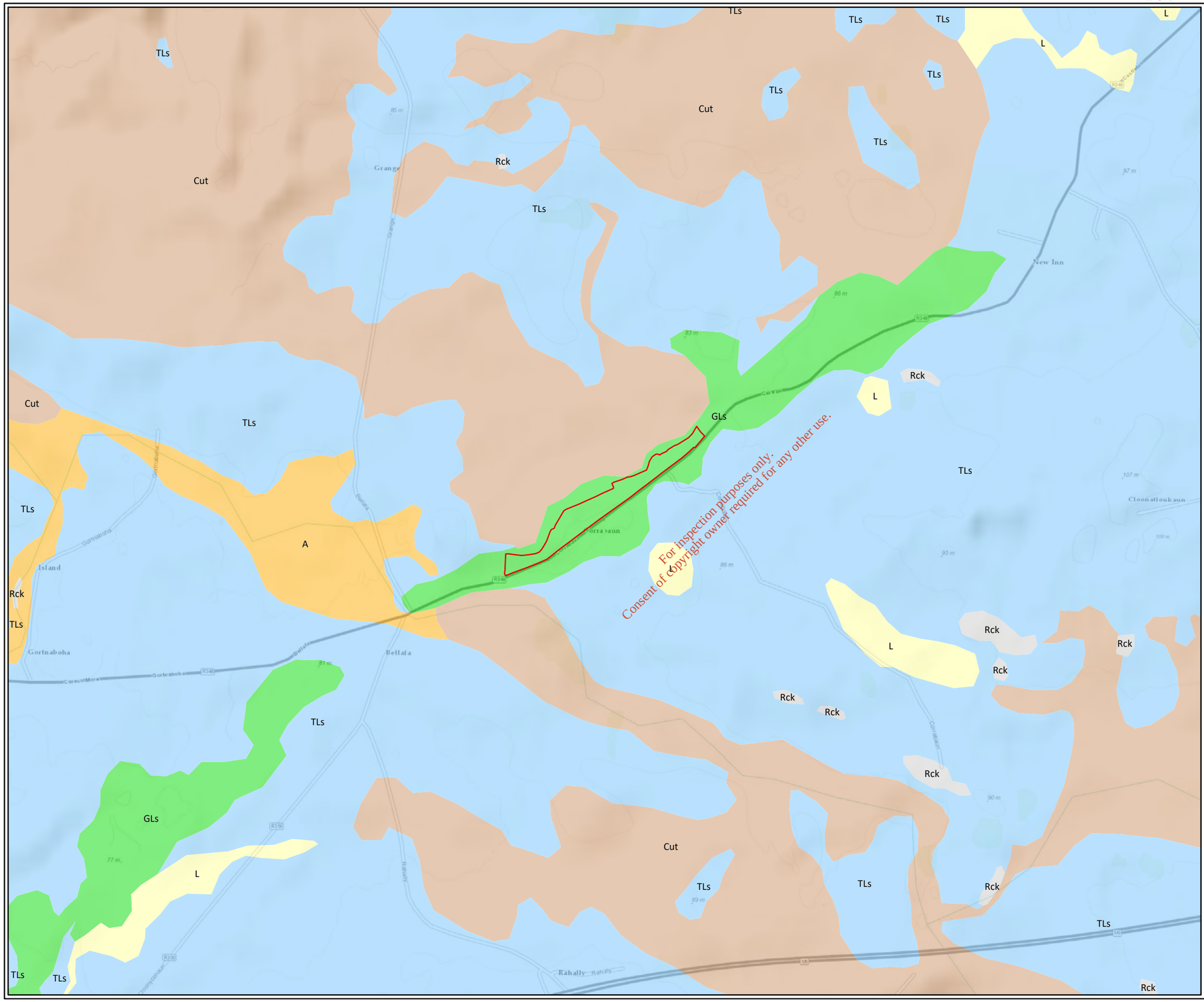

Site Boundary

Quaternary Sediments

- A, Alluvium
- Cut, Cut over raised peat
- GLs, Gravels derived from Limestones
- L, Lacustrine sediments
- Rck, Bedrock outcrop or subcrop
- TLs, Till derived from limestones

TITLE:	Quaternary Geology		
PROJECT:	New Inn Historic Landfill ERA		
FIGURE NO:	2.2		
CLIENT:	Galway County Council		
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DATE:	24/02/2020	**PAGE SIZE:**	A3

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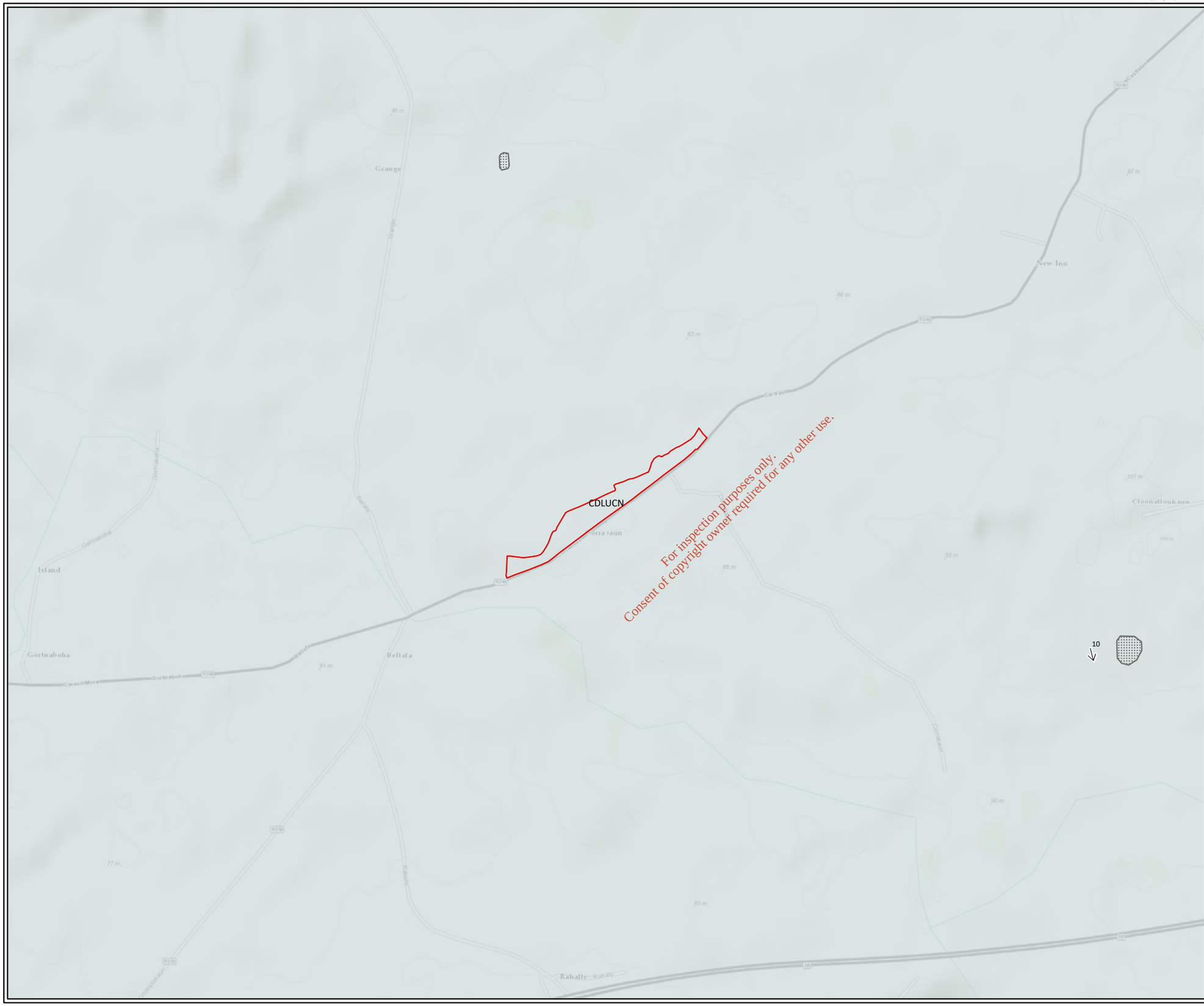
N W E S

0 0.25 0.5 1 Kilometers



Site Boundary

Dip of bedding or main foliation, old GSI data

Bedrock Outcrop

Bedrock Geology

Lucan Formation

Kilometers
0 0.25 0.5 1

TITLE:	Bedrock Geology		
PROJECT:	New Inn Historic Landfill ERA		
FIGURE NO:	2.3		
CLIENT:	Galway County Council		
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2.2.5 Hydrogeology

Bedrock aquifer mapping shows that bedrock groundwater beneath site comprises two different aquifers: 'Locally important gravel aquifer - Lg' and 'Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones - Ll' as defined by the GSI. The bedrock aquifer mapping is presented in Figure 2.4.

There are no karst landforms identified within the site boundary. The closest GSI recorded landform is located c.4.86 km north of the site (Regionally Important Aquifer - Karstified (conduit).

Historical mapping (1888-1913 and 1837-1842) for the area shows no springs within the site boundary or immediate vicinity (<1km). Several springs are located in New Inn town, over 1km from the site. It is noted that a portion of the site was also used as a former quarry. There are several standalone dwellings and clusters of residential units in relative proximity to the site and wider environment where unregistered private wells may be present. A review of the GSI registered wells and springs database was also conducted.

Table 2.1 below presents the details of the registered boreholes and springs within 1km of the site:

Table 2-1: Borehole and Spring Descriptions near the Project Site

BH/Spring	Yield class	Yield (m^3/day)	Use	Depth (m)	Depth to Rock confidence (m)	Distance from site (km)	Date
1421NEW025	Excellent	654	Group Scheme	4.6	-	1	1899

The GSI mapping showing approximate locations of known wells and springs is included in Figure 2.5.

There are no Groundwater Drinking Water Protection Areas within the site boundary according to GSI. However, the Zone of Contribution (ZOC) Rhynn Killeeneen groundwater protection zone is located c. 40m north of the site at its closest point. The ZOC encompasses sections of the Raford River (as a surface water contributor to the supply) and located north of the site. The 'G131 New Inn' source protection area is located in New Inn, less than 1km from the site to the north-east. Other groundwater protection zones in the region are located over 5km from the site.

The GSI mapping shows that the groundwater body (GWB) underlying the site is the Rahasane Turlough GWDTE (SAC000322), a poorly productive bedrock aquifer. The most recent (2013-2018) Water Framework Directive quality status for the GWB is 'Good'. The WFD risk to groundwater quality was most recently classified as 'At Risk'.

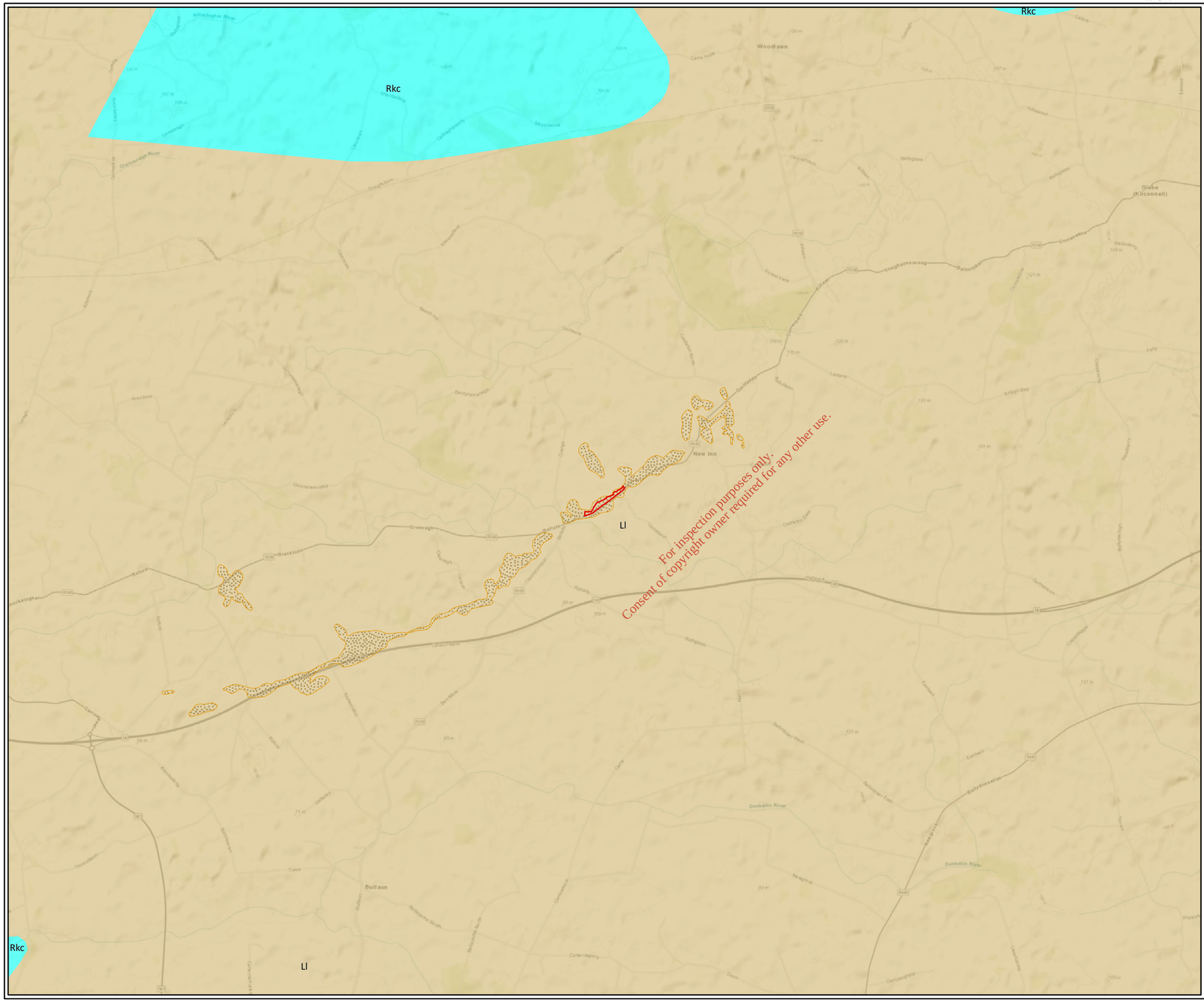
An EPA groundwater monitoring station (New Inn No.1) is located at New Inn for the purpose of monitoring groundwater quality of the GWDTE-Rahasane Turlough groundwater body. Summary monitoring data provided by the EPA shows that groundwater quality is achieving standards for total ammonia, conductivity and nitrate but is failing to achieve quality standards for Chloride and ortho-phosphate. A summary of the baseline concentrations for the 2010 - 2015 trend period (2012 baseline) are presented in Table 2.2.

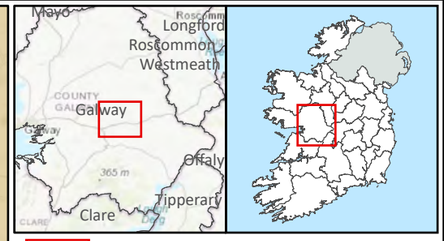
Table 2-2: Summary of EPA Monitoring Data at New Inn No.1 GW Station

Parameter	2012 baseline concentration	2018 Concentration
Ammonia-Total (as N) (mg/l)	0.018	0.028
Chloride (mg/l)	26.849	26.6
Conductivity@25oC (uS/cm)	728.667	705.667
Nitrate (as NO_3) (mg/l) (mg/l)	9.147	5.610
Ortho-phosphate (as P) (mg/l)	0.033	0.035

There are no recorded groundwater dependent ecosystems in the area.

GSI mapping shows groundwater recharge to be quite variable within and surrounding the site. Owing to the variation in geology, the recharge co-efficient values vary from 42.50% to 85%. Based on an effective rainfall rate of 724 mm/year for the area this yields aquifer recharge rates from 308 to 615 mm/year.





Site Boundary

Sand and Gravel Aquifers

Locally important gravel aquifer

Bedrock Aquifers

Ll: Locally Important Aquifer - Bedrock Mod Productive Locally

Rkc: Regionally Important Aquifer - Karstified (conduit)

N W E S

0 0.5 1 2 Kilometers

TITLE:	Aquifer Classification		
PROJECT:	New Inn Historic Landfill ERA		
FIGURE NO:	2.4		
CLIENT:	Galway County Council		
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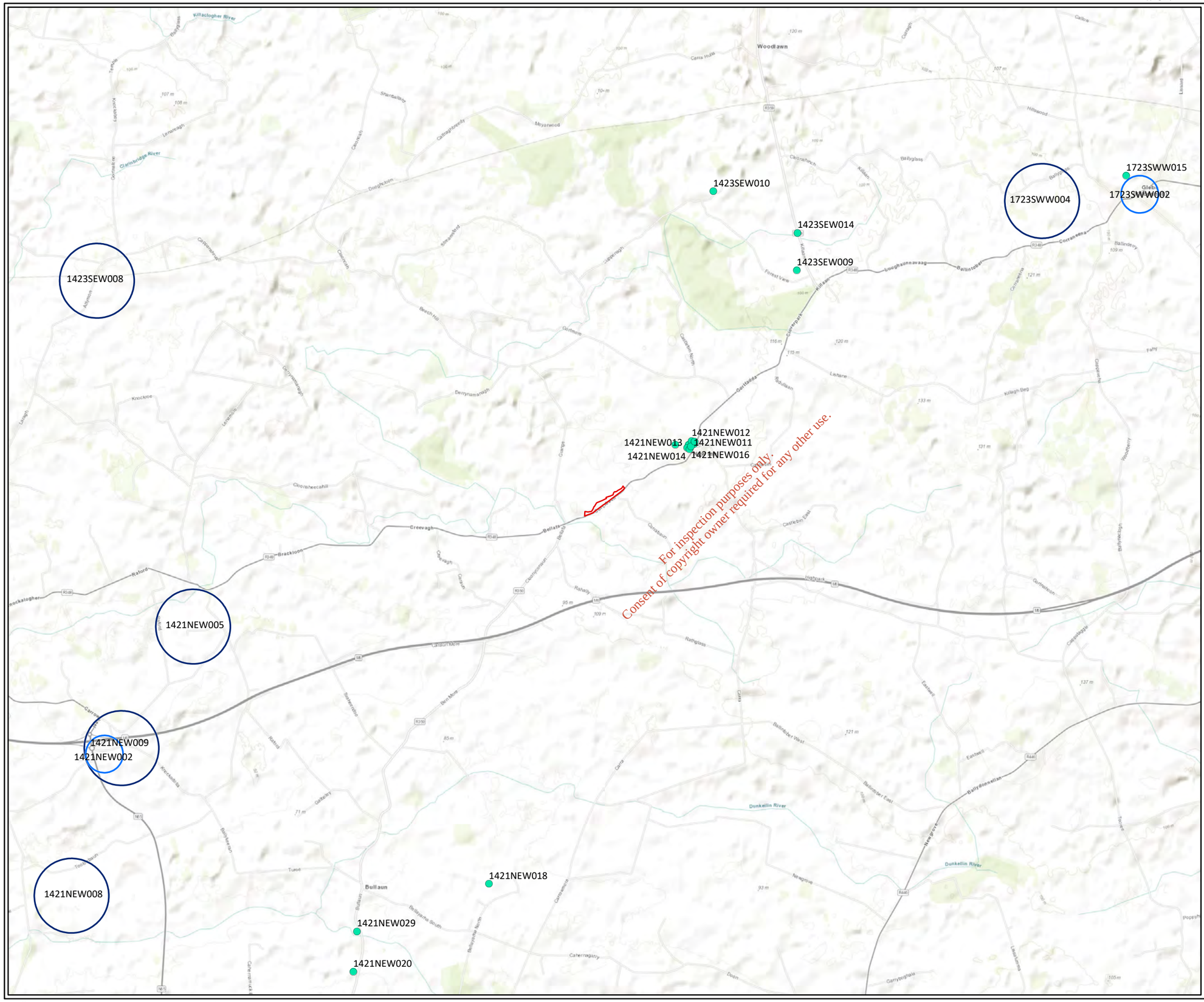

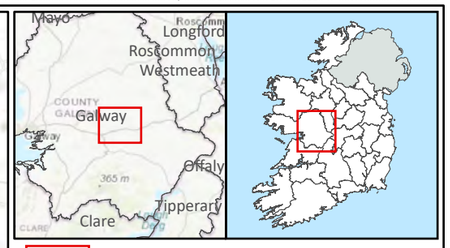

Site Boundary

Wells and Springs (10-50m Accuracy)

Wells and Springs (50-100m Accuracy)

Wells and Springs (100-200m Accuracy)

Wells and Springs (200-500m Accuracy)

Wells and Springs (500m-1km Accuracy)

N W E S

0 0.5 1 2 Kilometers

TITLE:	Wells and Springs		
PROJECT:	New Inn Historic Landfill ERA		
FIGURE NO:	2.5		
CLIENT:	Galway County Council		
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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 may be contaminated by human activities.

The factors used in assessing groundwater vulnerability include subsoil type and thickness and recharge type as indicated in Table 2.3. The GSI procedure whereby groundwater protection is assessed is outlined in the EPA-GSI publication *Groundwater Protection Schemes* (DELG/EPA/GSI, 1999).

The GSI Online mapping data set identifies the vulnerability of groundwater to contamination within the site area is classified as being high (H). Groundwater vulnerability does vary considerably in the area changing from rock near surface to low, north-east of the site. Drillers logs for boreholes GW02 show that waste material encountered at this location is underlain by <3m of sandy gravel (75.12 mAOD to 73.92 mAOD) with bedrock encountered at 73.92 mAOD. This suggests that the underlying bedrock aquifer may be extremely vulnerable to leachate migration. The groundwater vulnerability mapping is presented in Figure 2.6.

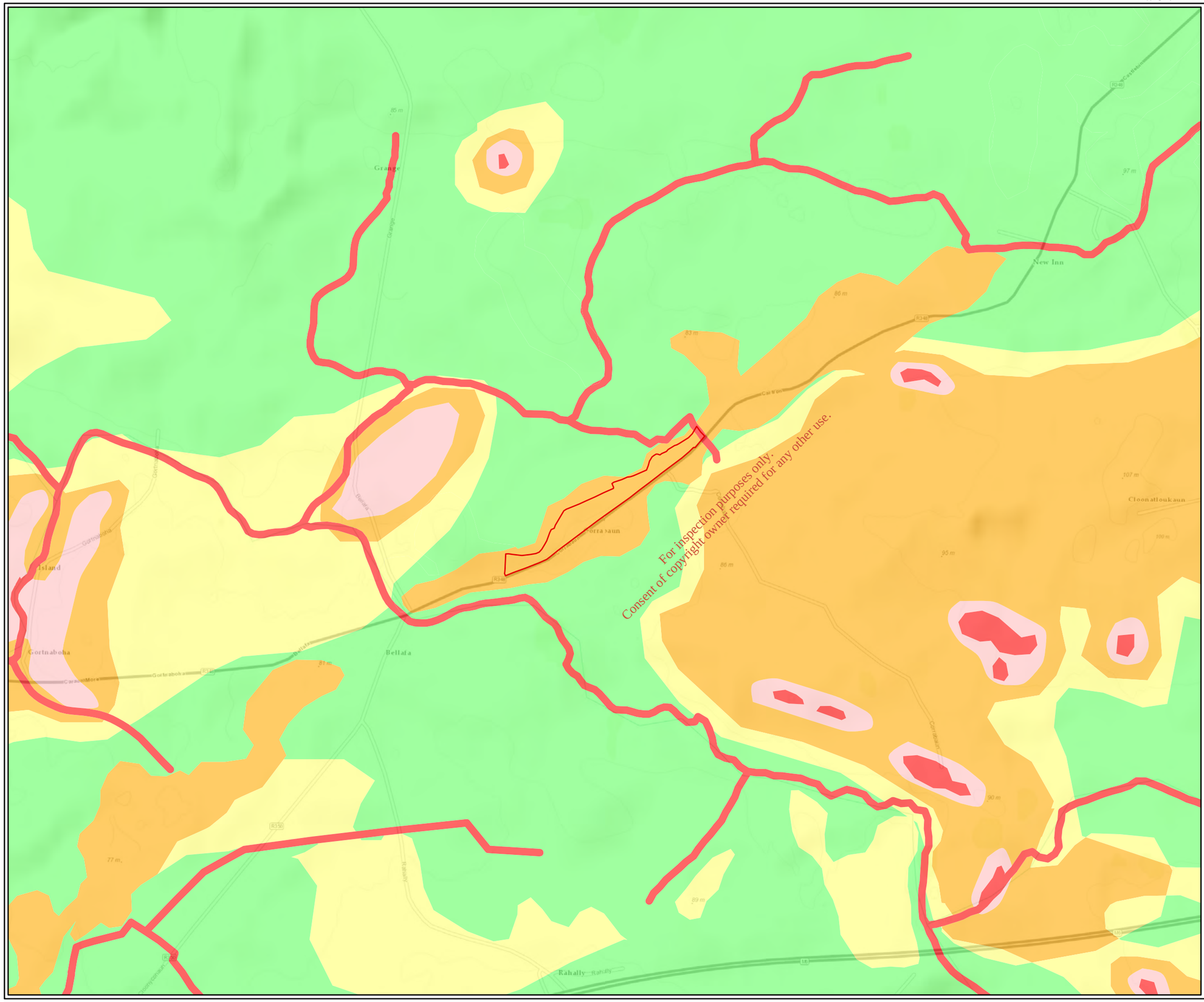
Table 2-3: GSI Guidelines – Aquifer Vulnerability Mapping

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.



Site Boundary

Groundwater Vulnerability

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

N W E S

0 0.25 0.5 1 Kilometers

TITLE:	Groundwater Vulnerability		
PROJECT:	New Inn Historic Landfill ERA		
FIGURE NO:	2.6		
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2.2.7 Hydrology

The site is located within the Galway Bay South East catchment (Hydrometric Area: 29), Raford_SC_010 sub-catchment and Raford_020 sub-basin. The nearest surface water feature to the site is a small river (EPA Name:Raford_020 river) (Status: Moderate) which is the northeast boundary of the site and flows in an east-west direction eventually converging with the Kilcolgan River (EPA Name) (Status: Bad) c.16km downstream of the site before discharging into Dunbulcaun Bay, south-west of New Inn town. Review of available mapping indicates and surveys of the site show the presence of land drains along the boundaries and in proximity to the site which indicate that there may be direct surface water connection e.g. land drains, ditches etc. between the landfill area and the River Raford.

Routine surface water quality monitoring is conducted by GCC at Bellafa Bridge monitoring station, located c.500m downstream of the site, and is the nearest EPA surface water monitoring station to the site. The most recent biological Q-Rating of surface water quality at this location (2018) was Q4, Good status. There is no record of upstream monitoring close to the site.

The river and catchment mapping are presented in Figure 2.7.

2.2.8 Ecology

The site is not located within or directly adjacent to any Natural Heritage Area (NHA), proposed NHA (pNHA), Special Area of Conservation (SAC) or Special Protection Area (SPA). The nearest protected site, Raford River Bog NHA (Site Code: 000321), is located c.800m to the north-west of the site at its closest point. There are no other protected sites in the vicinity of the site or any sites that would be considered likely to be at risk.

The ecology protected areas mapping is presented in Figure 2.8.

2.2.9 Existing Geological Heritage

The GSI holds no records of areas of Geological Heritage within the site boundary.

The nearest recorded of geological heritage held by the GSI is approximately 1.2km South of the site boundary is a 'Rahally M6 Road Cut' which refers to a '*a 500 m long road cutting along the M6 motorway, with both high and low cliffs of rock*'.

Another geological heritage area is a 'Toormore M6 Road Cut' located c.4.7km south-east of the site and is described as '*a 400 m long road cutting along the M6 motorway, with relatively low cliffs of rock'.*

The geological heritage mapping is presented in Figure 2.9.

2.2.10 Existing Geotechnical Stability

The GSI landslides database indicates that there are no recorded geo-hazards within the site boundary or in the surrounding area or region.

The closest record is located c.19.8 km to the south-west of the site, in Sonnagh Old Toberalatan, on edge of windfarm site road, in 2008.

2.2.11 Archaeological Heritage

Review of the 1837-1842 and 1888-1913 OSI historical maps for the area do not indicate the presence of any significant archaeological features within the site boundaries. The 1837-1842 mapping did indicate the presence of a graveyard, c.0.6km to the north of the site, an old malt kiln and a chapel, c.0.8km to the north-east of the site, still displayed on the 1888-1913 maps.

Review of the Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs' online historic environment viewer/database indicates the presence of 12 No of features within 1km of the site, some correspond with the monuments shown in the 1837-1842 and 1888-1913 OSI maps. Some records have not been uploaded and the Archaeological Survey of Ireland (ASI) is in the process of providing information.

Within the site boundary, to the west, there is a Children's burial ground, however, as the ASI notes, the entire area has been quarried out and there is no surviving trace. The other closest monument, an unclassified ringfort, is located c.0.3km south of the site boundary, defined by two banks and an intervening fosse. The ringfort is in fair condition and there is no surface trace elsewhere.

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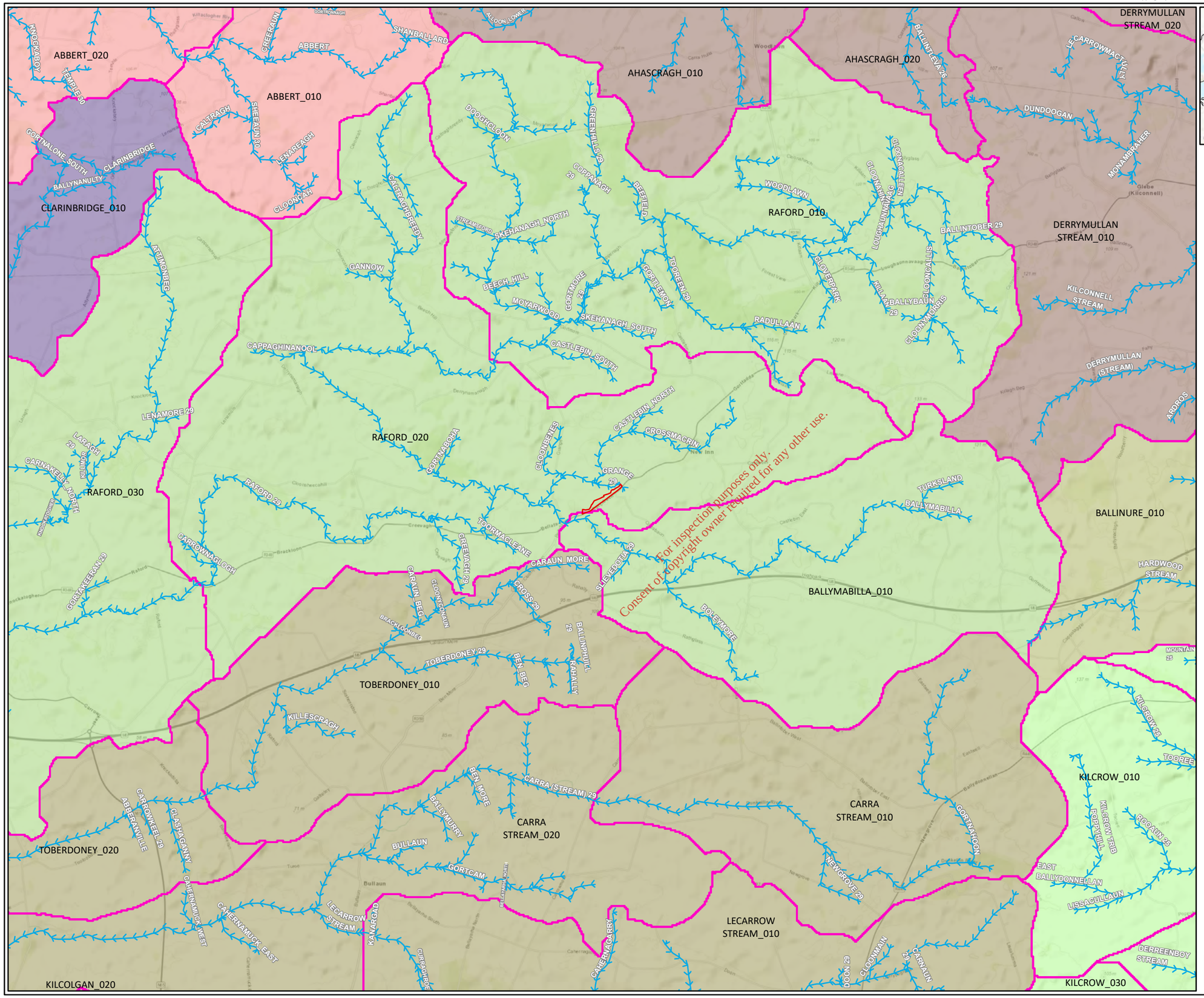

N W E S
0 0.5 1 2 Kilometers

TITLE: River and Waterbody Catchment			
PROJECT: New Inn Historic Landfill ERA			
FIGURE NO:	2.7		
CLIENT:	Galway County Council		
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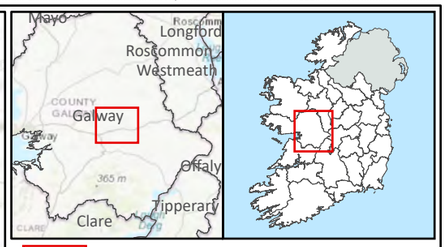

Site Boundary

Special Area of Conservation (SAC)

Natural Heritage Area (NHA)

N
W E
S

0 0.5 1 2 Kilometers

TITLE: Ecologically Protected Sites			
PROJECT: New Inn Historic Landfill ERA			
FIGURE NO:	2.8		
CLIENT:	Galway County Council		
SCALE:	1:50,000	**REVISION:**	0
DATE:	24/02/2020	**PAGE SIZE:**	A3

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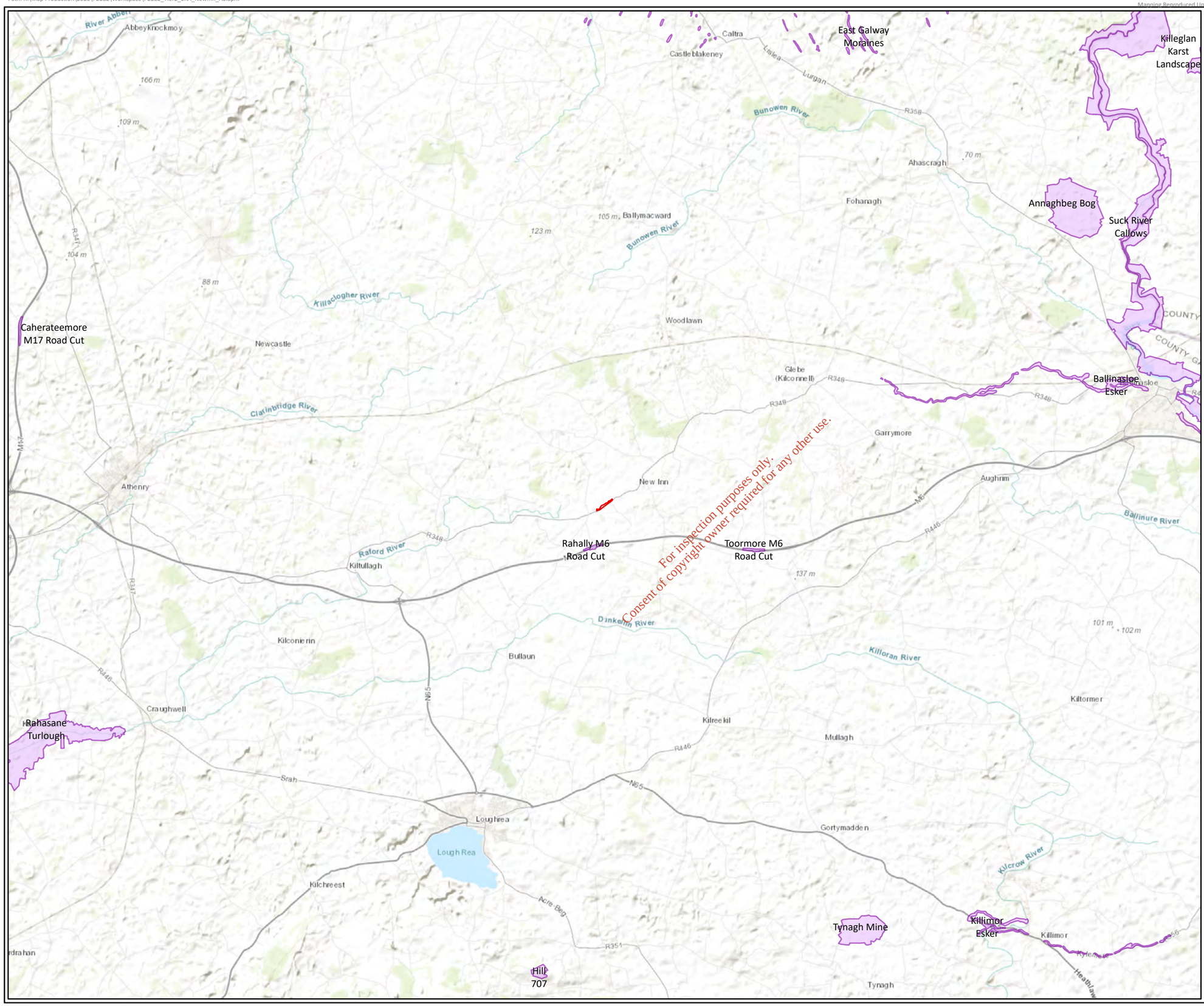

N W E S
0 0.5 1 2 Kilometers

TITLE: Geological Heritage			
PROJECT: New Inn Historic Landfill ERA			
FIGURE NO:	2.9		
CLIENT:	Galway County Council		
SCALE:	1:125,000	**REVISION:**	0
DATE:	07/10/2020	**PAGE SIZE:**	A3

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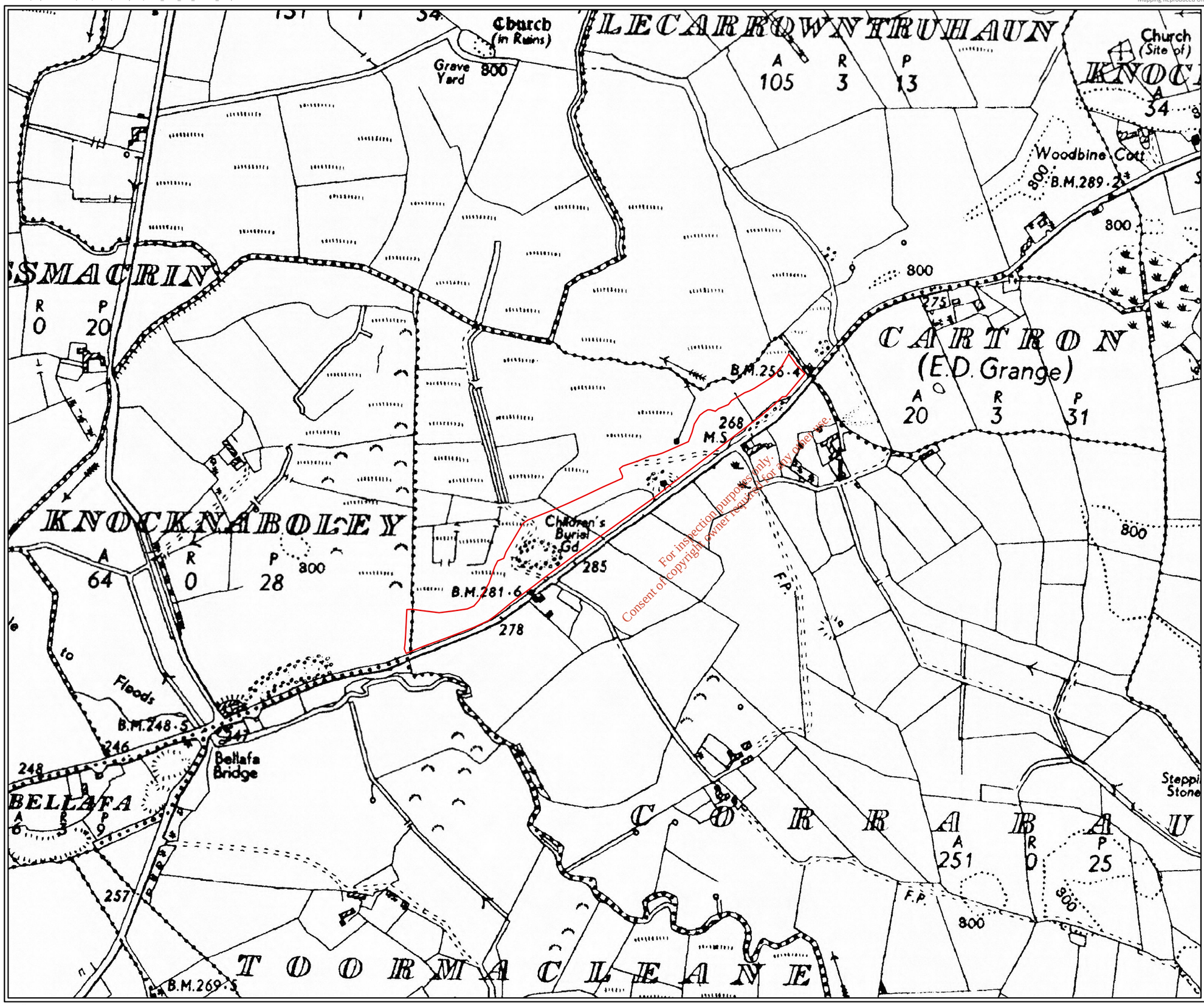
2.2.12 Site History

The earliest historical map available on the OSI website dates from 1837-1842 and there are no distinct features noted within the site boundary or in the vicinity. Review of the latter 1888-1913 OSI historical mapping shows that portions of the site were historically used as gravel pits. Historical OSI historical imagery, from 1995, show evidence of landfilling activities which seems to have ceased on imagery available from 2000. No other significant activities seem to have occurred according to imagery available from 2005-2012 and 2011-2013.

OSI historical mapping presented in Figure 2.10 and Aerial Imagery in Figure 2.11.



Site Boundary

TITLE:	OSi Historical Mapping
PROJECT:	New Inn Historic Landfill ERA
FIGURE NO:	2.10
CLIENT:	Galway County Council
SCALE:	1:5,000
REVISION:	0
DATE:	24/02/2020
PAGE SIZE:	A3

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N W E S

0 125 250 500 Meters

Historical Aerial Imagery (1995)

Historical Aerial Imagery (2000)

Historical Aerial Imagery (2005-2012)

Historical Aerial Imagery (2011-2013)

Figure 2-11: Historical Aerial Imagery[1]

[1] *Source:* http://map.geohive.ie/

3. TIER 2 SITE INVESTIGATION

3.1 Site Investigation Works

A site investigation rationale was devised based on findings of the Tier 1 assessment, site walkover, historical aerial photography and the preliminary risk assessment which formed part of that report.

The scope of site investigation works included:

- Topographical Survey
- 1 No. Geophysical survey (2D resistivity, EM31 Ground Conductivity and seismic refraction profiling)
- 2 No. groundwater monitoring wells
- 8 No. trial pits excavations
- Factual reporting.

The locations of the intrusive works at the site are presented in Figure 3.1.

The site investigation methodology considered the following literature sources:

- EPA 2003, Landfill Manuals: Landfill Monitoring (2nd Edition)
- EPA 1999, Landfill Manuals: Site Investigations
- BS 5930: 1999, Code of Practice for Site Investigations
- BS 6068 Water Quality: Sampling (parts 6.1-6.6 and 6.11-6.12, 6.14)
- BS 8855 Soil analysis (all parts)
- CLM: Ready Reference 2002, Section 3.1 Soil sampling strategies
- CLM: Ready Reference 2002, Section 3.2 Groundwater sampling/monitoring strategies
- CLM: Ready Reference 2002, Section 3.3 Gas sampling/monitoring strategies.

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Site Boundary

Groundwater Well

Trial Pit

TITLE:	Site Investigation Location Plan		
PROJECT:	New Inn Historic Landfill ERA		
FIGURE NO:	3.1		
CLIENT:	Galway County Council		
SCALE:	1:2,000	**REVISION:**	0
DATE:	17/08/2020	**PAGE SIZE:**	A3

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N W E S

0 50 100 200 Meters

3.1.1 Geophysical Investigation

Minerex Geophysics Ltd (MGX) were instructed by FT to undertake a geophysical investigation of the site. The survey was carried out on the 21st May and the 12th of June 2020. The MGX geophysical survey report is included in Appendix 3.

The geophysical survey consisted of reconnaissance EM Ground Conductivity Mapping with follow-up 2D Resistivity Profiling (RT) and Seismic Refraction Profiling. A total of 338m for Resistivity Profiling (RT) and 351m for Seismic Refraction Profiling of geophysical profiles were collected. The geophysical survey was used to estimate a general profile of the buried waste above the in-situ bedrock.

The survey indicates natural overburden underlying most of the site with some municipal solid waste (MSW) material to the south of the site. The extent of the historic landfill is estimated at 2,600 m^2, its depth is about 4m bgl which gives a total volume estimate of 10,400 m^3. The resistivities within the interpreted waste area would indicate primarily mixed waste but as the resistivity are not generally extremely low it may also contain Construction and Demolition (C &D) type waste. There is no engineered capping layer over the waste area and the geophysical survey does not show any significant natural material over the landfill.

MGX recorded RT profiles data along 3 designated profiles due to the elongated nature of the site. RT profiles named R1, R2 and R3, and three seismic refraction profiles (S1- S3) were recorded across the site. See Figure 3.2.

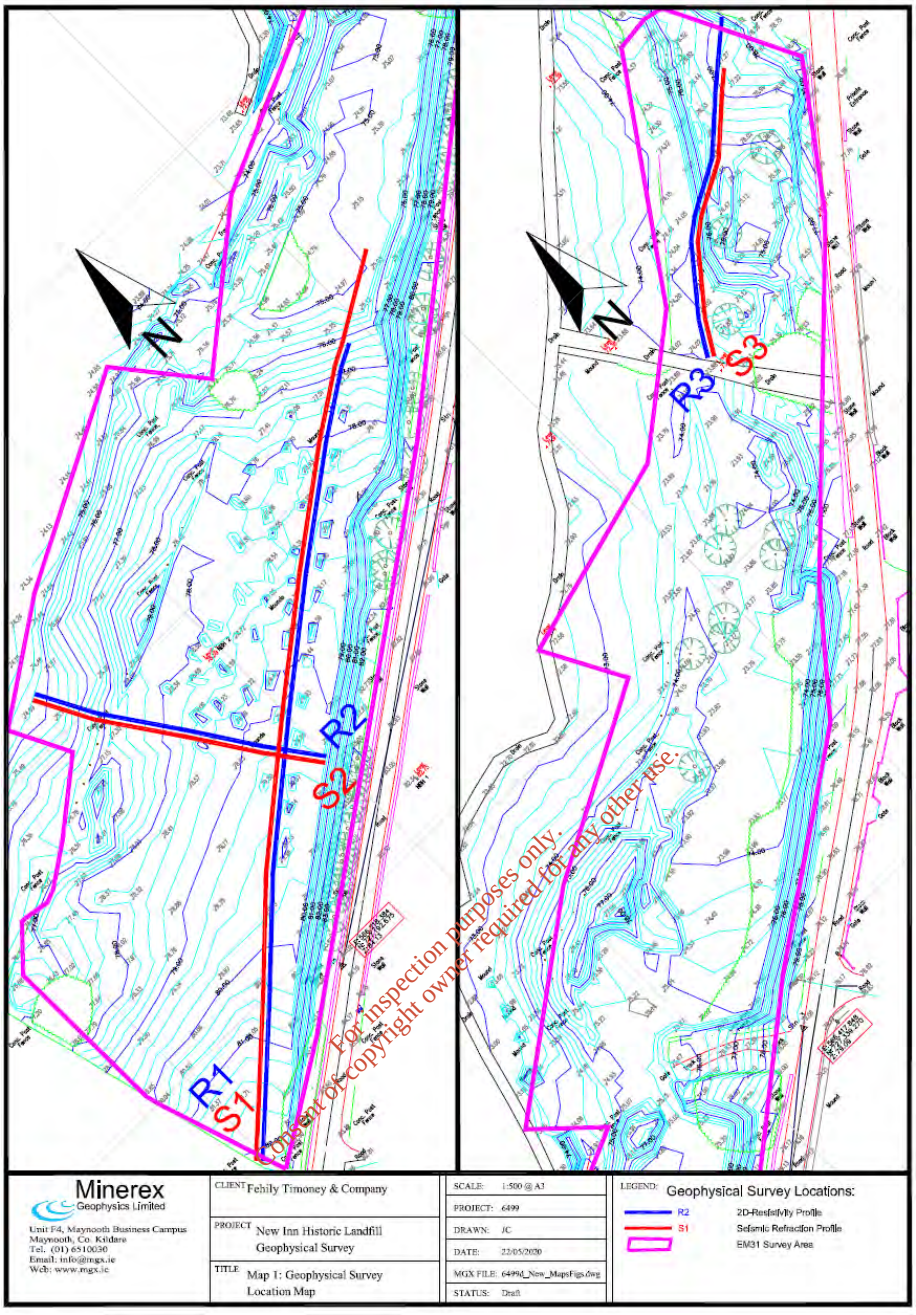

Figure 3-2: Geophysical Survey Location Map

Results

The geophysical survey succeeded in identifying the general location of the waste material. Elevated EM conductivity readings in combination with the trial pit logs show the waste to be located to the south of the survey area.

Most of the survey area shows low conductivities (<20 mS/m) which indicates no waste or possibly C&D waste material. There is one area in the south where conductivities rise to generally 20 – 40 mS/m. These conductivities would indicate some waste material, but the conductivities do not increase to very high levels which are typically found over deep landfills.

Low resistivities (<62.5 Ohm) indicate mainly municipal waste material or leachate but may also indicate clay-rich or peat overburden. Medium resistivities (62.5 – 500 Ohm) indicate boulder clay overburden while high resistivities (>500 Ohm) indicate sand and gravel near the surface and fresh limestone at depth.

A layered ground model was created from the modelled seismic data (See Figure 3.3):

Layer 1a has a seismic velocity range of 300 m/s and 400 m/s and is found in the South of the survey area. This velocity would represent landfill material, mainly MSW.

Layer 1b has a seismic velocity range of 300 m/s and 400 m/s and is found in most of the survey area. This velocity would represent topsoil with little or no waste material.

Layer 2a has a seismic velocity range of 900 and 1200 m/s. This layer is interpreted as overburden material with leachate, and it is found only in some areas below layer 1a.

Layer 2b has a seismic velocity range of 900 and 1200 m/s. This layer is interpreted as overburden material, and it is found in most of the survey area.

Layer 3 is interpreted as compact overburden or weathered Limestone, and is found in most of the survey area, under layers 2a and 2b. This layer has 2000 m/s seismic velocity.

Layer 4 is interpreted as fresh Limestone and is found only under profile R3, under layer 3. This layer has 4000 m/s seismic velocity.

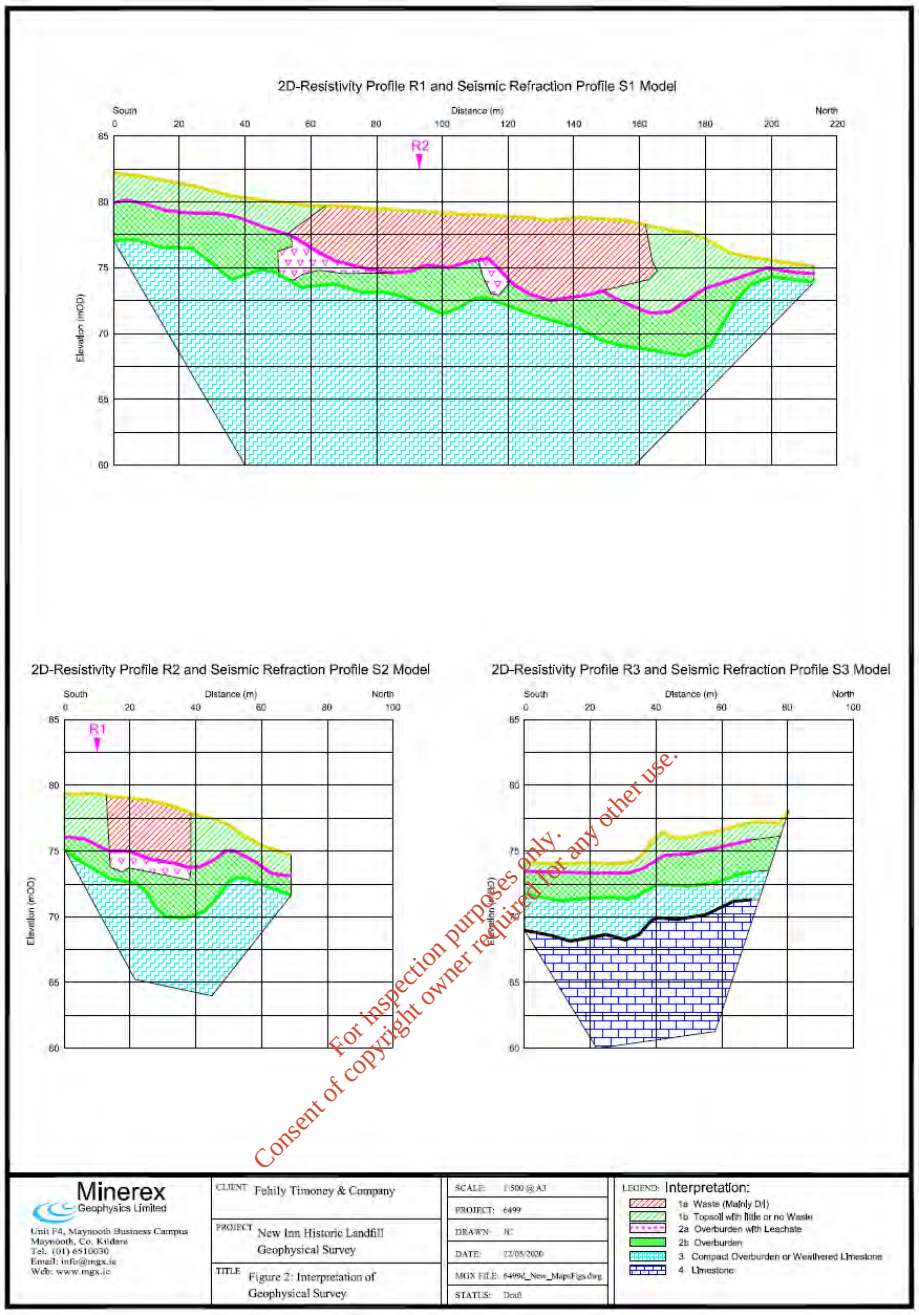

Figure 3-3: Integration of Geophysical Survey

3.1.2 Trial pitting

A Causeway Geotech (CGL) Engineering Geologist supervised the advancement of 8 No. trial pits, shown in Figure 3.1, on the 6th July 2020. Trial pits TP01 to TP04 were excavated within the area, previously defined by GCC as being the area of historic landfilling. TP05 to TP08 were excavated within adjacent lands to the north-east to confirm if landfilling activity also occurred beyond the known historic landfill area.

The trial pits (TP01 to TP08) were advanced to maximum depths of between 2.0m to 4.5m below existing ground level (BGL) using a 13t Tracked Excavator fitted with a 600mm wide bucket.

A summary of the ground conditions encountered at each trial pit is presented in Table 3.1 below with photographs and exploratory hole logs provided in the CGL site investigation report, Appendix 4.

Table 3-1: Summary of Ground Condition

Trial pit ID	Depth of cover material (m BGL)	Depth to base of made ground/waste (m BGL)	Profile Description
TP01	0.0 – 0.05 (Reworked Topsoil) 0.05 – 0.60 (Made Ground) 0.60 – 2.60 (Made Ground) 2.60 – 3.40 (Sand)	3.40 (base of excavation - terminated due to instability)	Reworked Topsoil; Made ground: Gravelly silty SAND with fragments of plastic, glass and steel wire; Made ground: Gravelly silty SAND with fragments of plywood, plastic, aluminium, pipes, timber, polystyrene, glass, clothing, tin and brick; Gravelly silty SAND.
TP02	0.0 – 0.10 (Reworked Topsoil) 0.10 – 0.60 (Made Ground) 0.60 – 4.50 (Made Ground)	4.50 (base of excavation – terminated at scheduled depth)	Reworked Topsoil; Made Ground: Gravelly silty SAND with fragments of glass, plastic and brick; Made Ground: Gravelly silty SAND with fragments of plastic, glass, clothing, tyres, steel wire, pipes, rope, timber, steel drum and cardboard.
TP03	0.0 – 0.05 (Reworked Topsoil) 0.05 – 0.90 (Made Ground) 0.90 – 3.40 (Made Ground) 3.40 – 4.0 (Sand)	4.0 (base of excavation – terminated due to instability)	Reworked Topsoil; Made Ground: Gravelly silty SAND; Made Ground: Gravelly clayey SAND with fragments of plastic, timber, glass, food waste, steel wire, fabric, cardboard, aluminium cans and nails; Made Ground: Gravelly silty SAND with SILT lenses.
TP04	0.0 – 0.05 (Reworked Topsoil) 0.05 – 0.20 (Made Ground) 0.20 – 4.20 (Made Ground)	4.20 (base of excavation – terminated due to instability)	Reworked Topsoil; Made Ground: Grey SAND with underlying geotextile membrane; Made Ground: Clayey SAND with fragments of plastic, timber, glass, oil drums, polystyrene, clothing, aluminium cans, steel wire, plastic cables, nappies, cardboard and paper.
TP05	0.0 – 0.10 (Topsoil) 0.10 – 1.50 (Gravel) 1.50 – 2.10 (Gravel)	2.10 (base of excavation – terminated due to stability)	Topsoil; Sandy GRAVEL of mixed lithologies; Sandy silty GRAVEL of mixed lithologies.
TP06	0.0 – 0.10 (Made Ground)	2.20 (base of excavation –	Made Ground: Sandy GRAVEL of mixed lithologies;

Trial pit ID	Depth of cover material (m BGL)	Depth to base of made ground/waste (m BGL)	Profile Description
	0.10 – 1.20 (Made Ground) 1.20 – 1.80 (Made Ground) 1.80 – 2.20 (Gravel)	terminated due to instability)	Made Ground: Sandy GRAVEL of mixed lithologies; Made Ground: Sandy clayey GRAVEL of mixed lithologies; Sand clayey GRAVEL of mixed lithologies.
TP07	0.0 – 0.10 (Topsoil) 0.10 – 0.30 (Made Ground) 2.30 – 3.10 (Clay)	3.10 (base of excavation – terminated due to instability)	Topsoil; Made Ground: Slightly sandy GRAVEL of mixed lithologies; Gravelly silty SAND with CLAY lenses; Slightly sandy gravelly silty CLAY.
TP08	0.0 – 0.10 (Topsoil) 0.10 – 2.0 (Sand)	2.0 (base of excavation – terminated due to instability and high groundwater in□ow)	Topsoil; Gravelly silty SAND.

3.1.3 Waste Sampling

Two samples of the made ground / waste at the site was collected from trial pits TP01 (southwestern portion of the site) and TP04 (advanced in the centre of the site).

Samples were submitted for Waste Acceptance Criteria (WAC) testing to Chemtest Ltd., a UKAS/MCERTS approved laboratory. Samples were collected from site under Chain of Custody procedures.

The results are provided in Appendix G of the CGL Ground Investigation report, Appendix 4 of this report.

The results are discussed in Section 4.2.

3.1.4 Evidence of Contamination

Evidence of waste material was identified in 4 No. trial pits locations (TP01 to TP04). The waste encountered was described as plastic, glass, steel wire, plywood, aluminium, pipes, timber, polystyrene, clothing, tin, brick, tyres, rope, steel drum, cardboard, food waste, fabric, aluminium cans, nails, oil drums, plastic cables, nappies and paper.

The waste material was encountered between depths 0.05m – 4.50m bgl in trial pits TP01 to TP04. Groundwater was encountered at depths between 0.60m – 3.40m bgl in trial pits TP02 (0.6m), TP03 (3.4) and TP05 (1.8m), TP06 (2.2m), TP07 (2.3m) and TP08 (1.8m). The description of the groundwater flow encountered varies from 'water strike' to 'strong inflow', with the strong inflow being encountered at TP08.

The base of the waste material was confirmed in trial pits TP01 and TP03 at depths of 2.6m bgl and 3.4m bgl. The waste is then underlain by natural soils. Waste material was recorded up the termination depths of 4.5m bgl and 4.2m bgl at TP02 and TP04 respectively. As the base of the waste was not confirmed it is possible that waste material may have been deposited at depths beyond the termination depths of those trial pits.

No waste material waste encountered in trial pits TP05 to TP08, indicating that landfill activity did not occur within these lands. Material encountered here comprised made ground and natural soils.

3.1.5 Waste Delineation

The combined findings of the geophysical survey and intrusive site investigation were used to interpret the aerial extent of the waste mass.

The findings of the ground conductivity and 2D-Resistivity show the area where landfill material is present. The interpreted landfill extent covers an area of approx. 2,600 m^2.

The depth of waste has been estimated from 2D-Resistivity, an average thickness of 4m has been calculated for the landfill material. This corresponds with trial pits logs for trial pits TP01 to TP04 which recorded the presence of waste material from 2.2 m up to 4.5m bgl. The estimate includes capping or natural fill material on top of the main waste body.

Based on the assumed thickness of 4m and waste footprint of 2,600 m^2. A volume calculation estimates an interred waste volume of 10,400m^3 at the site.

The maximum anticipated waste footprint is presented in Figure 3-4.

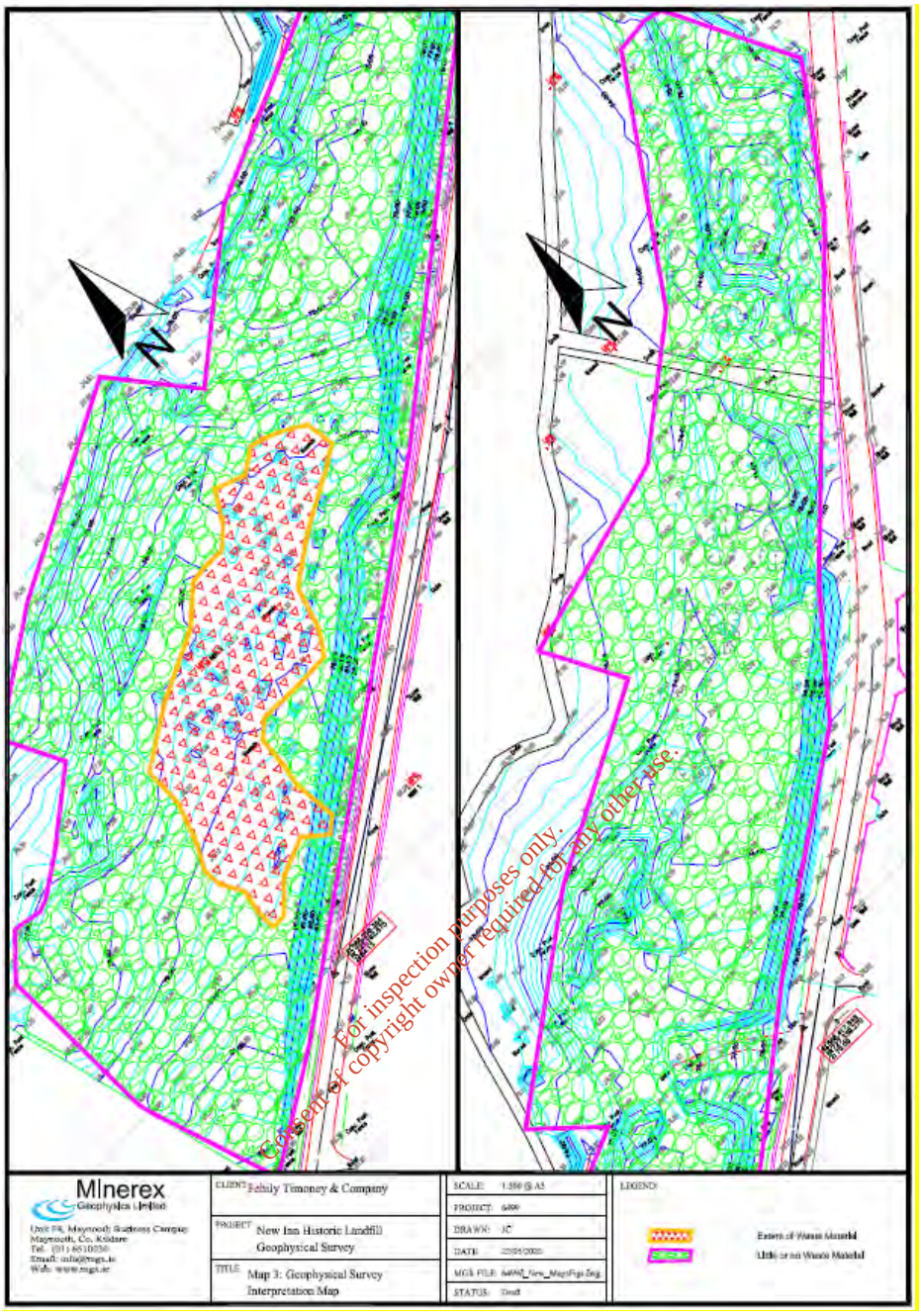

Figure 3-4: Geophysical Survey Estimated Waste Footprint

MGX note that low resistivities do not penetrate much deeper than layer 1. While there may be some minor leachate penetration below the landfill it is not interpreted as significant.

3.1.6 Borehole Installation, Groundwater and Leachate Sampling

Two groundwater monitoring wells (GW01 and GW02) were drilled to depths of, , 8.5m bgl and 10.0m BGL respectively.

The purpose of the boreholes was to intercept and define the groundwater flow direction across the site and waste body to determine the potential pathway for leachate migration and subsequently determine the potential impact the site may have on groundwater quality downgradient of the site.

Groundwater monitoring was undertaken in existing offsite groundwater monitoring wells BH01 and BH04 and new groundwater monitoring wells GW01 and GW02 on the 30th July 2020 and 25th August 2020. Prior to sampling, the standpipe wells were purged and developed with Waterra groundwater sampling pipework/ foot valves and gas caps installed by CGL between 29th June and 10th July 2020 in preparation for groundwater monitoring.

Leachate monitoring was also conducted at existing leachate monitoring well BH02, located within the waste body.

All samples were appropriately bottled (using prepared laboratory bottle ware) and packaged for submission to the laboratory. The samples were submitted for laboratory testing to ALS Environmental Ltd. The analysis results are contained in Appendix 5 and are further discussed in the proceeding sections.

3.2 Geotechnical Analysis

3.2.1 In-situ Capping Testing

Two bulk disturbed soil samples from TP02 were submitted for geotechnical analysis by Causeway Geotech Ltd for analysis of moisture content, Atterberg limits and particle size distribution (PSD). The results of the geotechnical analysis are included in the Intrusive Site Investigation Report prepared by CGL in Appendix 4 of this report.

Following testing soil samples were classified as being '*Grey gravelly clayey fine to coarse SAND*' and '*Brown gravelling silty fine to coarse SAND'*.

3.2.2 In-situ Variable Head Tests

Groundwater hydraulic conductivity/permeability by variable head test methods was also completed at GW01 and GW02.

The result of the permeability testing is shown below in Table 3.2.

Table 3-2: Permeability Results

Sample ID	K (m/s)
GW01	2.16×10^{-5} m/s
GW02	Insufficient drop in water level to calculate permeability, therefore permeability assumed to be very low

4. ENVIRONMENTAL ASSESSMENT

The results of the environmental assessment at the New Inn historic landfill site are presented in the sections 4.2 to 4.5.

Waste samples obtained during trial pitting were analysed and compared to waste acceptance criteria to aid defining the characteristics of the waste material present. The surface water and groundwater results were compared to relevant environmental quality standards in order to identify the potential and magnitude of any impacts on receiving surface water and groundwater.

4.1 Chemical Assessment Criteria

- Council Decision 2003/33/EC – Waste Acceptance Criteria.
- European Communities, Environmental Objectives (Groundwater)(Amendment) Regulations, 2016 (S.I. No. 366 of 2016).
- Interim Guideline Values (IGV) set out in the EPAs Groundwater *Towards Setting the Guideline Values for the Protection of Groundwater in Ireland*.
- European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009), as amended 2012 (S.I. No. 327 of 2012), 2015 (S.I. No. 386 of 2015), 2019 (S.I. No. 77 of 2019)
- European Communities (Quality of Surface Water Intended for the Abstraction of Drinking Water) Regulations, 1989 (S.I. No. 294/1989).

4.2 Waste / Made Ground Assessment

The waste / made ground samples analysed during this assessment have been compared against Waste Acceptance Criteria (WAC) to determine the appropriate waste classification rating associated with the interred waste. WAC screening is chosen for this assessment to suitably categorise the interred waste as being either inert, non-hazardous or hazardous material.

4.2.1 Chemical Results for Waste Samples

The waste / made ground samples analysed from the site investigations were assessed against the Waste Classification Assessment Criteria. A summary of the results for New Inn Historic Landfill is outlined in Table 4.1, while the laboratory reports are presented in Appendix G of the CGL Ground Investigation report, Appendix 4 of this report.

Table 4-1: Waste Sampling Results – Solid Waste Analysis

Parameter	Units	Inert Waste Acceptance Criteria	Non-Hazardous Waste Acceptance Criteria	Hazardous Waste Acceptance Criteria	Sampling Results - Sample ID	
					TP01 (1.0m)	TP04 (1.0m)
Arsenic	mg/kg	**0.5**	**2**	**25**	< 0.050	< 0.050
Barium	mg/kg	**20**	**100**	**300**	< 0.50	0.58
Cadmium	mg/kg	**0.04**	**1**	**5**	< 0.010	< 0.010
Chromium	mg/kg	**0.5**	**10**	**70**	< 0.050	< 0.050
Copper	mg/kg	**2**	**50**	**100**	< 0.050	< 0.050
Mercury Dissolved	mg/kg	**0.01**	**0.2**	**2**	< 0.0050	< 0.0050
Molybdenum	mg/kg	**0.5**	**10**	**30**	0.11	0.26
Nickel	mg/kg	**0.4**	**10**	**40**	< 0.050	< 0.050
Lead	mg/kg	**0.5**	**10**	**50**	< 0.010	< 0.010
Antimony	mg/kg	**0.06**	**0.7**	**5**	0.029	< 0.010
Selenium	mg/kg	**0.1**	**0.5**	**7**	< 0.010	0.015
Zinc	mg/kg	**4**	**50**	**200**	< 0.50	< 0.50
Chloride	mg/kg	**800**	**15000**	**25000**	< 10	25
Fluoride	mg/kg	**10**	**150**	**500**	2.1	1.5
Sulphate	mg/kg	**1000**	**20000**	**50000**	320	**6200**
Total Dissolved Solids	mg/kg	**4000**	**60000**	**100000**	2900	**9700**
Phenol Index	mg/kg	**1**	--	--	< 0.30	0.30
Dissolved Organic Carbon	mg/kg	**500**	**800**	**1000**	70	69
Total Organic Carbon	%	**3**	**5**	**6**	2.1	1.0
Loss on Ignition	%	--	--	**10**	4.1	4.6
Total BTEX	mg/kg	**6**	--	--	< 0.010	< 0.010
Total PCBs (7 Congeners)	mg/kg	**1**	--	--	< 0.10	< 0.10
TPH Total WAC (Mineral Oil)	mg/kg	**500**	--	--	50	< 10
Total (Of 17) PAH's	mg/kg	**100**	--	--	< 2.0	< 2.0
pH		--	**>6**	--	8.3	8.1
Acid Neutralisation Capacity	mol/kg	--	**To evaluate**	**To evaluate**	0.044	0.031

* Items in **bold** are in exceedance of the Inert WAC limit value

4.2.2 Waste Classification

As can be seen in Table 4.1 waste material encountered within the site is typically inert in terms of leachate production. This reflects the level of biological degradation that has taken place since waste placement commenced.

4.3 Groundwater and Leachate Analysis

The findings from the groundwater monitoring and an interpretation of the results are presented in the following sections.

4.3.1 Groundwater and Leachate Depth Analysis

Groundwater and leachate depth measurements were undertaken on two occasions following the installation of GW01 and GW02. Groundwater depths were also measured at existing groundwater wells BH01 and BH04 and leachate depths at BH02. Static groundwater and leachate levels from the 30th July 2020 and 25th August 2020 are calculated as shown in Table 4.2.

Table 4-2: Groundwater and Leachate Depth Analysis

Borehole ID	Location Gradient	Ground Level (mAOD)	Depth to Water/Leachate (m bgl)	Groundwater/Leachate Level (mAOD)
BH01	Upgradient	82.75	8.27	74.5
BH04	Downgradient	73.34	1	72.3
GW01	Cross-gradient	79.02	5.695	73.3
GW02	Downgradient	78.32	5.24	73.1
BH02	Within landfill area	78.59	3.135	75.5

Based on the above field survey measurements, the groundwater flow direction is estimated to be south to north. This corresponds with the general local topography. Groundwater level measurements, when compared against waste depths as per trial pit logs, also indicate that the groundwater table is below the base of waste material. However, it is noted that groundwater levels fluctuate seasonally and depending on weather conditions the water table may on occasion transect the waste body. A potentiometric map illustrating the hydraulic gradient and the direction of groundwater flow is presented in Figure 4.1.

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Site Boundary

Borehole Locations

1m Ground Elevation Contours

Indicative Groundwater Flow Direction

N
W E
S

0 50 100 200 Meters

TITLE:	Groundwater Flow Direction		
PROJECT:	New Inn Historic Landfill ERA		
FIGURE NO:	4.1		
CLIENT:	Galway County Council		
SCALE:	1:2,500	**REVISION:**	0
DATE:	06/10/2020	**PAGE SIZE:**	A3

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4.3.2 Groundwater Quality Monitoring

The analysis results of groundwater samples recovered from the 4 No. groundwater monitoring wells (BH01, BH04, GW01 and GW02) at the site have been assessed against the EPAs Interim Guideline Values (IGVs) and S.I No. 9 of the European Communities Environmental Objectives (Groundwater) Regulations 2010 (amended). A summary of results reported for each parameter for the monitoring rounds is outlined in Table 4.3, while the laboratory reports are presented in Appendix 5.

Table 4-3: Groundwater Sampling Results

Parameter	Units	S.I. No. 9 of 2010 Standards[1]	EPA IGV Standards[2]	Round 1 (30/07/2020)				Round 2 (25/08/2020)			
				BH01	BH04	GW01	GW02	BH01	BH04	GW01	GW02
				UG[3]	DG	CG	DG	UG	DG	CG	DG
Inorganics											
Conductivity @ 20 deg.C	mS/cm	0.8		0.623	0.794	0.748	1.27	0.643	0.798	0.727	1.45
Fluoride	mg/l	1	**1**	<0.5	<0.5	<0.5	0.908	0.786	0.79	<0.5	0.968
Oxygen, dissolved	mg/l		**NAC**	9.68	8.64	10	9.5	-	8.34	-	9.51
Phosphate (Ortho as PO4)	mg/l		**0.03**	-	-	-	-	-	-	-	-
Sulphate	mg/l	187.5	**200**	11.8	11.8	9.3	181	12.5	11.8	16.9	**235**
Chloride	mg/l	24	**30**	13.5	**73.6**	22.2	**46.4**	16.1	**66**	23.1	**55.6**
COD, unfiltered	mg/l			28.7	32.3	99.6	162	8.83	13.4	342	106
Ammoniacal Nitrogen as N (low level)	mg/l	0.065	**0.15**	0.0176	**0.186**	0.0283	**0.544**	0.0202	**0.558**	0.0438	**0.526**
Cyanide, Total	mg/l	0.0375	**0.01**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Total Oxidised Nitrogen as N	mg/l		**NAC**	1.89	<0.1	1.75	0.216	0.573	0.282	1.98	<0.1
Alkalinity, Total as HCO3	mg/l		**NAC**	451	482	1570	939	427	434	2280	1230
Sulphate (soluble) as S	mg/l	187.5	**200**	-	-	-	-	-	-	-	-
Filtered (Dissolved) Metals											
Mercury (diss.filt)	µg/l	0.75	**1**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic (diss.filt)	µg/l	7.5	**10**	0.521	0.869	<0.5	0.607	<0.5	2.96	<0.5	0.541
Barium (diss.filt)	µg/l		**100**	21.8	33.5	9.12	**129**	36.9	41.8	**1930**	**111**
Boron (diss.filt)	µg/l	750	**1000**	23.7	43.5	<10	180	64.3	136	348	193
Cadmium (diss.filt)	µg/l	3.75	**5**	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Chromium (diss.filt)	µg/l	37.5	**30**	<1	<1	<1	<1	<1	5.17	<1	<1
Copper (diss.filt)	µg/l	1500	**30**	4.98	<0.3	0.828	1.97	7.55	0.618	1.15	1
Lead (diss.filt)	µg/l	7.5	**10**	<0.2	<0.2	<0.2	0.356	0.616	1.52	<0.2	<0.2

Parameter	Units	S.I. No. 9 of 2010 Standards[1]	EPA IGV Standards[2]	Round 1 (30/07/2020)				Round 2 (25/08/2020)			
				BH01	BH04	GW01	GW02	BH01	BH04	GW01	GW02
				UG[3]	DG	CG	DG	UG	DG	CG	DG
Manganese (diss.filt)	µg/l		**50**	16	**115**	9.66	8.05	25.8	**105**	<3	14.9
Nickel (diss.filt)	µg/l	15	**20**	10.5	5.59	3.53	3.47	8.5	17.1	2.71	3.44
Zinc (diss.filt)	µg/l	75	**100**	26.6	1.95	3.01	1.98	10	5.81	**862**	<1
Sodium (Dis.Filt)	mg/l	150	**150**	6.42	45.8	8.43	**226**	10.6	46.5	19.3	**222**
Magnesium (Dis.Filt)	mg/l		**50**	10.1	8.08	5.7	28.3	18.9	12.8	7.94	35.6
Potassium (Dis.Filt)	mg/l		**5**	1.18	3.32	1.69	**5.26**	1.58	4.5	0.627	**5.49**
Calcium (Dis.Filt)	mg/l		**200**	139	139	143	71.8	109	128	138	64.5
Iron (Dis.Filt)	mg/l		**200**	<0.019	<0.019	<0.019	<0.019	0.0509	3.75	<0.019	0.0304
Microbiological											
Coliforms, Total*	MPN/100ml		**0**	-	-	-	-	<1	<1	**2**	**488**
Coliforms, Faecal*	CFU/100 ml		**0**	-	-	-	-	<1	<1	<1	**10**
Miscellaneous Organics											
MCPA	µg/l	0.075		<0.05	<0.05	<0.25	<0.25	<0.05	<0.1	<0.1	<0.1
Mecoprop	µg/l	0.075	**10**	<0.04	<0.04	<0.2	<0.2	<0.04	<0.08	<0.08	<0.08
Dichlorprop	µg/l		**100**	<0.1	<0.1	<0.5	<0.5	<0.1	<0.2	<0.2	<0.2
2,4-Dichlorophenoxyacetic acid	µg/l	0.075		<0.05	<0.05	<0.25	<0.25	<0.05	<0.1	<0.1	<0.1
Bromoxynil	µg/l		**5**	<0.04	<0.04	<0.2	<0.2	<0.08	<0.08	<0.08	<0.08
Pentachlorophenol	µg/l		**2**	<0.04	<0.04	<0.2	<0.2	<0.08	<0.08	<0.08	<0.08

[1] OTV-Overall threshold value, European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010) as amended in 2011, 2012, 2016.
[2] IGV-Interim Guideline Values, from EPA, Towards Setting Guideline Values for the Protection of Groundwater in Ireland, 2003.
3 UG = upgradient, DG=downgradient, IW = in waste, CG=cross-gradient
* Items shaded in **orange** are in exceedance of S.I No.9 of 2010 Standards
* Items shaded in **bold** are in exceedance of the EPA IGV Standards

4.3.3 Groundwater Analysis Discussion

The results of the groundwater monitoring from BH01, BH04, GW01 and GW02 have reported several exceedances of the IGVs and groundwater regulations overall limit values.

Samples obtained from monitoring wells reported ammoniacal nitrogen concentrations from 0.186 mg/l to 0.558 mg/l at BH04 and GW02 which exceed IGV and groundwater regulations limit values. The highest concentrations of ammoniacal nitrogen concentration are detected at downgradient wells GW02 and BH04, indicating the site landfill may causing an increase in ammoniacal nitrogen downgradient of the site.

Elevated concentrations of chloride above the OTV and EPA IGV are also detected in downgradient groundwater monitoring wells BH04 and GW02. Landfill leachate has the potential to contain high concentrations of chloride ions and may be the source of the concentrations observed at these locations.

The results of groundwater monitoring when assessed against thresholds for List 1 and List 2 substances – SVOCs, pesticides, herbicides, organics shows all results are below the laboratory limit of detection in all assessments across all four sampling locations on both rounds.

Based on the presence of elevated ammonia and chloride typical of landfill leachate, the shallow soil cap may not be suitable at preventing rainfall infiltration into the waste body and consequently is contributing to leachate generation , subsequent migration of leachate to the underlying groundwater and migration downgradient.

It is noted however, that elevated concentrations of chloride have also been recorded at a EPA groundwater monitoring station located at New Inn, therefore it may be possible that the elevated concentrations of chloride measured at GW02 and BH04 may be naturally occurring and are not directly associated with leachate migration from the landfill.

4.3.4 Leachate Monitoring

Two rounds of leachate monitoring were undertaken at the site on the 30th July 2020 and 25th August 2020 for leachate monitoring well BH02. A summary of the results from the monitoring are presented in Table 4.4 and the laboratory reports can be found in Appendix 5.

Table 4-4: Leachate Sampling Results

Parameter	Units	BH02	BH02
		30/07/2020	25/08/2020
Carbon			
Organic Carbon, Total	mg/l	12.7	12.6
Inorganics			
Conductivity @ 20 deg.C	mS/cm	5.88	3.03
Fluoride	mg/l	<0.5	<0.5
Oxygen, dissolved	mg/l	6.16	3.95
pH	pH Units	6.88	6.74

Parameter	Units	BH02	BH02
		30/07/2020	25/08/2020
Phosphate (Ortho as PO4)	mg/l	<0.05	<0.05
Sulphate	mg/l	29.4	23.9
Chloride	mg/l	1720	740
COD, unfiltered	mg/l	303	101
Ammoniacal Nitrogen as N (low level)	mg/l	22	10.8
BOD, unfiltered	mg/l	28.2	30.4
Total Oxidised Nitrogen as N	mg/l	<0.1	0.266
Filtered (Dissolved) Metals			
Mercury (diss.filt)	µg/l	<0.01	<0.01
Arsenic (diss.filt)	µg/l	2.73	3.55
Cadmium (diss.filt)	µg/l	<0.08	<0.08
Chromium (diss.filt)	µg/l	<1	<1
Copper (diss.filt)	µg/l	<0.3	0.622
Lead (diss.filt)	µg/l	<0.2	<0.2
Manganese (diss.filt)	µg/l	525	465
Nickel (diss.filt)	µg/l	55.2	52.7
Phosphorus (diss.filt)	µg/l	13.6	13.4
Selenium (diss.filt)	µg/l	<1	<1
Zinc (diss.filt)	µg/l	7.37	6.14
Sodium (Dis.Filt)	mg/l	1250	449
Magnesium (Dis.Filt)	mg/l	28.2	14.2
Potassium (Dis.Filt)	mg/l	25.7	14.7
Iron (Dis.Filt)	mg/l	3.87	3.79

4.3.5 Leachate Analysis Discussion

The leachate monitoring results show the presence of some pollutants at concentrations typical of MSW leachate i.e. ammoniacal nitrogen, chloride and COD.

As discussed in section 4.3.3, elevated concentrations of ammoniacal nitrogen and chloride at downgradient well GW02 indicate possible migration of leachate.

A comparison of leachate results and downgradient groundwater analysis, particularly samples from GW02 further indicate that the migration of leachate from the landfill is likely occurring and impacting on groundwater quality downgradient of the waste body at GW02. Elevated conductivity and concentrations of chloride, ammoniacal nitrogen and sodium are observed at GW02.

These parameters are also present at high levels in leachate samples from BH02 particularly chloride and sodium with maximum concentrations of 1720 mg/l and 1250 mg/l, recorded in samples taken on the 30th of July 2020. Dilution of leachate is occurring downgradient of the waste body but is likely causing concentrations that exceed the groundwater quality threshold values.

4.4 Landfill Gas Monitoring

FT carried out monitoring of landfill gas (LFG) at each monitoring well location (BH01, BH02, BH4, GW01 and GW02) as indicated on Figure 3.1. Methane, carbon dioxide, oxygen and atmospheric pressure were analysed at the 4 No. groundwater monitoring wells (outside the waste body) and 1 No. leachate monitoring well (within the waste body) using a landfill gas analyser.

4.4.1 Monitoring Results

The EPA Landfill Manuals - Landfill Monitoring 2nd Edition specifies trigger values for landfill gas monitoring at offsite monitoring locations. The trigger level for methane outside the waste body is 1% v/v and for carbon dioxide is 1.5% v/v. The two rounds of monitoring results for methane, carbon dioxide and oxygen levels for the perimeter borehole are summarised in Table 4.5.

Table 4-5: Perimeter Well Monitoring Results

Date: 29/07/2020						
Sample Station	CH_4 (% v/v)	CO_2 (% v/v)	O_2 (% v/v)	Atmospheric Pressure (mbar)	Staff Member	Weather
BH01	0.1	0.2	21.1	1001	Daniel Hayden	Overcast, Light Rain, Warm, 18-20°C
BH02	**16.8**	**15.9**	5.3			
BH04	0	0.3	20.6			
GW01	0.1	**3.6**	16.4			
GW02	0.1	0.3	20.7			
Date: 24/8/2020						
Sample Station	CH_4 (% v/v)	CO_2 (% v/v)	O_2 (% v/v)	Atmospheric Pressure (mbar)	Staff Member	Weather
BH01	0	0.6	20.8	1002	Daniel Hayden	Overcast, Light Rain, Warm, 16-18°C
BH02	**20.8**	**18.7**	2.5			
BH04	0	0.2	21.2			
GW01	0	**3.3**	17.6			
GW02	0	0.3	20.9			

As can be seen in Table 4-5, no methane or only trace quantities of methane are measured at offsite monitoring wells (GW01, GW02, BH01 and BH04). Carbon dioxide is only detected above the trigger value of 1.5% v/v at offsite monitoring well GW01 at concentrations of 3.6% v/v and 3.3% v/v in July and August respectively. These results indicate that lateral migration of landfill gas is not occurring, with wells GW02 and BH01 located in close proximity of the waste body.

Monitoring at leachate monitoring borehole BH02 show concentrations above the trigger values for both carbon dioxide and methane indicating that the landfill may still be biologically active with landfill gas continuing to be produced.

4.5 Surface Water Monitoring

4.5.1 Monitoring Locations

The surface water monitoring locations were selected upstream and downstream of the landfill footprint, as shown on Figure 4.2. Monitoring location SW1 was selected as the upstream location on Raford river to the north/north-east of the landfill. Monitoring location SW2 is located on the Raford River to the north-west, and downstream of the site.

Two rounds of surface water monitoring were carried out on the 30th July 2020 and 25th August 2020.

4.5.2 Monitoring Parameters

The results of surface water sampling analysed from the 2 No. sampling locations (SW1 and SW2) at the site have been assessed against the Maximum Admissible Concentration (MAC) and the Environmental Quality Standard (EQS) as per S.I. No. 77/2019 - European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019.

A summary of the maximum values reported for each parameter from the monitoring round is outlined in Table 4.6, while the laboratory reports are presented in Appendix 5.

Path: R:\Map Production\2020\P2282\Workspace\P2282_Tier2_ERA_NewInn_A3.aprx

Site Boundary

Surface Water Monitoring Locations

N
W E
S

0 50 100 200 Meters

TITLE:	Surface Water Sampling Locations		
PROJECT:	New Inn Historic Landfill ERA		
FIGURE NO:	4.2		
CLIENT:	Galway County Council		
SCALE:	1:2,500	**REVISION:**	0
DATE:	06/10/2020	**PAGE SIZE:**	A3

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Table 4-6: Surface Water Sampling Results

Parameter	Units	EQS[1]	MAC[2]	Upstream	Downstream	Upstream	Downstream
				SW01	SW02	SW01	SW02
				30/07/2020	30/07/2020	25/08/2020	25/08/2020
Inorganics							
Fluoride	mg/l	0.5		<0.5	<0.5	<0.5	<0.5
Ammoniacal Nitrogen as N (low level)	mg/l	≤0.140 (95%ile)		0.0237	0.0319	0.0716	0.0861
Cyanide, Total	mg/l	0.01		<0.05	<0.05	<0.05	<0.05
Filtered (Dissolved) Metals							
Mercury (diss.filt)	µg/l		**0.07**	<0.01	<0.01	<0.01	<0.01
Arsenic (diss.filt)	µg/l	25		<0.5	<0.5	0.91	1.14
Cadmium (diss.filt)	µg/l	0.15	**0.9**	<0.08	<0.08	<0.08	<0.08
Chromium (diss.filt)	µg/l	4.7	**32**	<1	<1	<1	1.5
Copper (diss.filt)	µg/l	30		0.932	1.01	3.15	2.93
Lead (diss.filt)	µg/l	1.2	**14**	<0.2	<0.2	0.352	0.43
Nickel (diss.filt)	µg/l	4	**34**	1.83	1.57	4.47	3.33
Zinc (diss.filt)	µg/l	100		2.07	2.49	8.82	10.4
Semi-Volatile Organic Compounds (SVOCs)							
1,2,4-Trichlorobenzene (aq)	µg/l	0.4	**not applicable**	<10	<8	<4	<4
Anthracene (aq)	µg/l	0.1	**0.1**	<10	<8	<4	<4
bis(2-Ethylhexyl) phthalate (aq)	µg/l	1.3	**not applicable**	<20	<16	<8	<8
Benzo(b)fluoranthene (aq)	µg/l		**0.017**	<10	<8	<4	<4

Parameter	Units	EQS[1]	MAC[2]	Upstream	Downstream	Upstream	Downstream
				SW01	SW02	SW01	SW02
				30/07/2020	30/07/2020	25/08/2020	25/08/2020
Benzo(k)fluoranthene (aq)	µg/l		**0.017**	<10	<8	<4	<4
Benzo(a)pyrene (aq)	µg/l	0.00017	**0.27**	<10	<8	<4	<4
Benzo(g,h,i)perylene (aq)	µg/l		**0.0082**	<10	<8	<4	<4
Diethyl phthalate (aq)	µg/l	1.3	**not applicable**	<10	<8	<4	<4
Fluoranthene (aq)	µg/l	0.0063	**0.12**	<10	<8	<4	<4
Hexachlorobenzene (aq)	µg/l		**0.05**	<10	<8	<4	<4
Hexachlorobutadiene (aq)	µg/l		**0.6**	<10	<8	<4	<4
Pentachlorophenol (aq)	µg/l	0.4	**1**	<10	<8	<4	<4
Phenol (aq)	µg/l	8	**46**	<10	<8	<4	<4
Naphthalene (aq)	µg/l	2	**130**	<10	<8	<4	<4
Indeno(1,2,3-cd)pyrene (aq)	µg/l		**not applicable**	<10	<8	<4	<4

Notes:

1. Environmental Quality Standard (EQS) as per European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I No. 272 of 2009). Refers to Annual-Average (AA) EQS for relevant parameters.
2. Maximum Admissible Concentration (MAC), as classified by European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I No. 272 of 2009).

* Items shaded in **orange** are in exceedance of the 2009 EQS Regulations

*** NAC – no abnormal change

4.5.3 Surface Water Analysis Discussion

The results of the surface water laboratory analysis as presented in Table 4.6 how only one slight exceedance of the surface waters regulations for nickel at upstream monitoring location SW1. All other parameters are shown to be below the surface water regulations limit values at both SW1 and SW2.

This indicates that the historic landfill is not having a deleterious effect on water quality of Raford River north of the site.

5. RISK ASSESSMENT

5.1 Introduction

Risk assessment considers the likelihood of occurrence and the consequence of occurrence of an event (Royal Society, 1992[2]). ERA (Environmental Risk Assessment) 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 completed site investigation, this CSM assumes the source to be the made ground containing waste deposit, the pathway to involve the migration of landfill gas, surface water and groundwater and the ultimate receptors to be the surface water features, groundwater, groundwater abstraction well and all human presence near the waste material.

5.2 Potential Pathways and Receptors

A pathway is a mechanism or route by which a contaminant encounters, 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 lateral or vertical migration of landfill gas to human receptors.

The potential pathways associated with the New Inn site are:

- Groundwater

5.2.1 Groundwater/Leachate Migration

According to the EPA CoP, there are three main pathways for leachate migration. These 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;
- Surface water features; and
- Human presence near the site.

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

5.2.2 Landfill Gas Migration

According to the EPA CoP, there are two main pathways for landfill gas migration. These 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

5.3 Conceptual Site Model

Based on the review of the Tier 1 risk scoring and site investigation works undertaken for New Inn Historic Landfill, 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 revised conceptual model to be produced for the site, which is presented in Figure 5.1,.

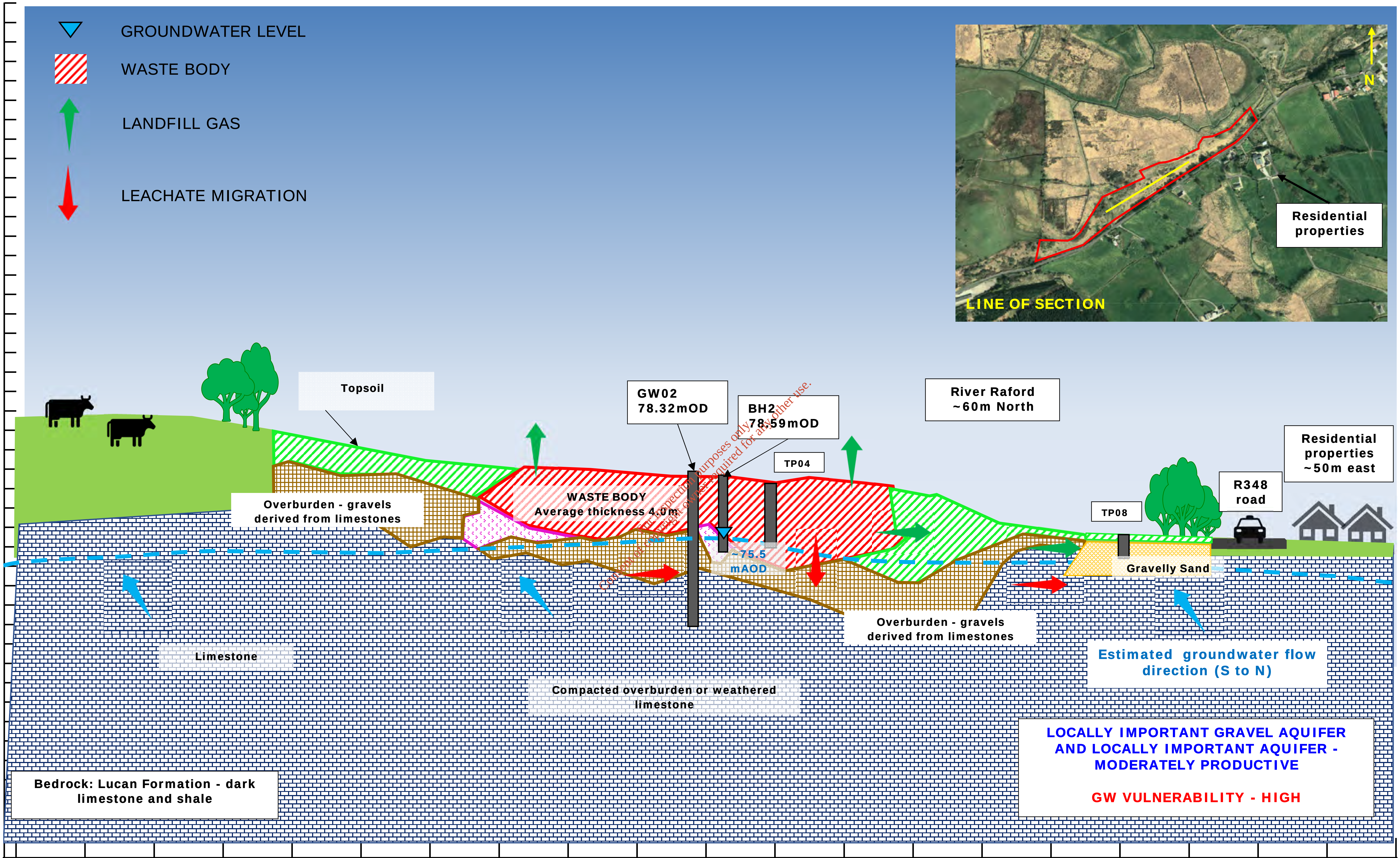

FIGURE 5.1 NEW INN HISTORIC LANDFILL
CONCEPTUAL SITE MODEL

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5.4 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 of New Inn Historic Landfill. Where there is insufficient information available (i.e. where there is a high degree of uncertainty) the highest score is assumed.

In accordance with the EPA CoP (2007) the scoring matrices 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 5.1 calculates the points awarded to each of the headings listed above.

Table 5-1: Risk Classification Calculation – New Inn Landfill

EPA Ref	Risk	Points	Rationale
1a	Leachate; source/hazard scoring matrix, based on waste footprint.	5	Based on a waste footprint of 0.26 ha and the presence of municipal waste the score of 5 is applied.
1b	Landfill gas; source/hazard scoring matrix, based on waste footprint.	5	Based on a waste footprint of 0.26 ha and the presence of municipal waste the score of 5 is applied.

EPA Ref	Risk	Points	Rationale
2a	Leachate migration: Pathway (Vertical)	3	GSI describes the groundwater vulnerability as High to extreme. Intrusive S.I and geophysical survey suggest only a narrow band of overburden exits between the base of waste material and bedrock and potentially the underlying groundwater aquifer.
2b	Leachate migration: Pathway (Horizontal)	2	The bedrock groundwater is classified by GSI as 'Locally important gravel aquifer - Lg' and 'Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones – Ll'.
2c	Leachate migration: Pathway (Surface water drainage)	2	Land drains are present at the site, and direct surface water pathway to the Raford river as verified during site walkover.
2d	Landfill gas: Pathway (Lateral migration potential)	1	A significant portion of the site is underlain by Gravels derived from Limestones.
2e	Landfill gas: Pathway (Upwards migration potential)	0	No buildings or structure are located directly above estimated waste footprint area.
3a	Leachate migration: Receptor (Human presence)	3	No buildings or structures are located directly above estimated waste footprint area. Nearest residential dwellings are located less 50m south of the waste body.
3b	Leachate migration: Receptor (Protected areas – SWDTE or GWDTE) (Surface water/ groundwater dependent terrestrial ecosystems)	1	Raford River Bog NHA (Site Code: 000321), is located c.800m to the north-west of the site at its closest point.
3c	Leachate migration: Receptor (Aquifer category – Resource potential)	3	'Locally important gravel aquifer - Lg' and 'Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones – Ll'.
3d	Leachate migration: Receptor (Public water supplies – other than private wells)	7	ZOC Rhynn Killeeneen groundwater protection zone is located c. 40m north of the site at its closest point.
3e	Leachate migration: Receptor (Surface water bodies)	2	The Raford_020 river (Status: Moderate) is located c.60m from the site to the north.
3f	Landfill Gas: Receptor (Human presence)	5	No buildings or structures are located directly above estimated waste footprint area. Nearest residential dwellings are located less 50m south of the waste body.

Table 5-2: 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	**70**	300	Leachate => surface water	23%
SPR2	1a x (2a + 2b + 2c) x 3b	**35**	300	Leachate => SWDTE	12%
Leachate migration through groundwater pathway					
SPR3	1a x (2a + 2b) x 3a	**75**	240	Leachate => human presence (private well)	31%
SPR4	1a x (2a + 2b) x 3b	**25**	240	Leachate => Protected Area (GWDTE)	10%
SPR5	1a x (2a + 2b) x 3c	**75**	400	Leachate => Aquifer	19%
SPR6	1a x (2a + 2b) x 3d	**175**	560	Leachate => Public Supply (well)	31%
SPR7	1a x (2a + 2b) x 3e	**50**	240	Leachate => Surface water body	21%
Leachate migration through surface water pathway					
SPR8	1a x 2c x 3e	**20**	60	Leachate => Surface Water	33%
SPR9	1a x 2c x 3b	**10**	60	Leachate =>Protected Area (SWDTE)	17%
Landfill gas migration pathway (lateral & vertical)					
SPR10	1b x 2d x 3f	**37.5**	150	Landfill Gas => Human Presence	25%
SPR11	1b x 2e x 3f	**0**	250	Landfill Gas => Human Presence	0%
Site maximum S-P-R Score					**33%**
Risk Classification					**Class C**

Table 5.2 shows the maximum S-P-R scoring for the site is **33%.**

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 **Low Risk Classification (Class C)**. The highest risk calculated for the site is the risk of leachate migration to surface water (SPR8), with a risk score of 33%.

6. CONCLUSION

A Tier 2 study was conducted by FT in accordance with the EPA CoP for New Inn Historic Landfill. The study consisted of a desktop study, geophysical survey and intrusive site investigation works. These works informed the development of the CSM and risk screening model.

The findings of the site investigation work and geophysical surveying suggest the waste material is deposited in a single infill area with the footprint of the historic landfill estimated at 2,600 m^2. 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 10,400 m^3.

Analysis of waste samples from the trial pits advanced at the site, when assessed against 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 biological degradation that has taken place since waste placement commenced. Trial pitting and site walkovers have confirmed the waste material is near the surface with a minimal soil cover present across the site.

Landfill gas monitoring from monitoring wells existing wells BH01, BH02, BH04 and new monitoring wells GW01 and GW02 at the site indicates gas concentrations detected are below threshold levels set by the EPA Landfill Manuals - Landfill Monitoring, with the exception of well BH02 which is located within the waste body.

Analysis of groundwater samples recovered from the monitoring wells BH01, BH04, GW01 and GW02 contain elevated concentrations of ammoniacal nitrogen and chloride at GW02 and BH04. Ammoniacal nitrogen and chloride constituents of leachate which commonly occur in high concentrations in leachate. However, EPA groundwater monitoring at New Inn has historically recorded elevated concentrations of chloride, therefore the elevated concentrations observed at GW02 and BH04 may not be directly attributed to leachate migration from the site.

The shallow soil cap is not suitable at preventing rainfall infiltration into the waste body which will continue to contribute to leachate generation.

Static groundwater level measurements indicate that the groundwater flow direction is south to north. Groundwater level measurements also indicated that groundwater table was slightly below the base of waste material at the time of monitoring, however it is noted that groundwater levels fluctuate seasonally, and the water table may transect the waste material at various times of the year.

The leachate monitoring results from BH02 show the presence of pollutants and at elevated concentrations typical of MSW landfill leachate i.e. ammoniacal nitrogen, chloride and COD.

Analysis results for surface water samples recovered from the Raford River located to the north of the site, at locations upstream and downstream of the historic landfill show only one exceedance of EQS limit values. Nickel concentrations were marginally above the EQS limit at upstream location SW1 for one monitoring round. The results indicate that the site is not having a negative impact on the water quality of this river.

Based on the results of the Tier 2 site assessment, the site can be classified as a **Low Risk Classification (Class C)**.

6.1 Recommendations

Based on the results of the initial Tier 2 assessment the site is classified as Low Risk. Although the application of the EPA risk screening tool determined all risks to be low it is recommended that a Tier 3 generic quantitative risk assessment (GQRA) be carried out specifically to further examine the potential risk to surface water quality of the Raford River, as it is included within the zone of contribution for a public drinking water supply and to and to potential impact on the New Inn group scheme water supply itself . The purpose of the GQRA will be to verify the low risk calculated based on the findings of the Tier 2 site investigation and assessment.

The Tier 3 GQRA be undertaken for the site in conjunction with an application for a Certificate of Authorisation for this site.

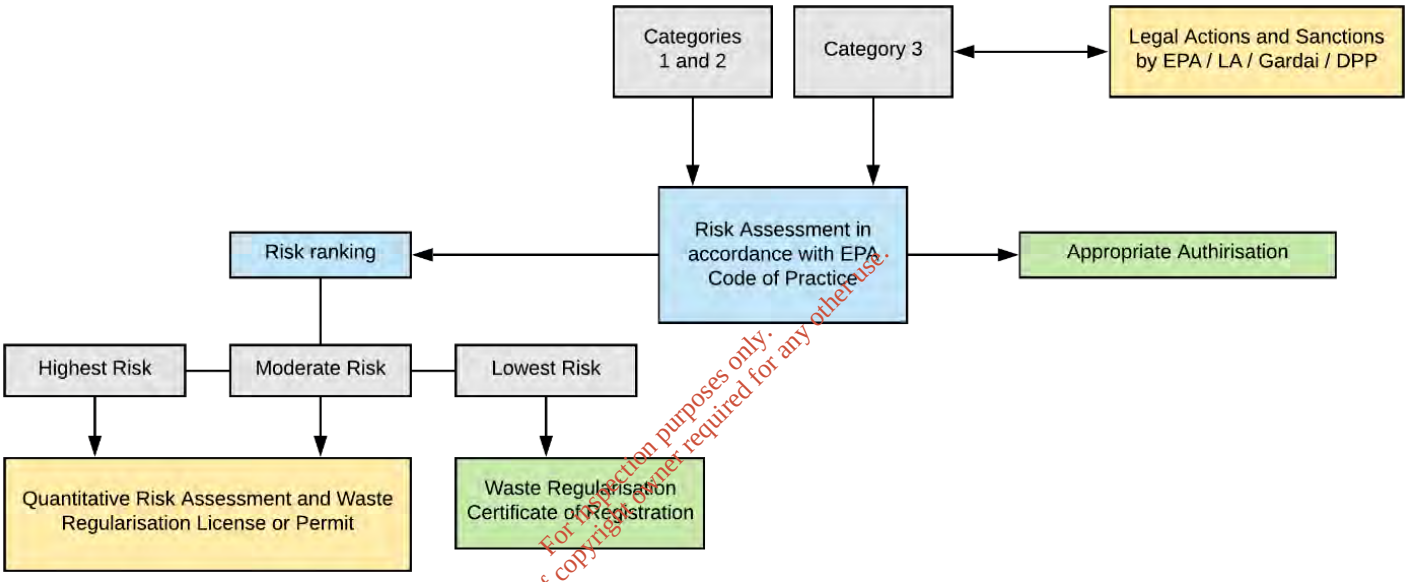

Figure 6-1: Extract from Section 1.3 of the EPA Code of Practice