

6. GEOLOGY AND SOILS

6.1 Introduction

6.1.1 Background & Objectives

McCarthy Keville O’Sullivan (MKO), on behalf of Glenveagh Living, has carried out an assessment of the likely significant effects of a proposed mixed-use development at Knocknacarra, west of Galway, on the land, soils and geology of the receiving environment.

This chapter provides a baseline assessment of the environmental setting of the Proposed Development in terms of land, soils, and geology, and discusses the potential impacts that the construction and operation of the Proposed Development will have. Where required, appropriate mitigation measures to limit any identified significant impacts to soils and geology are recommended and an assessment of residual impacts and significance of effects provided.

6.1.2 Statement of Authority

McCarthy Keville O’Sullivan Ltd. (MKO) is a specialist planning and environmental consultancy. Based in Galway but working nationwide, we deliver challenging and complex projects on behalf of our clients. MKO employs over 50 people across the company’s four planning, ecology, environmental and ornithology teams. Our multi-disciplinary service offering and broad range of nationwide experience add real value to our client’s projects.

MKO company experience spans the full range of industry sectors, including renewable energy, commercial development, roads and transport infrastructure, ports and marinas, tourism, energy infrastructure, retail, sport and leisure, quarrying and aggregates, manufacturing, education, housing, waste management, water, telecoms and other utilities.

Our areas of expertise and experience include a wide variety of environmental topics, including geology. We routinely are involved with carrying out impact assessments for land, soils and geology for a large variety of project types.

This chapter of the EIAR was prepared by Michael Watson and Thomas Blackwell.

Michael Watson completed an MA in Environmental Management at NUI, Maynooth in 1999. He is a professional geologist (PGeo) and full member of IEMA (MIEMA) as well as a Chartered Environmentalist (CEnv). Michael joined McCarthy Keville O’Sullivan Ltd. in 2014 having gained over 15 years’ experience in a Cork-based environmental & hydrogeological consultancy firm. Thomas Blackwell holds both a BA in Geography and a MSc in Environmental Resource Management. Prior to taking up his position with McCarthy Keville O’Sullivan, Thomas worked as an environmental consultant in the United States.

6.1.3 Relevant Legislation

The EIAR is carried out in accordance with the following Irish legislation:

- European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2001 - 2018
- Planning and Development Act, 2000, as amended;
- Directives 2011/92/EU and 2014/52/EU on the assessment of the effects of certain public and private projects on the environment, including Circular Letter PL 1/2017: Implementation of Directive 2014/52/EU on the effects of certain public and private projects on the environment (EIA Directive);

- › S.I. No. 349 of 1989: European Communities (Environmental Impact Assessment) regulations and subsequent amendments (S.I. No. 84 of 1995, S.I. No. 352 of 1998, S.I. No. 93 of 1999; S.I. No. 450 of 2000; S.I. No. 538 of 2001); S.I. No. 30 of 2000 the Planning and Development Act, 2000; and S.I. 600 of 2001 Planning and Development Regulations and subsequent amendments, on the assessment of the effects of certain public and private projects on the environment; and,
- › S.I. No. 4 of 1995: The Heritage Act 1995.

6.1.4 Relevant Guidance

The soils and geology section of this EIAR is carried out in accordance with guidance contained in the following documents:

- › Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended by 2014/52/EU);
- › Environmental Protection Agency (2017): Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports;
- › Environmental Protection Agency (September 2015): Draft - Advice Notes on Current Practice (in the preparation of Environmental Impact Statements);
- › Environmental Protection Agency (September 2015): Draft – Revised Guidelines on the Information to be Contained in Environmental Impact Statements;
- › Environmental Protection Agency (2003): Advice Notes on Current Practice (in the Preparation on Environmental Impact Statements);
- › Environmental Protection Agency (2002): Guidelines on the Information to be Contained in Environmental Impact Statements;
- › Institute of Geologists Ireland (2013): Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements; and,
- › National Roads Authority (2008): Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes.

6.2 Methodology

6.2.1 Desk Study

A desk study of the proposed development site and the surrounding study area was completed along with a walkover survey and site investigations. The desk study involved collecting all the relevant geological data for the Proposed Development and study area. This included consultation with the following:

- › Environmental Protection Agency database (www.epa.ie);
- › Geological Survey of Ireland - National Draft Bedrock Aquifer map;
- › Geological Survey of Ireland - Groundwater Database (www.gsi.ie);
- › Bedrock Geology 1:100,000 Scale Map Series, Sheet 14 (Geology of Galway Bay). Geological Survey of Ireland (GSI, 2003);
- › Geological Survey of Ireland – 1:25,000 Field Mapping Sheets; and,
- › General Soil Map of Ireland 2nd edition (www.epa.ie).

6.2.2 Site Investigations

A site inspection of the proposed development site and surrounding area was undertaken by an engineer from Ground Investigations Ireland Ltd (GII) on 29th April 2019. The GII investigation report is included as Appendix A of the Infrastructure Design Report which can be seen in Appendix 3-4 of this EIAR.

The purpose of the site investigation was to investigate subsurface conditions utilising a variety of investigative methods in accordance with the project specification. To achieve this purpose the following works were undertaken:

- 14 No. Trial Pits to a maximum depth of 3.8m BGL
- 2 No. Soakaways to determine a soil infiltration value to BRE digest 365
- Geotechnical Laboratory testing.

6.2.3 Impact Assessment Methodology

Using information from the desk study and data from the site investigation, an estimation of the importance of the soil and geological environment within the study area is assessed using the criteria set out in Table 6.1 (NRA, 2008).

Table 6.1. Estimation of Importance of Soil and Geology Criteria (NRA, 2008).

Importance	Criteria	Typical Example
Very High	Attribute has a high quality, significance or value on a regional or national scale. Degree or extent of soil contamination is significant on a national or regional scale. Volume of peat and/or soft organic soil underlying route is significant on a national or regional scale.	Geological feature rare on a regional or national scale (NHA). Large existing quarry or pit. Proven economically extractable mineral resource
High	Attribute has a high quality, significance or value on a local scale. Degree or extent of soil contamination is significant on a local scale. Volume of peat and/or soft organic soil underlying site is significant on a local scale.	Contaminated soil on site with previous heavy industrial usage. Large recent landfill site for mixed wastes. Geological feature of high value on a local scale (County Geological Site). Well drained and/or high fertility soils. Moderately sized existing quarry or pit. Marginally economic extractable mineral resource.

Medium	Attribute has a medium quality, significance or value on a local scale. Degree or extent of soil contamination is moderate on a local scale. Volume of peat and/or soft organic soil underlying site is moderate on a local scale.	Contaminated soil on site with previous light industrial usage. Small recent landfill site for mixed Wastes. Moderately drained and/or moderate fertility soils. Small existing quarry or pit. Sub-economic extractable mineral Resource.
Low	Attribute has a low quality, significance or value on a local scale. Degree or extent of soil contamination is minor on a local scale. Volume of peat and/or soft organic soil underlying site is small on a local scale.	Large historical and/or recent site for construction and demolition wastes. Small historical and/or recent landfill site for construction and demolition wastes. Poorly drained and/or low fertility soils. Uneconomically extractable mineral resource.

The statutory criteria (EPA, 2002, 2003, 2015 and 2017) for the assessment of impacts require that likely impacts are described with respect to their extent, magnitude, type (*i.e.* negative, positive or neutral) probability, duration, frequency, reversibility, and transfrontier nature (if applicable). The descriptors used in this environmental impact assessment are those set out in EPA (2017) Glossary of Impacts as shown in Chapter 1 of this EIAR. In addition, the two impact characteristics proximity and probability are described for each impact and these are defined in Table 6.2.

In order to provide an understanding of this descriptive system in terms of the geological/hydrological environment, elements of this system of description of impacts are related to examples of potential impacts on the geology and morphology of the existing environment, as listed in Table 6.3.

Table 6.2. Additional Impact Characteristics.

Impact Characteristic	Degree/Nature	Description
Proximity	Direct	An impact which occurs within the area of the proposed project, as a direct result of the proposed project.
	Indirect	An impact which is caused by the interaction of effects, or by off-site developments.
Probability	Low	A low likelihood of occurrence of the impact.
	Medium	A medium likelihood of occurrence of the impact.
	High	A high likelihood of occurrence of the impact.

Table 6.3. Impact descriptors related to the receiving environment.

Impact Characteristics		Potential Geological/Hydrological Impacts
Quality	Significance	
Negative only	Profound	Widespread permanent impact on: - The extent or morphology of a cSAC. - Regionally important aquifers. - Extents of floodplains. Mitigation measures are unlikely to remove such impacts.
Positive or Negative	Very Significant/ Significant	Local or widespread time dependent impacts on: -The extent or morphology of a cSAC / ecologically important area. -A regionally important hydrogeological feature (or widespread effects to minor hydrogeological features). -Extent of floodplains. Widespread permanent impacts on the extent or morphology of a NHA/ecologically important area, Mitigation measures (to design) will reduce but not completely remove the impact – residual impacts will occur.
Positive or Negative	Moderate	Local time dependent impacts on: - The extent or morphology of a cSAC / NHA / ecologically important area. - A minor hydrogeological feature. - Extent of floodplains. Mitigation measures can mitigate the impact OR residual impacts occur, but these are consistent with existing or emerging trends
Positive, Negative or Neutral	Slight	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
Positive, Negative or Neutral	Not Significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
Neutral	Imperceptible	No impacts, or impacts which are beneath levels of perception, within normal bounds of variation, or within the bounds of measurement or forecasting error.

6.3 Receiving Environment

6.3.1 Site Description & Topography

The Proposed Development site approximately 2.8 hectares in extent and is located in the townland of Ragoon in Knocknacarra, Co. Galway.

The proposed site consists of scrub land in the northern portion of the site and a construction compound in the southern portion of the site. There is a small area of landscaping adjacent to the access road that bisects the site. The existing underground void to the northwest of the main development site was constructed during Phase 2 of the Gateway Retail Park development. This area consists of a concrete lined underground void. It is proposed to fit this void out for use as an underground car park.

The elevation of the site ranges between approximately 27m and 32m OD (metres above Ordnance Datum). The overall local topography generally slopes from north to south with an undulating topography. The dominant land use on the bordering land is commercial development to the west, a primary school to the north, and residential development to the south and east.

6.3.2 Soils and Subsoils

According to GSI mapping (www.gsi.ie), the site is dominated by shallow, well drained mineral soils (AminSW) in the northern portion of the site and shallow, reasonably drained mineral soil derived from mainly acidic parent materials (AminSRPT) in the southern portion of the site. There is an area in the middle of the site that is classified as deep, poorly drained mineral soils, derived mainly from non-calcareous parent material (AminPD)

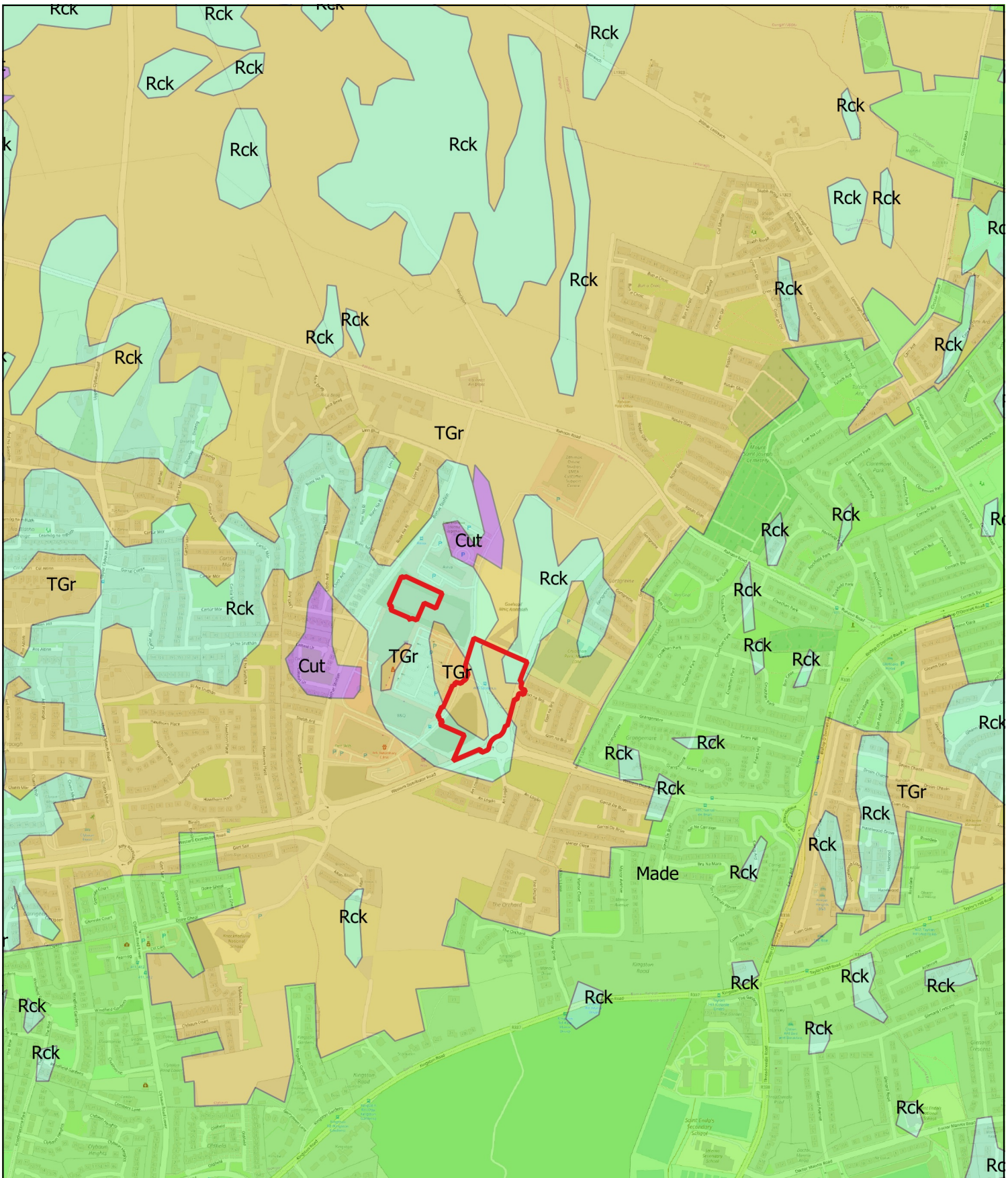
The mapped subsoil type (www.gsi.ie) for the proposed site indicate that the majority of the site either has bedrock at the surface (Rck) or is underlain by granite till (TGr). The local subsoils map is shown as Figure 6.1.

The ground conditions encountered during the site investigation are summarised below. The sequence of strata encountered were variable across the site and are generally comprised of Made Ground, Peat, Soft Cohesive Deposits, Granular Deposits (Possible Weathered Bedrock), and Presumed Bedrock. Details of the trial pit records are provided in Ground Investigation Report.

6.3.3 Bedrock Geology

Based on the GSI bedrock map of the region, the Proposed Development site is underlain by the Errisbeg Townland Granite which is part of the Galway Granite formation. This comprises Devonian Megacrystic pink/grey monzogranite (GaEb). These granites are classified by the GSI as a Poor Aquifer -Bedrock which is Generally Unproductive except for Local Zones (Pl).

A bedrock geology map of the area is included as Figure 6.2.



Map Legend

Site Boundary

Subsoils

- Blanket peat (BktPt)
- Cutaway/cutover peat (Cut)
- Karstified limestone bedrock at surface
- Made ground (Made)
- Beach sand (Mbs)
- Rock (Rck)

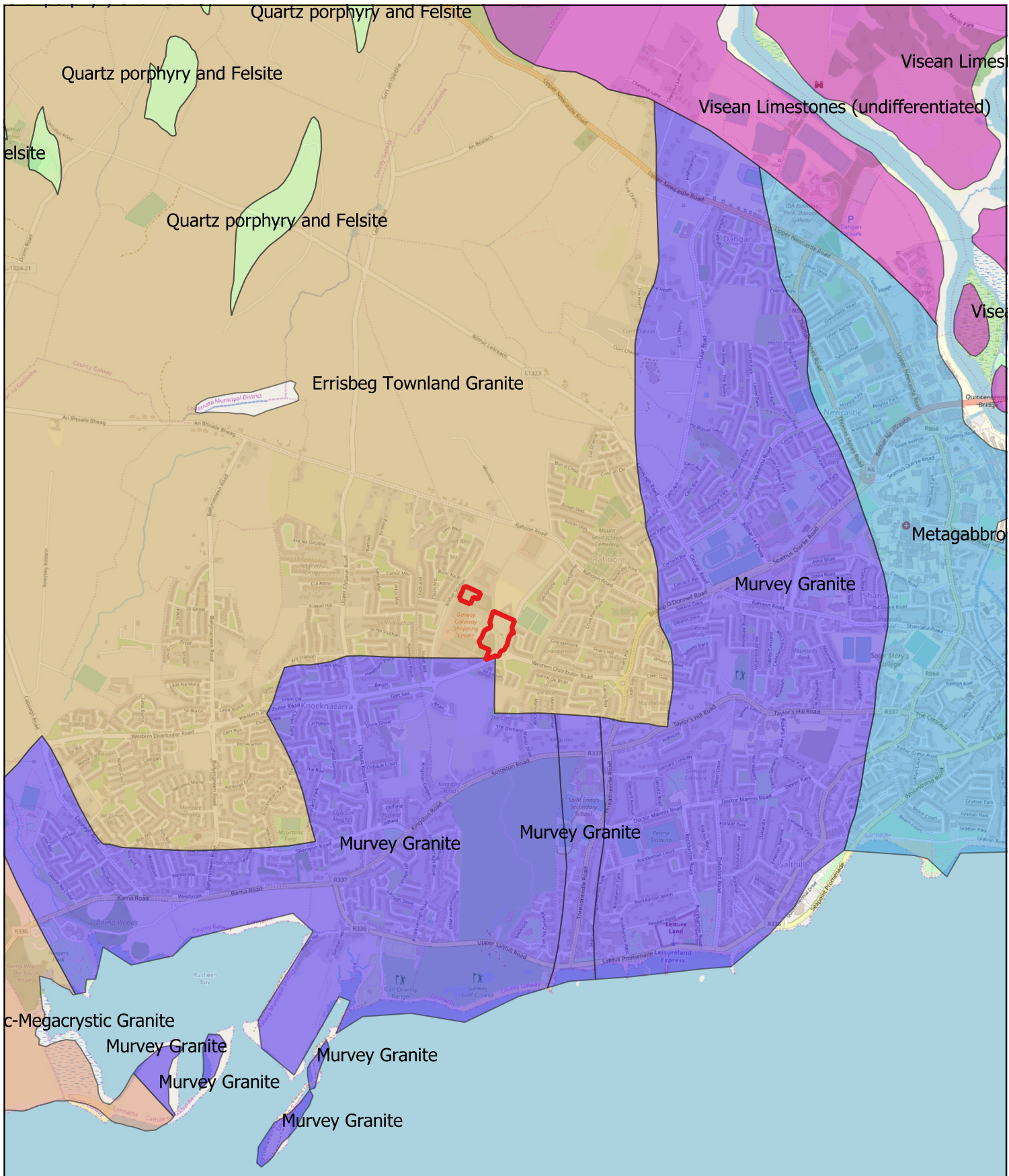
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Local Subsoils








Project Title
SHD at Knocknacarra District Centre


Drawn By TJB	Checked By MH
Project No. 180531-a	Drawing No. Figure 6.1
Scale 1:10000	Date 23.10.2019

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Map Legend

-  Site Boundary
- Bedrock Geology**
-  Errisbeg Townland Granite
-  Metagabbro & orthogneiss suite
-  Murvey Granite
-  Porphyritic-Megacrystic Granite
-  Quartz porphyry and Felsite
-  Visean Limestones (undifferentiated)




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Drawing Title
Bedrock Geology

Project Title
 SHD at Knocknacarra District Centre

Drawn By TJB	Checked By MH
Project No. 180531-a	Drawing No. Figure 6.2
Scale 1:25000	Date 23.10.2019



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6.3.4 Geological Heritage and Designated Sites

There are no recorded Geological Heritage sites within the proposed development area. The closest geological heritage site is the Barna Drumlin Swarm, which is located approximately 2km southwest of the site.

To the southwest of the proposed site is the Galway Bay Complex SAC (Code: 000268), and drainage from the site enters the Inner Galway Bay SPA (Code: 004031) approximately 1.5 kilometres downstream of the proposed site at Rusheen Bay.

6.3.5 Soil Contamination

There are no known areas of soil contamination on the site. During the site walkovers, no areas of particular contamination concern were identified. Any material on the site appears to be excavated rock type material.

According to the EPA online mapping (<https://gis.epa.ie/EPAMaps>), there are no licenced waste facilities on or within the immediate environs of the proposed development site.

There are no historic mines at or in the immediate vicinity of the site that could potentially have contaminated tailings.

6.3.6 Economic Geology

The GSI Online Minerals Database accessed via the Public Data Viewer shows no quarries within the proposed development area.

The GSI online Aggregate Potential Mapping Database shows that the proposed development site is not located within an area mapped as being of Very High or High granular aggregate potential (i.e. potential for gravel reserves).

6.4 Characteristics of the Proposed Development

The proposed development is described in Chapter 3 and will generally comprise the following:

1. *Construction of 332 no. residential units:*
 - *93 no. 1 bed apartments*
 - *219 no. 2 bed apartments*
 - *20 no. 3 bed apartments*
2. *Provision of 2,667 sq.m of commercial floorspace.*
3. *Provision of 93 sq.m of community use facilities*
4. *Provision of 470 sq.m of tenant amenity accommodation including shared workspaces, shared dining and lounge facilities*
5. *Provision of 174sq.m creche facility including an external secure play area.*
6. *Provision of 85 no. car parking spaces and provision of realigned road between Gort na Bró and Gateway Retail Park Road.*
7. *Change of use of underground void to 181 bay underground car park*
8. *Provision of shared communal and private open space, car parking, bicycle parking, bin storage, public lighting, site landscaping, services, signage, substation and all associated site development works.*

The proposed development will typically require minor alteration of ground levels to ensure it is at an adequate level for the proposed surface water drainage, foul water drainage and to mitigate flood risk.

Excavation of soil and subsoil will be required for the proposed development in preparation for the construction of building foundations and in the preparation of a suitable sub-formation for road construction, trenching for foul and drainage water infrastructure and other services. Significant excavations are not required as there are no subsurface basement type structures proposed.

6.5 Potential Impacts of the Proposed Development

6.5.1 Do Nothing Scenario

The use of the proposed development site as a construction compound would continue in the short term. Portions of the site would continue to be vacant scrub land. The potential for soil contamination through illicit dumping would continue as a result of the Do Nothing Scenario. The potential impacts are considered to be long term imperceptible in the Do Nothing scenario.

6.5.2 Likely impacts and Mitigation Measures – Construction Stage

The likely impacts of the proposed mixed use development and mitigation measures that will be put in place to eliminate or reduce them are shown below. These relate to the construction stage. It should be noted that the main potential impacts on the soils and geology environment will occur during the construction stage.

6.5.2.1 Subsoil Excavation and Bedrock Excavation

Excavation of existing fill, subsoil and bedrock will be required for site levelling, for the installation of foundations for the access roads, carpark and buildings, and service trenching. This will result in a permanent relocation of soil and subsoil at most excavation locations. The excavated materials are expected to include existing fill material, topsoil/subsoil, and some granite bedrock.

Mechanism: Extraction/excavation.

Receptor: Land, topsoil, subsoil and bedrock.

Potential Impact: Negative, slight, direct, likely, permanent impact on soil, subsoil and bedrock at a local level.

6.5.2.1.1 Mitigation Measures/Impact Assessment

- Excavated (existing) overburden material will be reused on site, where possible;
- A minimal volume of topsoil and subsoil will be removed to allow for infrastructural work to take place due to optimisation of the layout by mitigation by design (no basement structures are proposed); and,
- Construction of service trenching, pumping station and surface water attenuation features will generate excess material. All excess material will be sent to an authorised soil and stone or waste recovery facility.

6.5.2.1.2 Residual Impact

Negative, direct, imperceptible, likely, permanent impact on topsoil, subsoils and bedrock.

6.5.2.1.3 **Significance of Effects**

No significant effects on land, topsoil, subsoils or bedrock are anticipated.

6.5.2.2 **Contamination of Soil by Leakages and Spillages and Alteration of Soil Geochemistry**

Similar to all construction sites, plant and machinery will require refueling and so hydrocarbons will be stored on site. Managed incorrectly, there is the risk of spills and leaks associated with these operations impacting on land and soils.

Pathway: Topsoil, subsoil and bedrock pore space.

Receptor: Topsoil, subsoil and bedrock.

Potential Impact: Negative, direct, slight, short term, medium probability impact on topsoil, subsoils and bedrock.

6.5.2.2.1 **Proposed Mitigation Measures**

- All plant and machinery will be serviced before being mobilised to site;
- No plant maintenance will be completed on site, any broken down plant will be removed from site to be fixed;
- Refuelling will be completed in a controlled manner using drip trays at all times;
- Mobile bowsers, tanks and drums will be stored in secure, impermeable storage areas away from open water;
- Fuel containers will be stored within a secondary containment system, e.g. bunds for static tanks or a drip tray for mobile stores;
- Containers and bunding for storage of hydrocarbons and other chemicals will have a holding capacity of 110% of the volume to be stored;
- Ancillary equipment such as hoses and pipes will be contained within the bund;
- Taps, nozzles or valves will be fitted with a lock system;
- Fuel and chemical stores including tanks and drums will be regularly inspected for leaks and signs of damage;
- Drip-trays will be used for fixed or mobile plant such as pumps and generators in order to retain oil leaks and spills;
- Only designated trained operators will be authorised to refuel plant on site;
- Procedures and contingency plans will be set up to deal with emergency accidents or spills; and,
- An emergency spill kit with oil boom, absorbers *etc.* will be kept on-site for use in the event of an accidental spill. A specific team of staff will be trained in the use of spill containment.
- Highest standards of site management will be maintained and utmost care and vigilance followed to prevent accidental contamination or unnecessary disturbance to the site and surrounding environment during construction. A named person will be given the task of overseeing the pollution prevention measures agreed for the site to ensure that they are operating safely and effectively.

6.5.2.2.2 **Residual Impact**

Negative, Imperceptible, direct, short term, unlikely impact.

6.5.2.2.3 **Significance of Effects**

No significant effects on land, soils, subsoils or bedrock are anticipated.

6.5.2.3 **Assessment of Health Effects**

Potential health effects arise mainly through the potential for soil and ground contamination. Residential and retail developments are not a recognized source of significant pollution and so the potential for effects during the operational phase are negligible. Hydrocarbons will be used onsite during construction. However, the volumes will be small in the context of the scale of the project and will be handled and stored in accordance with best practice mitigation measures. The potential residual impacts associated with soil or ground contamination and subsequent health effects are imperceptible.

6.5.2.3.1 **Potential Cumulative Impacts**

Potential cumulative effects on geology and soils between the proposed development and other developments in the vicinity, including all those listed in Section 2.6.2 of this EIAR, were also considered as part of this assessment. No significant cumulative impacts on land, soils and geology environment are anticipated during the construction or operation phases as long as mitigation measures outlined are put in place.

6.5.3 **Likely Impacts and Mitigation Measures – Operational Stage**

No impacts on soils and geology are anticipated during the operational phase. The operational stage of the development consists of the typical activities in a residential area and will not involve further disturbance to the topsoil, subsoils and geology of the area.

No significant cumulative impacts on the land, soils and geology environment are envisaged during the operational stage.

6.5.4 **Conclusion**

Excavation of existing fill, topsoil, subsoil and bedrock will be required for site leveling and for the installation of drainage and services (wastewater, water supply, electricity, etc.) infrastructure. This will result in a permanent removal of subsoil and bedrock at most excavation locations.

All excess material will be used for reinstatement and landscaping works around the site at the end of the construction phase. Storage and handling of hydrocarbons/chemicals will be carried out using best practice methods. Measures to prevent subsoil erosion during excavation and reinstatement will be undertaken to prevent water quality impacts.

No significant impacts on the land, soil and geology of the site will occur.