FEHILY TIMONEY

CONSULTANTS IN ENGINEERING,
ENVIRONMENTAL SCIENCE & PLANNING

TIER 2 ERA REPORT FOR CASTLEISLAND HISTORIC LANDFILL

TIER 2 RISK ASSESSMENT

Prepared for: Kerry County Council

Comhairle Contae Chiarraí
Kerry County Council

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TIER 2 RISK ASSESSMENT

HISTORIC LANDFILL AT CASTLEISLAND, CO. KERRY

REVISION CONTROL TABLE, CLIENT, KEYWORDS AND ABSTRACT
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Keywords: Site Investigation, Environmental risk assessment, geophysical survey, waste, leachate, soil sampling, groundwater sampling.

Abstract: This report represents the findings of a Tier 2 risk assessment carried out at Castleisland Historic Landfill, Co. Kerry conducted in accordance with the EPA Code of Practice for unregulated landfill sites.

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EXECUTIVE SUMMARY

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

Castleisland historical landfill covers an area approximately 0.5Ha of open land located approximately 1.1km north-east from the centre of Castleisland town, which is located c.15km south-east of Tralee. The exact waste footprint area and exact timeframe which waste was deposited are unknown, however review of available information suggests that the site may been active through the 1980s. Evidence suggests that remediation works have been limited to capping the site with soil and no other management measures are in place.

A Tier 1 was previously completed by KCC in 2007 and a subsequent review report was prepared in 2011. KCC's 2011 assessment determined that the site had a moderate risk (Class B) to the environment, with the highest score assigned being 50% to leachate migration to surface water body via combined groundwater and surface water pathways, leachate migration through groundwater to underlying aquifer, leachate migration through groundwater to surface water body and leachate migration through surface drainage/runoff to surface water body.

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

The following site investigation works were undertaken at the site:

- 5 No. Trial pit excavations
- Installation and monitoring of 2 No. groundwater boreholes
- Groundwater and landfill gas monitoring
- 1 No. Geophysical survey (2D resistivity and seismic refraction profiling)
- Topographical Survey
- Factual reporting

The findings of the site investigation work and geophysical surveying suggest the waste material is deposited in a single infill area tending north-east of the site and the extent of the landfill is estimated at 2,192 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 13,152 m^3 (c.18,375 tonnes) including capping materials.

Analysis of waste samples from the trial pits excavated, when assessed against the inert waste acceptance criteria indicated that much of the waste material within the site can be classified as typically inert. The waste classification is considered to reflect the level of degradation over time since landfilling ceased. Trial pitting confirmed the waste material is near the surface with a minimal topsoil and clay cover present across the site.

Landfill gas monitoring from perimeter wells BH01 and BH02 at the site indicates gas concentrations detected are below threshold levels set by the EPA CoP.

Groundwater monitoring was attempted on two occasions in BH01 and BH02 on both occasions the wells were dry. Surface water sampling was not undertaken due to the distance of the site to the nearest open waster body (640m) and the nonexistence of a direct surface water pathway to the surface water receptor.

Based on the results of the Tier 2 site assessment, the site can be classified as a **Moderate Risk Classification (Class B)**. The principal risk identified on the site is the risk posed to the aquifer from migration of leachate from the waste material encountered at the site through groundwater.

1. INTRODUCTION

1.1 Background

Castleisland historical landfill covers an area approximately 0.5Ha of open land located approximately 1.1km north-east from the centre of Castleisland town, which is located c.15km south-east of Tralee. The landfill site is located in the townland of Bawnluskaha. The site is located in agricultural land and a local access road transects the site. The lands immediately surrounding the site are agricultural with hedgerows present along the site's northern boundary.

The exact waste footprint area is unconfirmed. The exact timeframe in which waste was deposited at the site is unknown however review of available information suggests that the site may been active through the 1980s. The site is currently under private ownership. Evidence suggests that remediation works have been limited to capping the site with soil and no other management measures are in place.

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

A Tier 1 was previously completed by KCC in 2007 and a subsequent review report was prepared in 2011. The site is also registered on the EPA Section 22 register. KCC's 2011 assessment determined that the site had a moderate risk to the environment, with the highest normalised score assigned being 50%.

1.2 Scope of Works

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

- Desk Study
- Site Walkover
- Intrusive Site Investigation
- Leachate Testing
- Environmental Risk Assessment (ERA)
- Geophysical and surveying to estimate extents and depths of waste
- Development of a conceptual site model (CSM)

As part of the initial desk study, a review of available information was undertaken. This was followed-up with a site walkover by FT personnel, notes can be found on Appendix 3. The desk study and site walkover were used to determine the locations for the intrusive site investigation.

The site walkover checklist and accompanying photolog are included in Appendix 3 to this report.

FT appointed Causeway Geotech Limited (CGL) to conduct the intrusive site investigation which included; excavation of trial pits and the installation of three onsite groundwater monitoring boreholes.

A full geotechnical report is included in Appendix 2 to this document.

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 5 to this document.

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

Laboratory analysis of waste samples were conducted to assess and quantify any potential or ongoing environmental impacts, included in Appendix 2 to this report, Appendix F of Causeway Geotechnical Report.

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
- Kerry County Council Site Plans and Drawings
- BS 5930: 1999, Code of Practice for Site Investigations
- BS 10175: 2000, Investigation of Potentially Contaminated Sites – Code of Practice
- EPA's Historic Mine Sites - Inventory and Risk Classification (2009)
- EPA - Assessing and Developing Natural Background Levels for Chemical Parameters in Irish Groundwater (2017)

A desktop review of available documentation for the site was conducted followed by a site walkover on 8th February 2019.

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 historic landfill is approximately 0.5Ha in size, of open land located to the north-east of Castleisland town and centre. The current land use for the site is agricultural grassland. Neighbouring land uses include additional grassland and residential land, which is located c. 100m west of the site. A cemetery is located c. 140m east/south-east of the site. A local agricultural access track traverses the site. There are no dwellings located within the subject site however a stated there is a housing development located west of the site and a small cluster of stand-alone houses are also located to the south of the site.

The Corine 2018 land use classification for the site agricultural areas-pasture.

The site is not in the ownership of the Local Authority – ownership is private and absolute.

The location of the site is shown in Figure 2.1.

2.2.2 Previous Studies

A Tier 1 Risk Assessment was conducted in 2007. KCC subsequently prepared a review assessment and report in 2011. Based on the available information, this Tier 1 Assessment determined that the overall risk score for Castleisland Landfill was 50%, resulting in a risk classification of Moderate (Class B).

A copy of this assessment is included in Appendix 1.

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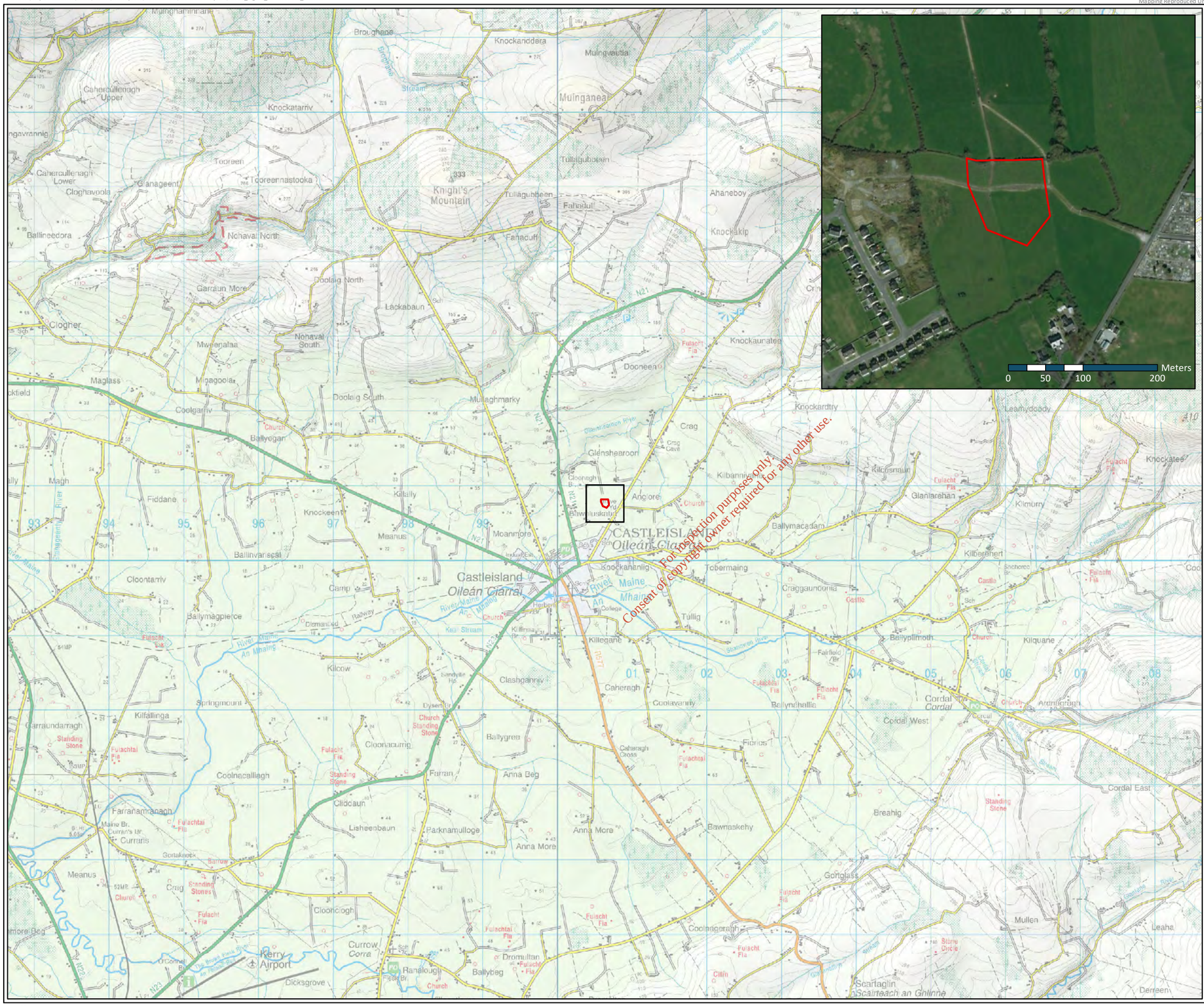

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DATE:	25/10/2019	**PAGE SIZE:**	A3

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2.2.3 Topography

Review of KCC's previous Tier 1 assessment and site walkover describe the site as having a slight dome shape. The portion of the site to the south of the access display a dome shape with elevations initially increasing from the southern edge of the road to a rounded peak c. 60m south of the road and decreasing again in a an all direction. Land immediately north of the road are gently sloping upwards away from the road to an earth bank.

Regionally, Castleisland town is located within a basin with land sloping upwards to the north, east and south of the town, with the Stack Mountains located to the north. The N21 road from Castleisland to Tralee follows a valley between the Stack Mountains and Slieve Mish mountains.

2.2.4 Geology

Drift/Quaternary Geology

The quaternary Map provided by GSI Online identifies the quaternary sediments at the site as 'Quaternary Sediments: Bedrock outcrop or subcrop' and its surroundings as 'Till derived from Namurian sandstones and shales'. Quaternary sediments are shown in Figure 2.2.

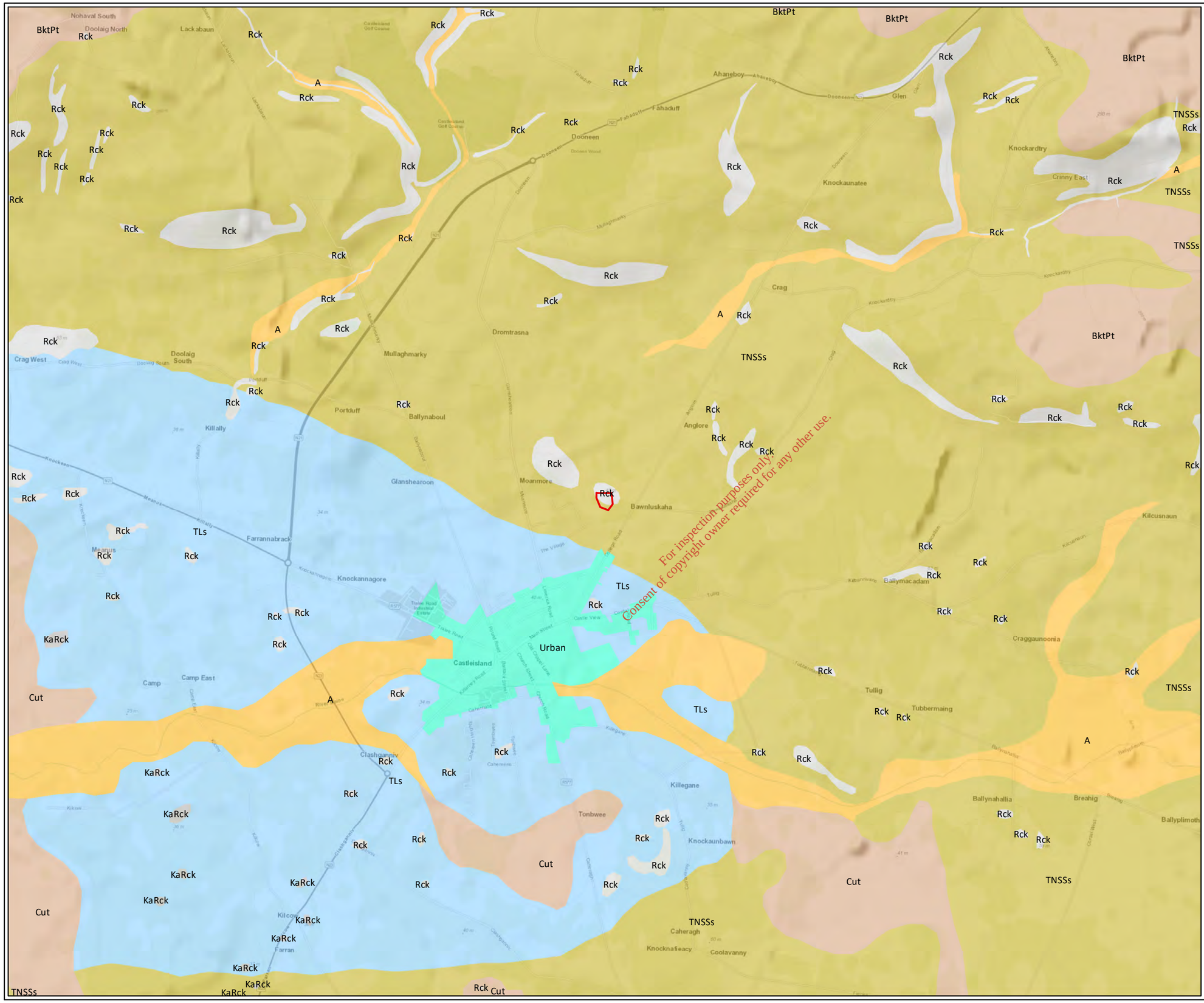
During the installation of boreholes during the site investigation, the presence of firm light brown sandy gravelly silty clay till is described in the driller's logs to a depth of approximately 8.30m BGL at borehole BH02 (See Appendix 2).

Solid or Bedrock Geology

The GSI online 1:100,000 scale bedrock geology map, shows the bedrock beneath the site is found on two different formations and geology types. The immediate infilled area is underlain by Cloonagh Limestone Formation comprising unbedded calcilutite limestone. The south portion of the wider site is underlain by the Rockfield Limestone Formation, which comprises fine-grained, dark grey, argillaceous, well-bedded limestones with some cross-stratification. Shale and chert horizons are rare. The boundary between these two formations transects the wider site in an almost west to east direction.

The bedrock geology is presented in Figure 2.3

"Limestone bedrock" was encountered at 0.3m BGL during the installation of borehole BH01 and at 8.80m during the installation of borehole BH02 as referenced in the CGL borehole logs, Appendix 2.



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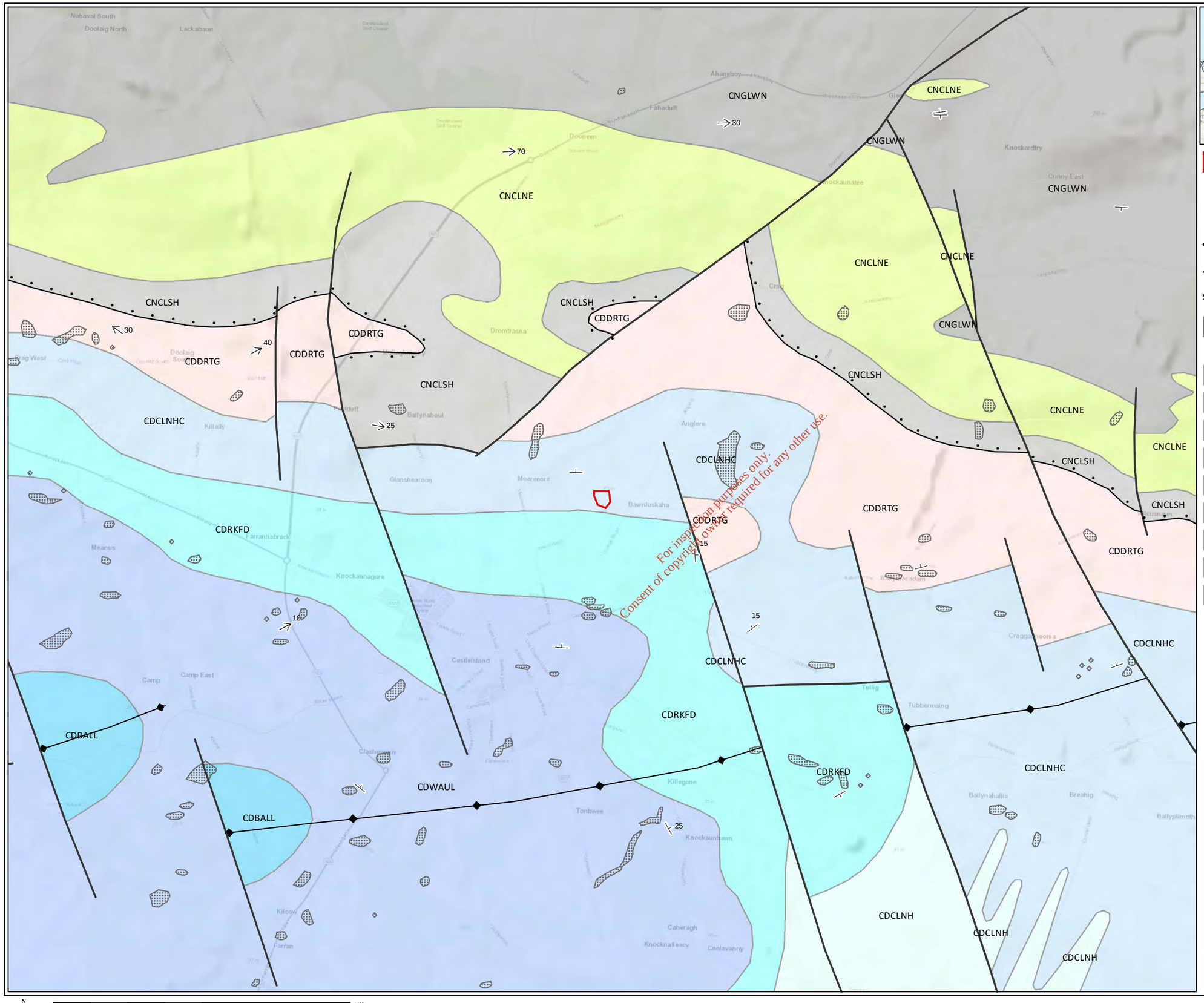

Site Boundary
Dip of bedding or main foliation, old GSI data
Strike and dip of bedding, way up unknown
Anticlinal Axis
Fault
Unconformity, dots on younger side
Bedrock Outcrop

Bedrock Geology

- Ballysteen Formation
- Cloonagh Limestone Formation
- Cracoean Reef Member
- Dirtoge Limestone Formation
- Rockfield Limestone Formation
- Waulsortian Limestones
- Cloone Flagstone Formation
- Clare Shale Formation
- Glenoween Shale Formation

N W E S
0 0.5 1 2 Kilometers

TITLE:	Bedrock Geology		
PROJECT:	Environmental Risk Assessment for Castleisland Landfill, Co. Kerry		
FIGURE NO:	2.3		
CLIENT:	Kerry County Council		
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2.2.5 Hydrogeology

An examination of the national bedrock aquifer map on the GSI online mapping classifies the underlying bedrock aquifer as 'Regionally Important Aquifer – Karstified (diffuse)' below the site and 'Locally Important Aquifer – Bedrock which is Moderately Productive only in Local Zones' to the south of the site. The bedrock aquifer mapping is presented in Figure 2.4.

GSI mapping indicates the presence of karst aquifer located within the site.

Historical mapping for the area shows several springs in the surrounding area. 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.

Table 2.1 presents the details of the GSI registered boreholes and springs within 1km of the site. It is noted that all wells listed below have location accuracies of 1 – 2km and may be located outside of the 1km radius.

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
0811SEW134	Undefined	Undefined	Other	-	6.7	0.22	1899
0811SEW133	Undefined	Undefined	Other	6	7.3	0.28	1899
0811SEW064	Poor	21.8	Domestic use only	-	19.8	0.38	1959
0811SEW017	Undefined	Undefined	Undefined	-	7.3	0.46	1899
0811SEW016	Undefined	Undefined	Undefined	2.4	6.4	0.49	1899
0811SEW113	Undefined	Undefined	Other	7.3	7.9	0.57	1961
0811SEW070	Undefined	Undefined	Undefined	-	-	0.8	1899
0811SEW071	Undefined	Undefined	Undefined	-	-	0.93	1899
0811SEW132	Undefined	Undefined	Other	-	5.4	0.98	1899
0811SEW069	Undefined	Undefined	Undefined	-	6.5	1	1899

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

There are no Groundwater Drinking Water Protection Areas within the site boundaries according to GSI. The closest one, Ardfert PWS SO, is located approximately 23.8km North-West from the site.

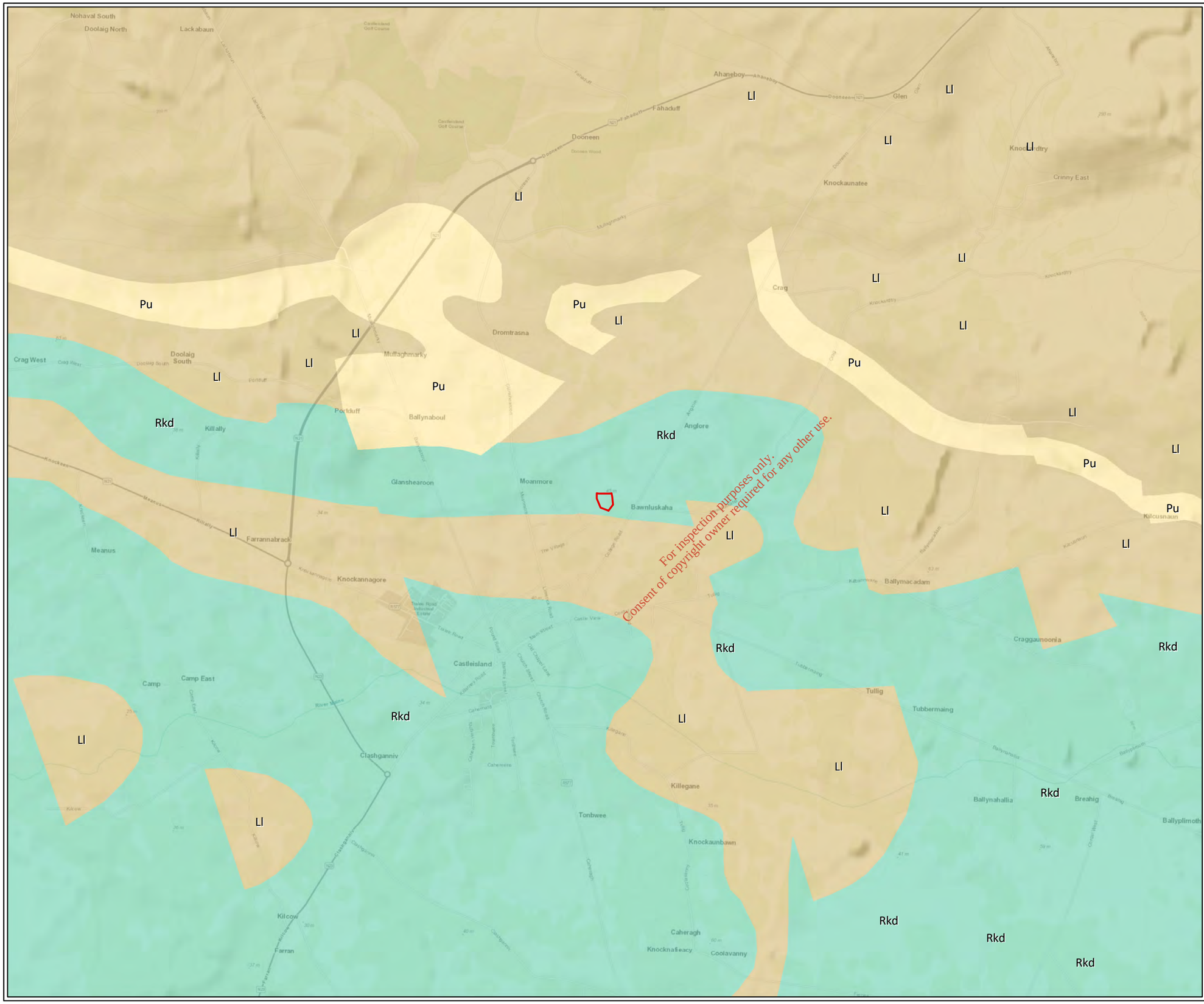
The GSI shows that the groundwater body (GWB) underlying the site is the Castlemaine GWB and it is a Karstic aquifer. The most recent (2015) Water Framework Directive quality status for the GWB is 'Good'. The WFD risk to groundwater quality was most recently classified as 'Review'.

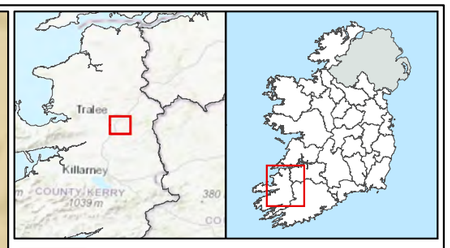
There are three ground water dependant ecosystems in the area according to Catchments Maps, Groundwater in SAC Species, Groundwater in SPA Habitats and Groundwater in SAC Habitats.

The GSI mapping shows three different groundwater vulnerability for recharge areas, the main two are:

a. *Rock at or near Surface or Karst: A pre-cap recharge rate of 988mm/yr for the site was calculated applying a recharge co-efficient of 85% to an effective rainfall rate of 1,162 mm/yr. GSI define the hydrogeological setting as areas where rock is at ground surface.*

b. *Extreme: A pre-cap recharge rate of 261mm/yr for the site was calculated applying a recharge co-efficient of 22.5% to an effective rainfall rate of 1,162 mm/yr. GSI define the hydrogeological setting as till overlain by poorly drained gley soil.*





Site Boundary

Bedrock Aquifers

Ll: Locally Important Aquifer - Bedrock Mod Productive Locally

Pu: Poor Aquifer Bedrock Generally Unproductive

Rkd: Regionally Important Aquifer - Karstified (diffuse)

TITLE:	Aquifer Classification		
PROJECT:	Environmental Risk Assessment for Castleisland Landfill, Co. Kerry		
FIGURE NO:	2.4		
CLIENT:	Kerry County Council		
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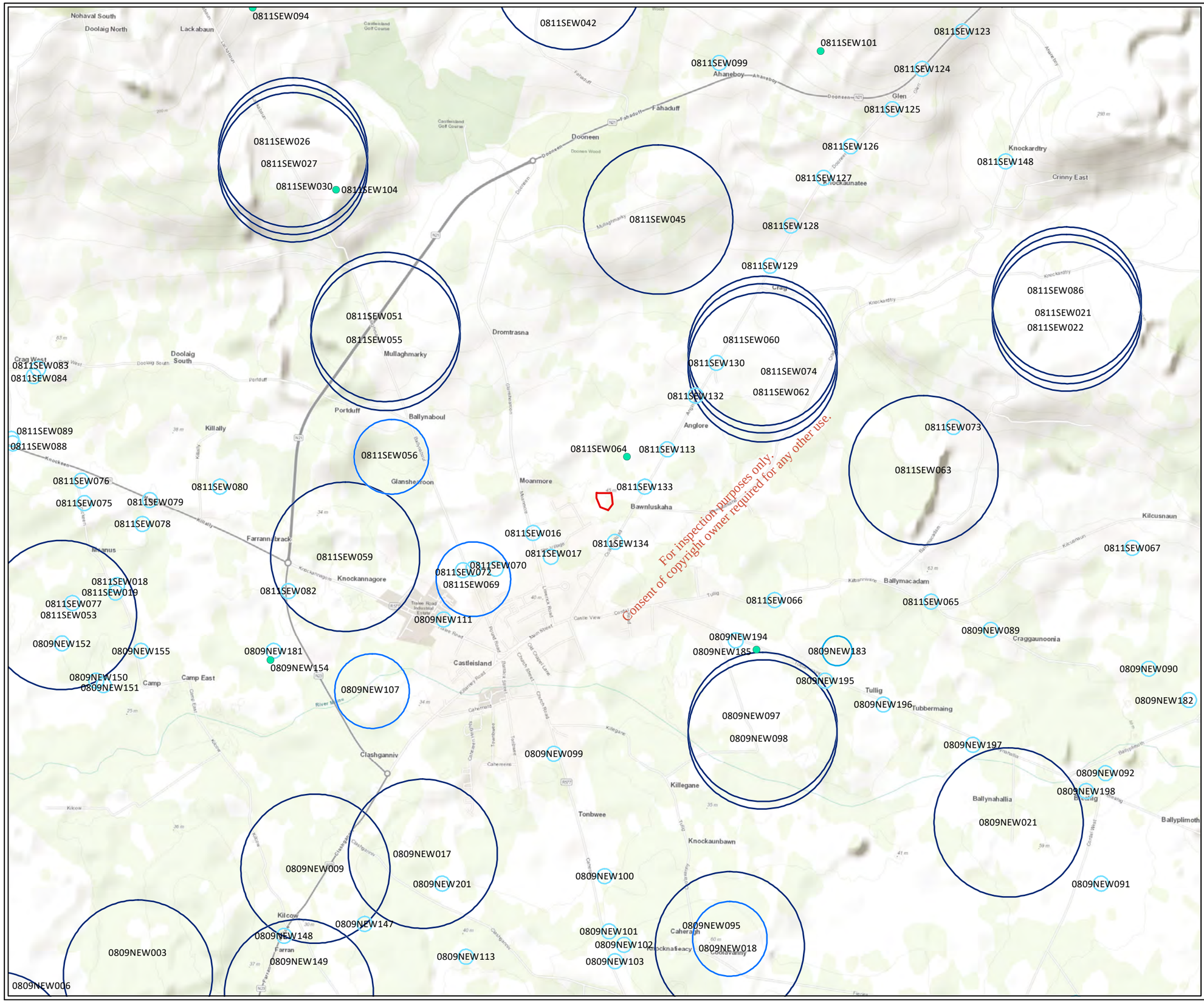
N W E S

0 0.5 1 2 Kilometers



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REVISION:	0
DATE:	25/10/2019
PAGE SIZE:	A3

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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 2.2. 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 is classified as X (Rock near surface) and is surrounded by E (Extreme) Vulnerability. The Groundwater Vulnerability mapping is presented in Figure 2.6.

The recharge coefficient associated with the areas where rock is at ground surface is 85% and the recharge rate is 988mm/year.

Table 2.2: GSI Guidelines – Aquifer Vulnerability Mapping

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

Notes:

N/A = Not Applicable

Precise permeability values cannot be given at present

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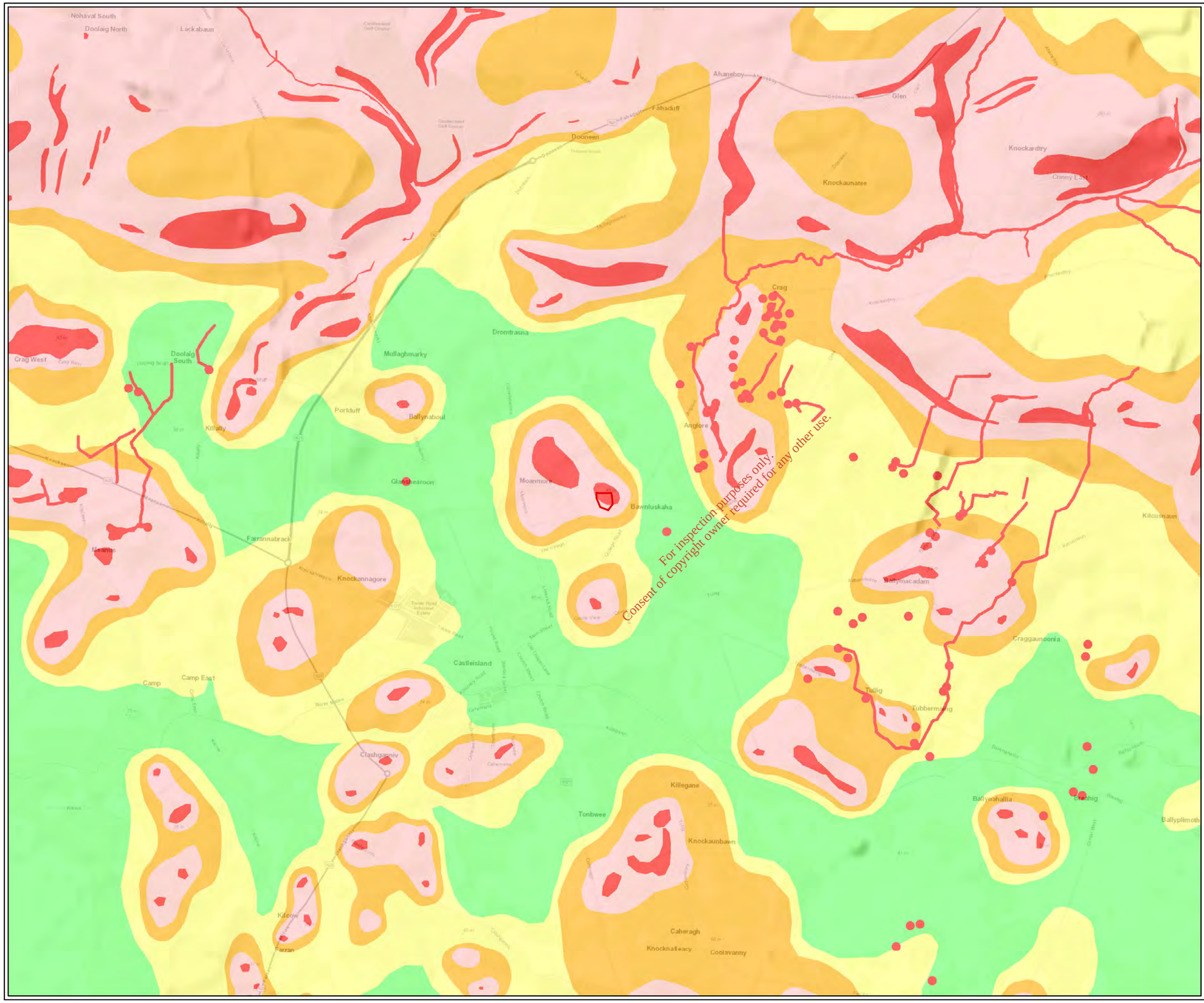

Site Boundary

Groundwater Vulnerability

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

N W E S

0 0.5 1 2 Kilometers

TITLE:	Groundwater Vulnerability		
PROJECT:	Environmental Risk Assessment for Castleisland Landfill, Co. Kerry		
FIGURE NO:	2.6		
CLIENT:	Kerry County Council		
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DATE:	25/10/2019	**PAGE SIZE:**	A3

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2.2.7 Hydrology

According to the Catchments Maps, the site is located within the Laune-Main-Dingle Bay catchment (Hydrometric Area 22), at Sub catchment Maine_SC_010 and Maine_020 river sub-basin. The nearest surface water feature to the site is the Maine_020 (also known as Glanshearon River) river (Status: Moderate) which is located 0.64km form the site to the north-west and flows in a southerly direction eventually meeting the Maine_030 river (Status: Good) c. 1.67km downstream of the site.

The Maine_030 river is located approximately 1.08km south of the site at its closest point. The Maine_030 river is subdivided into Maine_040 river (Status: Moderate) and Maine_050 river (Status: Unassigned), and discharges to Castlemaine Harbour (Status: Good) and at the end to Outer Dingle Bay (Status: Unassigned), which is c.25.4km south-west of the site.

There are no land drains located at the site, so no direct discharge pathway is present.

2.2.8 Ecology

The site is not 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 is the Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA (Site Code: 004161) and it is located c.2.8km north-east of the site at its closest point.

There does not appear to be any direct pathway or linkage between the site, and this protected area.

There is a Proposed Natural Heritage Area, Dooneen Wood (Site Code: 001349), located 2.1km north from the site.

Another protected site in relative proximity to the site is Anna More Bog NHA (Site Code: 000333), located around c.4.5km on the south of the site.

There are no other protected sites in the vicinity of the site or any sites that could be considered at risk.

The ecology protected areas mapping is presented in Figure 2.7.

2.2.9 Site History

The earliest historical map available on the OSI website dates from 1837-1842. The OSI identifies the land within the site boundary was historically used for agricultural purposes with evidence of minor quarrying activities. Review of the later 1888-1913 map series shows an extensive quarry with a nearby Lime Kiln the site has seen other significant use prior to its use as a landfill.

The OSI Historical Mapping is presented in Figure 2.8.

2.2.10 Existing Geological History

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 1km north-east of the site boundary at Crag Cave.

Crag Cave is described as a *"mature cave system: stream sinks, swallowholes, stream bed leakage, solution & collapse dolines, well-developed speleothems & sediments"* and the geological feature of note is *">12ka calcite".*

Another Geological Heritage is Tobermaing, located 1.65km south-east from the site. Tobermaing is described as *"Source of River Maine, a collapse feature"* and the geological feature of note is *"Karst spring"*.

The geological heritage mapping is presented in Figure 2.9.

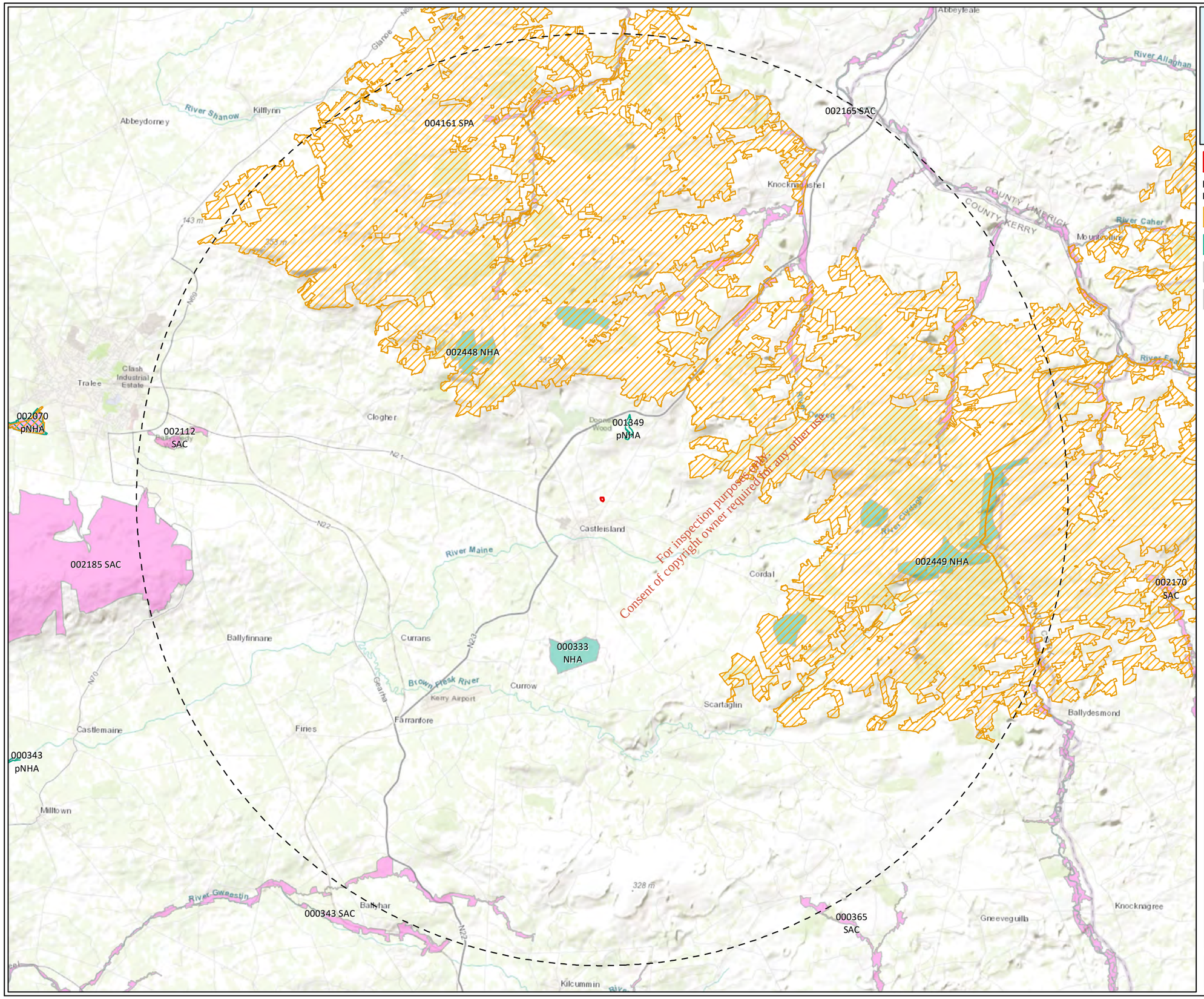
2.2.11 Existing Geotechnical Stability

The GSI landslides database indicates that there are no recorded geo-hazards within the site boundary.

The closest one is located 9.3km to the south-west of the site, at Tralee-Killarney Railway Line in November 1997.

2.2.12 Archaeological Heritage

There are four National Monuments north-west the site boundaries, between 0.2km and 0.4km. They all belong to Glanshearoon Townland. The Archaeological Survey of Ireland (ASI) is in the process of providing information on monuments, and these records have not been uploaded.



Site Boundary

15km Distance from Site Boundary

Special Protection Area (SPA)

Proposed Natural Heritage Area (pNHA)

Special Area of Conservation (SAC)

Natural Heritage Area (NHA)

N W E S

0 1 2 4 Kilometers

TITLE:	Ecologically Protected Areas		
PROJECT:	Environmental Risk Assessment for Castleisland Landfill, Co. Kerry		
FIGURE NO:	2.7		
CLIENT:	Kerry County Council		
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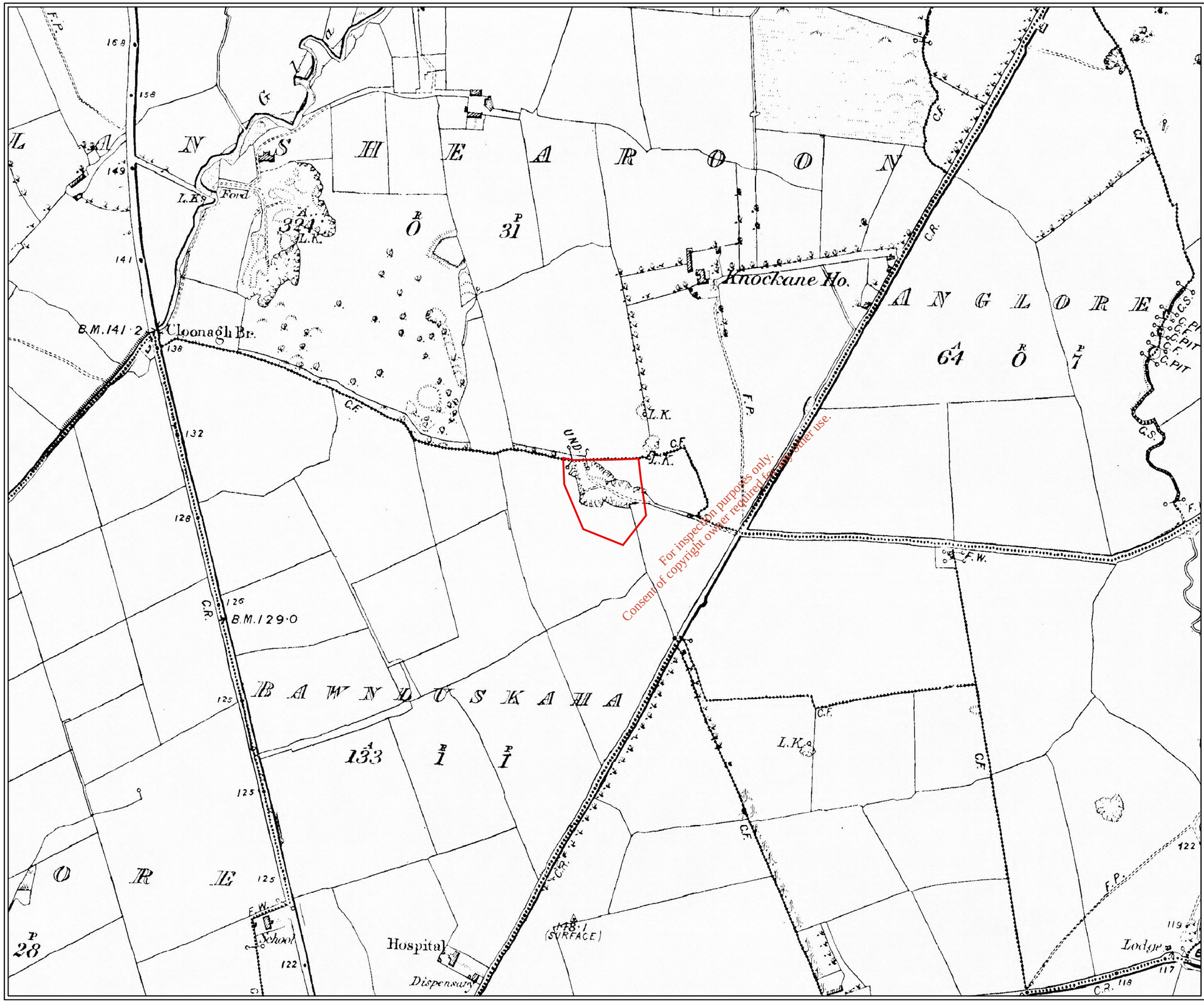

Site Boundary

Meters
0 50 100 200

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South coastal section of Kerry Head- westwards from Ballyheigue to Glenderry River

Kerry Head

Lixnaw Quarry

St. Bridget's (Newcastle West)

Plover Hill

Oyster Hill

Oyster Hill

Fenit Island

Kilfenora

Samphire Island

Crag Cave

Crag Cave

Tobermaing

Kilneedan Outlier

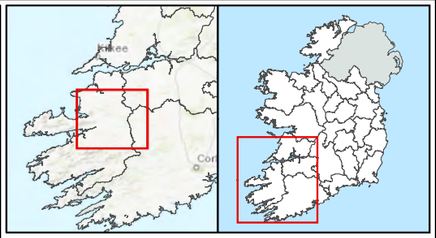
Listry

Tullig Beg

Lake section at Killarney

Ross Island

Lake Section Killarney



Geological Heritage Sites

Site Boundary

TITLE:	Geological Heritage		
PROJECT:	Environmental Risk Assessment for Castleisland Landfill, Co. Kerry		
FIGURE NO:	2.9		
CLIENT:	Kerry County Council		
SCALE:	1:175000	**REVISION:**	0
DATE:	25/10/2019	**PAGE SIZE:**	A3

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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:

- 1 No. Geophysical survey (2D resistivity and seismic refraction profiling)
- 5 No. Trial pit excavations
- Installation and monitoring of 2 No. groundwater boreholes
- Topographical Survey
- Factual reporting

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

The site investigation included the review of the following literature sources and websites:

- 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

3.1.1 Site Walkover

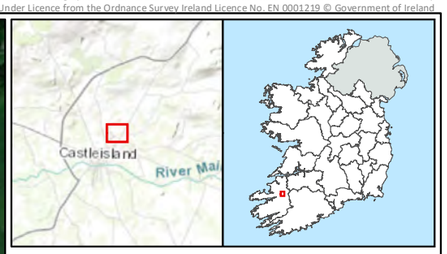
A site walkover was conducted prior to site investigation works by an FT Engineer. During the site walkover the scope of the investigative works were evaluated based on the findings in the Tier I assessment.

The scope was agreed based on the site walkover assessment, historic aerial photography and other information received by KCC.

The current immediate land use is agricultural in keeping with the general surroundings, a housing estate is located 100m south-west. The site is c.0.5 ha, with a very slight dome shape. The potential receptors identified were houses and groundwater. No immediate surface water, wetland, protected areas, public water supplies or other buildings identified, however private wells might be present, and a graveyard is located 150m east.

The potential source of contamination identified is buried waste, despite that, surface waste, leachate seepage and landfill gas odours were not noted, and surface ponding of leachate was not present. There is no evidence of any outfalls to surface water and no signs of impact on the environment.

The site walkover checklist and photo log are included in Appendix 3.



Borehole

Trial Pit

Site Boundary

N
W E
S

Meters
0 25 50 100

TITLE:	Site Investigation Location Plan		
PROJECT:	Castleisland Landfill, Co. Kerry		
FIGURE NO:	3.1		
CLIENT:	Kerry County Council		
SCALE:	1:2500	**REVISION:**	0
DATE:	13/11/2019	**PAGE SIZE:**	A3

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3.1.2 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 7th and 28th of March 2019. The MGX geophysical survey report is included in Appendix 5.

The geophysical survey consisted of reconnaissance EM Ground Conductivity Mapping with follow-up 2D Resistivity Profiling (RT) and Seismic Refraction Profiling. A total of 336m for Resistivity Profiling (RT) and 282m 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 located a waste body within an historic quarry in the NE of the site. The extent of the landfill is estimated at 2192 m^2, its depth is about 6m below ground level which gives a total volume of 13,152 m^3 including fill material placed on top of the landfill. The low resistivities and seismic velocities measured were noted as consistent with industrial and domestic waste.

MGX recorded RT profiles data along 2 designated profiles. RT profiles are named R1 and R2, two seismic refraction profiles (S1- S2) were recorded across the site. See Figure 3.2.

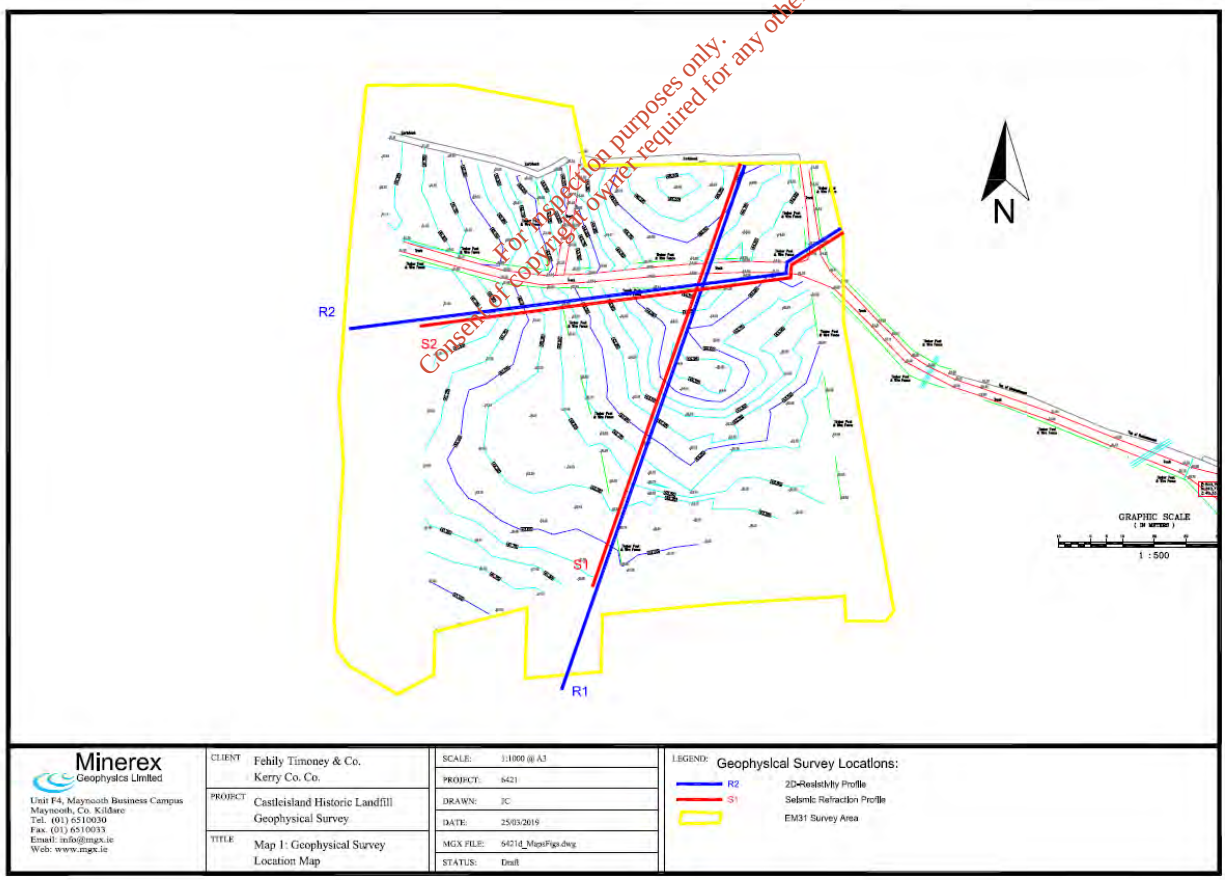


Figure 3.2: Geophysical Survey Location Map

Results

The geophysical survey succeeded in validating the general location of the waste material. Both the elevated EM conductivity readings in combination with the trial pit logs show the waste to be present within one central location of the survey area.

Most of the area surveyed had conductivities of <10 mS/m with some exception. Towards the west, conductivities gradually increase to 15 mS/m. This is likely due to the change in ground conditions to a marshier wet environment which was noted on site. In the NE corner of the site there is an area with conductivities higher than 10 mS/m. This is the likely location of the landfill site.

The resistivities measured on site show a lot of disturbance in the ground. Along profile R1 there is an area near the end of the profile where there are lower resistivities. There is a similar area near the end of Profile R2. These two areas conform with the low conductivity results in the NE. It was noted that's as the site is a former limestone quarry, the high resistivities around the landfill is likely limestone around the edge of the quarry.

It was further noted that the low resistivity below the landfill along R1 may be leachate escaping into the rock below, further south along profile R1 and in the west of R2 there are other areas of low resistivity at depth which are likely due to karstification of the rock in these areas.

The geophysics reported that the apparent karstification of the rock noticeable along the profiles may aid in the movement of leachate from the landfill into the rock.

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

Layer 1 has a seismic velocity of 300 m/s and is found only in the NE corner of the site. This velocity would represent landfill material which has a lower velocity than the surrounding natural ground

Layer 2 has a seismic velocity range of 400 and 550 m/s. This layer in interpreted as natural overburden material.

Layer 3 is interpreted as overburden or highly weathered Limestone and is only found away from the landfill towards the south. This layer has a seismic velocity of 1000 m/s.

Good rock is indicated by seismic velocities of 2600 – 3000 m/s. This layer is found all around the landfill.

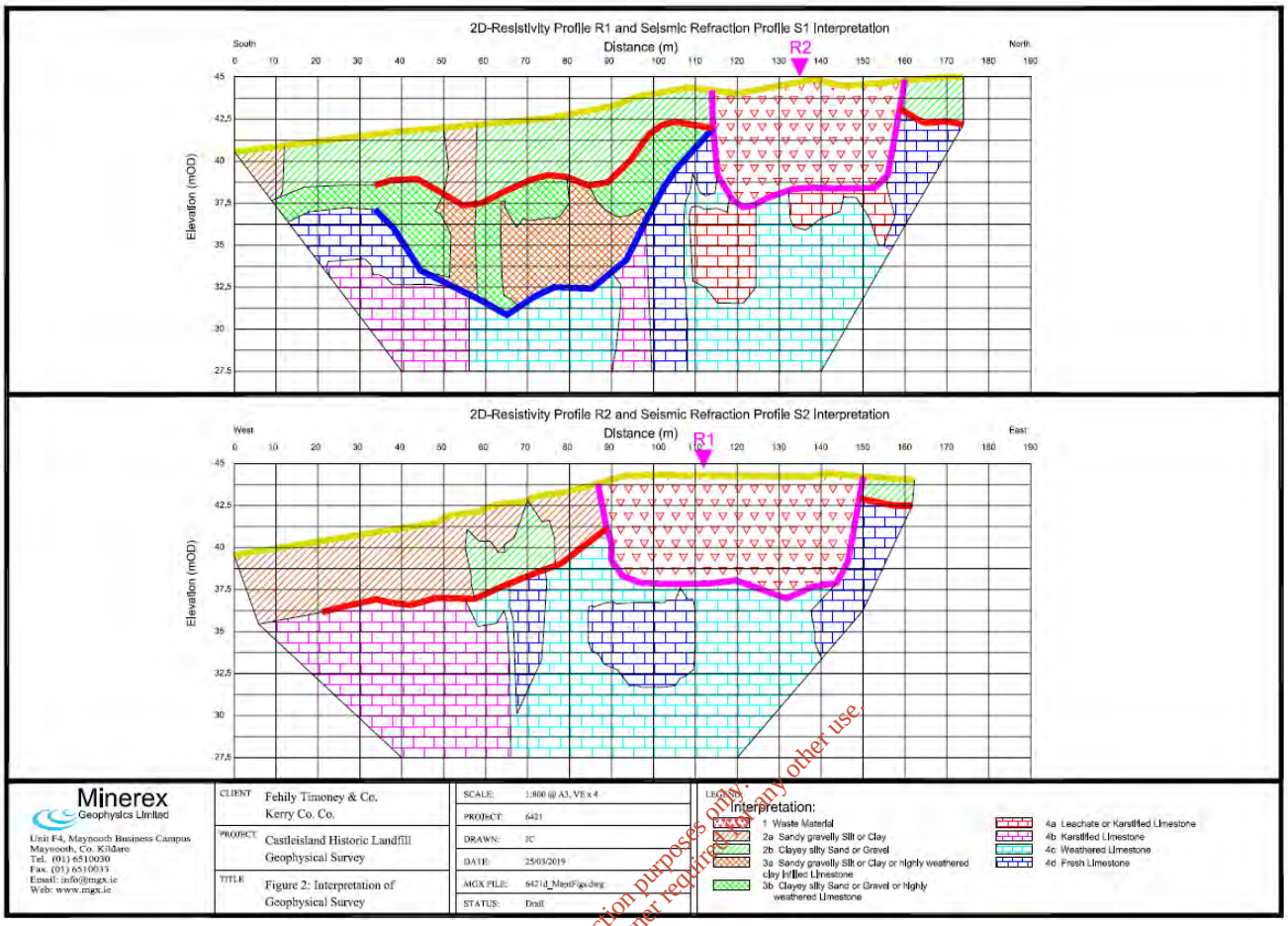


Figure 3.3: Interpretation of Geophysical Survey

3.1.3 Trial Pitting

A CGL Engineering Geologist supervised the advancement of 5 No. trial pits, shown in Figure 3.1 on the 31st May 2019.

Four trial pits (TP01–TP02, TP04-TP05) were excavated using a JCB 3CX excavator fitted with a 600mm wide bucket, to a maximum depth of 2.60m below existing ground level (BGL). A suitable location for TP03 was unable to be found. The geophysical survey used in conjunction with the profiles identified during trial pitting provided a picture of the underlying geology of the site and a general profile of the buried waste.

A summary of the ground conditions is presented in Table 3.1 below with photographs and exploratory hole logs provided in the CGL site investigation report, Appendix 2.

Table 3.1: Summary of Ground Conditions

Trial Pit ID	Depth of cover material (m BGL)	Depth to base of made ground/waste (m BGL)	Profile Description
TP01	0.0 - 0.20 (Topsoil) 0.20 – 1.0 (Made Ground) 1.0 – 1.95 (Made Ground)	1.95 (base of excavation)	Firm sandy slightly gravelly silty CLAY. Soft sandy slightly gravelly silty CLAY; waste – glass bottles, glass fragments and plastic bags, predominantly soil. Soft sandy slightly gravelly silty CLAY; waste - glass bottles, glass fragments, metal parts, white plastic, bags, predominantly soil.
TP02	0.0 - 0.15 (Topsoil) 0.15 – 0.40 (Made Ground) 0.40 – 1.10 (Made Ground)	1.10 (base of excavation - terminated on possible bedrock)	Topsoil Firm sandy slightly gravelly silty CLAY. Sandy slightly gravelly silty CLAY; waste – glass bottles, glass fragments and plastic bottles.
TP03	0.0 - 0.30 (Topsoil) 0.30 – 0.50 (Clay) 0.50 – 2.10 (Silt)	2.10 (base of excavation)	Firm sandy slightly gravelly silty CLAY. Firm sandy slightly gravelly silty CLAY. Grey sandy slightly gravelly clayey SILT
TP04	0.0 - 0.10 (Topsoil) 0.10 – 0.40 (Made Ground) 0.40 – 2.0 (Made Ground)	2.0 (base of excavation)	Topsoil Firm sandy slightly gravelly silty CLAY. Sandy slightly gravelly silty CLAY; waste – black, white and blue plastic bags, brick, glass bottles and socks
TP05	0.0 - 0.70 (Clay) 0.70 – 1.60 (Clay) 1.60 – 2.50 (Clay)	2.50 (base of excavation)	Firm sandy silty CLAY. Firm sandy gravelly silty CLAY. Firm sandy slightly gravelly silty CLAY.

Made ground comprising waste was encountered in 3 No. trial pits (TP01; TP02 and TP04). Possible bedrock was encountered in TP02 at 1.10m.

Waste material was encountered between 0.20m – 2.0m in trial pits TP01, TP02 and TP04. No groundwater was encountered.

Natural ground comprising of quaternary glacial till was confirmed in 2 No. trial pits (TP03 and TP05).

3.1.4 Waste Sampling

A total of 2 No. samples of the made ground / waste at the site was collected from trial pits TP01 and TP04 advanced in the northern portion of the site.

All 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 F of the CGL Ground Investigation report, Appendix 2 of this report.

The results are discussed in Section 4.2.

3.1.5 Evidence of Historic Landfilling

The trial pit excavation works identified waste material tending to the northern site boundary with thicknesses ranging from 0.20 – 2.0m BGL. Evidence of waste material was identified in 3 No. trial pits locations (TP01; TP02 and TP04). The waste encountered was described as glass bottles, glass fragments, plastic bottles, metal parts, white plastic, black, white and blue plastic bags, brick and socks. The waste material description as described by CGLs Engineering Geologist is very typical of MSW material.

Waste was not encountered in the perimeter trial pits TP03 and TP05 advanced in the west and south of the site. The base of the waste material was not reached at the termination depth of 2.0m BGL in any trial pit (TP02, TP03 and TP04).

As noted, most of the Made Ground waste material encountered comprised sandy gravelly Clay mixed with MSW.

3.1.6 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 show the area where landfill material is present however the exact lateral extent of waste is not very clear. The interpreted landfill extent covers an area of approx. 2,192 m^2.

The depth of waste has been estimated from the seismic refraction and 2D-Resistivity, an average thickness of 6m has been calculated for the landfill material. The estimate includes capping or natural fill material on top of the main waste body.

An initial volume calculation estimates an interred waste volume of approximately 13,152m^3 (c.18,375 tonnes) at the site.

The maximum anticipated waste footprint is presented in Figure 3.3.

MGX note that possible leachate was identified along profile R1. This leachate is in the rock layer and may have been made possible by weathered or karstified limestone. The report further notes that leachate from the landfill may be restricted by the fresh limestone surrounding most of the landfill. However, sand and gravel in the overburden and weathering and karstification of the limestone provide the potential for the movement of leachate.

3.1.7 Borehole Installation and Groundwater Sampling

Two boreholes (BH01 and BH02) were drilled to a total depth of 8.50m BGL and 10.0m BGL respectively at the site. The boreholes were drilled for installing groundwater monitoring installations.

The purpose of the boreholes was to intercept and define the groundwater flow direction upstream and downstream of the identified waste body.

Groundwater was not noted during drilling at any of the locations. However, it should be noted that the casing used in supporting the borehole walls during drilling may have sealed out any groundwater strikes and the possibility of encountering groundwater at other depths should not be ruled out. Further any groundwater strikes within bedrock may have been masked by the fluid used as the drilling flush medium.

Groundwater monitoring was attempted in boreholes BH01 and BH02 on July and September 2019. Both wells were dry at the time of sampling.

3.2 Geotechnical Analysis

3.2.1 In-Situ Capping Permeability Testing

Bulk disturbed soil sample from TP04 was 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 Causeway Geotech in Appendix 2.

Permeability testing by triaxial compression was also completed on soil sample submitted from trial pits TP04. This testing was undertaken to assess the suitability of the existing capping material at minimising rapid rainfall infiltration and preventing leachate generation within waste body.

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

Table 3.2: Permeability Results

Sample ID	K (m/s)
TP04	$4.3x10^{-10}$ m/s

4. ENVIRONMENTAL ASSESSMENT

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) (Amendment) Regulations, 2019 (S.I. No. 77 of 2019).
- European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations, 2015 (S.I. No. 386 of 2015).
- European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations, 2012 (S.I. No. 327 of 2012).
- European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I No. 272 of 2009).
- European Communities (Quality of Surface Water Intended for the Abstraction of Drinking Water) Regulations, 1989 (S.I. No. 294/1989).

The results of the environmental assessment at the Castleisland Historic Landfill site are presented in the following sections.

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 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 Castleisland Historic Landfill is outlined in Table 4.1 below, while the laboratory reports are presented in Appendix F of the CGL Ground Investigation report, Appendix 2 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 (1.70m)	TP04 (1.0m)
Asbestos in soil	--	**Detected**	**Detected**	**Detected**		
Arsenic	l.kg^{-1}	**0.5**	**2**	**25**	< 0.0010	0.0016
Barium	l.kg^{-1}	**20**	**100**	**300**	0.036	0.13
Cadmium	l.kg^{-1}	**0.04**	**1**	**5**	< 0.00010	< 0.00010
Chromium	l.kg^{-1}	**0.5**	**10**	**70**	0.0020	< 0.0010
Copper	l.kg^{-1}	**2**	**50**	**100**	< 0.0010	< 0.0010
Mercury	l.kg^{-1}	**0.01**	**0.2**	**2**	< 0.00050	< 0.00050
Molybdenum	l.kg^{-1}	**0.5**	**10**	**30**	0.010	0.012
Nickel	l.kg^{-1}	**0.4**	**10**	**40**	< 0.0010	0.096
Lead	l.kg^{-1}	**0.5**	**10**	**50**	< 0.0010	< 0.0010
Antimony	l.kg^{-1}	**0.06**	**0.7**	**5**	0.0024	0.0026
Selenium	l.kg^{-1}	**0.1**	**0.5**	**7**	0.012	0.0012
Zinc	l.kg^{-1}	**4**	**50**	**200**	< 0.0010	0.033
Chloride	l.kg^{-1}	**800**	**15000**	**25000**	5.3	3.2
Fluoride	l.kg^{-1}	**10**	**150**	**500**	0.19	0.12
Sulphate	l.kg^{-1}	**1000**	**20000**	**50000**	100	530
Total Dissolved Solids	l.kg^{-1}	**4000**	**60000**	**100000**	220	780
Phenol Index	l.kg^{-1}	**1**	**--**	**--**	< 0.030	< 0.030
Dissolved Organic Carbon	l.kg^{-1}	**500**	**800**	**1000**	7.0	14
Total Organic Carbon	%	**3**	**5**	**6**	1.0	**6.3**
Loss on Ignition	%	--	**--**	**10**	4.2	**20**
Total BTEX	mg.kg^{-1}	**6**	**--**	**--**	< 0.010	< 0.010
Total PCBs (7 Congeners)	mg.kg^{-1}	**1**	**--**	**--**	< 0.10	< 0.10
TPH Total WAC (Mineral Oil)	mg.kg^{-1}	**500**	**--**	**--**	< 10	**320**
Total (Of 17) PAH's	pH units	**100**	**--**	**--**	< 2.0	< 2.0
pH	%	--	**>6**	**--**	8.5	8.2
Acid Neutralisation Capacity		--	**To evaluate**	**To evaluate**	0.050	0.032

* Hazardous Waste Landfill Criteria: >6% TOC
* Items in **bold** are in exceedance of the Inert WAC limit value
* Items shaded in **green** are in exceedance of the Non-Hazardous WAC limit value
* Items shaded in **orange** are in exceedance of the Hazardous WAC limit value

4.2.2 Waste Classification

As can be seen in Table 4.1, based on the 2 No. samples submitted for laboratory analysis, waste material encountered within the site are typically inert in terms of their leachate production, except for TOC, LoI and TPH. The TOC and LoI is most likely due to the degradation of organic fractions within the MSW. TPH present at TP04 is likely from anthropogenic sources (waste) which is also likely a factor in the elevated TOC and LoI.

4.3 Groundwater Analysis

Two rounds of groundwater quality monitoring were attempted at the site in July and September 2019. The two boreholes were dry on both occasions.

4.4 Landfill Gas Monitoring

FT carried out monitoring of landfill gas (LFG) parameters at each monitoring borehole location (BH01 and BH02). In accordance with the EPA CoP, methane, carbon dioxide, oxygen and atmospheric pressure were analysed at the two monitoring wells using a GEM5000 Landfill Gas analyser.

4.4.1 Monitoring Results

In accordance with the CoP, the trigger level for methane outside the waste body is 1% v/v and for carbon dioxide is 1.5% v/v.

The monitoring results for methane, carbon dioxide and oxygen levels for the monitoring boreholes are summarised in Table 4.2.

Table 4.2: Landfill Gas Monitoring Results October 2019

Date: 24/10/2019						
Sample Station	CH_4	CO_2	O_2	Atmospheric pressure	Staff Member	Weather
	(% v/v)	(% v/v)	(% v/v)	mbar		
BH01	0.1	0.2	21.4	1009	Emily Archer	Scattered cloud with light showers, 8-12°C
BH02	0.1	0.1	21.6			

As can be seen in Table 4.2, concentrations of both CO_2 and CH_4 at all monitoring boreholes BH01 and BH02 were below the threshold values set by the CoP during the monitoring round.

4.5 Surface Water Monitoring

No surface water monitoring was undertaken as part of the Tier 2 assessment due to the distance of the nearest surface water body to the historic landfill area (640m) and no direct connection existing between the two.

5. RISK ASSESSMENT

5.1 Introduction

Risk assessment considers the likelihood of occurrence and the consequence of occurrence of an event (Royal Society, 1992[1]). 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 Castleisland site are:

- Groundwater; and
- Bedrock

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 nearby the site.

[1] 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

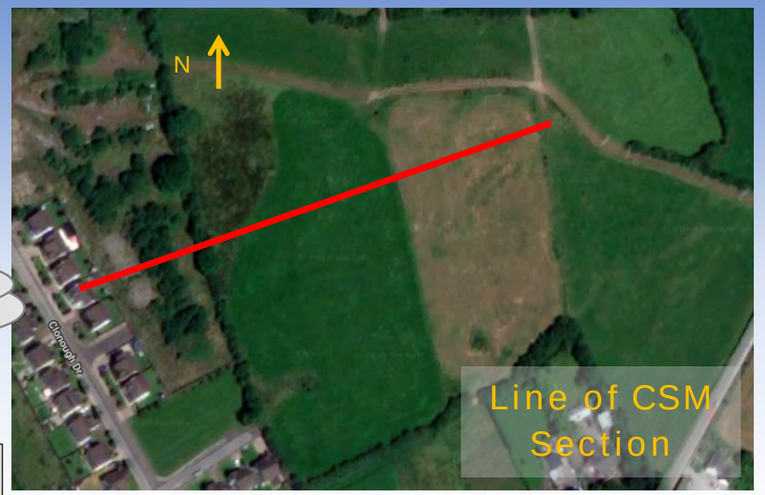
5.3 Conceptual Site Model

Based on the review of the Tier 1 assessment and site investigation works undertaken for Castleisland 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, overleaf.

Landfill Gas Migration

Leachate Migration

Measured Groundwater Level



Housing Estate ~200m West (and <150m South)

BH02
41.54mAOD

MADE GROUND / WASTE - 2192 m²

Topsoil Cover
0.15 – 0.30m

Depth of waste ~6m up to 7.5m BGL

~45.0mAOD

WASTE BODY

37.5mAOD

CLAY/SILT GLACIAL TILL

31.54 mAOD

<31.54 mAOD

Karstfied, Weathered and Fresh Limestone

Regionally Important Aquifer - Karstified (diffuse)

Vulnerability - Extreme

GW FLOW DIRECTION

Unknown

CROSS SECTION WEST-EAST

FIGURE 5.1 CASTLEISLAND 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 Castleisland 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 – Castleisland Landfill

EPA Ref	Risk	Points		Rationale
1a	Leachate; source/hazard scoring matrix, based on waste footprint.	Municipal ≤1ha	5.00	Based on a waste footprint of ≤1ha and the assumption of Municipal Waste the score should be 5.
1b	Landfill gas; source/hazard scoring matrix, based on waste footprint.	Municipal ≤1ha	5.00	Based on a waste footprint of ≤1ha and the discovery of typically Municipal Waste.

EPA Ref	Risk	Points	Rationale
2a	Leachate migration: Pathway (Vertical)	3.00	GSI describes the groundwater vulnerability as X (Rock near surface) surrounded by E (Extreme) Vulnerability and waste above possible bedrock as indicated during trial pitting.
2b	Leachate migration: Pathway (Horizontal)	5.00	The groundwater vulnerability is classified by the GSI as a Regionally Important Aquifer - Karstified - diffuse (Rkd).
2c	Leachate migration: Pathway (Surface water drainage)	0.00	There is no direct connection between the waste body and the adjacent Maine_20 river as verified during site walkover.
2d	Landfill gas: Pathway (Lateral migration potential)	3.00	Sand and Gravel, Made ground, urban, karst. Previously an historic quarry.
2e	Landfill gas: Pathway (Upwards migration potential)	5.00	Sand and Gravel, Made ground, urban, karst.
3a	Leachate migration: Receptor (Human presence)	2.00	Based on the presence of a housing development located to the south-west of the site boundary and within 150m of the waste body.
3b	Leachate migration: Receptor (Protected areas – SWDTE or GWDTE) (Surface water/ groundwater dependent terrestrial ecosystems)	0.00	Greater than 1km from the waste body.
3c	Leachate migration: Receptor (Aquifer category – Resource potential)	5.00	Regionally important aquifers (Rk, Rf, Rg).
3d	Leachate migration: Receptor (Public water supplies – other than private wells)	3.00	Greater than 1km (karst aquifer).
3e	Leachate migration: Receptor (Surface water bodies)	1.00	Surface waterbody Maine_20 river is within 1km from the waste body at certain locations.
3f	Landfill Gas: Receptor (Human presence)	3.00	Based on the presence of a housing development located to the south-west of the site boundary and within 150m of the waste body the score is being maintained at 3.

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	**80**	300	Leachate => surface water	27%
SPR2	1a x (2a + 2b + 2c) x 3b	**0**	300	Leachate => SWDTE	0%
Leachate migration through groundwater pathway					
SPR3	1a x (2a + 2b) x 3a	**80**	240	Leachate => human presence	33%
SPR4	1a x (2a + 2b) x 3b	**0**	240	Leachate => GWDTE	0%
SPR5	1a x (2a + 2b) x 3c	**200**	400	Leachate => Aquifer	**50%**
SPR6	1a x (2a + 2b) x 3d	**120**	560	Leachate => Surface Water	21%
SPR7	1a x (2a + 2b) x 3e	**40**	240	Leachate => SWDTE	17%
Leachate migration through surface water pathway					
SPR8	1a x 2c x 3e	**0**	60	Leachate => Surface Water	0%
SPR9	1a x 2c x 3b	**0**	60	Leachate => SWDTE	0%
Landfill gas migration pathway (lateral & vertical)					
SPR10	1b x 2d x 3f	**45**	150	Landfill Gas => Human Presence	30%
SPR11	1b x 2e x 3f	**75**	250	Landfill Gas => Human Presence	30%
Site maximum S-P-R Score					**50%**
Risk Classification					**Class B**

Table 5.2 shows the maximum S-P-R scoring for the site is **50%.**

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 principal risk identified on the site is the risk posed to the aquifer from migration of leachate from the waste material encountered at the site.

6. CONCLUSION

A Tier 2 study was conducted by FT in accordance with the EPA CoP for Castleisland 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 tending north-east of the site and the extent of the landfill is estimated at 2192 m^2.

A volume calculation based on the surveyed surface profiles for the existing ground level and the base of waste as interpreted, preliminary estimates indicate an interred waste volume of approximately 13,152 m^3 (c.18,375 tonnes) including fill material placed on top of the landfill.

Analysis of waste samples from the trial pits excavated, when assessed against the inert waste acceptance criteria indicated that much of the waste material within the site can be classified as typically inert. The waste classification is considered to reflect the level of degradation over time since landfilling ceased. Trial pitting confirmed the waste material is near the surface with a minimal topsoil and clay cover present across the site.

Landfill gas monitoring from perimeter wells BH01 and BH02 at the site indicates gas concentrations detected are below threshold levels set by the EPA CoP. Considering the low gas concentrations measured at the perimeter wells and the identified building receptors within 150m of the waste body, a low-risk score of 30% for SPR10 and SPR11 has been generated. The pathway between the waste body and the offsite building receptors will require further investigation to verify the risk, if any, to these receptors.

Groundwater monitoring was attempted on two occasions in BH01 and BH02 on both occasions the wells were dry. Surface water sampling was not undertaken due to the distance of the site to the nearest open waster body (640m) and the non-existence of a direct surface water pathway to the surface water receptor.

Based on the results of the Tier 2 site assessment, the site can be classified as a **Moderate Risk Classification (Class B)**. The principal risk identified on the site is the risk posed to the aquifer from migration of leachate from the waste material encountered at the site through groundwater.

6.1 Recommendations

Based on the results of the initial Tier 2 assessment the site is classified as Moderate Risk. For a moderate risk site, the CoP indicates that a Tier 3 Environmental risk analysis be undertaken including a Detailed Quantitative Risk Assessment (DQRA) The purpose of the DQRA will be to quantitatively assess the primary S-P-R linkage identified i.e. leachate migration to the Karst aquifer.

It is therefore recommended by FT that a Tier 3 assessment be undertaken for the site in conjunction with an application for a Certificate of Registration for this site.

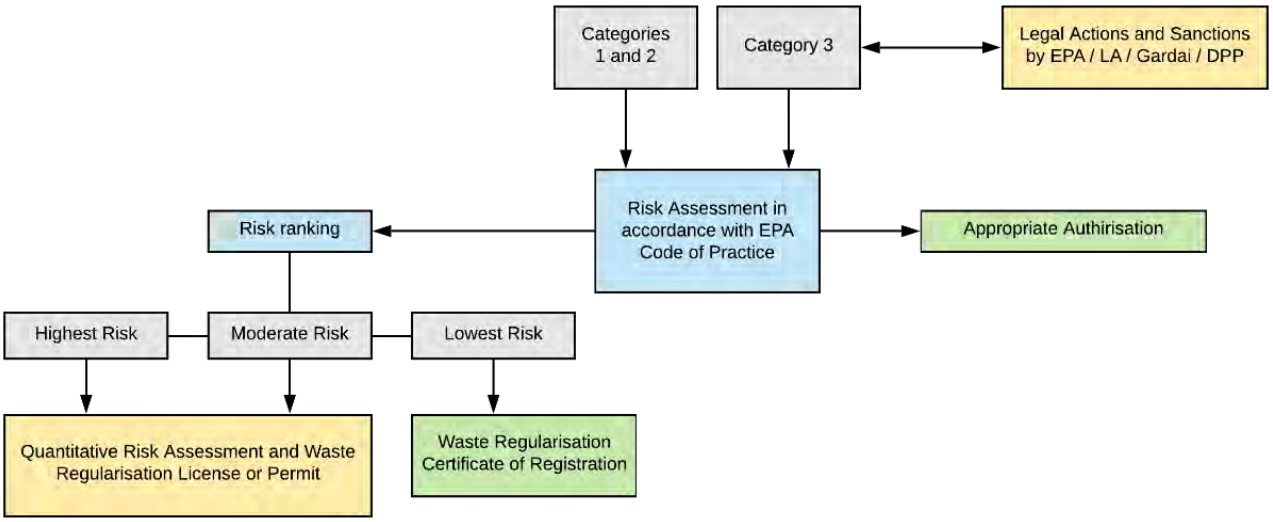

Figure 6.1: Extract from Section 1.3 of the EPA Code of Practice