

**SHORE ROAD HISTORIC LANDFILL,
CLIFDEN, CO. GALWAY**

**APPLICATION TO EPA
FOR
CERTIFICATE OF AUTHORISATION**

VOLUME II. SECTION D - PART A

***TIER 2 SITE INVESTIGATION & RISK ASSESSMENT
OF SHORE ROAD LANDFILL REPORT
(16th May 2014)***

24th March, 2021

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**TIER 2 SITE INVESTIGATION & RISK ASSESSMENT
OF
FORMER SHORE ROAD LANDFILL,
CLIFDEN, CO. GALWAY**

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REPORT

16TH May 2014

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2	Tier 2 Site Investigation & Risk Assessment of Former Shore Road Landfill - Appropriate Assessment Screening Report
3	<ul style="list-style-type: none"> • EPA/Teagasc Soil Mapping • EPA/Teagasc Subsoil Mapping
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5	GSI Hydrogeological Mapping Clifden-Castlebar Groundwater Body (GWB) Report
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1 INTRODUCTION

1.1 Project Background

Following a meeting on the 18th March, 2013 with Tony McInerney, Senior Engineer and Tom Dunworth, Senior Executive Technician Galway County Council, Mulroy Environmental were instructed to prepare a fee proposal for a Tier 2 Site Investigation and follow up Tier 3 Generic Quantitative Risk Assessment (GQRA) and if necessary a Detailed Quantitative Risk Assessment (DQRA) Assessment of Shore Road Landfill, Clifden, County Galway (see Figure 1 and Plate 1 below). This report and the field works carried out in connection with the report (together the "Services") were compiled and carried out for Galway County Council (the "client") in accordance with the terms of a contract, Proposal PRP214.05.04.2013, between Mulroy Environmental and the "client" dated 5th April 2013.

1.2 General Setting

The former Shore Road landfill site is located on the southern side of the Shore Road adjacent to the shore of Clifden Bay and is approximately 0.98 hectares (i.e. 9,800m²) in area (see Figures 1, 2 & 3). According to Galway C.C., the former municipal landfill at Shore Road, Clifden, County Galway, was in operation from the 1920s to the late 1960s. It is understood that the site was capped and a football field was constructed in the 1970s. However, the football pitch became disused due to water logging. The site is currently disused and has been left fallow since that time. During this 40-50 year period, as there are no records, it is not clear how many tonnes of mixed waste including domestic, commercial and construction & demolition (i.e. C & D) were deposited on site by the people of Clifden and/or the local authority. As stated, the total site area is 9,800m². However, the results of the site investigation indicate that an area of just 2,325m² was used for the deposition of waste i.e. domestic, commercial and construction & demolition (i.e. C & D) (see Plate 1 below). Taking an average waste depth of 4.5m, a total volume of waste is conservatively estimated at 10,500m³ (see Figures 4 & 5). A review of historical 25-inch mapping indicates that the southern 2/3 of the site is located on land that was formerly a part of the estuary (i.e. it is reclaimed land).



Plate 1. View of former Shore Road Landfill from north-eastern corner facing southeast

The site was wet under foot during the site investigation with rushes the predominant vegetation on site.

1.3 Surrounding Property

A number of public amenities are located along the sites western boundary. A public handball alley is located on the north-western corner of the site. A public basketball court and adjacent playground is located on the western boundary of the site. A sailing club boat storage yard owned by the local sailing club and slipway is located on the south-western corner of the site adjacent to the shore (see Figure 3). A helicopter landing pad is located immediately adjacent to the south-western corner of the site. This is provided with an access road. A pumping station is located besides this access road (see Plate 2 following).



Plate 2. View of handball alley, basketball court, playground, sailing club yard and helipad facing westwards

The site is located in a residential area with 4 residences located within 50m of the site's boundary (see Figure 3). Two of these residences are located approximately 10m to the north of the site's northern boundary, across the Shore Road (see Plates 3 & 4). Another residence is located to the northwest of the site (see Plates 4). This house is approximately 35m from the site boundary. Another residence is located further along the Shore Road 50m to the east of the site. Further housing exists just outside the 50m boundary, with a cluster of properties to the northeast, and a row of houses along the quay to the southwest of the site. The Clifden town hall, a public building, is located 36 meters northeast of the sites northern boundary. The site is bordered to the north by the Shore Road (i.e. also known locally as the Beach Road) which rises as it approaches the town centre. This road turns 90° to the south at the north-western corner of the site. As stated, the nearest residences to the site are located across this road to the northeast of the site (see Plate 3 following and Figure 3).



Plate 3. View of nearest residences to northeast of site facing northwards towards Shore Road

As stated, another residence is located to the northwest of the site to the west of the afore-mentioned corner (see Plate 4). This house is approximately 35m from the site boundary.



Plate 4. View of residences to northwest of site facing north-westwards towards Shore Road

1.4 Site History

It should be noted that a review of historical 25-inch mapping indicates that the site is located on land that was formerly a part of the estuary. A review of historical 6-inch mapping indicates that the site was mostly mudflat with the high water mark (HWM) extending to an area just south of the current handball alley (see Plate 5 below). The surface water body to the northeast of the site can be seen to cross the mudflat and discharge to the estuary.

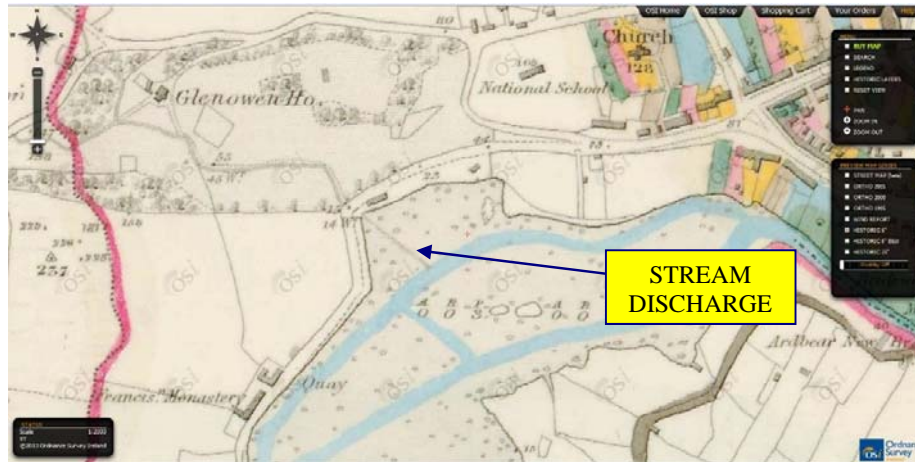


Plate 5. Historical 6-inch Ordnance Survey mapping showing location of surface water body passing through site

A review of historical 25-inch mapping indicates that the site was by 1900, infilled to almost 50% of its current volume with the high water mark now being marked some 20m to the south of that shown on the 6-inch mapping. The location of the current handball alley to the northwest of the site is clear on the 25-inch mapping (see Plate 6 below). However, it should be noted that the discharge point of the stream to the northwest of the site is now not clear.

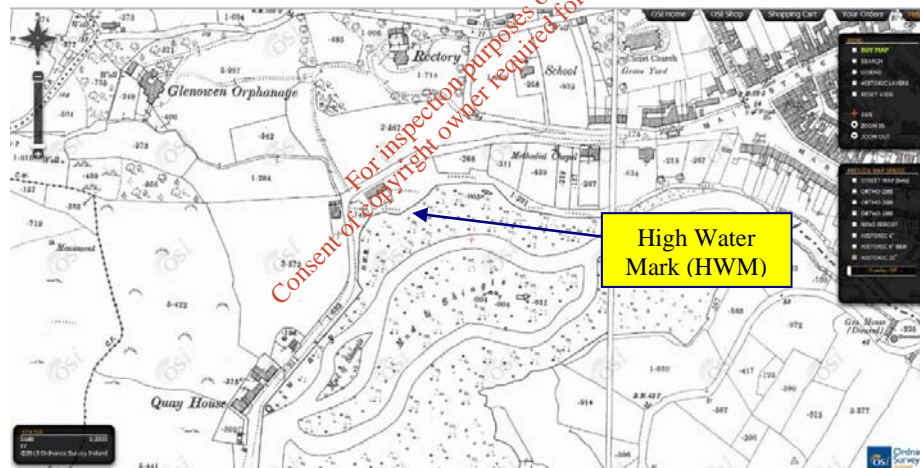


Plate 6. Historical 25-inch Ordnance Survey mapping showing location of new high water mark (HWM)

As previously, stated it is understood that the site was capped in the 1970s. It is understood that the quay walls were constructed at this time and that no further waste was imported afterwards. A review of 1995 aerial photography shows that the site was completely capped at this time and that there appears to be no alteration to the topography of the site from 1995 aerial photography to the most recent photography (see Plate 7 below).

However, having carried out the site investigation and having obtained more accurate information regarding the history of the site, a number of the 'Source Pathway Receptor Linkages' were revised. The results of this revised assessment are summarised in Table A1.1 which summarises the results of 'S-P-R Linkage Prioritisation' on the former landfill. The detailed rationale behind the in-house are also given in Appendix 1.

As can be seen from Table A1.1 in Appendix 1, the highest individual linkage proved to be for 'Leachate to SW' at 33%. It should be noted that if the score is 'Less than or equal to 40% for any individual SPR linkage', the Lowest Risk (Class C) applies. It should be noted that when each Local Authority carries out a Tier 1 Risk Assessment on their inventory of historic waste sites within their boundaries, typically a Lowest Risk (Class C) is regarded as requiring a low density (i.e. an exploratory) site investigation or no site investigation is required. Class C sites are not considered to pose a significant risk to the environment or human health. A verification report on the risk status of the site may be submitted as part of the regularisation process through an administrative system, which will be established for the purpose in the context of Section 22 of the Waste Management Acts, 1996 to 2005. While a Class C site is deemed not to pose a risk at the time of the evaluation a hazard may still be present.

It is critical, therefore that if there is a proposed change in land-use then a reappraisal of the risk, based on detailed site investigations, shall be carried out. All appropriate information shall be made available to the planning authority during the assessment of any planning application for a change in use.

Chapter 5 of EPA Code of Practice, Environmental Risk Assessment for Unregulated Waste Disposal Sites, 2007 deals with the Tier 2 Site Investigation and Testing process and reporting requirements. Following the findings of the trial pit site investigation, the scope of works was revised. The principle reasons for the reduction in the risk and subsequently the scope of works was the quantity of domestic waste identified during the site investigation, the age of the waste and the position of the waste on the southern boundary of the site (i.e. at a distance of greater than 50m downgradient from the nearest residence).

Given that there was no requirement to take soil samples or groundwater samples (i.e. via the installation of groundwater monitoring boreholes), there was no requirement to carry out a quantitative risk assessments as per Chapter 6 of EPA Code of Practice, Environmental Risk Assessment for Unregulated Waste Disposal Sites, 2007.

The following site investigation works have been drawn up to provide that information (see Section 3).

2 OBJECTIVE

The objectives of the risk assessment are as follows:

- To evaluate potential liabilities associated with historic and/or current uses of the site, and their impact on soil and groundwater quality;
- To evaluate potential liabilities associated with historic and/or current uses of the site, and their impact on surface water quality (i.e. Clifden Bay estuary);
- To evaluate potential liabilities associated with historic and/or current uses of the site on off-site residences and their residents; and
- If required, to make recommendations on the remediation of the site or mitigation measures to remove the afore-mentioned risks.

3 SCOPE OF WORKS

Field results of geological, hydrogeological and environmental information were collated and interpreted with a view to evaluating potential environmental liabilities associated with soil/groundwater quality.

Qualitative Risk Assessment

A qualitative risk assessment was undertaken to provide a basis for decision making, to ensure the continued safe habitation of the nearest off-site residences (i.e. to the northwest and northeast of the site) for the future safe use of the proposed park and to ensure that there will be no adverse impact to the environment particularly Clifden Bay estuary to the south of the site. A risk assessment is defined as a process of establishing, to the extent possible, the existence, nature and significance of risk. Risk is defined as the probability of the occurrence of, and magnitude of the consequences of, and unwanted adverse effect to a receptor.

There are 4(no.) stages involved in a risk assessment:

1. *Hazard Identification* – This will involve identifying contaminants of concern and will be achieved through the intrusive site investigation programme and the soil and groundwater sampling regime.
2. *Hazard Assessment Stage* - This stage involves the development of a Conceptual Site Model. Conceptual Models are described below.
3. *Risk Estimation Stage* – A Quantitative Risk Assessment is undertaken as part of this stage to determine risks to human health and the surface water and groundwater environments. The proposed Quantitative Risk Assessment for this contract is described in more detail below.
4. *Risk Evaluation Stage* – This stage involves recommendation of remedial works.

As stated previously, given the quantity, age and position of the waste within the curtilage of the site, it was concluded that a quantitative risk assessment, which would require soil and groundwater monitoring, was not merited.

Conceptual Model

The risk to the surrounding environment will be assessed based on the geological and hydrogeological information gathered through the site investigation programme. This information can be used to develop a conceptual model of the underlying environment, in terms of identifying potential contaminants, pathways and sensitive receptors.

A conceptual model is defined as a textual and/or schematic hypothesis of the nature and sources of contamination, potential migration pathways (including description of the ground and groundwater) and potential receptors, developed on the basis of the information from the preliminary investigation and refined during subsequent phases of investigation. The development of a conceptual model is an essential basic component of the risk assessment process. The development of a conceptual model is an iterative process, which is progressively refined based on additional focused investigations.

The results of site investigations and the development of a conceptual model should define all known aspects of the site that could impinge upon or affect the overall environment. The conceptual model will be based on the hazard – pathway – receptor concept, where:

- A hazard represents the inherently dangerous quality of a substance, procedure or event;
- A pathway is a mechanism or route by which a contaminant comes in contact with, or otherwise affects, a receptor; and
- A receptor is a human being, living organism, ecological system, controlled water, atmosphere, structures and utilities that could be adversely affected by the hazard. Surface water channels and springs are also considered to be sensitive receptors as the groundwater environment may provide baseflow to these features.

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4 ENVIRONMENTAL SETTING

4.1 Introduction

This section describes the site's environmental setting including the site's background (Section 4.2), topography and hydrology (Section 4.3), soil (Section 4.4), geology (Section 4.5) and hydrogeology (Section 4.6) of the area.

4.2 Site Background

As stated in the introduction, the site is located in an urban port area (see Figures 1 & 2). The former Shore Road landfill site is located on the southern side of the Shore Road adjacent to Clifden Bay and is approximately 0.98 hectares (i.e. 9,800m²) in area. As can be seen from historical mapping, the majority of site was formerly tidal mudflat with the High Water Mark (HWM) being located at the site of the current handball alley. A public basketball court and adjacent playground is located on the western boundary of the site. A sailing club boat storage yard and slipway is located on the south-western corner of the site. A helicopter landing pad is located immediately adjacent to the south-western corner of the site. This is provided with by an access road. A pumping station is located beside this access road (see Plate 2).

As stated previously, according to Galway C.C., the former municipal landfill at Shore Road, Clifden, County Galway, was in operation from the 1920s to the late 1960s. It is understood that the site was capped and a football field was constructed in the 1970s. However, the football pitch became disused due to water logging. The site is currently disused and has been left fallow since that time. During this 40-50 year period, as there are no records, it is not clear how many tonnes of mixed waste including domestic, commercial and C & D were deposited on site by the people of Clifden and/or the local authority. As stated, the total site area is 9,800m². However, the results of the site investigation indicate that an area of just 2,325m² was used for the deposition of waste (i.e. domestic, commercial and C & D) (see Plate 1). Taking an average waste depth of 4.5m, a total volume of waste is calculated at 10,500m³ (see Figures 4 & 5). A review of historical 25-inch mapping indicates that the southern 2/3 of the site is located on land that was formerly a part of the estuary i.e. it is reclaimed land.

4.3 Topography

Given that the site is located in a harbour area, the overall regional gradient is from east to west (see Figures 1 to 3) towards the Atlantic Ocean. The existing site layout and its surrounding property is illustrated in Figure 3. The existing site layout with topographical data is illustrated in Figure 4. The gradient on site is generally north to south. The highest point on site is at an elevation 10.14m AOD on a small area within the north-eastern corner. The lowest point appears to be at 2.28m AOD on the southern boundary to the east of the helipad. It should be noted however that the afore-mentioned elevated area exists on site in the north-eastern corner which is over 6.5m higher than the land surface to the south and west. The elevation on the northern boundary of the site varies from 3.69m AOD on the western end of the site to 4.47m AOD towards the eastern end. This gradient from the northern boundary of the site to the southern boundary represents a gradient of 1:60.

4.4 Stormwater and Drainage Infrastructure

As stated in Section 1.4, a stream which flows towards the site from the uplands to the west of the site is culverted under the Shore Road. The route of this stream is evident on 6-inch historical mapping in Plate 5. This culvert was not encountered during the site investigation nor was it found during an inspection of the mudflats to the south of the site during low tide. It is assumed that this culvert runs in a north to south direction along the western boundary of the site.

Flexible PVC agricultural land drains were encountered during the site investigation in trialpits, TP13 and TP17 with a disused concrete storm drain in TP11 (see trialpit logs in Appendix 7). A disused concrete foul sewer was encountered running in a north to south direction in trialpit, TP15.

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4.5 Soil

4.5.1 Soil (Top Horizon)

The formation of topsoil is known as the 'pedogenic' process. Reference to the General Soil Map of Ireland, published by An Foras Talúntais (1980) indicates that the predominant or principal soil type in the area west of Clifden town are Peaty Podzols (75%) with Lithosols (15%) with and blanket peats (10%) mapped as secondary soils. The parent material for Soil Association 1 are granite and sandstone

A National Soil Mapping Project carried out jointly by the EPA and Teagasc have identified the northern footprint of the site as soil type: MADE (i.e. made ground). The southern half of the site does not appear to have been mapped but the findings of the site investigation would indicate that the lower southern half of the site should be classified as MADE also. The nearest soil type to the north is classed as AminDW (i.e. an Acid Brown Earths/Brown Podzolics (Deep Well Drained Mineral) soil) (see Appendix 3). The nearest soil type to the west is classed as AminSW (i.e. Lithosols/Regosols (Shallow Well Drained Mineral) soil).

Based on Mulroy Environmental's site-specific observations during the trialpitting exercise, the general classification for the area is considered appropriate for the site. The surface soils encountered in the north-eastern corner of the site would appear to be indigenous and consistent with Acid Brown Earths/Brown Podzolics,

4.5.2 Subsoil (Quaternary) Geology

The origin of the subsoil material in this region is associated with the movement and deposition from glaciers during the last Ice Age. The ice sheets ground down the underlying bedrock, breaking the rock and grinding it to small sizes ranging from clays to boulders. The powerful erosive force of these ice sheets are considered to have moulded/sculpted the landscape in the area, with glacial features evident in the area. Glacial deposits in the area consist of tills, which were deposited at the base of moving glaciers, and to a lesser extent fluvio-glacial sand and gravels, which were deposited by glacial meltwaters.

The National Soil Mapping Project carried out jointly by the EPA and Teagasc have identified the northern footprint of the site as subsoil type: MADE (i.e. ground). The southern half of the site does not appear to have been mapped but the findings of the site investigation would indicate that the lower southern half of the site should be classified as MADE also. The nearest subsoil type to the north is classed as TMP (i.e. Metamorphic Till). The nearest subsoil type to the west is classed as Rck (i.e. Rock outcrop). In effect to the west of the site in upland areas, Lithosols/Regosols type subsoils lie directly on the bedrock.

Based on Mulroy Environmental's site-specific observations during the trialpitting exercise, the general classification for the area is considered appropriate for the site. The subsoils encountered in the north-eastern corner of the site would appear to be indigenous and consistent with Metamorphic Till (TMP).

4.6 Geology

4.6.1 Regional Geology

General information concerning the bedrock geology of the region is contained in the Geological Survey of Ireland (GSI) 1:100,000 scale Sheet No. 10 “Geology of Connemara and South Mayo” (see Appendix 4). The Clifden area is composed primarily of Precambrian Quartzites, Gneisses & Schists, Ordovician Metasediments and Silurian Metasediments and Volcanics. Precambrian Marbles cross cut the southern half of the Clifden area in two areas, at Clifden and Letterfrack.

The bedrock map indicates that Lakes Marble Formation (LM) underlies the southern 2/3 of the site. This group consists essentially of limestones and calc-silicate granulites. The limestone which are commonly opicalcites are bright green in colour and are well known as a beautiful decorative marble. The matrix of the rock is white calcite while the green discoloration is caused by chlorite and serpentine after diopside and tremolite.

Approximately 250m to the northwest of the site the Streamstown Schist Formation (ST) is located. This formation consists of Pre-cambrian quartzite, gneisses and schists.

Approximately 200m to the north of the site the Barnanoraun Schist Formation (BZ) is located. This formation consists of aluminous schists and hornblendic rocks.

A review of GSI geological records within 1km of the site revealed only 1 borehole record. This record which contains a map location is presented in Appendix 4. This borehole is a bored well approximately 960m to the northeast of the site. A total depth of 35m is given with bedrock at the surface. A poor yield class (i.e. 21.8m³) was given. This yield would be expected for a poor aquifer such as that with the Streamstown Formation.

4.6.2 Site Geology

4.6.2.1 Subsoil/Made Ground

Seventeen trial pits were dug by Mulroy Environmental from 20th to 21st January, 2014. Trial pit depths varied between 1.5 and 4.2m below the ground level (i.e. depending on bedrock and maximum reach of the excavator) (see trialpit logs, TP1 to TP17 in Appendix 7). Only indigenous soil (i.e. the ground not disturbed) was found in 2 of a total of the 17 trial pit locations i.e. TP1 and TP2. In both of these trialpits a yellow/light brown sandy gravelly CLAY with boulders and cobbles was found to overlie loose grey/white coarse sandy GRAVEL.

In 15 of the 17 trialpits, a 0.2m thick horizon of soft light brown sandy CLAY acts as a 'Landfill cap'.

Varying thicknesses of a soft grey gravelly CLAY (MADE GROUND) was found under the clay cap in trialpits, TP3 to TP10.

Loose clayey gravelly COBBLES/ BOULDERS or GRAVEL were found in trialpits TP3, TP4 and TP7. These were found to lie directly on weathered bedrock.

In trialpits, TP3 to TP10, no waste or very little waste was observed. However, the ground was classed as MADE GROUND as it was noted to have been disturbed with different soils imported and infilled on site. As stated previously, a number of shallow land drains (i.e. plastic and concrete) were observed on site.

Of the seventeen trial pits, construction and demolition WASTE (C&D) was encountered at trialpits, TP13, TP15, TP16 and TP17. This type of waste consisted mostly of builder's rubble, tarmac, concrete and some timber.

Of the seventeen trial pits, municipal solid waste (MSW)/commercial WASTE was encountered at 3 trialpits, TP11, TP12 and TP14. This waste was found to be composed of black plastic bin bag waste/ plastics, skip waste, residential, renovation waste, electric cables, timber shards, plastic and glass bottles, ash and cinder, rubber hosing, car parts, etc. It should be noted that negligible 'domestic waste-type odours' were observed at each of the 3 trialpits. The waste, although exhibiting sulphur staining and slight sulphide odours, gave no evidence of putrescible materials (i.e. a carbon source) still remaining within the waste. As such, it was concluded that the methanogenesis phase within the waste body had concluded. This is consistent with the age of the waste i.e. 40-50 years old.

The location of the domestic/commercial waste along the southern boundary of the site is consistent with local knowledge of the site i.e. that the waste was pushed out by bulldozer in the 1960s prior to being capped.

¹ Where non-soil materials (e.g. wood fragments, masonry, etc.) are found within a subsoil matrix and where the volume would be less than 10% of the dominant matrix, the soil would be regarded as a MADE GROUND and not as a WASTE.

4.6.2.2 On-site Bedrock

Bedrock was encountered in 15 of the 17 trialpits and at its shallowest at approximately 1.5m below ground level (bgl) at TP1. Bedrock was found at its deepest at 3.95m bgl in TP12. In 2 of the trialpits, TP7 and TP8 bedrock was not encountered due to collapsing sides wherein trialpitting had to be halted for health and safety reasons.

Bedrock, as expected, sloped steeply from the northern end of the site towards the south with the trialpits on the northern end encountering bedrock from 1.5m to 2.10m bgl. As you move southwards, the depth to bedrock increased to 3.9 in TP6 and 3.5m bgl in TP10. This is equivalent to a gradient of 1:10 across the site.

The depth to bedrock found at the northern end of the site is consistent with the regional geology of the area with the presence of thin lithosols/regosols type soils overlying bedrock on upland areas to the west of the site.

4.7 Hydrogeology

4.7.1 General Hydrogeological Classification

The Lakes Marble Formation (LM), which underlies the site, and the adjacent Streamstown Schist Formation (ST) are classed as a 'Poor Aquifer - Bedrock which is generally unproductive except for local zones.'

As stated previously, a review of GSI geological records within 1km of the site revealed only 1 record which is for a poor yield borehole 990m from the site which appears to be within the Streamstown Schist Formation (ST). Bedrock was found at the surface at this borehole.

The site is located with the Clifden Groundwater Body (see Appendix 5). This GWB is composed primarily of Precambrian Quartzites, Gneisses & Schists, Ordovician Metasediments and Silurian Metasediments and Volcanics. Most groundwater flux will be in the uppermost part of the aquifer; comprising a broken and weathered zone typically less than 3m thick; a zone of interconnected fissuring 10-15 m thick; and a zone of isolated poorly connected fissuring typically less than 150 m, in which strikes are noted between 40-50 m and 50-56 m below ground level in two boreholes near Louisburgh, but yields from these isolated depths are low.

Well data are sparse in the GWB. Three boreholes located in the schists north of Clifden, at Glenbricken and Coolacloy, have reported yields of 33, 26 and 15 m³/d with specific capacities of 15, 1.3 and 0.6 m³/d/m respectively. The data indicate low transmissivities – in the range of 0.7-20 m²/d. Two wells near Louisburgh also have similar yields and implied transmissivities. In the vicinity of faults, transmissivity may be higher. Storativity is expected to be low (<0.5%). The data are inadequate to calculate groundwater gradients, however, these are expected to be greater than 0.01.

Subsoil thickness data are sparse. Available data indicate the thickness of the subsoils is generally less than 3m over the GWB. Subsoils are thicker in the low lying flatter areas of the GWB. The thickness of the blanket peat ranges from 0-6 m, depending on topography.

Diffuse recharge occurs via rainfall percolating through the subsoil and rock outcrops. Due to the low permeability of much of the subsoil (blanket peat) and the aquifers, a high proportion of the available recharge will discharge to the streams. In addition, the steep slopes in the mountainous areas promote surface runoff. The stream density is approximately 1.5 km/km², indicating the high proportion of surface runoff.

4.7.2 Groundwater Flow

Groundwater flow is most likely through the underlying overburden which consists of metamorphic tills and gravels and to a lesser extent through the underlying schist or marble bedrock. Groundwater follows the topography of the site and land to the south towards Clifden Bay. Probable groundwater flow direction is indicated on Figure 6. Groundwater flow is expected to be concentrated in fractured and weathered zones and in the vicinity of fault zones.

Shallow groundwater is likely to discharge to streams and lakes, but the limited bedrock transmissivity means that the baseflow component of the total streamflow will be low. Small springs and seeps are likely to issue at the stream heads and along their course. Seepages will develop on the coastal cliff faces.

Groundwater flow is expected to be concentrated in fractured and weathered zones and in the vicinity of fault zones. Generally, water levels are 0-8 m below ground level. Flow paths are likely to be short (30-300m) with groundwater discharging rapidly to nearby streams and small springs. There are observed deep water strikes, indicating that there is a component of deep groundwater flow, however shallow groundwater flow is dominant. Groundwater flow directions are expected to follow topography – overall in a westerly direction.

Groundwater will discharge locally to streams and rivers crossing the aquifer and also to small springs and seeps. Owing to the poor productivity of the aquifers in this body it is unlikely that any major groundwater - surface water interactions occur. Baseflow to rivers and streams is likely to be relatively low. Lakes comprise approximately 3% of the GWB.

4.7.3 Groundwater Vulnerability

Groundwater vulnerability is a term used to represent the intrinsic geological and hydrogeological characteristics that determine the ease with which groundwater may be contaminated by human activities. The vulnerability category is based on the relative ease with which infiltrating water and potential contaminants may reach groundwater in a vertical or sub-vertical direction. The permeability and thickness of the subsoil, which influences the attenuation capacity, are important elements in determining the vulnerability of groundwater.

The DoE-LG, EPA and GSI have produced guidelines on groundwater vulnerability mapping that aim to represent the intrinsic geological and hydrogeological characteristics that determine how easily groundwater may be contaminated by human activities. Vulnerability depends on the quantity of contaminants that can reach the groundwater, the time taken by water to infiltrate to the water table and the attenuating capacity of the geological deposits through which the water travels. These factors are

controlled by the types of subsoils that overlie the groundwater, the way in which the contaminants recharge the geological deposits (whether point or diffuse) and the unsaturated thickness of geological deposits from the point of contaminant discharge.

For vulnerability assessments with regard to bedrock aquifers the relevant geological layer is the subsoil between the release point of contaminants and the top of the bedrock. Any unsaturated bedrock layer is not considered as it is assumed that bedrock has little or no attenuation capacity due to its fissure flow characteristics. Groundwater encountered in low permeability glacial tills, or other non-aquifer subsoils, is not considered to be a target. Therefore, where low permeability subsoils overlie the bedrock it is the thickness of subsoil between the release point of contaminants and bedrock that is considered when assessing vulnerability of bedrock aquifers, regardless of whether the low permeability materials are saturated or not.

The DoE-LG, EPA and GSI vulnerability mapping guidelines allow for the assignment of vulnerability ratings from “extreme” to “low”, depending upon the subsoil type and thickness. With regard to sites where both low and high permeability subsoils are present, the following thicknesses of unsaturated zone are specified:

Table 1. Groundwater Vulnerability Mapping Guidelines

VULNERABILITY RATING	HIGH PERMEABILITY (SAND/GRAVEL)	MODERATE PERMEABILITY (SANDY TILL, SUBSOIL)	LOW PERMEABILITY (CLAYEY SUBSOIL, CLAY, PEAT)
Extreme	0 – 3.0m	0 – 3.0m	0 – 3.0m
High	>3.0m	3.0 – 10.0m	3.0 – 5.0m
Moderate	N/A	>10m	5.0 – 10.0m
Low	N/A	N/A	>10.0m

Groundwater Source Protection

The DoE-LG, EPA and GSI guidelines for Groundwater Protection Schemes allow for the combination of aquifer classification and vulnerability rating giving classifications of groundwater protection zones. The purpose of these zones is to place a control on the activities practised within a zone and thus provide protection to any underlying groundwater resources. Using DoE-LG, EPA and GSI criteria and the aquifer classification and vulnerability categories defined for the northern half of the site, a *PI/H*, ‘*Poor Aquifer with High vulnerability*’ classification is assigned to the entire subject site (see vulnerability mapping in Appendix 5). It should be noted that the southern half of the site has not been given an aquifer class or a vulnerability rating. It should be noted that the ‘*Extreme*’ vulnerability classification given by the GSI to the east of the site is most likely based on rock outcrops in this area.

It should also be noted that the a study carried out by the Western River Basin Management Body under the Water Framework Directive in 2008 has classed the ‘Clifden’ Groundwater Body, in which the site is located as ‘*2a – Probably Not at Risk*’.

4.8 Hydrology

The site although adjacent to Clifden Bay is located in the periphery of Ownglen-Dauros-Culin-Traheen-Coastal Catchment and is part of Hydrometric Area 32/Erriff Clew Bay of the Western River Basin District. Its Water Management Unit is West Galway.

As stated previously, a review of historical 25-inch mapping indicates that the site is located on land that was formerly a part of the estuary. A review of historical 6-inch mapping indicates that the site was mostly mudflat with the high water mark (HWM) extending to an area just south of the current handball alley (see Plate 5 previous). The surface water body to the northeast of the site can be seen to cross the mudflat and discharge to the estuary.

A review of historical 25-inch mapping indicates that the site was by 1900, infilled to almost 50% of its current volume with the high water mark now being marked some 20m to the south of that shown on the 6-inch mapping. The location of the current handball alley to the northwest of the site is clear on the 25-inch mapping (see Plate 6 previous). However, it should be noted that the discharge point of the stream to the northwest of the site is now not clear on Plate 6.

A review of flooding archives indicates that 2 flood events have occurred in the vicinity of the site. Both of these occurred on the Shore Road to the north of the site. An extract of the Local Area Engineer's report states 'C20. 5/6 Jan 1991– Exceptional storm caused tidal flood all along the coast' (see Appendix 6).

A public beach is located 1.km to the west of the site. This beach has been classed by the EPA as having 'Poor Water Quality' (see Appendix 6).

A review of public records indicates that the Clifden Public Wastewater treatment plant is located 320m to the south of the site across the estuary. It is understood that this plant 'Failed due to lack of secondary treatment in operation' (see Appendix 6).

A study carried out by the Western River Basin Management Body under the Water Framework Directive in 2008 has classed the 'Ownglin-Dauros-Culin-Traheen-Coastal Catchment' Surface Water Body, in which the site is located as '1a – At Risk' (see Appendix 6).

The EPA have carried out biological monitoring approximately 510m upstream of the site at the Ardber Old Bridge in Clifden since 2004. A biological quality value (Q-Rating) of 4 or 'Good' overall status has been given by the EPA (see Appendix 6 for EPA monitoring point location). No detailed historical data on the Q-status of the river at the point was obtainable from the EPA website

5 RISK ASSESSMENT & REFINED CONCEPTUAL MODEL

The site conceptual model (SCM) identifies sources of contamination, receptors that could be impacted together with pathways, termed potentially complete pollutant linkages that connect the two. When a potentially complete pollutant linkage is identified, an estimation of the risk should be made which may involve further investigation or risk assessment.

The key findings of the desk based review of ordnance survey historical mapping, geological, quaternary, hydrogeological and hydrological data and the trialpit investigation were:

- The quantity of domestic waste identified during the site investigation was calculated at 10,500m³. This quantity was significantly less than that expected and would be regarded as relatively small for closed/historic landfills;
- Consultation with local construction workers with a comprehensive knowledge of the site, indicate that most of the waste within the site is over 40 years old. This is consistent with the findings of the trialpit investigation;
- The domestic waste is confined to the southern boundary of the site and is over 55m from the nearest house;
- The methane generating potential of the site's domestic waste has effectively disappeared given the age of the waste. The lack of landfill gas type odours during the site investigation indicated that methanogenesis within the site had long since ceased (i.e. most landfills cease to produce viable quantities of methane approximately 25 years after the importation of waste has ceased and the site has been capped);
- It is unlikely that any risk from methane gas to the residences to the northwest and northeast of the site exists given the lack of any evidence of landfill gas during the site investigation. It is unlikely that even in the event of significant disturbance of the waste in the southern half of the site, that a risk is posed by the site (i.e. there is no gas to migrate);
- Given that the site is effectively an infilled mudflat, the groundwater table on site fluctuates significantly with the tidal pattern within Clifden Bay (i.e. albeit following a lag period). It should be noted that this was observed during the site investigation in trialpits that were left open for 9 hours in the southern half of the site. The tidal effect on the waste material is significant in that it works to 'flush out' leachable contaminants which come into contact with the estuarine water table, effectively drawing contaminants into the estuary as the water table falls at low tide;
- The dilution of contaminants within Clifden Bay is very significant and any impact now posed by low levels of contaminants still leaching from the site would be regarded as negligible;
- The nearest protected site is pNHA/SAC No. 002031, The Twelve Bens/Garaun Complex (see Appendix 2). This is the closest protected site to Shore Road landfill site, located approximately 266m hydraulically upgradient to the southeast of the site. Given that this site is upstream, even though Clifden Bay is tidal, as stated previously, the dilution of contaminants within Clifden Bay would very significant and as such, any impact now posed by contaminants on the upgradient protected site would be negligible;

Table 2 records the potential pollutant linkages that have been identified at the site. Justifications for the identification of a potential pollutant linkage together with the likelihood are also discussed in Table 2.

Table 2. Identification of Potentially Complete Pollutant Linkages

SOURCE	PATHWAY	RECEPTOR	LINKAGE?	
Potentially contaminated soil or domestic waste	Direct contact; ingestion, dermal contact and inhalation of dust and soils.	Residents of houses to northwest & northeast of site	Incomplete. Site covered in 200mm capping, plausible pathway absent. Residents not expected to come into contact with underlying soil or waste during routine activities.	
		Livestock or ponies	Incomplete. Site covered in 200mm capping, plausible pathway absent.	
		Future construction workers	Incomplete. Construction workers may come into contact with site soil and/or waste. However the use of suitable PPE and good hygiene measures should mitigate risks posed through this pathway.	
	Leaching and subsequent migration		Groundwater in Poor aquifer	Incomplete: Waste is outside of aquifer and is tidally effected
			Groundwater (shallow) body within superficial sand & gravel deposits	Incomplete: Waste is outside of aquifer and is tidally effected
			Clifden Bay	Incomplete: Contaminants within waste have most likely dissipated to negligible level. Dilution within Clifden Bay likely to be significant
			Boreholes within 1km site; closest 990m upgradient to the northeast of the site	Incomplete. Plausible pathway absent due to distance and direction of groundwater flow.

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Table 2. Identification of Potentially Complete Pollutant Linkages (continued)

SOURCE	PATHWAY	RECEPTOR	LINKAGE?
Landfill gas generated by domestic waste to south of site	Lateral Migration	Residences to northwest and northeast of site	Incomplete: Landfill gas not present and distance to residents significant
		Basketball court, handball alley & playground users	Incomplete: Landfill gas not present and distance to public amenities significant
		Sailing club boat yard	Incomplete: Landfill gas not present and distance to yard significant
		Single borehole within 1km from site	Incomplete. Landfill gas not present and distance to well significant
	Vertical migration and inhalation of vapours	Future users of parkland on site of former landfill for recreation (i.e. football, etc)	Incomplete. Any remaining vapours likely to migrate vertically and then dilute with air at the surface hence plausible pathway considered absent.

A Plan Site Conceptual Model illustrating the potentially complete pollutant linkages is included in Figure 6. Future risks to construction workers will be task specific and can be managed with appropriate health and safety protocols thus are not considered further in this report.

6 CONCLUSIONS & RECOMMENDATIONS

The site poses negligible risk to human receptors within the vicinity of the site (i.e. in the residences to the northwest and northeast of the site).

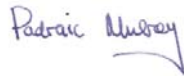
The site poses negligible risk to Clifden Bay to the south of the site.

The site poses negligible risk to pNHA/SAC No. 002031, The Twelve Bens/Garaun Complex located 266m upgradient of the site.

Even though the leachate producing potential has significantly dissipated, it is recommended that prior to the construction of the park on site that the capping is improved through the importation of soil with the following properties:

- Coefficient of permeability (hydraulic conductivity) of 1×10^{-9} m/s or less;
- Minimum clay content of 10%;
- Minimum Fines (clay & silt) content > 30%;
- Plasticity index >10% and <65%;
- Liquid limit < 90%; and
- Maximum particle size of 75mm.

If you have any questions or require clarification with regard to any item of this report, please contact me at 086-8770380.



Padraic Mulroy, BSc., MSc., MIEI, MIPSS, C.Sci., SiLC, GSAS-CGP
Managing Director
Mulroy Environmental

7 REFERENCES

- 1 Interim Report "Towards Setting Guideline Values for the Protection of Groundwater in Ireland May 2003.
- 2 Information and Guidance Note: The Selection of Materials for Water Supply Pipes to be Laid in Contaminated Land. No 9-04-03 Issue 1. Published by Water Regulations Advisory Scheme (WRAS), October 2002.
- 3 BS10175. Investigation of Potentially Contaminated Sites -Code of Practice. BSi. 2001.
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- 5 Risk-Based Corrective Action (RBCA) Tool Kit Version 2.0, Groundwater Services, 2003.
- 6 Department of the Environment. The Contaminated Land Exposure Assessment Model (CLEA): Technical basis and algorithms, Contaminated Land Research Report No. 10, London; Department of the Environment.
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- 8 CLEA Briefing Note 3 – Update of supporting values and assumptions describing UK Building Stock. Version 1.1 dated July 2004.
- 9 Environment Agency. Review of the Fate and Transport of Selected Contaminants in the Soil Environment. Draft Technical Report P5-079/TR1. September 2003.
- 10 Hartman, B. 2002. How to collect reliable soil-gas data for risk-based applications. Part 1: Active Soil-Gas Method. LUST Line Bulletin, 42, October 2002.

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MULROY ENVIRONMENTAL SERVICE CONSTRAINTS

1. This report and the Environmental Site Assessment carried out in connection with the report (together the "Services") were compiled and carried out by Mulroy Environmental for Galway County Council (the "client") in accordance with the terms of a contract, Proposal PRP214.05.04.2013, between Mulroy Environmental and the "client" dated 6th April 2013. The Services were performed by Mulroy Environmental with the skill and care ordinarily exercised by a reasonable Environmental consultant at the time the Services were performed. Further, and in particular, the Services were performed by Mulroy Environmental taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between Mulroy Environmental and the client.

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5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of Mulroy Environmental. In the absence of such written advice of Mulroy Environmental, reliance on the report in the future shall be at the client's own and sole risk. Should Mulroy Environmental be requested to review the report in the future, Mulroy Environmental shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between Mulroy Environmental and the client.

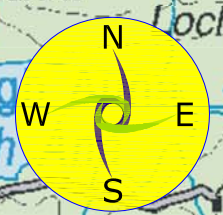
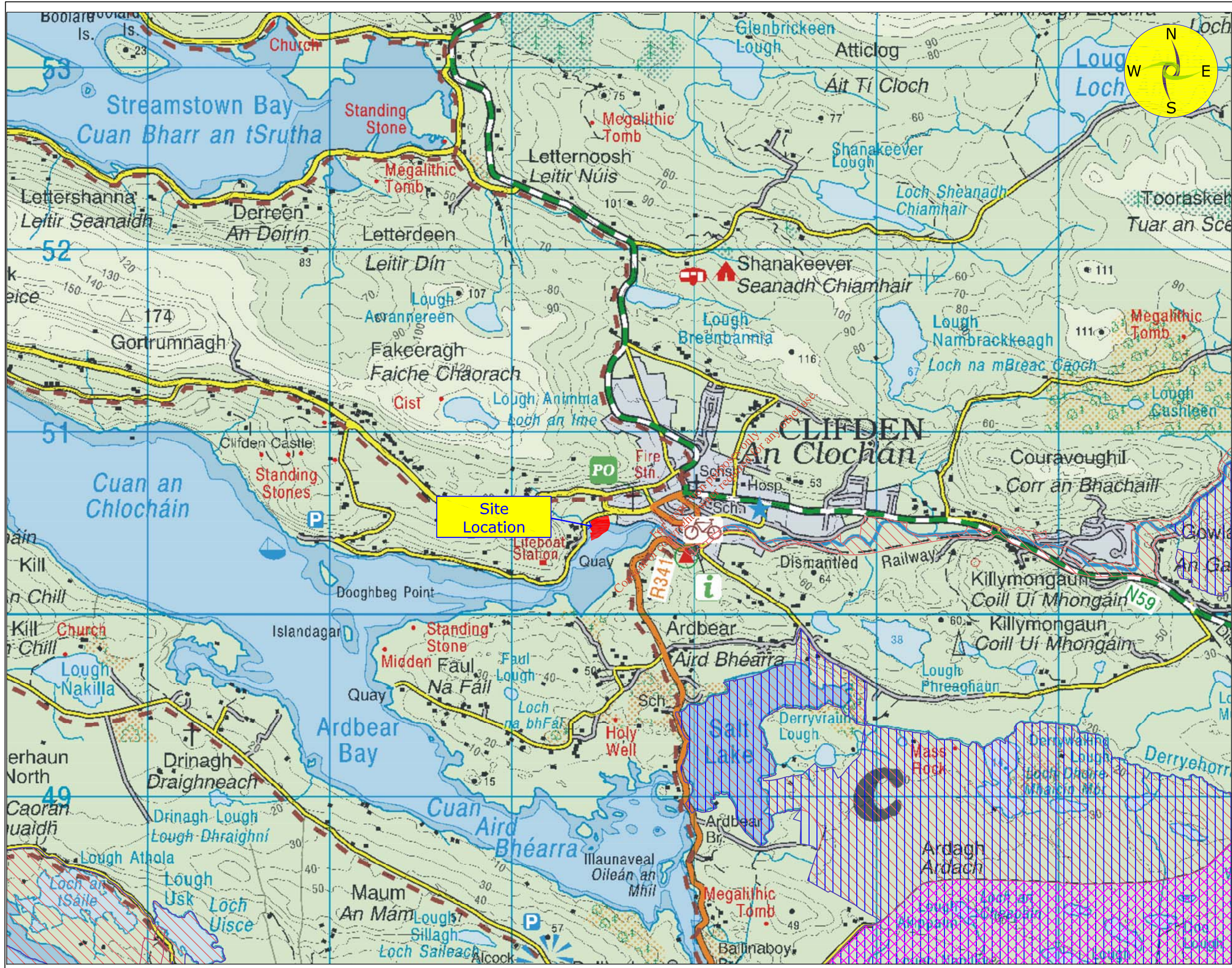
6. The observations and conclusions described in this report are based solely upon the Services which were provided pursuant to the agreement between the client and Mulroy Environmental. Mulroy

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7. The Services are based upon Mulroy Environmental's observations of existing physical conditions at the Site gained from a walk-over survey of the site together with Mulroy Environmental's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which Mulroy Environmental was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by Mulroy Environmental and the observations possible at the time of the walk-over survey. Further Mulroy Environmental was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. Mulroy Environmental is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to Mulroy Environmental and including the doing of any independent investigation of the information provided to Mulroy Environmental save as otherwise provided in the terms of the contract between the client and Mulroy Environmental.

8. The Phase II or intrusive environmental site investigation aspects of the Services is a limited sampling of the site at pre-determined borehole and soil vapour locations based on the operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and Mulroy Environmental] [based on an understanding of the available operational and historical information,] and it should not be inferred that other chemical species are not present.

9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site.



LEGEND

-  Site Boundary
-  Special Area of Conservation (SAC)
-  Special Protected Area (SPA)
-  Proposed Natural Heritage Area (pNHA)

NOTES

1. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING
2. ALL LEVELS SHOWN RELATE TO ORDNANCE SURVEY DATUM AT MALIN HEAD

Issue	Date	Description	By	Chkd.

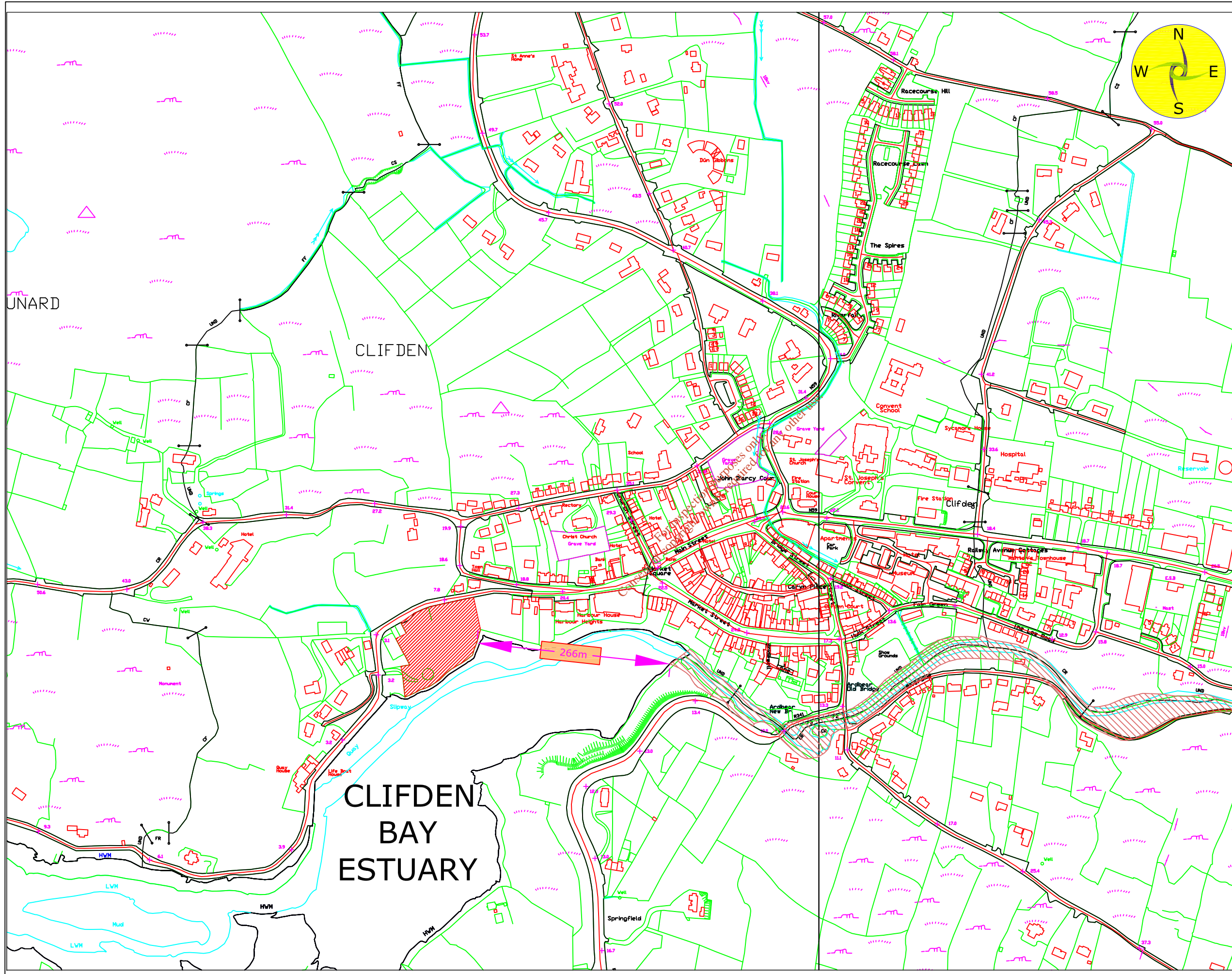
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Project:	Tier 2 Site Investigation & Tier 3 GQRA Assessment of Former Road Landfill			
Title:	Site Location & Proximity of SACs, pNHAs & SPAs			
Scale:	1:20,000@A3			
Prepared by:	Checked:	Date:		
C.D.	P.M.	08-04-14		
Project Director:	P.MULROY			





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Drawing No.: Figure 1

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LEGEND

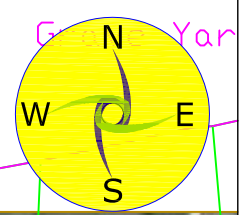
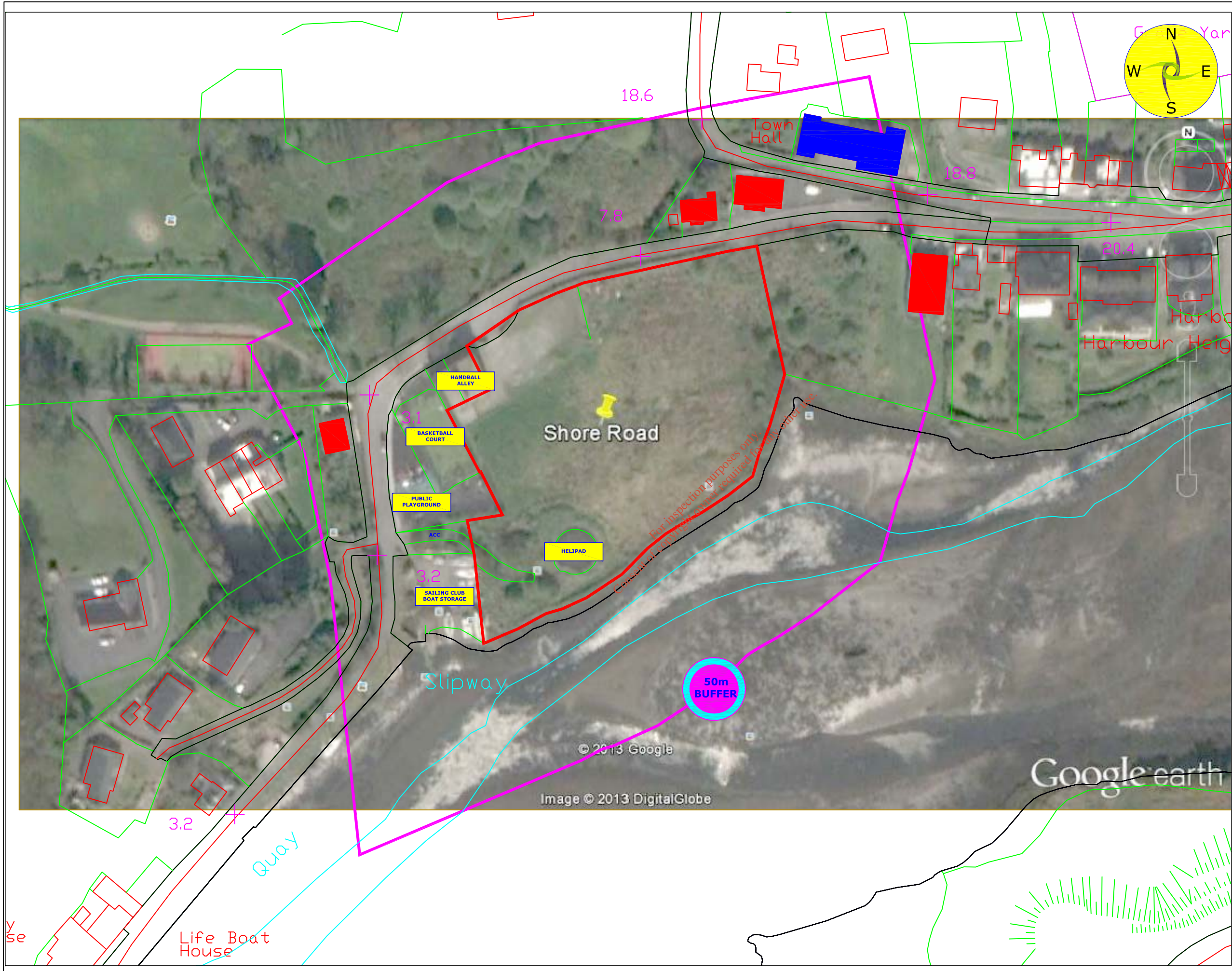
-  Site Boundary
-  Special Area of Conservation
SAC No. 002031
The Twelve Bens/
Garaun Complex





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Issue	Date	Description	By	Chkd.

Client: Galway County Council	
Project: Tier 2 Site Investigation & Tier 3 GQRA Assessment of Former Shore Road Landfill	
Title: Site Location & Proximity of SAC No. 002031, The Twelve Bens/Garaun Complex	
Scale: 1:5,000@A3	
Prepared by: C.D.	Checked: P.M.
Date: 08-04-14	
Project Director: P.MULROY	
	
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Drawing No.:	Figure 2
Issue: 0	



- ### LEGEND
-  Site Boundary
 -  Residential property
 -  Public property
 -  50m Buffer

- ### NOTES
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Issue	Date	Description	By	Chkd.

Client:
Galway County Council

Project:
Tier 2 Site Investigation & Tier 3 GQRA Assessment of Former Shore Road Landfill

Title:
Site Location & Surrounding Property

Scale:
1:1,250@A3

Prepared by: C.D. Checked: P.M. Date: 08-04-14

Project Director: P.MULROY



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LEGEND

 Site Boundary

NOTES

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Issue	Date	Description	By	Chkd.

Client:
Galway County Council

Project:
Tier 2 Site Investigation & Tier 3 GQRA Assessment of Former Shore Road Landfill

Title:
Site Layout & Topographical Survey

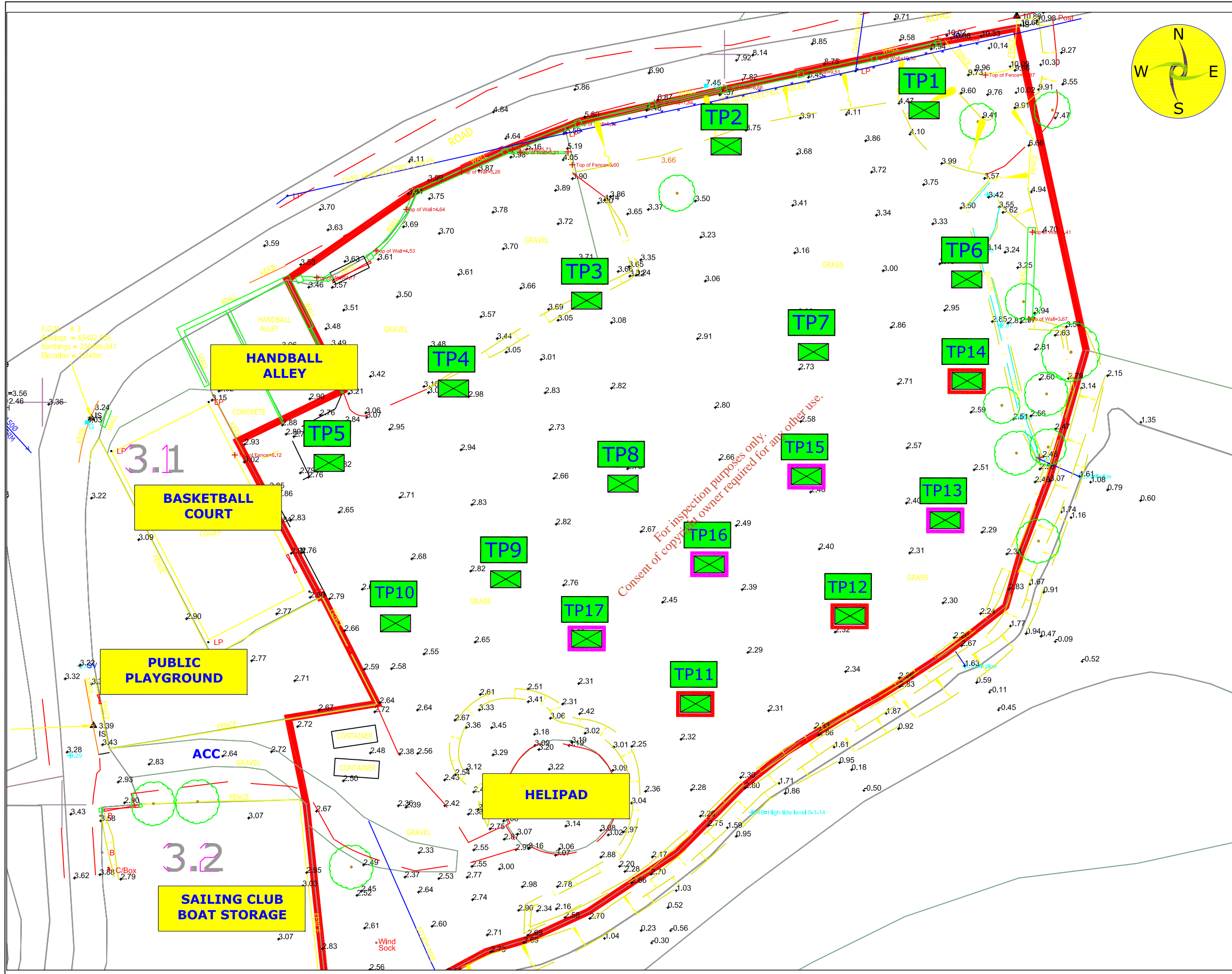
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Prepared by: C.D. Checked: P.M. Date: 08-04-14
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LEGEND

-  Site Boundary
-  Trialpit Location
-  Trialpit where Domestic Waste was found (red square surround)
-  Trialpit where C & D Waste was found (magenta square surround)

- NOTES**
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Issue	Date	Description	By	Chkd.

Client:
Galway County Council


Project:
Tier 2 Site Investigation & Tier 3 GQRA Assessment of Former Shore Road Landfill

Title:
Trialpit Locations

Scale:
1:500@A3

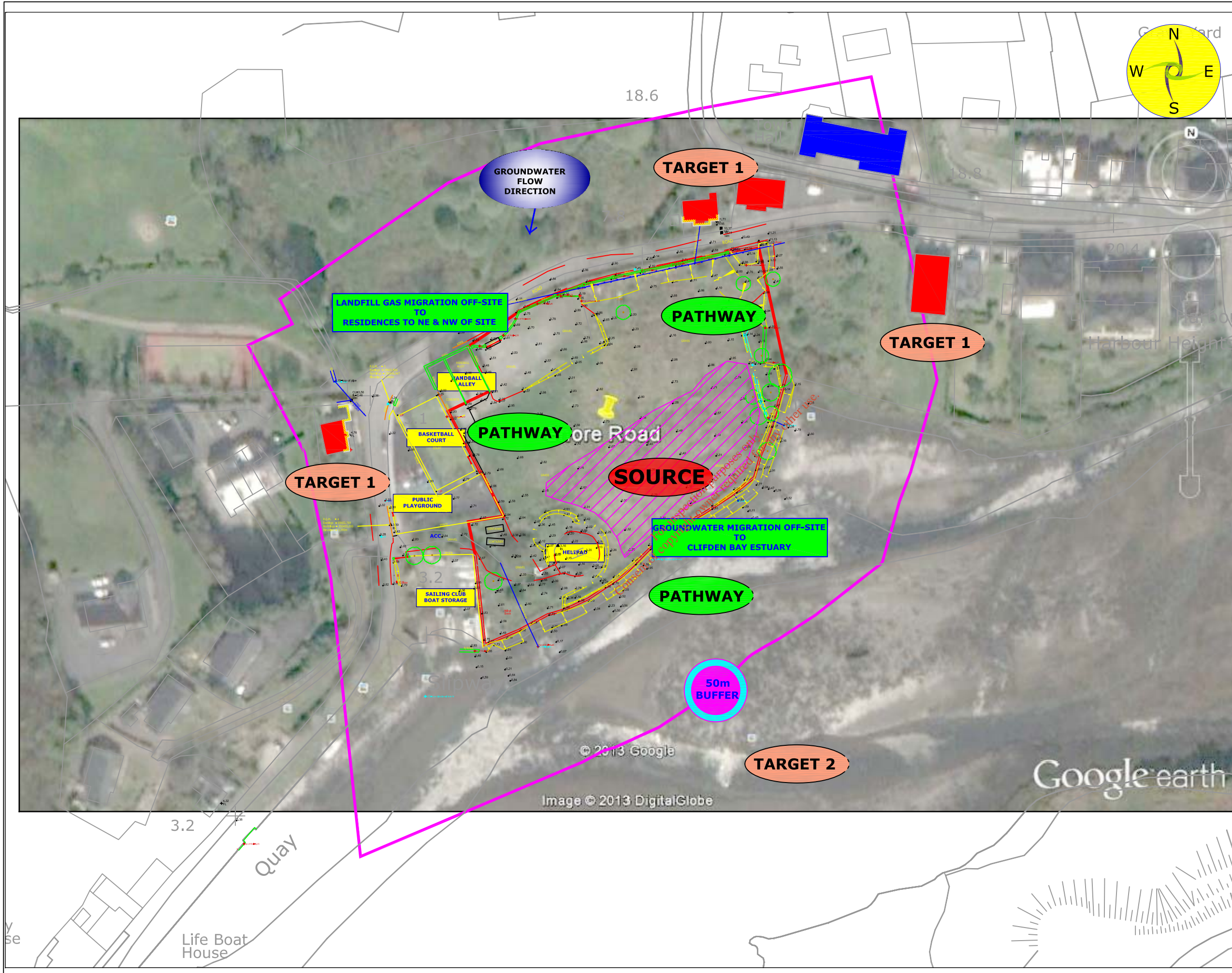
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Project Director: P.MULROY











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Drawing No.: Figure 5 Issue: 0



LEGEND

-  Site Boundary
-  Residential property
-  Public property
-  50m Buffer
-  Remaining residual contaminants from Domestic Waste on site
-  Landfill gas migration or groundwater migration off-site
-  Target 1. Near Residences
-  Target 2. Clifden Bay

NOTES

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Issue	Date	Description	By	Chkd.

Client:	Galway County Council		
Project:	Tier 2 Site Investigation & Risk Assessment of Former Shore Road Landfill		
Title:	Conceptual Site Model		
Scale:	1:1,250@A3		
Prepared by:	Checked:	Date:	
G.F.	P.M.	19-08-14	
Project Director:	P.MULROY		



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Issue: 0

**SHORE ROAD HISTORIC LANDFILL,
CLIFDEN, CO. GALWAY**

**APPLICATION TO EPA
FOR
CERTIFICATE OF AUTHORISATION**

**VOLUME II. SECTION D - PART B
*TIER 2 SITE INVESTIGATION & RISK ASSESSMENT
OF SHORE ROAD LANDFILL REPORT***

(16th MAY, 2014)

24th March, 2021

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LIST OF APPENDICES

APP. NO.	DESCRIPTION
1	<ul style="list-style-type: none"> • Preliminary Conceptual Site Model (CSM) • Walkover Survey Checklist (carried out originally in 2014, repeated with Further S.I. In June 2020) • EPA's Code of Practice: Environmental Risk Assessment for Unregulated Waste Disposal Sites Tier 1. Risk Screening & Prioritisation (Post-Site Investigation) • EPA Code of Practice Matrix 1 – Preliminary & Exploratory Investigations For All Unregulated Waste Disposal Sites – Green Block Indicates Completed (Annotated For Si Rationale)
2	Tier 2 Site Investigation & Risk Assessment of Former Shore Road Landfill - Appropriate Assessment Screening Report
3	<ul style="list-style-type: none"> • EPA/Teagasc Soil Mapping • EPA/Teagasc Subsoil Mapping
4	GSI Bedrock Mapping
5	<ul style="list-style-type: none"> • GSI Hydrogeological Mapping • Clifden-Castlebar Groundwater Body (GWB) Report
6	<ul style="list-style-type: none"> • EPA Coastal Water Mapping • EPA Surface Water Mapping • WFD Catchment Mapping <ul style="list-style-type: none"> • Flood Mapping
7	Trialpit Logs

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APPENDIX 1

PRELIMINARY CONCEPTUAL SITE MODEL

WALKOVER SURVEY CHECKLIST (CARRIED OUT ORIGINALLY IN 2014, REPEATED WITH FURTHER S.I. IN JUNE 2020)

TABLE A1.1. RESULTS OF S-P-R LINKAGE PRIORTISATION ON FORMER LANDFILL AT SHORE ROAD, CLIFDEN, COUNTY GALWAY (BY MULROY ENVIRONMENTAL)

DETAILS OF S-P-R LINKAGE PRIORTISATION ON FORMER LANDFILL AT SHORE ROAD, CLIFDEN, COUNTY GALWAY (BY MULROY ENVIRONMENTAL)

EPA CODE OF PRACTICE MATRIX 1 – PRELIMINARY & EXPLORATORY INVESTIGATIONS FOR ALL UNREGULATED WASTE DISPOSAL SITES – GREEN BLOCK INDICATES COMPLETED (ANNOTATED FOR SI RATIONALE)

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1. Site Description and Assessment

The former Shore Road landfill site is located on the southern side of the Shore Road adjacent to the shore of Clifden Bay and is approximately 0.98 hectares (i.e. 9,800m²) in area. According to Galway C.C., the former municipal landfill at Shore Road, Clifden, County Galway, was in operation from the 1920s to the late 1960s. It is understood that the site was capped and a football field was constructed in the 1970s. However, the football pitch became disused due to water logging. The site is currently disused and has been left fallow since that time. During this 40-50 year period, as there are no records, it is not clear how many tonnes of mixed waste including domestic, commercial and construction & demolition (i.e. C & D) were deposited on site by the people of Clifden and/or the local authority.

A number of public amenities are located along the sites western boundary. A public handball alley is located on the north-western corner of the site. A public basketball court and adjacent playground is located on the western boundary of the site. A sailing club boat storage yard owned by the local sailing club and slipway is located on the south-western corner of the site adjacent to the shore. A helicopter landing pad is located immediately adjacent to the south-western corner of the site. This is provided with an access road. A pumping station is located besides this access road.

The site is located in a residential area with 4 residences located within 50m of the site's boundary. Two of these residences are located approximately 10m to the north of the site's northern boundary, across the Shore Road. Another residence is located to the northwest of the site. This house is approximately 35m from the site boundary. Another residence is located further along the Shore Road 50m to the east of the site. Further housing exists just outside the 50m boundary, with a cluster of properties to the northeast, and a row of houses along the quay to the southwest of the site. The Clifden town hall, a public building, is located 36 meters northeast of the sites northern boundary. The site is bordered to the north by the Shore Road (i.e. also known locally as the Beach Road) which rises as it approaches the town centre. This road turns 90° to the south at the north-western corner of the site. As stated, the nearest residences to the site are located across this road to the northeast of the site.

As stated, another residence is located to the northwest of the site to the west of the afore-mentioned corner. This house is approximately 35m from the site boundary.

Preliminary Conceptual Site Model

A conceptual site model is a means of understanding the manner in which a system for contaminated land/waste body and the surrounding environment is likely to interact. A well-defined conceptual site model should be used as a basis for all the subsequent risk assessments. It should be 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.

Source

The municipal landfill at Shore Road, Clifden has an area of 1.145Ha. According to Galway County Council the landfill was in operation from the 1920s to the late 1960s. It is understood that the site was capped, and a football field was constructed in the 1970s. However, the football pitch became disused due to water logging. The site is currently disused and has been left fallow since that time. During this 40-50 year period, as there are no records, it is not clear how many tonnes of mixed waste including domestic, commercial and construction & demolition (i.e. C & D) were deposited on site by the people of Clifden and/or the local authority. The site is located on the southern side of the Shore Road adjacent to the shore of Clifden Bay. The landfill is effectively an infilled mudflat.

Pathway

The geology of the area consists of schists and quartzites, with the maps indicating that the site is underlain by psammitic schists. A review of historical 25-inch mapping indicates that the site is located on land that was formerly a part of the estuary. A review of historical 6-inch mapping indicates that the site was mostly mudflat with the high-water mark (HWM) extending to an area just south of the current handball alley which is located on the western end of the site. The surface water body to the northeast of the site can be seen to cross the mudflat and discharge to the estuary. The principle pathway for leachate migration is along the bedrock surface, to emerge at the downstream northeast side of the site.

Receptor

There are residents nearby and the Clifden Bay could be considered a receptor.

The Potential SPR linkages for the Shore Road Landfill can be identified as:

1. Migration of leachate to Clifden Bay;
2. Migration of leachate to the pNHA/SAC No. 002031, The Twelve Bens/Garaun Complex located 266m upgradient of the site; and
3. Gas migration to the residences to the northwest and northeast of the site.

Walkover Survey Checklist (carried out originally in 2014, repeated with Further S.I. in June 2020) Part A

Information	Checked	Comment (include distances from site boundary)
1. What is current Land Use?	YES	The site is currently disused and has been left fallow since it was used as a football field in the 1970s.
2. What are the neighbouring Land Uses?	YES	Several public amenities are located along the site's western boundary. A public basketball court and adjacent playground is located on the western boundary of the site. A sailing club boat storage yard owned by the local sailing club and slipway is located on the south-western corner of the site adjacent to the shore. Adjacent to the boatyard is a wastewater pumping station which collects sewage by gravity and pumps it by rising main to the WWTP on the southern bank of Clifden Harbour. A helicopter landing pad is located immediately adjacent to the south-western corner of the site. These is provided with by an access road.
3. What is the size of the Site?	YES	1.145 Hectares
4. What is the topography?	YES	The former landfill is located in a harbour area, the overall regional gradient is from northeast to southwest towards the Atlantic Ocean. The site is located on land that was formerly a part of the estuary i.e. it is reclaimed land.
5. Are there potential receptors (if yes, give details)?	YES	Yes
Houses	YES	Nearest residential area is 10m to the north of the site's northern boundary across the Shore road.
Surface Water Features (if yes, distance and direction of flow)	YES	There is a culverted stream which flows through the western end of the site from the uplands to the west of the site under the Shore road. It discharges on the southwestern corner of the site.
Any wetland or protected areas	YES	The Twelve Bens/Garaun Complex (SAC-002031) is located 266m hydraulically upgradient to the southeast of the site.
Public Water Supplies	YES	Yes, the lake Lough Nambrackeagh supplies Clifden with potable water and is located 1.7km northeast of the site. However, this is hydraulically separated and upgradient of the site.
Private Wells	YES	No
Services	YES	A gravity sewer collects foulwater from upgradient properties in Clifden town and discharges to a pump sump chamber to the southwest of the site. The collected foulwater is then pump by pressurised water main to the Clifden WWTP on the southern bank of Clifden Harbour. Both the gravity sewer and rising main run along the western boundary of the site.
Other Buildings	YES	Clifden Town Hall is located 35m to the northeast of the site
Other	YES	No

Walkover Survey Checklist
(carried out originally in 2014, repeated
with Further S.I. in June 2020) Part B

Information	Checked	Comment (include distances from site boundary)
6. Are there any potential sources of contamination (if yes, give details)?	YES	Yes. However, the original waste within the site is 50-100 years old and has lost a lot of its potency by leaching chronically into the adjacent estuary. Site is infilled over former foreshore. It is likely that low levels of leachate from the waste body is still being generated. C&D waste was deposited on site in 2018 and S.I. indicates that it is inert.
Surface Waste (if yes, what type?)	YES	No. All the waste is covered by a 200mm cap.
Surface ponding of leachate	YES	No
Leachate seepage	YES	An inspection of the retaining wall on the foreshore during low tide did not reveal any evidence of seepage/iron mottling.
Landfill gas odours	YES	No. Putrescible waste was not identified during trialpit investigations in 2014 and 2020. Age of waste indicates that it is likely that no more methane/biogases are being produced. No landfill gas odours experienced on site in 2020 and no complaints received by Galway C.C. from neighbouring residents.
7. Are there any outfalls to surface water? (If yes, are there any discharges and what is the nature of the discharge?)	YES	Yes. There is a culverted stream which flows through the western end of the site from the uplands to the west of the site under the Shore road. It discharges on the southwestern corner of the site.

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Walkover Survey Checklist (carried out originally in 2014, repeated with Further S.I. in June 2020) Part C

Information	Checked	Comment (include distances from site boundary)
8. Are there any signs of impact on the environment? (If yes, take photographic evidence)	YES	No. There is no evidence of impact on the adjacent estuary given the dilution and tidal 'washing' of leachate away from the site.
Vegetation die off, bare ground	YES	No evidence of methane effects on vegetation on site.
Leachate seepages	YES	No. An inspection of the retaining wall on the foreshore during low tide did not reveal any evidence of seepage/iron mottling.
Odours	YES	No. Site is capped and waste is 50-100 years old.
Litter	YES	No. Site has been entirely capped.
Gas bubbling through water	YES	No
Signs of settlement, subsidence, waterlogged areas	YES	No indication of settlement/subsidence. The site is located in an urban port area which has shown signs of water logging in the past during the winter period. A network of land drains were installed in 2018 to facilitate the development of a public park on the site. The outlet to the land drains have been channelled through the southern retaining wall
Drainage or hydraulic issues	YES	
Downstream water quality appears poorer than upstream water quality	YES	No. There does not appear to be any effect on the estuary or on the discharge from the stream on the SW corner of the site.
9. Are there any indications of remedial measures? (Provide details)	YES	Yes.
Capping	YES	A layer of capping (i.e. brown clay) was placed over the entire landfill area. The site was used as a football pitch in the 1970s.
Landfill gas collection	YES	No. Size and age of waste body and location of the landfill adjacent to estuary indicated that this was not required. Presence of services and culverted stream passing through the site on the western side may have aided in the 'venting' of any ground gases.
Leachate collection	YES	No. Given waste was placed on ground surface, leachate collection to prevent entry into underlying culverted stream was not feasible
10. Describe fences and security features (if any)	YES	Site is enclosed by a 0.5m stone wall to the north and some palisade fencing with standard metal mesh fencing to the west separating the site from the basketball court and the playground. A stock fence is located on the southern boundary. A temporary fence is currently in place blocking the entrance to the site.
Any other relevant information?		No

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Table A1.1 Results of S-P-R Linkage Prioritisation on Former Landfill at Shore Road, Clifden, County Galway

SOURCE		PATHWAYS					RECEPTORS					
LEACHATE	LANDFILL GAS	GROUNDWATER VULNERABILITY (VERTICAL)	GROUNDWATER FLOW REGIME (HORIZONTAL)	SURFACE WATER DRAINAGE	LANDFILL GAS LATERAL MIGRATION	LANDFILL GAS VERTICAL MIGRATION	LEACHATE - HUMAN PRESENCE	LEACHATE - PROTECTED AREAS	LEACHATE - AQUIFER CLASS	LEACHATE - PUBLIC WATER	LEACHATE - SURFACE WATER	LANDFILL GAS - HUMAN PRESENCE
1A	1B	2A	2B	2C	2D	2E	3A	3B	3C	3D	3E	3F
5	5	3	1	2	1	0	3	1	1	0	2	3

Source Pathway Receptor	Formula	Score	% Score	Linkages
SPR 1	$1a * (2a + 2b + 2c) * 3e$	60	20.0	Leachate to SW
SPR 2	$1a * (2a + 2b + 2c) * 3b$	30	10.0	Leachate to GWDTE
SPR 3	$1a * (2a + 2b) * 3a$	60	25.0	Leachate to Private Well
SPR 4	$1a * (2a + 2b) * 3b$	20	8.3	Leachate to GWDTE
SPR 5	$1a * (2a + 2b) * 3c$	20	5.0	Leachate to aquifer
SPR 6	$1a * (2a + 2b) * 3d$	0	0.0	Leachate to PWS
SPR 7	$1a * (2a + 2b) * 3e$	40	16.7	Leachate to SW
SPR 8	$1a * 2c * 3e$	20	33.3	Leachate to SW
SPR 9	$1a * 2c * 3b$	10	16.7	Leachate to GWDTE
SPR 10	$1b * 2d * 3f$	15	10.0	Landfill gas - humans
SPR 11	$1b * 2e * 3f$	0	0.0	Landfill gas - humans
HIGHEST INDIVIDUAL SCORE		75	50.0	Landfill gas - humans

Highest score but no allowance has been given to age of waste i.e. over 45 years old and subsequent lack of leachate.

House 60m from edge of domestic waste 45 years old

No house directly on top of waste body

Risk Classification	Range of Risk Scores
Highest Risk (Class A)	Greater than or equal to 70% for any individual SPR linkage
Moderate Risk (Class B)	Between 40 to 70% for any individual SPR linkage
Lowest Risk (Class C)	Less than or equal to 40% for any individual SPR linkage

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Table 1a: Leachate: Source/Hazard Scoring Matrix

WASTE TYPE	WASTE FOOTPRINT (ha)		
	≤ 1 ha	> 1 ≤ 5 ha	> 5 ha
C&D ²⁰	0.5	1	1.5
Municipal ²¹	5	7	10
Industrial ²²	5	7	10
Pre-1977 sites ²³	1	2	3
		MAX	10

Most of the site's waste is C & D with only a small % (i.e. xx%) classified as Municipal (i.e. Domestic Waste).

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

WASTE TYPE	WASTE FOOTPRINT (ha)		
	≤ 1 ha	> 1 ≤ 5 ha	> 5 ha
C&D ²⁰	0.5	0.75	1
Municipal ²¹	5	7	10
Industrial ²²	3	5	7
Pre-1977 sites ²³	0.5	0.75	1
		MAX	10

²⁰ Predominantly inert waste with low biodegradable fraction and/or small industrial waste fraction.

²¹ Typically non-hazardous domestic waste (highly biodegradable) with potentially small hazardous waste fraction and/or small industrial waste fraction, e.g. town dump.

²² Generally industrial waste where hazardous waste was known to have been deposited or there is a strong likelihood that hazardous waste was deposited due to the close proximity of such industries.

²³ Pre 1977 wastes would have been substantially degraded within the landfill.

Table 2a: Leachate Migration: Pathways

Parameters	Points available
GROUNDWATER VULNERABILITY (Vertical pathway)	
Extreme Vulnerability	3
High Vulnerability	2
Moderate Vulnerability	1
Low Vulnerability	0.5
High – Low Vulnerability	2

Table 2b: Leachate Migration: Pathways

Parameters	Points available
GROUNDWATER FLOW REGIME (Horizontal pathway)	
Karstified Groundwater Bodies (Rk) ²⁵	5
Productive Fissured Bedrock Groundwater Bodies (Rf and Lm) ²⁵	3
Gravel Groundwater Bodies (Rg and Lg) ²⁵	2
Poorly Productive Bedrock Groundwater Bodies (Ll, Pl, Pu) ²⁵	1

Table 2c: Leachate Migration: Pathways

Parameters	Points available
SURFACE WATER DRAINAGE ²⁶ (surface water pathway)	
Is there a direct connection between drainage ditches associated with the waste body and adjacent surface water body? Yes	2
If no direct connection	0

²⁵ Refer to DEHLG/EPA/GSI 1999, Groundwater Protection Schemes.

Table 2d: Landfill Gas: Pathway Assuming Receptor Within 250m of Source

Parameters	Points available
LANDFILL GAS LATERAL MIGRATION POTENTIAL	
Sand and Gravel, Made ground, urban, karst	3
Bedrock	2
All other Tills (including limestone, sandstone etc – moderate permeability)	1.5
All Namurian or Irish Sea Tills (low permeability)	1
Clay, Alluvium, Peat	1

* Residence approx. 30m to NE and another 40m to the NW of site. It is likely that there is made ground directly on top of bedrock to the north and west of the waste body which would be relatively permeable (i.e. the foundations of the handball alley, the shore road foundations, old building foundations, etc). However, the domestic waste is 60m from the nearest house and the predominant soil within the native soil, imported capping and infilled C & D material are impermeable clays and silts.

Table 2e: Landfill Gas: Pathway Assuming Receptor Located Above Source

Parameters	Points available
LANDFILL GAS VERTICAL (UPWARDS) MIGRATION POTENTIAL	
Sand and Gravel, Made ground, urban, karst	5
Bedrock ²	3
All other Tills (including limestone, sandstone etc – moderate permeability) ²	2
All Namurian or Irish Sea Tills (low permeability)	1
Clay, Alluvium, Peat	1

* Assigned a score of 0 – Nearest residence approx. 30m to the NE of site. There is a handball alley, basketball court and playground possibly located on top of the edges of the waste body but these don't class as receptors as there are no confined spaces. However, the domestic waste is 60m from the nearest house and the predominant soil within the native soil, imported capping and infilled C & D material are impermeable clays and silts.

Table 3a: Leachate Migration: Receptors

Parameters	Points available
HUMAN PRESENCE (presence of a house indicates potential private wells)	
On or within 50m of the waste body	3
Greater than 50m but less than 250m of the waste body	2
Greater than 250m but less than 1km of the waste body	1
Greater than 1 km of the waste body	0

* Nearest residence approx. 30m and upgradient to the NE of site boundary. However, the distance to the waste body (i.e. specifically containing domestic waste is 60m). It is likely that there is made ground directly on top of bedrock to the north and west of the waste body which would be relatively permeable (i.e. the foundations of the handball alley, the shore road foundations, old building foundations, etc). However, given the age of the waste proven through the site investigation to be over 44 years old and the distance to the domestic waste, the risk is relatively low.

Table 3b: Leachate Migration: Receptors

Parameters	Points available
PROTECTED AREAS (SWDTE or GWDTE)	
Within 50m of the waste body	3
Greater than 50m but less than 250m of the waste body	2
Greater than 250m but less than 1km of waste body	1
Greater than 1 km of the waste body	0
Undesignated sites ²⁴ within 50m of site of the waste body	1
Undesignated sites ²⁴ greater than 50m but less than 250m of the waste body	0.5
Undesignated sites ²⁴ greater than 250m of the waste body	0

- SAC 002031 The Twelve Bens/Garraun Complex located approximately 275m to east of site.

²⁴ The term 'Undesignated sites' refers to wetland sites that are not designated under the Habitats or Birds Directive or Wildlife Act but are considered to be important on a local scale. Consultation with NPWS is required to identify such sites.

Table 3c: Leachate Migration: Receptors

Parameters	Points available
AQUIFER CATEGORY ²⁶ (resource potential)	
Regionally Important Aquifers (Rk, Rf, Rg)	5
Locally Important Aquifers (Ll, Lm, Lg)	3
Poor Aquifers (Pl, Pu)	1

Table 3d: Leachate Migration: Receptors

PUBLIC WATER SUPPLIES (other than private wells)	
Within 100m of site boundary	7
Greater than 100m but less than 300m or within Inner SPA (SI) for GW supplies	5
Greater than 300m but less than 1km or within Outer SPA (SO) for GW supplies	3
Greater than 1km (karst aquifer)	3
Greater than 1km (no karst aquifer)	0

Table 3e: Leachate Migration: Receptors

Parameters	Points available
SURFACE WATER BODIES	
Within 50m of site boundary	3
Greater than 50m but less than 250m	2
Greater than 250m but less than 1km	1
Greater than 1km	0

*Clifden Bay immediately to south of site. Site infilled on former harbour inlet.

²⁶ This element needs to be determined during the site inspection (including walkover survey). The presence of a direct link between surface water drainage from the waste body and any adjacent surface water body implies the existence of a pathway.

Table 3f: Landfill Gas: Receptor

Parameters	Points available
HUMAN PRESENCE	
On site or within 50m of site boundary	5
Greater than 50m but less than 150m	3
Greater than 150m but less than 250m	1
Greater than 250m	0.5

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<p>IMPORTANT NOTE: THIS INITIAL PHASE OF WORK IS MANDATORY FOR ALL SITES AND SHOULD AIM TO COMPLETE A TIER 1, THE FINDING OF WHICH WILL BE CONFIRMED BY THE INITIAL TIER 2 WORKS. EACH PHASE OF ASSESSMENT WILL DEVELOP THE CONCEPTUAL SITE MODEL (CSM) AND SHOULD GUIDE THE DESIGN OF THE NEXT PHASE OF SITE INVESTIGATION (SI). THE APPLICATION OF THE SI PROCESS AND METHODOLOGIES SHOULD BE COMPLETED IN ACCORDANCE WITH THE RELEVANT STANDARDS/EPA GUIDANCE DOCUMENTS AND UNDERTAKEN BY EXPERIENCED PRACTITIONERS.</p>			TIER 1: PRELIMINARY INVESTIGATION			TIER 2: EXPLORATORY INVESTIGATION & SAMPLING													
			DESK STUDY	WALKOVER SURVEY	CONCEPTUAL SITE MODEL (CSM)	TRIAL PITS & TRENCHES	WASTE TYPE	WASTE SAMPLING	LEACHATE SAMPLING	SOIL SAMPLING	Surface or Groundwater Sampling	Topographic & GPS SURVEY							
SPR LINKAGE	SOURCE	PATHWAY	RECEPTOR			<p>After Tier 1 Investigation, Develop Conceptual Site Model, Determine Risk Classification & Scope Exploratory Investigation</p>													
SPR 1	LEACHATE	Vertical & Horizontal Groundwater to Surface Water Drainage/Runoff	Surface Water Body	M	M								M	M	R	R	R	R/S	R/S
SPR 2	LEACHATE	Vertical & Horizontal Groundwater to Surface Water Drainage/Runoff	Surface Water Body Protected Area (SWDTE)	M	M								M	M	R	R	R	R/S	R/S
SPR 3	LEACHATE	Vertical & Horizontal Groundwater Migration	Human Presence (Private Well)	M	M								M	M	R	R	R	R/S	R/S
SPR 4	LEACHATE	Vertical & Horizontal Groundwater Migration	Groundwater Protected area (GWDTE)	M	M								M	M	R	R	R	R/S	R/S
SPR 5	LEACHATE	Vertical & Horizontal Groundwater Migration	Aquifer Category	M	M								M	M	R	R	R	R/S	R/S
SPR 6	LEACHATE	Vertical & Horizontal Groundwater Migration	Public Supply (Well) (includes Group Water Schemes)	M	M								M	M	R	R	R	R/S	R/S
SPR 7	LEACHATE	Vertical & Horizontal Groundwater Migration	Surface Water Body	M	M								M	M	R	R	R	R/S	R/S
SPR 8	LEACHATE	Surface Water Drainage/Runoff	Surface Water Body	M	M								M	M	R	R	R	R/S	R/S
SPR 9	LEACHATE	Surface Water Drainage/Runoff	Surface Water Body Protected Area (SWDTE)	M	M								M	M	R	R	R	R/S	R/S
SPR 10	LANDFILL GAS	Lateral Migration (Subsoil)	Human Presence	M	M								M	M	R	R	R	R/S	R/S
SPR 11	LANDFILL GAS	Vertical Migration (Subsoil)	Human Presence	M	M	M	M	R	R	R	R/S	R/S							
Source & Pathway & Receptor Parameters Targeted for CSM & Risk Screening			Research of all available published site information - Site history, waste type, extent and volumes, possible historic sources, local receptors, infrastructure etc. Interviews with previous site staff should be considered.	Walkover should confirm desk study data and investigate Source Pathway Receptor scenarios being considered.	The CSM should graphically represent the relationship's between the waste body and potential receptor's developed on the basis of hazard identification and refined during subsequent phases of assessment.	Waste type/composition, footprint, volume, depth & groundwater vulnerability, leachate & gas source & migration potential. Should assess nature and depth of any cap or under soils, if encountered.	Waste type, general composition and extent within the landfill area, leachate and gas source & migration potential.	waste type, dry soils quality and leachate potential	Waste type, leachate concentrations and leachate potential	Ground vulnerability, horizontal or vertical pathway assessment & material use in remediation of site.	Surface water or groundwater receptor and potential horizontal pathway information.	Waste area & volume estimate using trial pit data, site topography, layout/setting, access roads, surface features, accurate SI points, levels for groundwater flow direction, etc							
General comments & COP Section Reference - Note: the development of the CSM and design of the site investigation should involve an experienced SI practitioner.			Critical first step in site and waste characterisation, all potential data sources should be considered. Note Section 3.2 of COP	Allows visual assessment of site and local environs, important that walkover confirms findings of desk study and allows accurate CSM to be developed. Note Section 3.4 of COP	This is a fundamental part of the Risk Assessment exercise - the CSM information should be clearly documented and accessible in the form of text, figures and tables. Note section 3 of COP and reporting requirements in Chapter 8.	Trial pits and trenching is a very important phase of work to enable the potential sources and types of leachate & gas to be determined. Detailed logs and photographic records important. Note Section 5.5.2 of COP.	Characterises waste type and contamination potential. Note Section 4.3.1 of COP & Table 1a & Table 1b of Scoring Matrix.	Characterises waste type, age and contamination potential. Note Section 4.3.1 of COP & Table 1a & Table 1b of Scoring Matrix. Dry soils analysis for comparison and screening against Target Screening Values (TSVs) such as the UK CLEA model and compared to parameters in EPA Landfill Design Document 2000 - Sections 7.1 & 7.2	Characterises waste type, age and contamination potential, samples can be acquired during trial pitting or from existing borehole infrastructure, if present. Leachate characteristics can be compared to parameters in EPA Landfill Design Document 2000 - Sections 7.1 & 7.2	Characterises geology type, material strength and permeability	Full suites should be completed at least once. Should be completed as per best practice and relevant guidelines. Refer to COP 5.3.2 and EPA Landfill Monitoring Guidelines, 2nd Edition 2003, especially Sections 4 and 5.	Topographic surveys give base map for site layout, investigation points, sample and water level depths, groundwater flow direction etc. recommended.							
Provisional Guidance on Extent of Testing/Sampling - This will ultimately depend on the type of risk identified, size of site, extent & volume of waste, ground conditions, variability of the waste material, etc...			Office based assessment using all available existing site data that is vital in assessing the initial risk level and conceptual model for the site. Sites may have GIS data available. Note: Section E of EPA Certificate of Authorisation requires ecological Assessment Habitat Screening to be completed for waste sites so any designated protection areas should be identified at this stage.	Locations and access issues for sampling and site suitability should be assessed at this stage. Presence of potential sensitive ecological habitats requiring appropriate Assessment Screening to be noted.	A good conceptual site model will facilitate an initial risk classification for the site and guide future works.	Typically 7 to 10 trial pits are completed to 3 to 5m per day. Depending on size of site one to two days of trial pitting should be undertaken on and around the waste body to confirm extent and composition. Initial gas monitoring can be by hand held gas and volatile monitors & based on physical observations. Further Trial Pits & Trenching can be completed as part of the Main SI if required and boreholes may be necessary to achieve greater depths.	Each trial pit should be logged as per BS 5930:1999 or ISO 14688-2 (2006) and nature of waste and composition recorded. Photographic records important. Potential to cause source of contamination to be assessed. Physical evidence of contamination such as visual discoloration, presence of leachate, odours etc to be recorded.	Leachability testing of waste should be completed to allow comparison to the European Waste Acceptance Criteria (WAC) analysis, as per the BS 12457 testina standard. A minimum of two samples should be acquired for the test for the trial pit phase of work. Results should be used as a preliminary screening tool to assess the potential level of contamination that the historical waste may pose. Original domestic & C&D Waste is approx. 40 - 50 years old and therefore methanogenesis has ceased and testing was not justified on this waste.	Will depend on nature and composition of the waste and number of investigation points. Initially one to three samples should be taken with one full screen as per Table C.2 of EPA Landfill Monitoring Manual 2003, and at other locations to do indicator parameters such as pH Conductivity, Temp, BOD, Ammonia, Chloride, Sulphate, Sodium and Potassium. Waste is approx. 40 - 50 years old and therefore methanogenesis has ceased and testing was not justified	Will depend on nature and variability of soil material around waste body and number of investigation points. Initially three disturbed samples should be taken and assessed for soil type, particle size analysis, and if possible permeability and strength, refer to BS 5930 standard. Waste is approx. 40 - 50 years old and therefore methanogenesis has ceased and testing was not justified	Adjacent or nearest accessible down gradient locations should be considered for exploratory sampling. Survey of springs if required. Basic indicator parameters such as pH, Conductivity, Temp, BOD, Ammonia, Chloride, Sulphate, Sodium and Potassium should be completed as a minimum. All surface water bodies/drains/streams/ditches should be considered, as per Water Framework Directive. Waste is approx. 40 - 50 years old and therefore methanogenesis has ceased and testing was not justified	A topographical survey should be considered for the site area and immediate environs of low risk sites and is recommended for all moderate and high risk sites. GPS survey locations as required. Due to the low risk of the site (CLASS C), this was not deemed necessary							

IMPORTANT NOTE: THIS INITIAL PHASE OF WORK IS MANDATORY FOR ALL SITES AND SHOULD AIM TO COMPLETE A TIER 1, THE FINDING OF WHICH WILL BE CONFIRMED BY THE INITIAL TIER 2 WORKS. EACH PHASE OF ASSESSMENT WILL DEVELOP THE CONCEPTUAL SITE MODEL (CSM) AND SHOULD GUIDE THE DESIGN OF THE NEXT PHASE OF SITE INVESTIGATION (SI). THE APPLICATION OF THE SI PROCESS AND METHODOLOGIES SHOULD BE COMPLETED IN ACCORDANCE WITH THE RELEVANT STANDARDS/EPA GUIDANCE DOCUMENTS AND UNDERTAKEN BY EXPERIENCED PRACTITIONERS.

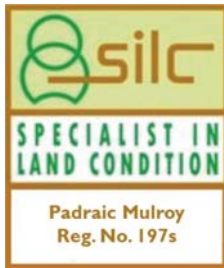
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APPENDIX 2

TIER 2 SITE INVESTIGATION & RISK ASSESSMENT OF FORMER SHORE ROAD LANDFILL - APPROPRIATE ASSESSMENT SCREENING REPORT

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**TIER 2 SITE INVESTIGATION & RISK ASSESSMENT
OF
FORMER SHORE ROAD LANDFILL**

AA SCREENING REPORT

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16TH May 2014

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ANNEX NO.	ANNEX DESCRIPTION
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1 INTRODUCTION

As part of the Tier 2 Site Investigation and Risk Assessment (GQRA) an Appropriate Assessment Screen is required for the former Shore Road Landfill (see Figures 1, 2 & 3). This is required as part of the application to the EPA for the Certificate of Registration. The purpose of this assessment is to ascertain whether the development complies with the Department of Environment, Heritage and Local Government 2009 publication, *'Appropriate Assessment of Plans and Projects in Ireland, Guidance for Planning Authorities.'*

This report has been carried out in accordance with the Department of Environment, Heritage and Local Government 2009 publication, *'Appropriate Assessment of Plans and Projects in Ireland, Guidance for Planning Authorities'* and European Commission Guidance Document *'Assessment of Plans and Projects Significantly affecting Natura 2000 sites – Methodological Guidance on the Provisions of Articles 6(3) and (4) of the Habitats Directive 92/43/EEC (European Commission, 2001).'*

2 LEGISLATIVE BACKGROUND

The Habitats Directive (Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora) provides legal protection for habitats and species of European importance. The main aim of this Directive is to *'contribute towards ensuring biodiversity through the conservation of natural habitats and of wild fauna and flora in the European territory of the Member States to which the Treaty applies'*. In order to meet the aims of the Directive, actions must be designed *to maintain or restore, at favourable conservation status, natural habitats and species of wild fauna and flora of Community interest* (Habitats Directive).

Under the Habitats Directive, Special Areas of Conservation (SAC) or candidate Special Areas of Conservation (cSAC) have been selected as important examples of habitat types listed in Annex I, and the habitats of certain species listed in Annex II of the Habitats Directive. SACs (including cSACs) together with Special Protection Areas (SPAs) (including proposed SPAs) make up a network of European sites called the Natura 2000 network. SPAs are designated under the Council Directive on the Conservation of Wild Birds (79/409/EEC), otherwise known as the *'Birds Directive'*.

Appropriate Assessment is required under the Habitats Directive for any plan or project likely to have a significant effect on a Natura 2000 site. Article 6, paragraphs 3 and 4 of the Directive state:

'6(3) - Any plan or project not directly connected with or necessary to the management of the site (Natura 2000 site) but likely to have significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national

authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public.

6(4)- *If, in spite of a negative assessment of the implications for the site and in the absence of alternative solutions, a plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature, the Member State shall take all compensatory measures necessary to ensure that the overall coherence of Natura 2000 is protected. It shall inform the Commission of the compensatory measures adopted.*

Where the site concerned hosts a priority natural habitat type and/or a priority species, the only considerations which may be raised are those relating to human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest.'

3 SCREENING

Screening involves the following:

1. Description of the plan/project including details of the local site or plan area characteristics;
2. Identification of relevant Natura 2000 sites, and compilation of information on their qualifying interests and conservation objectives;
3. Assessment of likely effects (direct, indirect and cumulative) through the completion of a desk study or field survey; and
4. Screening statement including conclusions.

2.1 Description of Existing Site

The former Shore Road landfill site is located on the southern side of the Shore Road adjacent to the shore of Cliften Bay and is approximately 0.99 hectares (i.e. 9,900m²) in area (see Figures 2 & 3). A council owned helipad has been built on the south western periphery of the the site. The site was wet under foot during the site investigation with rushes the predominant vegetation on site. A public handball alley is located on the north-western corner of the site. A public basketball court and adjacent playground is located on the western boundary of the site. A sailing club boat storage yard and slipway is located on the south-western corner of the site. A helicopter landing pad is located immediately adjacent to the south-western corner of the site. This is accessed by an access road. A pumping station is located besides this access road

According to Galway C.C., the former municipal landfill at Shore Road, Clifden, County Galway, was in operation between the years of 1920s and the late 1960s. It is understood that the site was capped and a football field was constructed in the 1970s. However, the football pitch became disused due to water logging. The site is currently disused and has been left fallow since that time. During this 40-50

year period, as there are no records, it is not clear how many tonnes of mixed waste including domestic, commercial and construction & demolition (i.e. C & D) were deposited on site by the people of Clifden and/or the local authority. The total site area is 0.98 hectares (ha). However, the results of the site investigation indicate that an area of just 2,325m² was used for the deposition of waste i.e. domestic, commercial and construction & demolition (i.e. C & D). Taking an average waste depth of 4.5m, a total volume of waste is calculated at 10,500m³ (see Figures 4 & 5). A review of historical 25-inch mapping indicates that the southern 2/3 of the site is located on land that was formerly a part of the estuary i.e. it is reclaimed land.

2.2 Surrounding Property

The site is located in a residential area with 4 residences located within 50m of the site's boundary (see Figure 3). Two of these residences are located approximately 10m to the north of the site's northern boundary, across the Shore Road. Another residence is located to the northwest of the site. This house is approximately 35m from the site boundary. Another residence is located further along the Shore road 50m to the east of the site. Further housing exists just outside the 50 meter boundary, with a cluster of properties to the northeast, and a row of houses along the quay to the southwest of the site. The Cliften town hall, a public building, is located 36 meters northeast of the sites northern boundary. As stated previously, a number of public amenities are located along the sites western boundary, including a handball alley, basketball court and public playground. A boat storage yard owned by the local sailing club is located on the southwestern boundary of the site, adjacent to the shore (see Figure 3).

2.3 Natura 2000 Sites

The Shore Road site is located in the vicinity of a number of Natura 2000 designated protected sites, including Special Areas of Conservation (SAC), Special Protected Areas (SPA) and proposed Natural Heritage Areas (pNHA). These are the West Connect coast, Slyn Head peninsula, the Conemarra Bog complex and The Twelve Bens/ Garaun complex.

The Twelve Bens/ Garaun Complex is the closest protected site to Shore Road landfill site, located approximately 266m to the southeast of the site's eastern boundary (see Figures 1 & 2). This is protected as:

- A Special Area of Conservation (SAC) No. 002031; and
- A proposed Natural Heritage Area (pNHA) No. 002031.

The Site Synopsis and the Qualifying Interests for The Twelve Bens/ Garaun Complex are located in Annex 1. The overarching Conservation Objective for The Twelve Bens/ Garaun Complex Special Protection Area is to ensure the maintenance of the habitats and species for which the SAC has been selected at favourable conservation status.

The Conservation Objectives for The Twelve Bens/ Garaun Complex can be summarised as follows:

Objective 1: To maintain the Annex I habitats for which the SAC has been selected at favourable conservation status.

To be favourable the following habitat must remain intact and at their current percentage:

- Blanket bogs (active) (26% area of the site);
- Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) (6% area of the site);
- Siliceous rocky slopes with chasmophytic vegetation (5% area of the site);
- Calcareous rocky slopes with chasmophytic vegetation (3% area of the site);
- Siliceous scree of the montane to snow levels (*Androsacetalia alpinae* and *Galeopsietalia ladani*) (1% area of the site);
- Alpine and Boreal heaths (2% area of the site);
- Old Oak Woods with *Ilex* and *Blechnum* in the British Isles (1% area of the site);
- Depressions on peat substrates of the *Rhynchosporion* (1% area of the site).

Objective 2: To maintain the Annex II species for which the SAC has been selected at favourable conservation status.

To be favourable the following habitat must remain intact only.

- Slender Naiad;
- Otter;
- Freshwater Pearlmussel;
- Salmon.

Objective 3: To maintain the extent, species richness and biodiversity of the entire site.

Objective 4: To establish effective liaison and co-operation with landowners, legal users and relevant authorities.

4 ASSESSMENT OF LIKELY EFFECTS

A review of the proposed development indicates that there will not be:

- Any impact on an Annex I habitat;
- Any reduction in the area of a Natura 2000 site;
- Direct or indirect damage to the physical quality of the environment in the Natura 2000 site;
- Serious or ongoing disturbance to species or habitats for which Natura 2000 is selected;
- Direct or indirect damage to the size, characteristics or reproductive ability of populations on the Natura 2000 site; and
- Interference with mitigation measures put in place for other plans/projects.

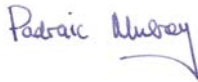
5 SCREENING CONCLUSION AND STATEMENT

The findings and conclusions of the screening process are as follows:

1. *No potential for significant effects/AA is not required*

Screening established that there is **no potential for significant effects** and the project/plan can proceed as proposed. However, no changes may be made after this as this will invalidate the findings of the screening.

Yours sincerely,



Padraic Mulroy

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Managing Director

Mulroy Environmental

MULROY ENVIRONMENTAL SERVICE CONSTRAINTS

1. This report and the Environmental Site Assessment carried out in connection with the report (together the "Services") were compiled and carried out for Galway County Council (the "client") in accordance with the terms of a contract, Proposal PRP214.05.04.2013, between Mulroy Environmental and the "client" dated 6th April 2013. The Services were performed by Mulroy Environmental with the skill and care ordinarily exercised by a reasonable Environmental consultant at the time the Services were performed. Further, and in particular, the Services were performed by Mulroy Environmental taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between Mulroy Environmental and the client.
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6. The observations and conclusions described in this report are based solely upon the Services which were provided pursuant to the agreement between the client and Mulroy Environmental. Mulroy Environmental has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and Mulroy Environmental. Mulroy Environmental is

not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, Mulroy Environmental did not seek to evaluate the presence on or off the site of asbestos, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials.

7. The Services are based upon Mulroy Environmental's observations of existing physical conditions at the Site gained from a walk-over survey of the site together with Mulroy Environmental's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which Mulroy Environmental was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by Mulroy Environmental and the observations possible at the time of the walk-over survey. Further Mulroy Environmental was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. Mulroy Environmental is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to Mulroy Environmental and including the doing of any independent investigation of the information provided to Mulroy Environmental save as otherwise provided in the terms of the contract between the client and Mulroy Environmental.

8. The environmental monitoring aspects of the Services is a limited sampling of the site at pre-determined borehole and soil vapour locations based on the operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and Mulroy Environmental] [based on an understanding of the available operational and historical information,] and it should not be inferred that other chemical species are not present.

9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features

ANNEX 1

- SITE SYNOPSIS SAC NO. 002031
- QUALIFYING INTERESTS FOR TWELVE BENS/
GARAUN COMPLEX

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SITE SYNOPSIS

SITE NAME: THE TWELVE BENS/GARRAUN COMPLEX

SITE CODE: 002031

This is an extensive site situated in the north-west of Connemara, dominated by mountainous terrain. The site is bounded to the south by the Connemara Bog Complex, to the east by the Maumturk Mountains and to the north by Killary Harbour. Included within the site are the Twelve Bens mountain range, the mountains to the north of Kylemore (Doughruagh, Garraun and Benchoona), rivers including the Ballynahinch and Owenglin systems and an area of coastal heath and machair near Glassilaun. The site also includes some extensive tracts of lowland blanket bog which are continuous with the mountains. Most of the mountain summits reach a height in excess of 500 m, the highest being Ben Baun in the Twelve Bens which reaches 730 m. The site includes a large portion of the Connemara National Park and a Statutory Nature Reserve at Derryclare Wood.

Geologically, the site can be divided into two distinct parts. The Twelve Bens are composed of resistant quartzite with schists in the valleys while the mountains north of Kylemore are composed of gneiss and various types of sandstones and mudstones. There are also areas of gabbro (Doughruagh and Currywongaun), mica schist (Muckanaght) and marble outcrops (south of Kylemore Lough). The main soil type within the site is peat.

The site is a candidate SAC selected for active blanket bog a priority habitat on Annex I of the E.U. Habitats Directive. The site is also selected as a candidate SAC for, alpine heath, calcareous rocky siliceous rocky and siliceous scree vegetation, lowland oligotrophic lakes, Rhynchosporion and old Oak woodlands all habitats listed on Annex I of the E.U. Habitats Directive. The site is also selected for the following species listed on Annex II of the same directive - Freshwater Pearl Mussel, Atlantic Salmon, Otter and the plant Slender Naiad.

The predominant vegetation type on the site is upland blanket bog/heath dominated by Heather (*Calluna vulgaris*), Deergrass (*Scirpus cespitosus*), Cross-leaved Heath (*Erica cinerea*) and the mosses *Racomitrium lanuginosum* and *Sphagnum capillifolium*). In places this vegetation can be rich in liverwort species such as *Adelanthus lindenbergianus* and *Bazzania pearsonii*. This unusual type of species-rich dwarf shrub heath is almost confined to the mountains of the west of Ireland and Scotland and is particularly well developed in the Twelve Bens. Close to the mountain summits this blanket bog/heath is often very thin with a high proportion of outcropping bedrock.

Another important and widespread habitat is lowland blanket bog dominated by Purple Moor-grass (*Molinia caerulea*), Black Bog-rush (*Schoenus nigricans*), Cross-leaved Heath and the liverwort *Pleurozia purpurea*. These areas of lowland blanket bog usually occur in the valleys between the mountains, e.g. the Gleninagh Valley.

Rhynchosporion vegetation is well represented around pools, in wet hollows and in quaking and flush areas associated with the lowland blanket bog. White Beak-sedge (*Rhynchospora alba*) occurs in association with such species as Bog Cotton (*Eriophorum angustifolium*), Bogbean (*Menyanthes trifoliata*), Black Bog-rush (*Schoenus nigricans*), and a range of bog mosses, including *Sphagnum auriculatum* and *S. cuspidatum*.

The site contains a large range of other habitats, including upland grassland dominated by Sheep's Fescue (*Festuca ovina*) and Mat-grass (*Nardus stricta*), Sessile Oak (*Quercus petraea*) woodland, scree, oligotrophic (nutrient-poor) lakes, rivers, reedbeds, freshwater marshes, coastal heath, machair, sand dune and salt marsh.

A number of rare, Red Data Book plant species are found within the site: Alpine Saw-wort (*Saussurea alpina*), Holly Fern (*Polystichum lonchitis*), Purple Saxifrage (*Saxifraga oppositifolia*), and the legally protected (Flora Protection Order, 1999) Parsley Fern (*Cryptogramma crispa*). These are generally confined to mountain cliffs above 400 m, where a number of other scarce plant species, for example, Alpine Meadow-rue (*Thalictrum alpinum*), are also found. Other Red Data Book species have also been recorded from the site: Marsh Clubmoss (*Lycopodiella inundata*), Corncockle (*Agrostemma githago*) and the legally protected Heath Cudweed (*Omalotheca sylvatica*). The latter two species have not been recorded from the site in recent years. St. Dabeoc's Heath (*Daboecia cantabrica*), a species which in Ireland is restricted to Connemara and south Mayo, occurs commonly within the site.

The suite of lowland lakes that encircle the mountains represent some of the finest oligotrophic lakes in the country and two rare, Red Data Book plant species, Slender Naiad (*Najas flexilis*) and Pillwort (*Pillularia globulifera*) occur. Slender Naiad is rare in Europe and is listed on Annex II of the EU Habitats Directive.

The site contains several small areas of Sessile Oak woodland, a habitat which is particularly rare in Connemara. The best examples on the site of this habitat are found at Kylemore and on the north shore of Derryclare Lough. Derryclare Wood, a Statutory Nature Reserve, has been particularly well studied. It is composed mostly of Sessile Oak, with some Rowan (*Sorbus aucuparia*), Downy Birch (*Betula pubescens*) and occasional Ash (*Fraxinus excelsior*) forming the canopy layer. There is a well-developed lichen and fungus flora present. The fungal parasite, *Hemigrapha astericus*, a native of Australia and South America, was first recorded in the northern hemisphere from this wood. The Kylemore woods, though heavily infested by Rhododendron (*Rhododendron ponticum*), still retain a diverse flora and support interesting communities of mosses and liverworts, including such species as *Radula voluta*, *Lejeunea holtii*, *L. hibernica*, *L. flava* subsp. *moorei*, *Cephalozia hibernica*, *Teleranea nematodes*, *Campylopus setifolius*, *Oxystegus hibernicus*, *Grimmia hartmanii* and *G. funalis*.

Irish Hare, Otter, Freshwater Pearl-mussel and Common Frog have been recorded from the site. These species are protected under the 1976 Wildlife Act. The Owenglin River and Ballynahinch system supports an important population of Salmon and salmon nursery grounds. Arctic Charr, a species listed in the Irish Red

Data Book as threatened in Ireland, has been recorded from Lough Inagh, Kylemore Lough, Lough Muck and Lough Fee.

Birdlife reported from the site includes Raven, Wheatear, Stonechat, Meadow Pipit, Red Grouse, a declining species of Heather moorland, Snipe, Curlew, Woodcock, Hooded Crow, Twite, Ring Ouzel (the latter two both Irish Red Data Book species) and the EU Birds Directive Annex I species, Peregrine, Merlin, Golden Plover and Chough. The site provides excellent habitat for Peregrine and this species has traditionally bred at several locations within it.

The upland vegetation of the site is most threatened by overstocking with sheep and by afforestation with coniferous species.

The Twelve Bens/Garraun Complex includes a wide variety of habitat types, eight of which are listed on Annex I of the EU Habitats Directive, and populations of many rare or scarce plant and animal species. It is one of the largest and most varied sites of conservation interest in Ireland.

6.10.2006

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NATURA 2000
STANDARD DATA FORM

FOR SPECIAL PROTECTION AREAS (SPA)

FOR SITES ELIGIBLE FOR IDENTIFICATION AS SITES OF
COMMUNITY IMPORTANCE (SCI)

AND

FOR SPECIAL AREAS OF CONSERVATION (SAC)

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1. SITE IDENTIFICATION

<i>1.1. TYPE</i>	<i>1.2. SITE CODE</i>	<i>1.3. COMPILATION DATE</i>	<i>1.4. UPDATE</i>
B	IE0002031	199511	

1.5. RELATION WITH OTHER NATURA 2000 SITES:

1.6. RESPONDENT(S):

National Parks & Wildlife Service of the Department of the Environment, Heritage and Local Government. 7 Ely Place, Dublin 2, Ireland.

1.7. SITE NAME:

The Twelve Bens/Garraun Complex

1.8. SITE INDICATION AND DESIGNATION/CLASSIFICATION DATES:

DATE SITE PROPOSED AS ELIGIBLE AS SCI:

199805

DATE CONFIRMED AS SCI:

DATE SITE CLASSIFIED AS SPA:

DATE SITE DESIGNATED AS SAC:

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2. SITE LOCATION

2.1. SITE CENTRE LOCATION

LONGITUDE

W 9 52 45

W/E (Greenwich)

LATITUDE

53 32 18

2.2. AREA (HA):

16170.08

2.3. SITE LENGTH (KM):

2.4. ALTITUDE (M):

MINIMUM

0

MAXIMUM

730

MEAN

350

2.5. ADMINISTRATIVE REGION:

NUTS CODE

IE013

REGION NAME

West

% COVER

99

Marine area not covered by a NUTS-region

2.6. BIOGEOGRAPHIC REGION:

Alpine

Atlantic

Boreal

Continental

Macaronesian

Mediterranean

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3. ECOLOGICAL INFORMATION

3.1. HABITAT types present on the site and assessment for them:

ANNEX I HABITAT TYPES:

CODE	%COVER	REPRESENTATIVITY	RELATIVE SURFACE	CONSERVATION STATUS	GLOBAL ASSESSMENT
7130	44	B	B	C	C
3110	6	A	B	A	A
8220	2	A	B	A	A
7150	1	A	C	B	A
91A0	1	A	B	B	A
4060	1	B	B	B	B
8110	1	A	B	A	A
8210	1	A	B	A	A

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3.2. SPECIES

covered by Article 4 of Directive 79/409/EEC

and

listed in Annex II of Directive 92/43/EEC

and

site assessment for them

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3.2.a. BIRDS listed on Annex I of Council directive 79/409/EEC

CODE	NAME	POPULATION			SITE ASSESSMENT		
		Resident	Migratory		Population	Conservation	Isolation
		Breed	Winter	Stage			
A103	Falco peregrinus	3	p		C	A	C

3.2.b. Regularly occurring Migratory Birds not listed on Annex I of Council directive 79/409/EEC

3.2.c. MAMMALS listed on Annex II of Council directive 92/43/EEC

CODE	NAME	POPULATION			SITE ASSESSMENT		
		Resident	Migratory		Population	Conservation	Isolation
		Breed	Winter	Stage			
1355	Lutra lutra	p			C	A	C

3.2.d. AMPHIBIANS and REPTILES listed on Annex II of Council directive 92/43/EEC

CODE	NAME	POPULATION	SITE ASSESSMENT		
			Population	Conservation	Isolation
1833	Najas flexilis	P	B	A	C

3.2.e. FISHES listed on Annex II of Council directive 92/43/EEC

CODE	NAME	POPULATION			SITE ASSESSMENT		
		Resident	Migratory		Population	Conservation	Isolation
		Breed	Winter	Stage			
1106	Salmo salar	C			C	B	C

3.2.f. INVERTEBRATES listed on Annex II of Council directive 92/43/EEC

CODE	NAME	POPULATION			SITE ASSESSMENT		
		Resident	Migratory		Population	Conservation	Isolation
		Breed	Winter	Stage			
1029	Margaritifera margaritifera	P			B	B	B

3.2.g. PLANTS listed on Annex II of Council directive 92/43/EEC

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3.3. Other Important Species of Flora and Fauna

GROUP	SCIENTIFIC NAME	POPULATION	MOTIVATION
B M A R F I P			
P	Pilularia globulifera	P	A
P	Saussurea alpina	P	A
P	Omalotheca sylvatica	P	A
P	Cryptogramma crispa	R	A
P	Agrostemma githago	P	A
P	Lycopodiella inundata	P	A
P	Polystichum lonchitis	P	A
I	Stethophyma grossum	P	D
I	Conops vesicularis	P	D
I	Epistrophe nitidicollis	P	D
I	Ctenophora atrata	P	D
F	Salvelinus alpinus	P	A
A	Rana temporaria	P	A
M	Lepus timidus hibernicus	P	A
A	Rana temporaria	P	C
M	Lepus timidus hibernicus	P	B
M	Lepus timidus hibernicus	P	C

(B = Birds, M = Mammals, A = Amphibians, R = Reptiles, F = Fish, I = Invertebrates, P = Plants)

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4. SITE DESCRIPTION

4.1. GENERAL SITE CHARACTER:

Habitat classes	% cover
Marine areas, Sea inlets	1
Coastal sand dunes, Sand beaches, Machair	1
Inland water bodies (Standing water, Running water)	7
Bogs, Marshes, Water fringed vegetation, Fens	46
Heath, Scrub, Maquis and Garrigue, Phygrana	34
Humid grassland, Mesophile grassland	1
Broad-leaved deciduous woodland	1
Inland rocks, Scree, Sands, Permanent Snow and ice	9
Total habitat cover	100 %

Other site characteristics

An extensive area incorporating the predominantly quartzite mountains of the Twelve Bens and encompassing a range of habitat types, including blanket bog, oligotrophic lakes, heath, exposed rock and scree, acid grassland and remnants of oak woodland. The northern part of the site is bounded by coastline and includes rocky shore and small areas of sandy beach, machair, tidal river, mud flats and saltmarsh. Several river headstreams are also within the site.

4.2. QUALITY AND IMPORTANCE:

One of the largest and most varied sites of conservation interest in Ireland, including the scenically renowned Twelve Bens mountain range, which support extensive areas of blanket bog, heath and exposed rock and a range of arctic-alpine plants. Rhynchosporion vegetation is well represented in the wet areas of blanket bog. The suite of lowland lakes that encircle the mountains represent some of the finest oligotrophic lakes in the country and support several rare species such as *Pilularia globulifera* and populations of *Salvelinus alpinus*. The site also has a significant population of *Lutra lutra*, and an important population of *Salmo salar*. The site includes a large portion of the Connemara National Park and a National Nature Reserve at Derryclare Wood. Additional areas are included in the site under EU LIFE funded restoration projects.

4.3. VULNERABILITY

Large tracts of blanket bog are currently overgrazed by sheep and are vulnerable to erosion, a problem that could be accentuated by the striping of commonage which is taking place in some areas. Other threats are the further expansion of commercial afforestation on blanket bog, and the development of fish-farming in the oligotrophic lakes.

4.4. SITE DESIGNATION:

4.5. OWNERSHIP

National Parks and Wildlife Service (14%)
 Department of the Environment (9%)
 Privat : Multiple (77%)

4.6. DOCUMENTATION

Central Fisheries Board (2001). Irish Salmon Catches 2000. <http://www.cfb.ie/>: February 2001.

Doris, Y., McGarrigle, M.L., Clabby, K.J., Lucey, J., Neill, M., Flanagan, M., Quinn, M.B. & Lehane, M., (eds.) (1999). Water Quality in Ireland 1995-1997. Statistical compendium of River Quality Data, Environmental Protection Agency.

Douglas, C., Garvey, L., Kelly, L. and O'Sullivan, A. (1989). A Survey to Locate Blanket Bogs of Scientific Interest in County Galway, Part 2. Unpublished report to the Wildlife Service, Dublin.

Douglas, C. and Grogan, (1987). A Survey to Locate Lowland Blanket Bogs of Scientific Interest in Connemara, County Galway. Unpublished report to the Wildlife Service, Dublin.

Ferguson, D.K. and Westhoff, V. (1987). An Account of the Flora of Derryclare Wood, Connemara, (Co. Galway), Western Ireland. Proceedings of The Koninklijke Nederlandse Akademie van Wetenschappen, C90 (2) : 139-172.

Folan, A.C.M. and Mitchell, M.E. (1970). The Lichens and Lichen Parasites of Derryclare Wood, Connemara. Proceedings Of The Royal Irish Academy, Section B, 70 (7) : 163-170.

Heuff, H. (1984). The Vegetation of Irish Lakes. Unpublished report to the Wildlife Service, Dublin.

McGarrigle, M.L., Bowman, J.J., Clabby, K.J., Lucey, J., Cunningham, P., MacCarthaigh, M., Keegan, M., Cantrell, B., Lehane, M., Clenaghan, C. and Toner, P.F. (2002). Water Quality in Ireland 1998-2000. Environmental Protection Agency, Wexford.

Neff, M. (1972). Conservation Report. Derryclare Wood, Ballynahinch Forest, Co Galway. Internal Report to Forest & Wildlife Service.

O'Reilly, P. (1991). Trout and Salmon Rivers of Ireland: an angler's guide. Merlin Unwin Books, London.

Quinn, A.C.M. (1971). Areas of Scientific Interest in County Galway. Unpublished preliminary report prepared for Galway County Council. An Foras Forbartha, Dublin.

Roden, C.M. (1986). A Survey of the Flora of some Mountain Ranges in the West of Ireland. Irish Naturalists' Journal, 22 (2) : 52-59.

Scannell, M.J.P. and White, J. (1975). *Cryptogramma crispum* In West Galway. Irish Naturalists' Journal, 18 : 336.

Tangney, D.E. & Fairley, J.S. (1994). Otter signs and diet in Connemara National Park and its environs. Irish Naturalists' Journal 24: 434 -440.

Webb, D.A. and Scannell, M.J.P. (1983). Flora of Connemara and the Burren. Royal Dublin Society and Cambridge University Press, Cambridge.

5. SITE PROTECTION STATUS AND RELATION WITH CORINE BIOTOPES

5.1. DESIGNATION TYPES at National and Regional level:

CODE	% COVER
IE01	1
IE03	13

5.2. RELATION OF THE DESCRIBED SITE WITH OTHER SITES:

designated at National or Regional level:

TYPE CODE	SITE NAME	OVERLAP TYPE	% COVER
IE01	Derryclare Nature Reserve	+	1
IE03	Connemara National Park	*	13

designated at International level:

5.3. RELATION OF THE DESCRIBED SITE WITH CORINE BIOTOPE SITES:

CORINE SITE CODE	OVERLAP TYPE	% COVER
800000208		
800000182		
800000243		

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6. IMPACTS AND ACTIVITIES IN AND AROUND THE SITE

6.1. GENERAL IMPACTS AND ACTIVITIES AND PROPORTION OF THE SURFACE OF THE SITE AFFECTED

IMPACTS AND ACTIVITIES WITHIN the site

CODE	INTENSITY	% OF SITE	INFLUENCE
140	A B C	90	+ 0 -
200	A B C	1	+ 0 -
220	A B C	5	+ 0 -
230	A B C	10	+ 0 -
301	A B C	1	+ 0 -
311	A B C	1	+ 0 -
312	A B C	1	+ 0 -
501	A B C	1	+ 0 -
502	A B C	1	+ 0 -
622	A B C	5	+ 0 -
900	A B C	30	+ 0 -
954	A B C	1	+ 0 -

IMPACTS AND ACTIVITIES AROUND the site

CODE	INTENSITY	INFLUENCE
140	A B C	+ 0 -
161	A B C	+ 0 -
311	A B C	+ 0 -
312	A B C	+ 0 -
403	A B C	+ 0 -
502	A B C	+ 0 -
610	A B C	+ 0 -
622	A B C	+ 0 -

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6.2. SITE MANAGEMENT AND PLANS

BODY RESPONSIBLE FOR THE SITE MANAGEMENT

National Parks and Wildlife Service (c. 14%)
Private ownership (77%)
Department of Environment (9%)

SITE MANAGEMENT AND PLANS

A management plan is being prepared.

7. MAPS OF THE SITE

- *Physical map*

- *Aerial photograph(s) included:*

8. SLIDES

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Conservation Objectives for The Twelve Bens/Garraun Complex SAC [002031]

The overall aim of the Habitats Directive is to maintain or restore the favourable conservation status of habitats and species of community interest. These habitats and species are listed in the Habitats and Birds Directives and Special Areas of Conservation and Special Protection Areas are designated to afford protection to the most vulnerable of them. These two designations are collectively known as the Natura 2000 network.

European and national legislation places a collective obligation on Ireland and its citizens to maintain habitats and species in the Natura 2000 network at favourable conservation condition. The Government and its agencies are responsible for the implementation and enforcement of regulations that will ensure the ecological integrity of these sites.

The maintenance of habitats and species within Natura 2000 sites at favourable conservation condition will contribute to the overall maintenance of favourable conservation status of those habitats and species at a national level.

Favourable conservation status of a habitat is achieved when:

- its natural range, and area it covers within that range, are stable or increasing, and
- the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future and
- the conservation status of its typical species is favourable.

The favourable conservation status of a species is achieved when:

- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

Objective: To maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the SAC has been selected:

- ◆ [1029] *Margaritifera margaritifera*
- ◆ [1106] *Salmo salar* (only in fresh water)
- ◆ [1355] *Lutra lutra*
- ◆ [1833] *Najas flexilis*
- ◆ [3110] Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*)
- ◆ [4060] Alpine and Boreal heaths
- ◆ [7130] Blanket bogs (* if active only)
- ◆ [7150] Depressions on peat substrates of the *Rhynchosporion*
- ◆ [8110] Siliceous scree of the montane to snow levels (*Androsacetalia alpinae* and *Galeopsietalia ladani*)
- ◆ [8210] Calcareous rocky slopes with chasmophytic vegetation
- ◆ [8220] Siliceous rocky slopes with chasmophytic vegetation
- ◆ [91A0] Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles

Citation:

NPWS (2011) Conservation objectives for The Twelve Bens/Garraun Complex SAC [002031]. Generic Version 3.0. Department of Arts, Heritage & the Gaeltacht.

For more information please go to: www.npws.ie/protectedsites/conservationmanagementplanning

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APPENDIX 3

- EPA/TEAGASC SOIL MAPPING
- EPA/TEAGASC SUBSOIL MAPPING

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Soils
AeoUND - Aeolian Undifferentiated
AlluvMIN - Mineral alluvium
AlluvMRL - Marl type soils
AlluvUND - Alluvium undifferentiated
AminDW - Acid Brown Earths / Brown Podzolics
AminPD - Surface water Gleys / Ground water Gleys Acidic
AminPDPT - Peaty Gleys Acidic
AminSP - Surface water Gleys / Ground water Gleys Shallow
AminSPPT - Peaty Gleys Shallow
AminSRPT - Podzols Peaty
AminSW - Lithosols / Regosols
BktPt - Blanket peat
BminDW - Grey Brown Podzolics / Brown Earths Basic
BminPD - Surface water Gleys / Ground water Gleys Basic
BminPDPT - Peaty Gleys Basic Parent Materials Basic
BminSP - Surface water Gleys / Ground water Gleys Shallow



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x: 64923.29 y: 250153.21

Results



x: 64584.63 y: 250301.37

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











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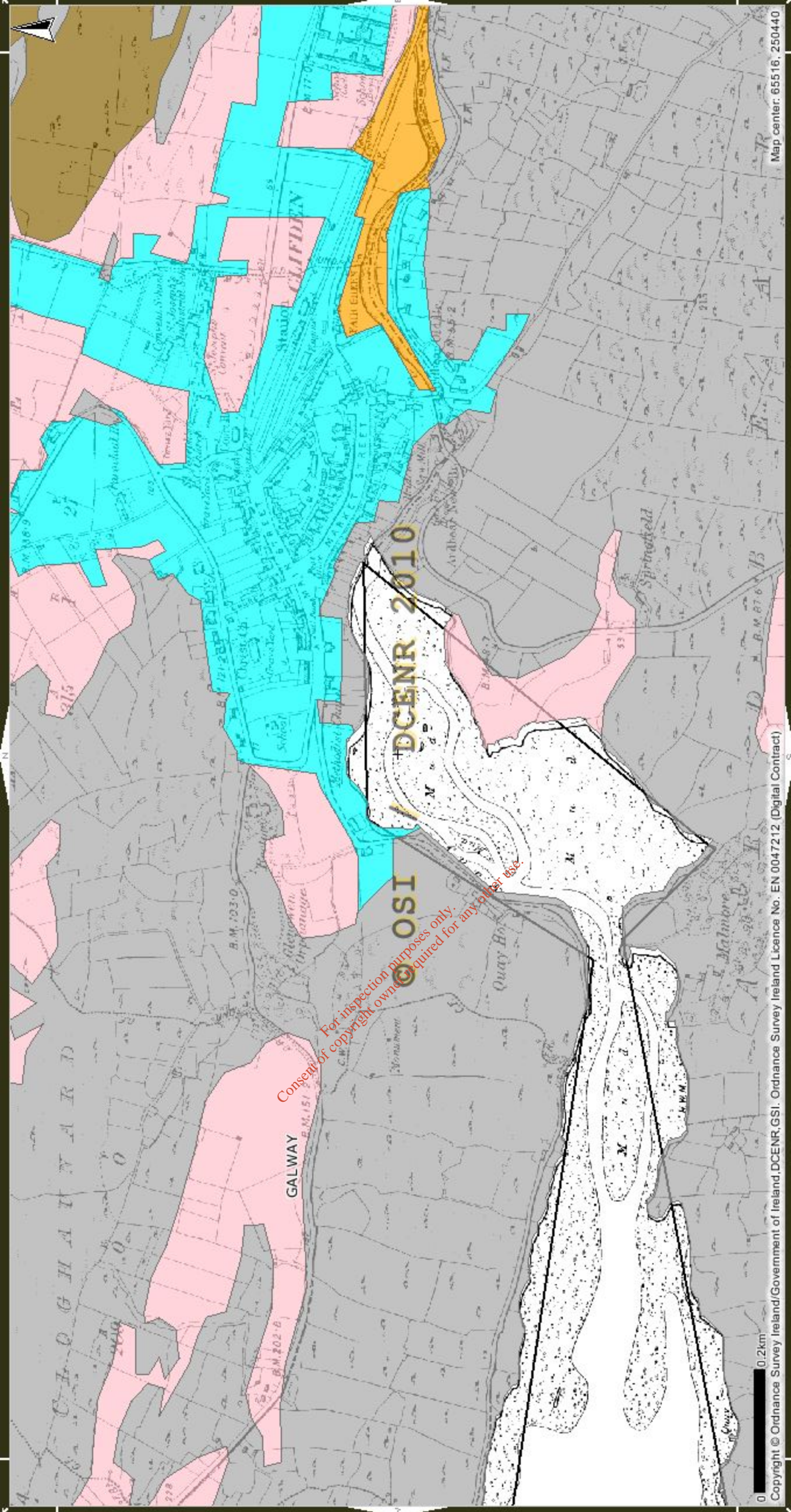
	TDCSSS - Sandstone and shales till Devonian/Carboniferous
	TdlMr - Tidal Marsh
	TDSs - Sandstone till Devonian
	TGr - Granite till
	TLPDSs - Sandstone till Lower Palaeozoic/Devonian
	TLPs - Shale till Lower Palaeozoic
	TLPSSs - Sandstone till Lower Palaeozoic
	TLPSSs - Sandstone and shales till Devonian/Carboniferous
	TLs - Limestone till Carboniferous
	TMP - Metamorphic till
	TNCSSs
	TNSSs
	TQz - Quartzite till
	Water
	Ws - Blown sand
	Wsd - Blown sand in dunes
<input type="checkbox"/>	Corine 1990
<input type="checkbox"/>	Corine 2000

Results

Map Legend

Settings

-  RBD Subsoils
-  Alluvium
-  Beach sands and gravels
-  Bedrock outcrop and subcrop
-  Esker sands and gravels
-  Glaciofluvial sands and gravels
-  Lake sediments
-  Made ground
-  Marine/estuarine silts and clays
-  Marsh
-  Peat
-  Scree
-  Till derived chiefly from Devonian sandstones
-  Till derived chiefly from Lower Palaeozoic rocks
-  Till derived chiefly from Namurian rocks
-  Till derived chiefly from granite
-  Till derived chiefly from limestone
-  Till derived chiefly from metamorphic rocks
-  Till derived from mixed Devonian and Carboniferous rocks
-  Water
-  Windblown sands
-  County Boundaries
-  Watermark



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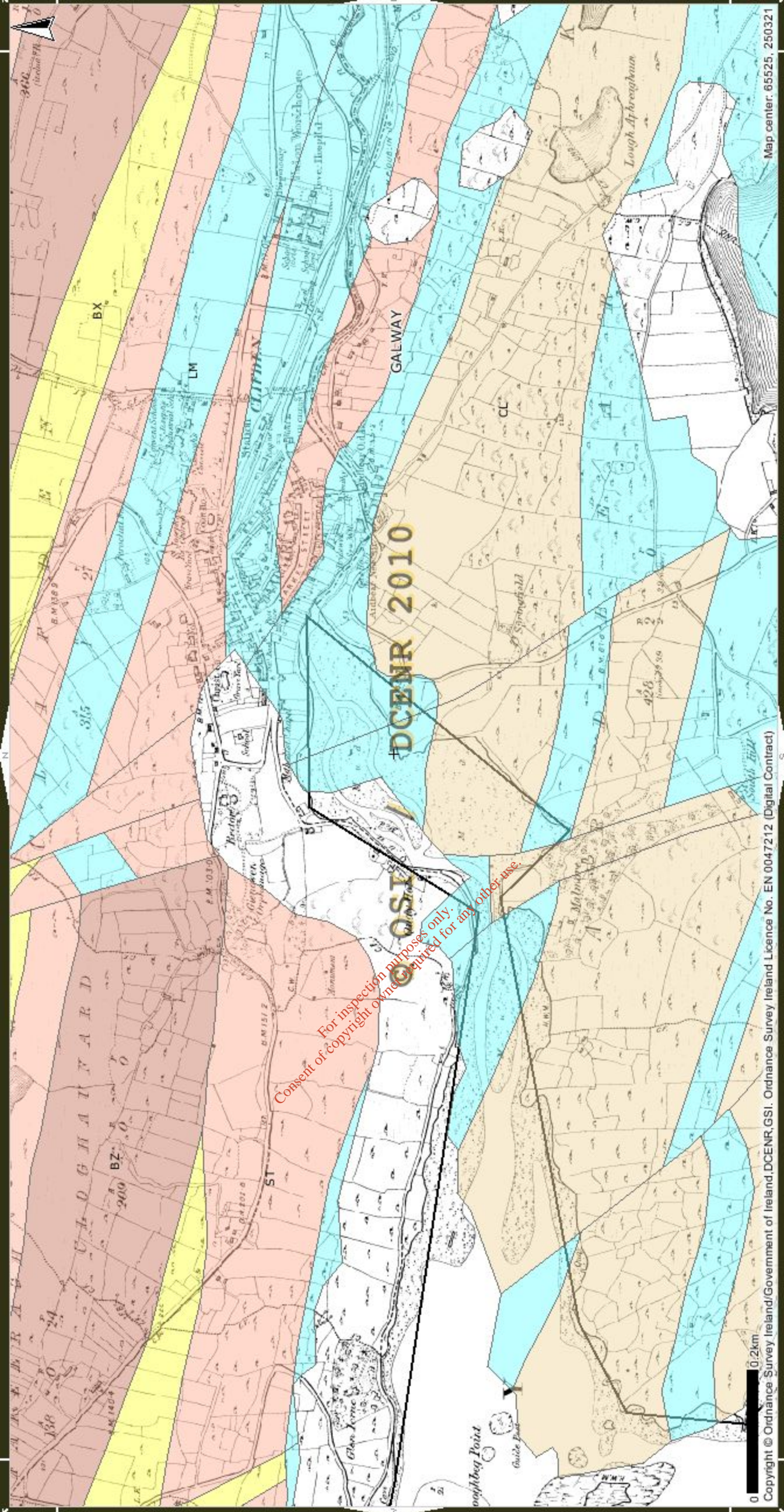
APPENDIX 4

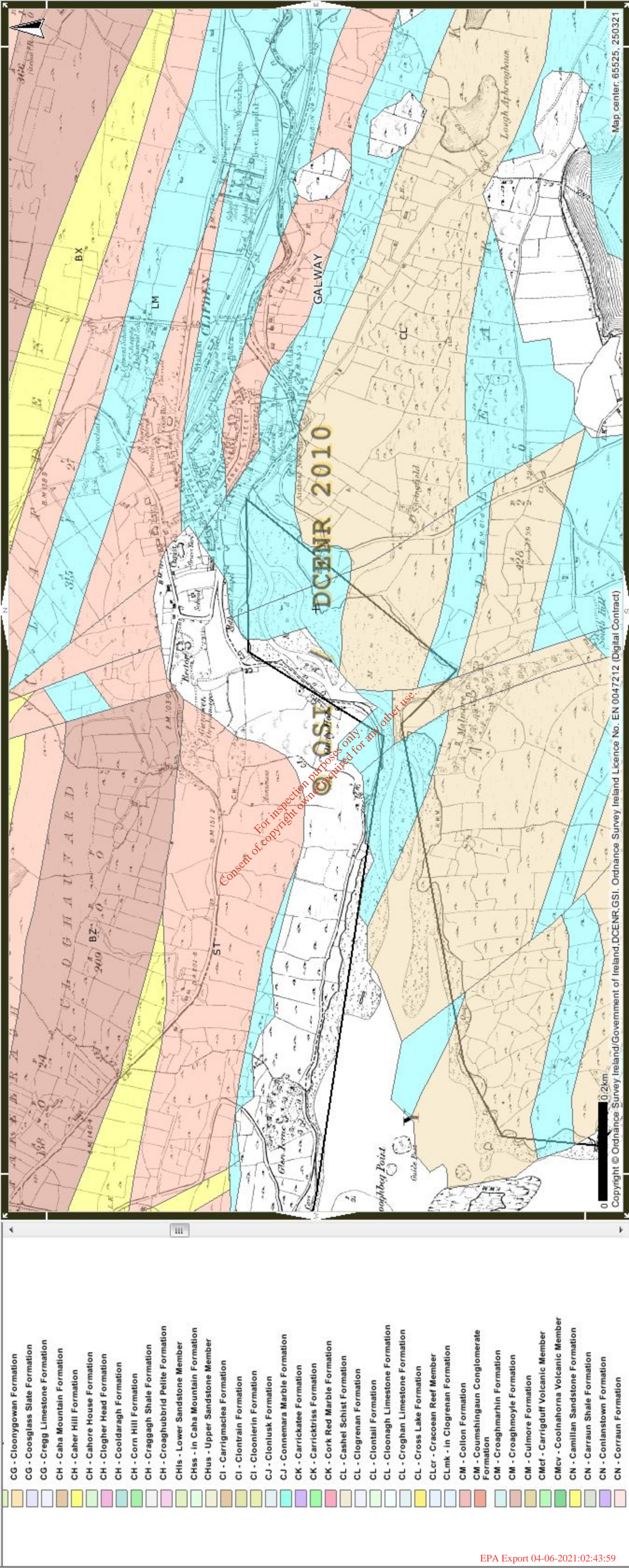
GSI BEDROCK MAPPING

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- SLfh - Fahee North Member
- SLII - Lissillisheen Member
- SLmk - In Silevenaglasha Formation
- SLtu - Turret Volcanic Member
- SM - Shanmullagh Formation
- SM - Silevenamuck Conglomerate Formation
- SMG - Sileve Mish Group
- SN - Sheskin Formation
- SP - Silevenore Psammitic Formation
- SQ - Slate Quarries Formation
- SR - Shrough Formation
- SR - Smugglers Cave Formation
- SR - Srah Formation
- SR - Sraheens Lough Formation
- SS - Silverspring Formation
- SS - Skerries Formation
- SS - Silevenore Schist Formation
- SSqs - South Slope Quartzite Member
- ST - Seamount Formation
- ST - Sileve Tooley Quartzite Formation
- ST - Streamstown Schist Formation
- SU - Suir Limestone Formation
- SV - Skerdagh River Volcanic Formation
- SV - Slevoir Formation
- SV - Subulter Volcanic Formation
- SVma - Glenlara Marble Member
- SW - Snowtown Formation
- SWB - Slishwood Division, Semi-pelitic biotite schists
- SWBbas - Slishwood Division, Semi-pelitic biotite schists
- SWC - Slishwood Division, Metallimestones
- SWG - Smerwick Group
- SWK - Slishwood Division, Pelitic & semi-pelitic paragneiss
- SWKbas - Slishwood Division, Pelitic & semi-pelitic paragneiss
- SWO - Slishwood Division, Psammitic Paragneiss
- SWObas - Slishwood Division, Psammitic Paragneiss
- SY - Srahiaghy Quartzite Formation
- St - Saitees Granite
- Sy - Syenite
- T - Trachyte
- TA - Tawnyshane Tillite Formation





- CG - Cloonygowan Formation
- CG - Coosglass Slate Formation
- CG - Cregg Limestone Formation
- CH - Caha Mountain Formation
- CH - Caher Hill Formation
- CH - Cahore House Formation
- CH - Clogher Head Formation
- CH - Cooldaragh Formation
- CH - Corn Hill Formation
- CH - Craggagh Shale Formation
- CH - Croaghubbrid Petite Formation
- CHs - Lower Sandstone Member
- CHss - In Caha Mountain Formation
- CHus - Upper Sandstone Member
- CI - Carrignaclea Formation
- CI - Clontrain Formation
- CI - Cloonlerin Formation
- CJ - Clonlusk Formation
- CJ - Connemara Marble Formation
- CK - Carrickatee Formation
- CK - Carricktriss Formation
- CK - Cork Red Marble Formation
- CL - Cashel Schist Formation
- CL - Clogrenan Formation
- CL - Clontail Formation
- CL - Cloonagh Limestone Formation
- CL - Croghan Limestone Formation
- CL - Cross Lake Formation
- CLcr - Cracoean Reef Member
- CLmk - In Clogrenan Formation
- CM - Collon Formation
- CM - Coumshingaun Conglomerate Formation
- CM - Croaghmarhin Formation
- CM - Croaghmoyle Formation
- CM - Culmore Formation
- CMcf - Carrigduff Volcanic Member
- CMev - Coolmahorna Volcanic Member
- CN - Camilian Sandstone Formation
- CN - Carraun Shale Formation
- CN - Conlanstown Formation
- CN - Corraun Formation

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APPENDIX 5

GSi HYDROGEOLOGICAL MAPPING

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Map Legend

Settings

- Karst Features**
 - Borehole
 - Cave
 - Dry Valley
 - Enclosed Depression
 - Estevelle
 - Spring
 - Superficial Solution Features
 - Swallow Hole
 - Turlough
- Tracer Lines**
- Tracer Output Site**
- National Draft Bedrock Aquifer Map**
 - Rf - Regionally Important Aquifer - Fisured bedrock
 - Rk - Regionally Important Aquifer - Karstified
 - Rkd - Regionally Important Aquifer - Karstified (diffuse)
 - Rkc - Regionally Important Aquifer - Karstified (conduit)
 - Lm - Locally Important Aquifer - Bedrock which is Generally Moderately Productive
 - Lk - Locally Important Aquifer - Karstified
 - Li - Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones
 - Pi - Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones
 - Pu - Poor Aquifer - Bedrock which is Generally Unproductive
 - Unclassified
- RBD Boundaries**
- County Boundaries**

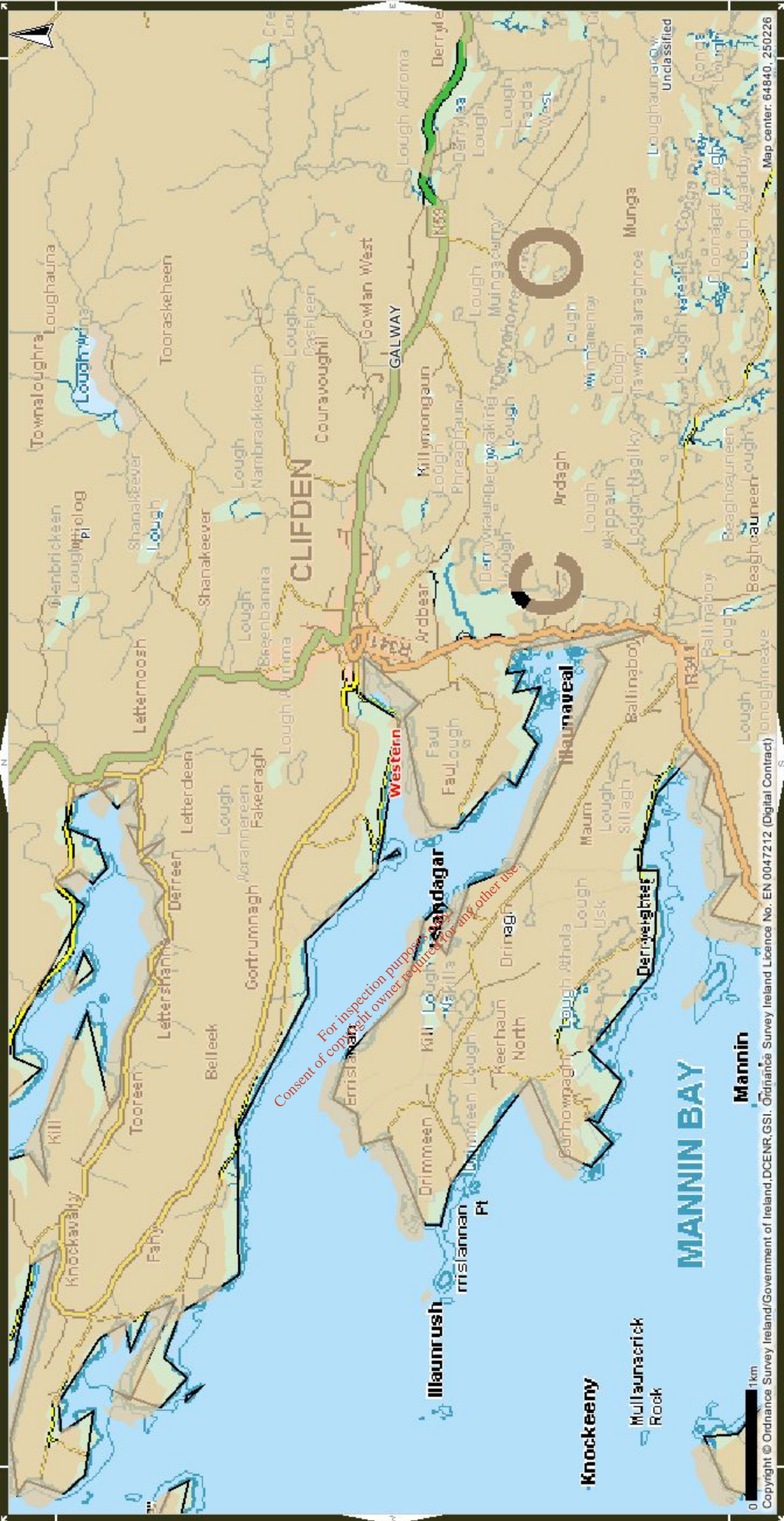


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- Hydrometric Gauges
- Rivers Group
 - Rivers
 - Streams
- Lakes
- Coastal waterbodies
- Transitional waterbodies
- Ground waterbodies
 - Gravel
 - Karstic
 - Poorly productive bedrock
 - Productive fissured bedrock
- Domestic Waste Water Risk
- WFD Risk Scores
- WFD Register of Protected Areas
- WFD Status
- Water Regions
- National Soils Database
- Land
 - Soils

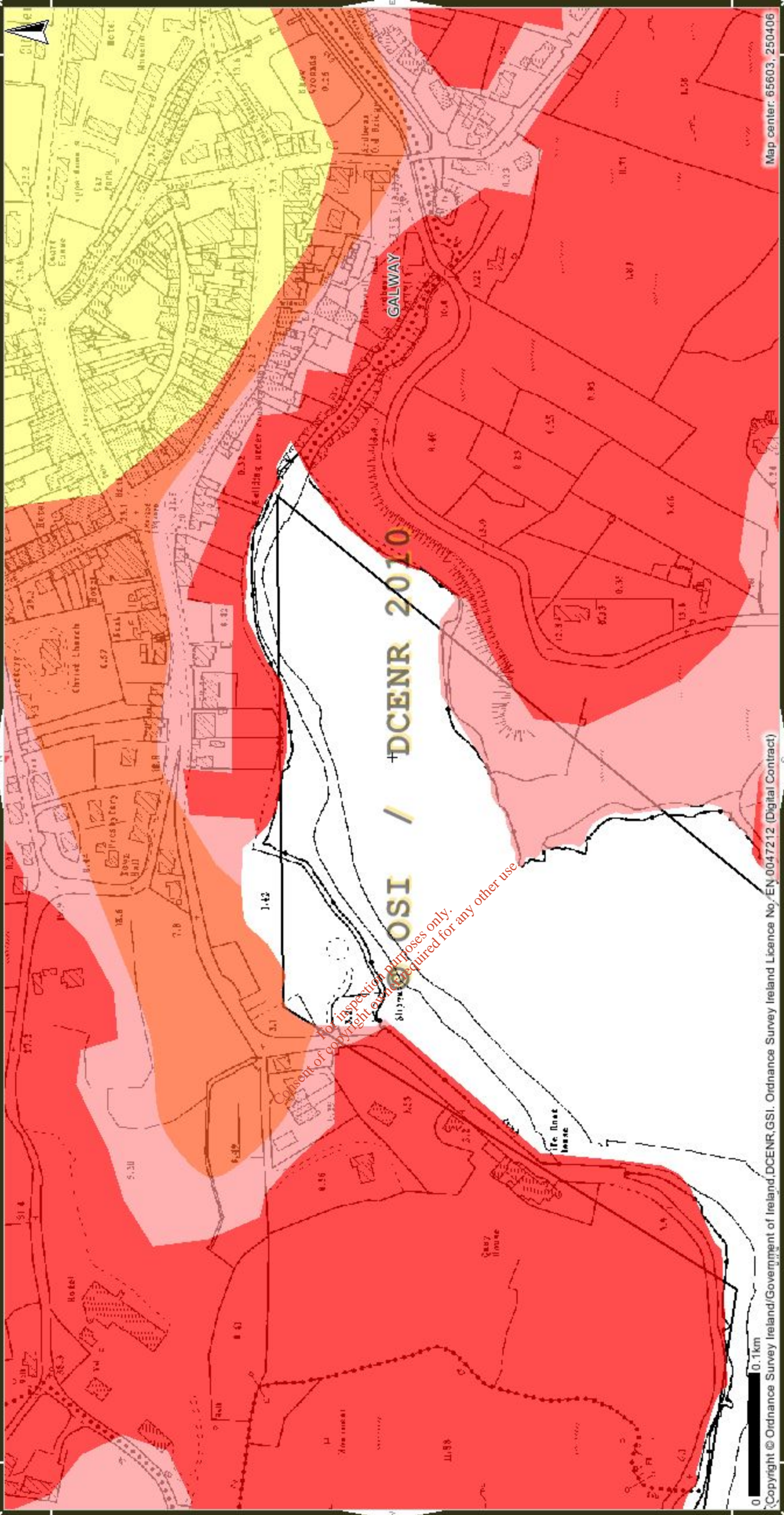
Results



Map Legend

- Vulnerability**
- X (Rock near Surface or Karst)
 - E - Extreme
 - H - High
 - M - Moderate
 - L - Low
 - HL - High to Low. Only an Interim study took place.
 - Water
 - No Data Available
 - County Boundaries
 - Watermark

Settings



Enhanced Layer List

Identify

Results Found 1

Clear

Groundwater Wells and Springs

GSI Code: 0525SEW001

Well Type: Borehole

Original Name: ILC 1846, BH1, Site N

Owner Name:

Drill Date: 11/28/1978

Locational Accuracy (metres): to 50m

Depth(metres): 35.3

Depth to Rock: 0

Townland: CLIFDEN

County: Galway

Six Inch Sheet: 35

Easting: 65960

Northing: 251400

Well Use:

Well Class: Poor

Yield m3d: 21.8

Buffer (metres):

Town:

Abstraction m3d:

Abstraction:

SC_M3DM: 1.23

Casing Diameter: 175

General Comments: unknown

Drill Comments: site map in ILC folder and on large well card

Casing Comments: noticeably turbid

Area:

Bedrock Aquifer

Bedrock Aquifer

Bedrock Geology

Bedrock Structure Labels

Bedrock Structure Symology

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1st Draft Clifden-Castlebar GWB Description July .2004

Clifden-Castlebar GWB: Summary of Initial Characterisation.

Hydrometric Area Local Authority	Associated surface water features	Associated terrestrial ecosystem(s)	Area (km ²)
32 Galway, Mayo Co Co's	There are numerous rivers, unnamed streams and lakes. See Table 1 for a full listing of the surface water features.	Connemara Bog Complex / The Twelve Pins - Garraun Complex / Mweelrea-Sheffry-Errif Complex (O'Riain, 2004).	898
Topog- raphy	The land surface is characterised by steep slopes and mountainous terrain, flattening in a westerly direction toward the coastline. Elevations range from 10-810 mAOD. The Twelve Pins, Sheffry Hills, Partry Mountains and the Maamturk Mountains are present in the GWB. The GWB stretches from Clifden in the south to Castlebar in the north.		
Geology and Aquifers	Aquifer categories	The main aquifer category in this GWB is: Pl: Poor aquifer which is generally unproductive except for local zones. It composes 98% of the GWB. Between Castlebar and Newport, there is a narrow area with an aquifer category of Li: Locally important aquifer which is moderately productive only in local zones. East of Louisburgh, near Aghagower, East of Leenaun, in the Partry Mountains and just north of Toormakeady there are three small areas (5 km ² , 0.5 km ² , 6 km ²) of Moy Sandstone which is: Lm: Locally important aquifer which is generally moderately productive. Also just north of Toormakeady is an area (0.8 km ²) occupied by Visean Limestone which is: Rk^c: Regionally important karstified aquifer dominated by conduit flow	
	Main aquifer lithologies	This GWB is composed primarily of Precambrian Quartzites, Gneisses & Schists, Ordovician Metasediments and Silurian Metasediments and Volcanics. Table 2 presents a full list of lithologies present. Precambrian Marbles cross cut the southern half of the GWB in two areas, at Clifden and Letterfrack and are part of the Letterfrack GWB.	
	Key structures	The rocks in the GWB have undergone several episodes of deformation, comprising intense folding and faulting. The main structural trend is E-W. Major E-W trending folds include the Mweelrea Syncline and the Croagh Patrick Syncline. Parallel to these synclines are several major faults such as the Lough Nafuoey, Derry Bay, Errif Valley and Doon Rock Fault. The Maam Valley Fault Zone is a major NW-SW trending fault structure. (Long <i>et al</i> , 2002). Bedrock strata tend to be steeply dipping.	
	Key properties	Well data are sparse in the GWB. Three boreholes located in the schists north of Clifden, at Glenbricken and Coolacloy, have reported yields of 33, 26 and 15 m ³ /d with specific capacities of 15, 1.3 and 0.6 m ³ /d/m respectively. The data indicate low transmissivities – in the range of 0.7-20 m ² /d. Two wells near Louisburgh also have similar yields and implied transmissivities. In the vicinity of faults, transmissivity may be higher. Storativity is expected to be low (<0.5%). The data are inadequate to calculate groundwater gradients, however, these are expected to be greater than 0.01.	
	Thickness	Most groundwater flux will be in the uppermost part of the aquifer; comprising a broken and weathered zone typically less than 3 m thick; a zone of interconnected fissuring 10-15 m thick; and a zone of isolated poorly connected fissuring typically less than 150 m, in which strikes are noted between 40-50 m and 50-56 m below ground level in two boreholes near Louisburgh, but yields from these isolated depths are low.	
Overlying Strata	Lithologies	Approximately 32% of the subsoils are dominated by Blanket Peat. A full listing is given in Table 3.	
	Thickness	Subsoil thickness data are sparse. Available data indicate the thickness of the subsoils is generally less than 3 m over the GWB. Subsoils are thicker in the low lying flatter areas of the GWB. The thickness of the blanket peat ranges from 0-6 m, depending on topography (Daly, 1985).	
	% area aquifer near surface	[Further Information to be added at a later date]	
	Vulnerability	[Further Information to be added at a later date]	
Recharge	Main recharge mechanisms	Diffuse recharge occurs via rainfall percolating through the subsoil and rock outcrops. Due to the low permeability of much of the subsoil (blanket peat) and the aquifers, a high proportion of the available recharge will discharge to the streams. In addition, the steep slopes in the mountainous areas promote surface runoff. The stream density is approximately 1.5 km/km ² , indicating the high proportion of surface runoff.	
	Est. recharge rates	[Information to be added to and checked]	
Discharge	Large springs and large known abstractions (m³/d)	There are no known large springs or large abstractions in the GWB.	
	Main discharge mechanisms	Shallow groundwater is likely to discharge to streams and lakes, but the limited bedrock transmissivity means that the baseflow component of the total streamflow will be low. Small springs and seeps are likely to issue at the stream heads and along their course. Seepages will develop on the coastal cliff faces.	

1st Draft Clifden-Castlebar GWB Description July .2004

	Hydrochemical Signature	Wells north of Clifden have alkalinities in the range of 67-180 mg/l CaCO ₃ and hardness in the range of 75-178 mg/l CaCO ₃ . The signature in the GWB is predominantly Ca-Mg-HCO ₃ .
	Groundwater Flow Paths	Groundwater flow is expected to be concentrated in fractured and weathered zones and in the vicinity of fault zones. Generally, water levels are 0-8 m below ground level. Flow paths are likely to be short (30-300 m) with groundwater discharging rapidly to nearby streams and small springs. There are observed deep water strikes, indicating that there is a component of deep groundwater flow, however shallow groundwater flow is dominant. Groundwater flow directions are expected to follow topography – overall in a westerly direction.
	Groundwater & Surface water interactions	Groundwater will discharge locally to streams and rivers crossing the aquifer and also to small springs and seeps. Owing to the poor productivity of the aquifers in this body it is unlikely that any major groundwater - surface water interactions occur. Baseflow to rivers and streams is likely to be relatively low. Lakes comprise approximately 3% of the GWB.
Conceptual model		<ul style="list-style-type: none"> • The GWB is bounded to the west by the coast. The northern, southern and eastern boundaries are surface water catchment divides. The terrain is characterised by mountainous areas, flattening toward the coastline. • The GWB is composed primarily of low transmissivity rocks. Most of the groundwater flux is in the uppermost part of the aquifer: comprising a broken and weathered zone typically less than 3m thick; a zone of interconnected fissuring typically less than 10m; and a zone of isolated fissuring typically less than 150m. • Groundwater flow is expected to be concentrated in fractured and weathered zones and in the vicinity of fault zones. • Recharge occurs diffusely through the subsoils and via outcrops. Recharge is limited by the peat and the low permeability bedrock, thus most of the available recharge discharges rapidly to nearby streams. • Flow paths are likely to be short (30-300 m) with groundwater discharging rapidly to nearby streams and small springs and flow directions are expected to follow topography. • Groundwater discharges rapidly to nearby small streams, lakes, small springs and seeps. Overall flow direction is westwards. • The rock units in GWB are generally of low permeability and baseflow to rivers and streams is likely to be relatively low.
Attachments		Table 1, 2, 3 and Figure 1.
Instrumentation		Stream gauges: 32004*, 32005, 32008, 32010, 32011*, 32013, 32014, 32015, 32016, 32017, 32018, 32019, 32020, 32023, 32060, 32072, 32073, 32074, 32078. * Adjusted Dry River Flow data available EPA Water Level Monitoring boreholes: (Mayo 84) EPA Representative Monitoring points: None
Information Sources		Daly, D. (1985) <i>Groundwater in County Galway with particular reference to its Protection from Pollution</i> . Geological Survey of Ireland report for Galway County Council. 98pp. Pracht, M., Lees, A., Leake, B., Feely, M., Long, B., Morris, J., McConnell, B., (2003). <i>A geological description to accompany the Bedrock Geology 1:100,000 Scale Map Series, Sheet 14, Galway Bay</i> . Unpublished Geological Survey of Ireland Map Series Report. Long, B., McConnell, B., Philcox, M.E. (2002). <i>A geological description to accompany the Bedrock Geology 1:100,000 Scale Map Series, Sheet 11, South Mayo</i> . Geological Survey of Ireland Map Series Report. Aquifer Chapters: The Granite, Ordovician, Precambrian and Ordovician Aquifers. O' Riain, G., (2004). <i>Water Dependent Ecosystems and Subtypes Draft Report</i> . WFD Support Projects. Compass Informatics in association with National Wildlife and Parks Service (DEHLG).
Disclaimer		Note that all calculation and interpretations presented in this report represent estimations based on the information sources described above and established hydrogeological formulae.

Table 1 Associated surface water features

Rivers: Bellakip, Bunanakee, Bundorrah, Bunleemshough, Bunowen, Carrowbeg, Carrownisky, Cross, Culfin, Davros, Derrycraff, Erriff, Glaishwy, Glencullin, Glendavock, Glenlaur, Glenummera, Keeraun, Kylemore, Lugatoran, Moyour, Mweelin, Newport, Owenacunny, Owenadornaun, Owencloghagh, Owenduff, Owengarr, Owenglin, Owenmore, Owennabaunoge, Owennabrockagh, Owennaglogh, Owennasallagh, Owenwee, Polladirk, Shanaveagh, Traheen, Streamstown, Traheen, Erriff, Owenwee, Glenisland.

Streams: Owengarve

Lakes: Tonacrick Lough, Tawnyard Lough, Shanakeever Lough, Rusheenduff Lough, Rusheen Lough, Roonagh Lough, Prospect Lough, Moher Lough, Maw Lough, Lugaloughan, Lugharry Lough, Lugacolliee Lake, Loughnakilky, Loughbaun, Loughawnphaudeen, Loughaun's, Loughaunattin, Loughaunarow, Loughaunaroor, Loughaun, Loughaun, Loughaun, Loughanshee, Loughans, Loughanillaun, Loughanboy, Loughanaveeny, Loughan, Loughan, Loughan, Woongar, Usk, Tully, Touthter, Tonagh, Tarriff, Tanny, Srahwee, Sillagh, Sallagher, Phreaghaun, Oughter, Nawarawaun, Natawny, Nasoodery, Namucka, Nambrackkeagh, Nambrackkeagh, Nambrackkagh, Nakilla, Nakilla, Nahoomin, Nahillion, Nahaltora, Naguroge, Nagap, Nacorussaun, Nacorra, Nacarrigeen, Muingacurry, Muck, Maladrolaun, Lugaloughan, Louracheragh, Laraha, Laraha, Knockaunbaun, Greney, Glenawough, Gall, Fee, Fee, Fadda, Emlaghnacourty, Emilagh, Doo, Donoghmeave, Darrdun, Cunnel, Cunnel, Cashleen, Cahasy, Bunnaboghec, Breenbannia, Brawn, Benchoona, Ben, Bellawaun, Beg, Beg, Beg, Beg, Beflawaum, Awaniareen, Awaddy, Auna, Athola, Ascardaun, Apillaun, Anima, Alisheen, Agh, Adroma, Acreragh, Acrannereen, Loch an Gherarrain Bhain, Lettershask North, Lettereen Lough, Kylemore/Pollacappul Lough, Knappaghmore Lough, Knappagh Lough, Knappagh Lough, Killadangan Lough, Island Lough, Island Lough, Is_Inland, Glencullin Lough, Glenbrickeen Lough, Gibson's Lough, Fin Lough, Fiddaungil, Feenune Lough, Faul Lough, Emlaghbeg Lough, Drinagh Lough, Drimeen Lough, Drimeen Lough, Doonloughan Lough, Doonloughan Lough, Dooaghtry Lough, Doo Lough, Derrywaking Lough, Derryvraun Lough, Derrylea Lough, Derrygarvebeg, Derryaun Lough, Derryasorra Lough, Derrintin Lough, Derrarlau Lough, Cuilmore Lough, Cross Lough, Croft Lough, Creggan Lough, Cregg Lough, Creeggan Lough, CourhoorLough, Corragaun Lough, Cogaula Lough, Cashel Lough, Carrowevagh Lough, Carrickawaddy Lough, Boolagare Lough, Boheh Loughs, Boheh Loughs, Beltra Lough, Barnahallia Lough, Ballynakill Lough, Ballynacarrick Lough, Ballybwee Lough, Ballinaboy Lough, Aughrusbeg Lough, Anivan

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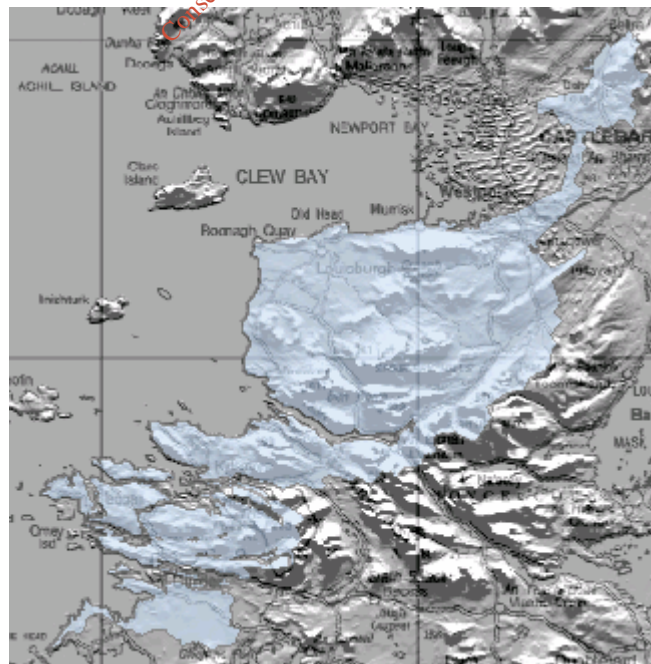
Table 2. Rock units in Clifden GWB

RockUnit	category	aquifer type	%AREA of	Code	Unit name
Dinantian Pure Bedded Limestones	Rkc	Pending Classification	1%	VIS	Visean Limestones (undifferentiated)
Cambrian Metasediments	Pl	Poorly Productive Bedrock Aquifer	2%	WG	Westport Grit Formation
Devonian Old Red Sandstones	Pl	Poorly Productive Bedrock Aquifer	5%	GM	Graffa More Formation
Granites & other Igneous Intrusive rocks	Pl	Poorly Productive Bedrock Aquifer	12%	S	Serpentine
Ordovician Metasediments	Pl	Poorly Productive Bedrock Aquifer	36%	SH	Slate Members
Ordovician Volcanics	Pl	Poorly Productive Bedrock Aquifer	2%	FN	Farnacht Formation
Precambrian Quartzites, Gneisses & Schists	Pl	Poorly Productive Bedrock Aquifer	22%	ST	Streamstown Schist Formation
Silurian Metasediments and Volcanics	Pl	Poorly Productive Bedrock Aquifer	19%	SK	Strake Banded Formation
Dinantian Sandstones	Lm	Productive Fractured Bedrock Aquifer	1%	MO	Moy Sandstone Formation

Table 3. List of Subsoils in Clifden GWB.

Parent Material	Code	%area of GWB
Alluvium	A	1.07%
Alluvium clayey	Ac	0.03%
Acidic esker sand/gravel	AcEsk	0.00%
Alluvium gravelly	Ag	0.00%
Alluvium silty	Asi	0.01%
Blanket peat	BktPt	32.09%
cutover	Cut	0.70%
Sandstone sand/gravel (devonian/carb)	GDCSs	0.00%
sandstone sand/gravel (lower palaeozoic)	GLPSs	0.68%
sandstone and shale sand/gravel (lower palaeozoic)	GLPSsS	0.03%
metamorphic sand/gravel	Gmp	0.18%
Lake sediments undifferentiated	L	0.00%
Lakes	Lake	2.80%
islands	Lk_isle	0.02%
Madeground	Made	0.10%
Beach Sand	Mbs	0.49%
Estuarine Sediments	Mesc	0.08%
Rock at surface	Rck	41.61%
Scree	Scree	0.90%
Till sandstone devonian carboniferous	TDCSs	0.07%
Till sandstone devonian	TDSs	3.27%
Till Granitic	TGr	0.73%
Sandstone dominated Lower Palaeozoic Till	TLPSs	4.88%
Till sandstone and shaleSandstone and shale dominated till (Devonian/Carboniferous)	TLPSSs	5.42%
Limestone till	TLs	0.06%
Metamorphic Till	Tmp	4.57%
Blown sand	Ws	0.19%

Figure 1. Clifden-Castlebar GWB [reference only]



APPENDIX 6

EPA COASTAL WATER MAPPING

EPA SURFACE WATER MAPPING

WFD CATCHMENT MAPPING

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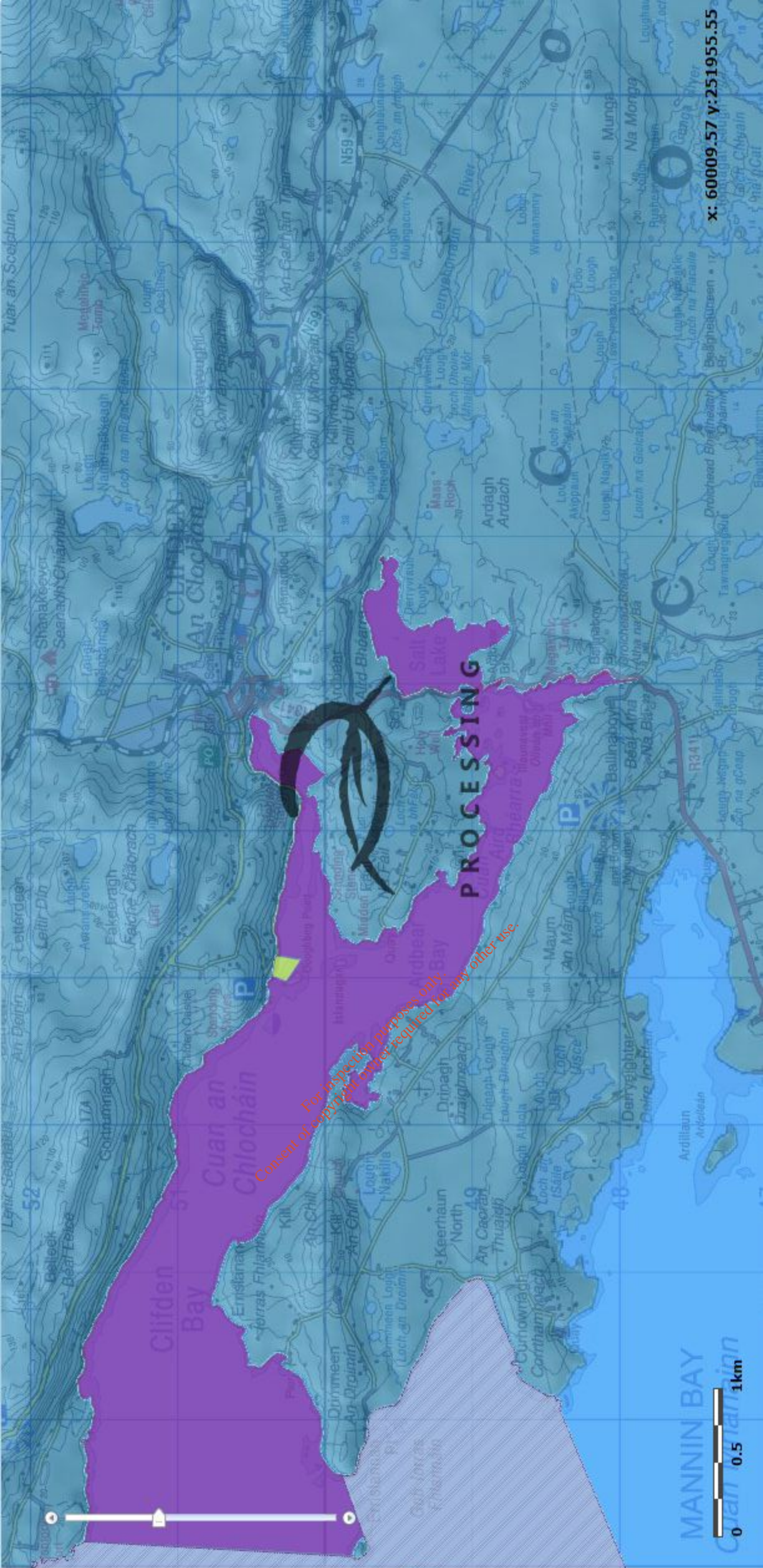
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- Nutrient Sensitive - Waterbodies
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- Bathing Water Areas
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- Water Regions
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- General Administrative
- Orthophoto 2005

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 - Bathing Water Quality
 - Good Water Quality
 - Sufficient Water Quality
 - Poor Water Quality
 - No Data
 - River Water Quality
 - Q4-5, Q5 - High Status
 - Q4 - Good Status
 - Q3-4 - Moderate Status
 - Q2-3, Q3 - Poor Status
 - Q1, Q1-2, Q2 - Bad Status
 - Lake Water Quality
 - Transitional and Coastal Water Quality

Results



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8 Zone DWW Risk categories with Areas of Spec

Zone 1A

Zone 1B

Zone 2A

Zone 2B

Zone 3A

Zone 3B

Zone 4A

Zone 4B

WFD Risk Scores

River Waterbody Score

No Score

1a - At risk of not achieving good status

1b - Possibly at risk of not achieving good status

2a - Expected to achieve good status

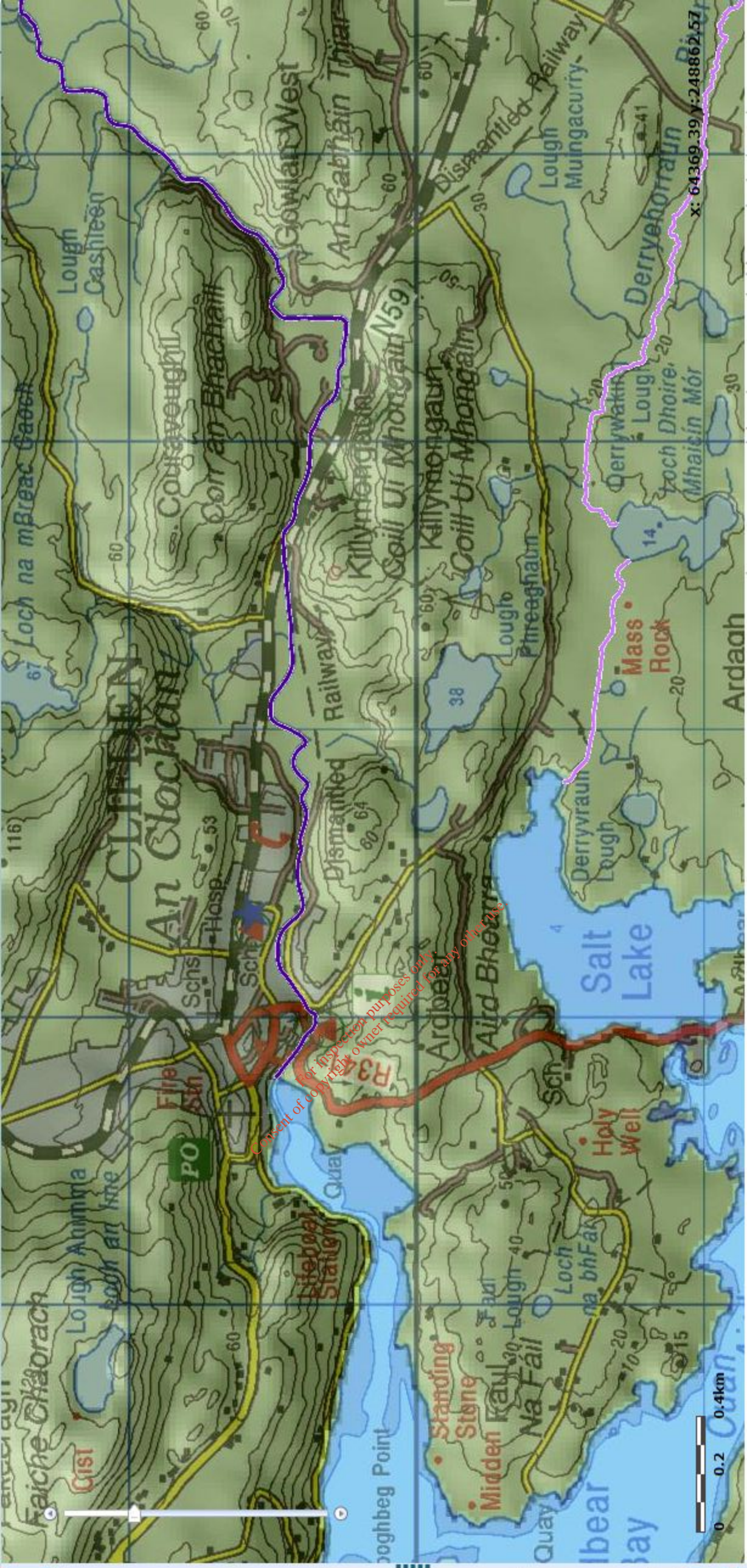
2b - Strongly expected to achieve good status

Lake Waterbody Score

Coastal Waterbody Score

Transitional Waterbody Score

Results



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APPENDIX 7





TRIALPIT LOGS

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BOREHOLE CONSTRUCTION	SAMPLE NUMBER		SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	TRIALPIT NUMBER: TP01		PAGE 1 OF 1
							EXCAVATION DATE: 20/01/14		METHOD: TRACKED HYMAC
	CONTRACTOR: Bernard Corbett						DIAMETER: N/A		
	LOGGED BY: DG/PM						GRID REF.: E65516 N250539		
	CHECKED BY: PM						ELEVATION: approx. 3.99m AOD		








				DESCRIPTION	COMMENTS	
			0	Soft light brown sandy SILT	Green color on wall of pit	0
			0.5	Soft yellow/light brown sandy gravelly CLAY with boulders and cobbles	No evidence of contamination	0.5
			1.0	indigenous soil	Indigenous Mottling	1.0
			1.5	Gray/ white coarse sandy GRAVEL with cobbles	Water ingress at 1.5m bgl	1.5
			2.0	Terminated at 1.55m bgl - hit weathered bedrock		2.0
			2.5			2.5
			3.0			3.0
			3.5			3.5
			4.0			4.0
			4.5			4.5
			5.0			5.0

<u>LOCATION / NOTES:</u> NE corner. Some inflow of ponded water top of pit. Water rose to approximately 1m bgl.	<u>LEGEND</u> <input checked="" type="checkbox"/> Disturbed Sample <input type="checkbox"/> Undisturbed Sample * Headspace Analysis  Down Borehole Analysis  Groundwater Table  Perched Water Table	TRIALPIT LOG	
		JOB TITLE	SHORE ROAD SITE INVESTIGATION
		LOCATION	CLIFDEN, CO. GALWAY
		CLIENT	GALWAY C.C.
			

BOREHOLE CONSTRUCTION	SAMPLE		SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	TRIALPIT NUMBER: TP02		PAGE 1 OF 1
							EXCAVATION DATE: 20/01/14		METHOD: TRACKED HYMAC
	CONTRACTOR: Bernard Corbett						DIAMETER: N/A		
	LOGGED BY: DG/PM						GRID REF.: E65489 N250534		
	CHECKED BY: PM						ELEVATION: approx. 3.75m AOD		

				DESCRIPTION	COMMENTS	
			0	Light brown sandy SILT		0
			0.5	Soft yellow/light brown gravelly CLAY with boulders and cobbles Indigenous soil	No evidence of contamination	0.5
			1.0	Loose gray/ white coarse sandy GRAVEL with cobbles	Iron mottling	1.0
			1.5		Slight water ingress at 1.5m bgl	1.5
			2.0	Terminated at 1.75m bgl - hit weathered bedrock		2.0
			2.5			2.5
			3.0			3.0
			3.5			3.5
			4.0			4.0
			4.5			4.5
			5.0			5.0

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<u>LOCATION / NOTES:</u> Near northern boundary.	<u>LEGEND</u>  Disturbed Sample  Undisturbed Sample  Headspace Analysis  Down Borehole Analysis  Groundwater Table  Perched Water Table	TRIALPIT LOG	
		JOB TITLE	SHORE ROAD SITE INVESTIGATION
LOCATION	CLIFDEN, CO. GALWAY		
CLIENT	GALWAY C.C.		
			


BOREHOLE CONSTRUCTION	SAMPLE		SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	TRIALPIT NUMBER: TP03		PAGE 1 OF 1	
							EXCAVATION DATE: 20/01/14		METHOD: TRACKED HYMAC	
	CONTRACTOR: Bernard Corbett						DIAMETER: N/A			
	LOGGED BY: DG/PM						GRID REF.: E65470 N250513			
	CHECKED BY: PM						ELEVATION: approx. 3.05m AOD			


				DESCRIPTION	COMMENTS	
			0	Soft dark brown sandy CLAY (MADE GROUND/LANDFILL CAP)		0
			0.5	Yellow/ light brown gravelly CLAY (MADE GROUND) with boulders and cobbles- rounded, sub rounded and sub-angular		0.5
			1.0	Some timber, occasional pods of peat		1.0
			1.5	Loose clayey gravelly COBBLES/ BOULDERS (MADE GROUND)	Possible stone drain	1.5
			2.0	Terminated at 1.82m bgl - hit weathered bedrock	At 1.5m bgl very strong inflow of clean water	2.0
			2.5			2.5
			3.0			3.0
			3.5			3.5
			4.0			4.0
			4.5			4.5
			5.0			5.0



<u>LOCATION / NOTES:</u> Located at the edge of the car park.	<u>LEGEND</u> <input checked="" type="checkbox"/> Disturbed Sample <input type="checkbox"/> Undisturbed Sample * Headspace Analysis † Down Borehole Analysis Groundwater Table Perched Water Table	TRIALPIT LOG	
		JOB TITLE	SHORE ROAD SITE INVESTIGATION
		LOCATION	CLIFDEN, CO. GALWAY
		CLIENT	GALWAY C.C.

BOREHOLE CONSTRUCTION	SAMPLE		SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	TRIALPIT NUMBER: TP04		PAGE 1 OF 1	
							EXCAVATION DATE: 20/01/14		METHOD: TRACKED HYMAC	
	NUMBER	TYPE					CONTRACTOR: Bernard Corbett		DIAMETER: N/A	
							LOGGED BY: DG/PM		GRID REF.: E65452 N250501	
							CHECKED BY: PM		ELEVATION: approx. 3.02m AOD	

				DESCRIPTION	COMMENTS	
			0	Soft light brown sandy CLAY (MADE GROUND/LANDFILL CAP)		0
			0.5	Soft yellow/ light brown gravelly CLAY with boulders and cobbles (rounded)	Iron mottling, black staining	0.5
			1.0	Loose angular clayey COBBLES (MADE GROUND) with boulders	Strong water inflow at 0.8m bgl	1.0
			1.5	clayey GRAVEL with cobbles		1.5
			2.0	Terminated at 2.10m bgl - hit weathered bedrock		2.0
			2.5			2.5
			3.0			3.0
			3.5			3.5
			4.0			4.0
			4.5			4.5
			5.0			5.0


<u>LOCATION / NOTES:</u>	<u>LEGEND</u> <input checked="" type="checkbox"/> Disturbed Sample <input type="checkbox"/> Undisturbed Sample * Headspace Analysis † Down Borehole Analysis ▼ Groundwater Table ▽ Perched Water Table	TRIALPIT LOG	
		JOB TITLE	SHORE ROAD SITE INVESTIGATION
		LOCATION	CLIFDEN, CO. GALWAY
		CLIENT	GALWAY C.C.
			

BOREHOLE CONSTRUCTION	SAMPLE		SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	TRIALPIT NUMBER: TP05		PAGE 1 OF 1	
							EXCAVATION DATE: 20/01/14		METHOD: TRACKED HYMAC	
	CONTRACTOR: Bernard Corbett						DIAMETER: N/A			
	LOGGED BY: DG/PM						GRID REF.: E65435 N250491			
	CHECKED BY: PM						ELEVATION: approx. 2.8m AOD			


				DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
				0		Soft light brown sandy CLAY (MADE GROUND/LANDFILL CAP)		0
				0.5		yellow/light brown gravelly CLAY with boulders and cobbles. Rounded, sub-rounded, sub-angular etc	No evidence of contamination Drainage pipe Layers become stratified over time	0.5
				1.0		some builders blocks	Water ingress at 1.5m bgl	1.0
				1.5				1.5
				2.0		soft light gray gravelly CLAY with cobbles (rounded)		2.0
				2.5		Terminated at 2.4m bgl - hit weathered bedrock		2.5
				3.0				3.0
				3.5				3.5
				4.0				4.0
				4.5				4.5
				5.0				5.0








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<u>LOCATION / NOTES:</u> South east of handball alley	<u>LEGEND</u> <input checked="" type="checkbox"/> Disturbed Sample <input type="checkbox"/> Undisturbed Sample * Headspace Analysis † Down Borehole Analysis ▼ Groundwater Table ▽ Perched Water Table	TRIALPIT LOG	
		JOB TITLE	SHORE ROAD SITE INVESTIGATION
		LOCATION	CLIFDEN, CO. GALWAY
		CLIENT	GALWAY C.C.
			








BOREHOLE CONSTRUCTION	SAMPLE		SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	TRIALPIT NUMBER: TP06		PAGE 1 OF 1
							EXCAVATION DATE: 20/01/14		METHOD: TRACKED HYMAC
	CONTRACTOR: Bernard Corbett						DIAMETER: N/A		
	LOGGED BY: DG/PM						GRID REF.: E65522 N250516		
	CHECKED BY: PM						ELEVATION: approx. 3.05m AOD		

				DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
				0		Soft light brown sandy CLAY (MADE GROUND/LANDFILL CAP)		0
				0.5		Soft light gravelly CLAY (MADE GROUND) with boulders	Trapped clay pipe with water	0.5
				1.0		Soft/firm yellow brown gravelly CLAY		1.0
				1.5		Soft gray gravelly CLAY with cobbles/boulders interspersed	No evidence of contamination Mottling	1.5
				2.5		Soft gray sandy gravelly SILT with rounded boulders and cobbles	Collapsing sides	2.5
				3.5		Coarse gray sandy GRAVEL with boulders and cobbles	Water ingress at 3.5m bgl	3.5
				4.0				4.0
				4.5		Terminated at 3.9m bgl- hit weathered bedrock		4.5

LOCATION / NOTES: Near shallow land drain. Noticeable drop off in depth to bedrock.	LEGEND  Disturbed Sample  Undisturbed Sample  Headspace Analysis  Down Borehole Analysis  Groundwater Table  Perched Water Table	TRIALPIT LOG	
		JOB TITLE	SHORE ROAD SITE INVESTIGATION
		LOCATION	CLIFDEN, CO. GALWAY
		CLIENT	GALWAY C.C.
			


BOREHOLE CONSTRUCTION	SAMPLE		SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	TRIALPIT NUMBER: TP07		PAGE 1 OF 1
							EXCAVATION DATE: 20/01/14		METHOD: TRACKED HYMAC
	CONTRACTOR: Bernard Corbett						DIAMETER: N/A		
	LOGGED BY: DG/PM						GRID REF.: E65501 N250506		
	CHECKED BY: PM						ELEVATION: approx. 2.75m AOD		

				DESCRIPTION	COMMENTS	
			0	Soft light brown sandy CLAY (MADE GROUND/LANDFILL CAP)		0
			0.5	soft gray gravelly CLAY (MADE GROUND)		0.5
			1.0	Coarse gray sandy silty GRAVEL with boulders and cobbles		1.0
			1.5			
			2.0	Indigenous soil		2.0
			2.5			
			3.0		Collapsing sides Water ingress at 3.0m bgl.	3.0
			3.5	Terminated at 3.35m bgl - collapsing sides		3.5
			4.0			4.0
			4.5			4.5
			5.0			5.0

<u>LOCATION / NOTES:</u> No waste observed	<u>LEGEND</u>  Disturbed Sample  Undisturbed Sample  Headspace Analysis  Down Borehole Analysis  Groundwater Table  Perched Water Table	TRIALPIT LOG	
		JOB TITLE	SHORE ROAD SITE INVESTIGATION
LOCATION	CLIFDEN, CO. GALWAY		
CLIENT	GALWAY C.C.		
			








BOREHOLE CONSTRUCTION	SAMPLE NUMBER		SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	TRIALPIT NUMBER: TP08		PAGE 1 OF 1
							EXCAVATION DATE: 20/01/14		METHOD: TRACKED HYMAC
	CONTRACTOR: Bernard Corbett						DIAMETER: N/A		
	LOGGED BY: DG/PM						GRID REF.: E65475 N250488		
	CHECKED BY: PM						ELEVATION: approx. 2.73m AOD		

				DESCRIPTION	COMMENTS	
			0	Soft light brown sandy CLAY (MADE GROUND/LANDFILL CAP)		0
			0.5	Soft dark gray/ black gravelly CLAY (MADE GROUND)		0.5
			1.0	with boulders and cobbles.		1.0
			1.5	Contains some blocks and timber	Some water inflow at 1.5m bgl. Very slight sulphide odour	1.5
			2.0	Soft black/ dark gray gravelly sandy SILT	Collapsing sides	2.0
			2.5	with boulders		2.5
			3.0	Indigenous soil		3.0
			3.5			3.5
			4.0	Terminated at 3.75m bgl - did not hit bedrock, collapsing sides		4.0
			4.5			4.5
			5.0			5.0


<u>LOCATION / NOTES:</u>	<u>LEGEND</u> <input checked="" type="checkbox"/> Disturbed Sample <input type="checkbox"/> Undisturbed Sample * Headspace Analysis † Down Borehole Analysis ▼ Groundwater Table ▽ Perched Water Table	TRIALPIT LOG	
		JOB TITLE	SHORE ROAD SITE INVESTIGATION
		LOCATION	CLIFDEN, CO. GALWAY
		CLIENT	GALWAY C.C.
			


BOREHOLE CONSTRUCTION	SAMPLE NUMBER		SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	TRIALPIT NUMBER: TP09		PAGE 1 OF 1
							EXCAVATION DATE: 20/01/14		METHOD: TRACKED HYMAC
	CONTRACTOR: Bernard Corbett						DIAMETER: N/A		
	LOGGED BY: DG/PM						GRID REF.: E65459 N250475		
	CHECKED BY: PM						ELEVATION: approx. 2.79m AOD		

				DESCRIPTION	COMMENTS	
			0	Soft light brown sandy CLAY (MADE GROUND/LANDFILL CAP)		0
			0.5	coarse green/gray gravelly SAND (MADE GROUND)		0.5
			1.0			1.0
			1.5	soft brown/gray gravelly SILT Bits of timber, masonry, sticks, occasional boulders High percentage of angular boulders at depth	Strong water ingress at 1.5m bgl.	1.5
			2.0			2.0
			2.5			2.5
			3.0			3.0
			3.5		Constant flow	3.5
			3.5	Terminated at 3.5m bgl- hit weathered bedrock	Collapsing sides	3.5
			4.0			4.0
			4.5			4.5
			5.0			5.0

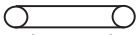
<u>LOCATION / NOTES:</u>	<u>LEGEND</u>  Disturbed Sample  Undisturbed Sample  Headspace Analysis  Down Borehole Analysis  Groundwater Table  Perched Water Table	TRIALPIT LOG	
		JOB TITLE	SHORE ROAD SITE INVESTIGATION
		LOCATION	CLIFDEN, CO. GALWAY
		CLIENT	GALWAY C.C.
			

BOREHOLE CONSTRUCTION	SAMPLE		SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	TRIALPIT NUMBER: TP10		PAGE 1 OF 1
							EXCAVATION DATE: 20/01/14		METHOD: TRACKED HYMAC
	CONTRACTOR: Bernard Corbett						DIAMETER: N/A		
	LOGGED BY: DG/PM						GRID REF.: E65444 N250469		
	CHECKED BY: PM						ELEVATION: approx. 2.62m AOD		

				DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
				0		Soft light brown sandy CLAY (MADE GROUND/LANDFILL CAP)		0
				0.5		soft yellow/light brown gravelly CLAY with boulders and cobbles- rounded, sub-rounded, sub-angular etc some builders blocks		0.5
				1.0				1.0
				1.5				1.5
				2.0				2.0
				2.5		soft black/dark gray gravelly sandy SILT with boulders	Sulphide odor/brackish smell Strong water ingress	2.5
				3.0				3.0
				3.5		End of hole at 3.5m bgl - hit weathered bedrock		3.5
				4.0				4.0
				4.5				4.5
				5.0				5.0








<u>LOCATION / NOTES:</u>	<u>LEGEND</u> <input checked="" type="checkbox"/> Disturbed Sample <input type="checkbox"/> Undisturbed Sample * Headspace Analysis † Down Borehole Analysis ▼ Groundwater Table ▽ Perched Water Table	TRIALPIT LOG	
		JOB TITLE	SHORE ROAD SITE INVESTIGATION
		LOCATION	CLIFDEN, CO. GALWAY
		CLIENT	GALWAY C.C.
			

BOREHOLE CONSTRUCTION	SAMPLE		SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	TRIALPIT NUMBER: TP11		PAGE 1 OF 1
							EXCAVATION DATE: 20/01/14	METHOD: TRACKED HYMAC	
	CONTRACTOR: Bernard Corbett	DIAMETER: N/A							
	LOGGED BY: DG/PM	GRID REF.: E65485 N250458							
NUMBER	TYPE						CHECKED BY: PM	ELEVATION: approx. 2.32m AOD	

		DESCRIPTION	COMMENTS	
	0	Soft light brown sandy CLAY (MADE GROUND/LANDFILL CAP)		0
	0.5		 Drainage pipe at 0.5m bgl Strong inflow	0.5
	1.0	Mixed WASTE (DOMESTIC/COMMERCIAL/C&D)	Slight Sulphide odor	1.0
	1.5	Black plastic bin bag waste/ plastics, skip waste, residential renovation waste, electric cables, timer shards, plastic & glass bottles, ash and cinder, rubber hosing, car parts, inflow from perched water table into overlying plastic sheeting.		1.5
	2.0			2.0
	2.5			2.5
	3.0		Collapsing pit walls	3.0
	3.5		No sheen on water.	3.5
	3.9		Strong inflow	3.9
	4.0	Terminated at 3.9m bgl - hit weathered bedrock or very large boulder.		4.0
	4.5			4.5
	5.0			5.0



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LOCATION / NOTES: East of helepad	LEGEND  Disturbed Sample  Undisturbed Sample  Headspace Analysis  Down Borehole Analysis  Groundwater Table  Perched Water Table	TRIALPIT LOG	
		JOB TITLE	SHORE ROAD SITE INVESTIGATION
LOCATION	CLIFDEN, CO. GALWAY		
CLIENT	GALWAY C.C.		
			

BOREHOLE CONSTRUCTION	SAMPLE NUMBER		SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	TRIALPIT NUMBER: TP12		PAGE 1 OF 1
							EXCAVATION DATE: 20/01/14		METHOD: TRACKED HYMAC
	CONTRACTOR: Bernard Corbett						DIAMETER: N/A		
	LOGGED BY: DG/PM						GRID REF.: E65506 N250470		
	CHECKED BY: PM						ELEVATION: approx. 2.34m AOD		








				DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
				0		Soft light brown sandy CLAY (MADE GROUND/LANDFILL CAP)		0
				0.5				0.5
				1.0				1.0
				1.5		Mixed WASTE (DOMESTIC/COMMERCIAL/C&D) skip waste, residential renovation waste, electric cables, timer shards, masonry, plastic & glass bottles, ash and cinder, rubber hosing, car parts, inflow from perched water table into overlying plastic sheeting.	No evidence of Contamination	1.5
				2.0				2.0
				2.5				2.5
				3.0				3.0
				3.5				3.5
				4.0		Terminated at 3.95m bgl - hit weathered bedrock.		4.0
				4.5				4.5
				5.0				5.0



LOCATION / NOTES: East of helipad	LEGEND <input checked="" type="checkbox"/> Disturbed Sample <input type="checkbox"/> Undisturbed Sample * Headspace Analysis † Down Borehole Analysis Groundwater Table Perched Water Table	TRIALPIT LOG	
		JOB TITLE	SHORE ROAD SITE INVESTIGATION
		LOCATION	CLIFDEN, CO. GALWAY
		CLIENT	GALWAY C.C.


BOREHOLE CONSTRUCTION	SAMPLE NUMBER		SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	TRIALPIT NUMBER: TP13		PAGE 1 OF 1
							EXCAVATION DATE: 20/01/14	METHOD: TRACKED HYMAC	
	CONTRACTOR: Bernard Corbett						DIAMETER: N/A		
	LOGGED BY: DG/PM						GRID REF.: E65519 N250487		
CHECKED BY: PM		ELEVATION: approx. 2.35m AOD							

				DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
				0		Soft light brown sandy CLAY (MADE GROUND/LANDFILL CAP)	Land drain	0
				0.5		Soft gray/green gravelly CLAY with boulders and cobbles		0.5
				1.0				1.0
				1.5				1.5
				2.0				2.0
				2.5		C & D WASTE With pods of clay and silt Tree trunks and pockets of peat		2.5
				3.0				3.0
				3.5			Collapsing sides	3.5
				4.0		Terminated at 3.75m bgl - hit weathered bedrock		4.0
				4.5				4.5
				5.0				5.0

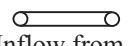

<u>LOCATION / NOTES:</u> No domestic waste found within C&D waste.	<u>LEGEND</u>  Disturbed Sample  Undisturbed Sample  Headspace Analysis  Down Borehole Analysis  Groundwater Table  Perched Water Table	TRIALPIT LOG	
		JOB TITLE	SHORE ROAD SITE INVESTIGATION
LOCATION	CLIFDEN, CO. GALWAY		
CLIENT	GALWAY C.C.		
			








BOREHOLE CONSTRUCTION	SAMPLE		SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	TRIALPIT NUMBER: TP14		PAGE 1 OF 1	
							EXCAVATION DATE: 20/01/14		METHOD: TRACKED HYMAC	
	CONTRACTOR: Bernard Corbett						DIAMETER: N/A			
	LOGGED BY: DG/PM						GRID REF.: E65522 N250502			
	CHECKED BY: PM						ELEVATION: approx. 2.70m AOD			

				DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
				0		Soft light brown sandy CLAY (MADE GROUND/LANDFILL CAP)		0
				0.5		Soft green / dark gray gravelly CLAY (MADE GROUND)		0.5
				1.0				1.0
				1.5		Mixed WASTE (DOMESTIC/COMMERCIAL/C&D)	Black staining on clay	1.5
				2.0		Black plastic bin bag waste/ plastics, skip waste, residential renovation waste, electric cables, timer shards, plastic & glass bottles, ash and cinder, rubber hosing, car parts, inflow from perched water table into overlying plastic sheeting		2.0
				2.5		Soft light brown/green gravelly CLAY		2.5
				3.0		Indigenous soil		3.0
				3.5		End of hole at 3.4m bgl - hit weathered bedrock		3.5
				4.0				4.0
				4.5				4.5
				5.0				5.0


<u>LOCATION / NOTES:</u>	<u>LEGEND</u> <input checked="" type="checkbox"/> Disturbed Sample <input type="checkbox"/> Undisturbed Sample * Headspace Analysis † Down Borehole Analysis ▼ Groundwater Table ▽ Perched Water Table	TRIALPIT LOG	
		JOB TITLE	SHORE ROAD SITE INVESTIGATION
		LOCATION	CLIFDEN, CO. GALWAY
		CLIENT	GALWAY C.C.
			








BOREHOLE CONSTRUCTION	SAMPLE		SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	TRIALPIT NUMBER: TP15		PAGE 1 OF 1
							EXCAVATION DATE: 20/01/14	METHOD: TRACKED HYMAC	
	CONTRACTOR: Bernard Corbett	DIAMETER: N/A							
	LOGGED BY: DG/PM	GRID REF.: E65500 N250489							
	CHECKED BY: PM	ELEVATION: approx. 2.48m AOD							

				DESCRIPTION	COMMENTS	
			0	Soft light brown sandy CLAY (MADE GROUND/LANDFILL CAP)		0
			0.5	C&D WASTE	 Inflow from pipe, possibly an old foul sewer	0.5
			1.0	Large amount of boulders and rubble		1.0
			1.5	Some pipes		1.5
			2.0	Pockets of Peat, low percentage domestic waste		2.0
			2.5		Collapsing sides	2.5
			3.0			3.0
			3.5			3.5
			4.0	Terminated at 3.75m bgl - hit weathered bedrock		4.0
			4.5			4.5
			5.0			5.0


<u>LOCATION / NOTES:</u>	<u>LEGEND</u>  Disturbed Sample  Undisturbed Sample  Headspace Analysis  Down Borehole Analysis  Groundwater Table  Perched Water Table	TRIALPIT LOG	
		JOB TITLE	SHORE ROAD SITE INVESTIGATION
		LOCATION	CLIFDEN, CO. GALWAY
		CLIENT	GALWAY C.C.
			








BOREHOLE CONSTRUCTION	SAMPLE		SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	TRIALPIT NUMBER: TP16		PAGE 1 OF 1
							EXCAVATION DATE: 20/01/14	METHOD: TRACKED HYMAC	
	NUMBER	TYPE					CONTRACTOR: Bernard Corbett	DIAMETER: N/A	
							LOGGED BY: DG/PM	GRID REF.: E65487 N250477	
			CHECKED BY: PM	ELEVATION: approx. 2.47m AOD					

				DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
				0		Soft light brown sandy CLAY (MADE GROUND/LANDFILL CAP)		0
				0.5		Soft green/dark gray gravelly CLAY (MADE GROUND) with cobbles and boulders		0.5
				1.0				1.0
				1.5				1.5
				2.0				2.0
				2.5		black C&D WASTE with builders rubble		2.5
				3.0		Dark red/brown sandy gravelly SILT with rounded boulders and cobbles	No evidence of Contamination	3.0
				3.5		End of hole at 3.5m bgl - hit weathered bedrock		3.5
				4.0				4.0
				4.5				4.5
				5.0				5.0

<u>LOCATION / NOTES:</u>	<u>LEGEND</u>  Disturbed Sample  Undisturbed Sample  Headspace Analysis  Down Borehole Analysis  Groundwater Table  Perched Water Table	TRIALPIT LOG	
		JOB TITLE	SHORE ROAD SITE INVESTIGATION
		LOCATION	CLIFDEN, CO. GALWAY
		CLIENT	GALWAY C.C.
			

BOREHOLE CONSTRUCTION	SAMPLE		SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	TRIALPIT NUMBER: TP17		PAGE 1 OF 1	
							EXCAVATION DATE: 20/01/14		METHOD: TRACKED HYMAC	
	CONTRACTOR: Bernard Corbett						DIAMETER: N/A			
	LOGGED BY: DG/PM						GRID REF.: E65470 N250647			
NUMBER	TYPE					CHECKED BY: PM		ELEVATION: approx. 2.60m AOD		

		DEPTH (m)	DESCRIPTION	COMMENTS	
		0	Soft light brown sandy CLAY (MADE GROUND/LANDFILL CAP)	Land Drain	0
		0.5	Soft light brown/green gravelly CLAY		0.5
		1.0	C&D WASTE (MADE GROUND)	No odor	1.0
		1.5	Boulders, bricks, blocks, ash, timber, some glass, metal, some plastics	Strong inflow from N face and S face	1.5
		2.0	Mottling around waste		2.0
		2.5			2.5
		3.0			3.0
		3.5	soft brown gravelly CLAY with cobbles	Indigenous	3.5
		4.0	Terminated at 3.85m bgl - hit weathered bedrock		4.0
		4.5			4.5
		5.0			5.0

LOCATION / NOTES: Located beside helipad.	LEGEND  Disturbed Sample  Undisturbed Sample  Headspace Analysis  Down Borehole Analysis  Groundwater Table  Perched Water Table	TRIALPIT LOG	
		JOB TITLE	SHORE ROAD SITE INVESTIGATION
LOCATION	CLIFDEN, CO. GALWAY		
CLIENT	GALWAY C.C.		
			

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