5.0 SOILS, LAND AND GEOLOGY

5.1 Introduction

This Chapter of the rEIAR considers and assesses any potential impacts resulting from quarrying related activities that have been carried out at the Site on the surrounding land, soils and geology.

The loss of agricultural soils will also be considered, as will the potential impact on geologically important sites and land quality. Associated secondary potential impacts from changes to land quality on human health are also considered. It should be noted that this assessment does not, however, constitute a contaminated land risk assessment, a geotechnical/geohazard risk assessment, or detailed quantitative human health risk assessment.

5.1.1 Technical Scope

The technical scope of this assessment is to consider the potential impacts and effects on soils, land and geology that could have resulted as a consequence of the quarrying related activities that have been carried out at the Site on the surrounding land, soils and geology. The assessment considers the potential sources of change resulting from Development activities detailed in the project description (Chapter 2).

The potential loss of agricultural soils will be considered, as will the potential to have impacted geologically important sites and land quality. Associated secondary potential impacts of changes to land quality on human health are also considered. It should be noted that this assessment does not, however, constitute a contaminated land risk assessment, a geotechnical/geohazard risk assessment, or detailed quantitative human health risk assessment.

The potential effects associated with hydrogeological and hydrological receptors are considered in Chapter 6 (Water). The effects of the Development on population and human health are addressed in Chapter 3 (Population & Human Health), although as noted above the potential effects of land quality on human health are considered in the current chapter. Any secondary effects on ecology or biodiversity due to changes in land quality or habitat removal are considered in Chapter 4 (Ecology and Biodiversity).

5.1.2 Geographical and Temporal Scope

The geographical study area for the assessment covers the EIA site boundary (Site) (identified on Figure 5.1) and a buffer zone of 500 m from the EIA boundary (i.e. the study area), because most potential effects to geological and soil receptors are anticipated to occur within the Development footprint or immediately adjacent to it. In the context of the rEIAR, the Site boundary contains lands which form the existing quarry site and some areas which extend beyond the working areas. The substitute consent (the Planning Application) boundary is shown on the drawing set which accompanies the planning application.

The baseline for this rEIAR has been set to 01 February 1990, and the rEIAR process has assessed environmental impacts from that date to the present. This assessment period equates to 31 years and is identified as ‘long-term’ duration (those lasting fifteen to sixty years).

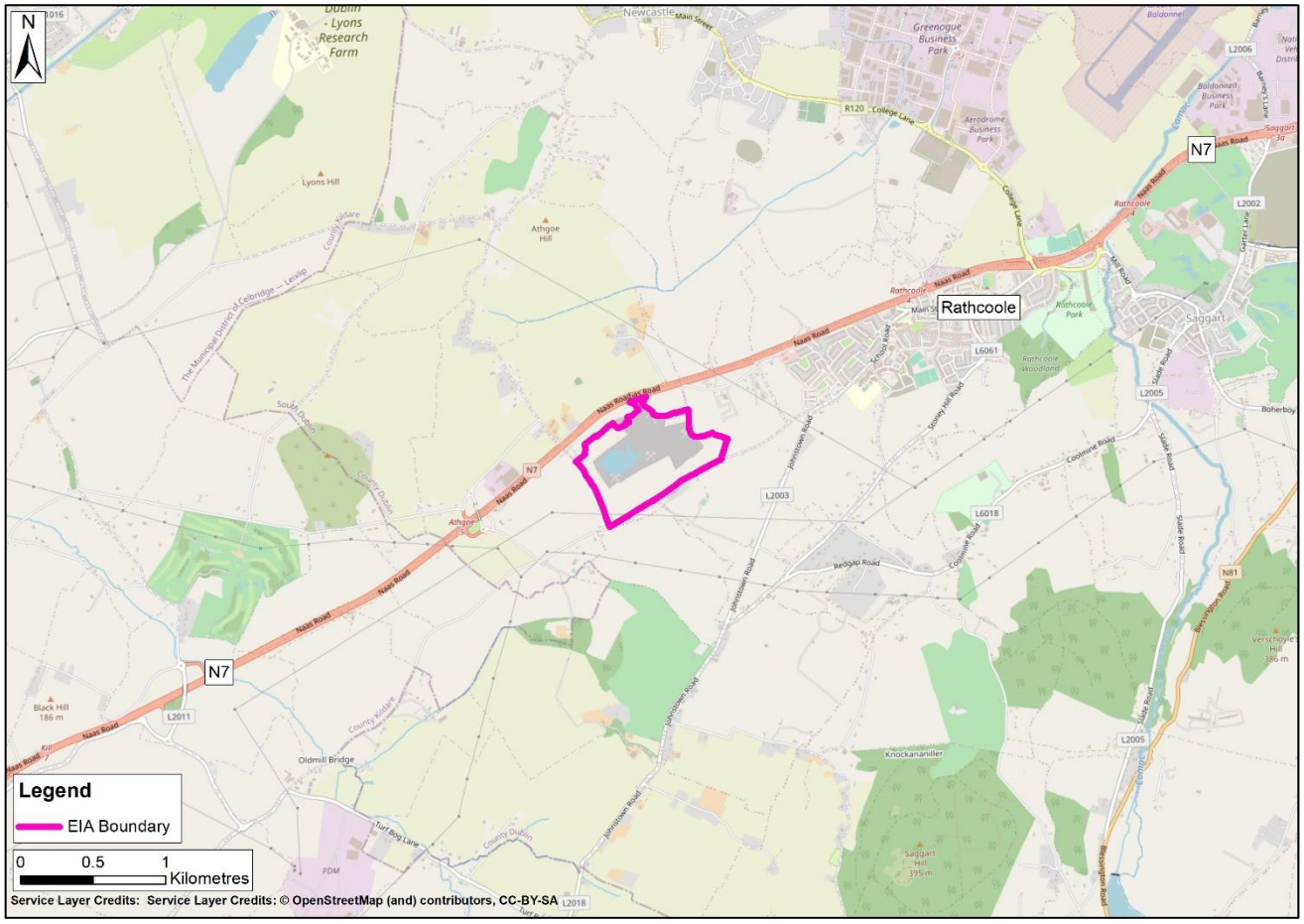

Figure 5.1: Location of the Site (EIA site boundary)

5.2 Legislative and Policy Context

This section addresses the legislation and guidance that has been considered when preparing this chapter, and key policy context relevant to soils, land and geology that has guided the focus of the assessment.

5.2.1 Legislation and Guidance

This assessment has been made with cognisance to relevant guidance, advice and legislation, including, but not limited to:

- European Union Directive 2011/92/EU as amended by Directive 2014/52/EU – these Directives required that certain private and public projects which are likely to have significant resultant environmental impacts are subject to a formalised Environmental Impact Assessment prior to their consent.
- European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (SI No. 296 of 2018) which amended the Planning and Development Act, 2000, and the Planning and Development Regulations, 2001. The 2014/52/EU Directive was transposed into Irish law through this Directive.
- Relevant European Commission guidance considered as part of this assessment included: Environmental Impact Assessment of Projects – Guidance on the Preparation of the Environmental Impact Assessment Report (2017).
- The European Communities (Environmental Liability) Regulations 2008 (as amended) - These Regulations (SI 547/2008) transpose EU Directive 2004/35/CE on environmental liability with regard to the prevention and remedying of environmental damage. The purpose of these Regulations is to establish a framework

of environmental liability based on the 'polluter-pays' principle, to prevent and remedy environmental damage. The Environmental Protection Agency (EPA) is designated as the competent authority for all aspects of these Regulations.

- The Environmental Protection Agency Act 1992 and the Protection of the Environment Act 2003 – which detail the requirements associated with general pollution control and activities that come under integrated pollution prevention and control.
- The EPA Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (Draft, August 2017) – which presents key topics of interest, high-level information on the interactions that should be considered in relation to EIA legislation, and overviews on the recommended approach to describing the baseline environment, completing impact assessments, describing effects, and addressing mitigation and monitoring.
- The EPA Advice Notes for Preparing Environmental Impact Statements (Draft, September 2015).
- Department of Housing, Planning and Local Government. Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (August 2018).
- Gov.uk online guidance, Guidance on Land Contamination Risk Management (LCRM). Available at https://www.gov.uk/guidance/land-contamination-how-to-manage-the-risks. Uses a tiered approach to risk assessment, including preliminary risk assessment, generic quantitative risk assessment and detailed quantitative risk assessment.
- The National Roads Authority Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (2008) in relation to aspects to be considered and assessment approach (including relative receptor importance and cross discipline interactions).
- Institute of Geologists of Ireland. Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements (April 2013).
- The National Roads Authority Guidelines for the Creation, Implementation and Maintenance of an Environmental Monitoring Plan (undated) in relation to impact mitigation.
- CIRIA C741: Environmental Good Practice on Site (2015, Fourth Edition) in relation to source of impact and mitigation.
- Scottish and Northern Irish Pollution Prevention Guidelines (PPGs) and Guidance for Pollution Prevention (GPPs) – these, although not Irish guidance, provide environmental good practice guidance for activities such as oil and chemical storage, works in or near water, works on construction sites, and dealing with spills and pollution incidents.

5.2.2 Local Policy

The **National Planning Framework (Project Ireland 2040)** includes National Policy Objective 60 to “Conserve and enhance the rich qualities of natural and cultural heritage of Ireland in a manner appropriate to their significance”.

There is currently no local plan for Rathcoole, however the **South Dublin County Council Development Plan 2016-2022** incorporated the relevant policies and objectives for the area.

The area is included in Zoning Objective ‘Ru’ of the South Dublin County Council Development Plan 2016-2022 which has the description *‘to protect and improve rural amenity and to provide for the development of agriculture’.*

Specific policies relating to the protection of the geological environment and land include the following:

- IE2 Objective 10: To require adequate and appropriate investigations to be carried out into the nature and extent of any soil and groundwater contamination and the risks associated with site development work, in particular for brownfield development.
- ET10 Objective 1: To facilitate mineral extraction in suitable locations subject to the protection of amenity and environmental quality.
- ET10 Objective 2: To limit the operation of the extractive industry and ancillary uses at environmentally sensitive locations and within areas designated with Zoning Objective 'HA – DM', 'HA-LV' and 'HA-DV' where extraction would result in significant adverse effects and/or prejudice the protection of the County's natural and built heritage.
- ET10 Objective 3: To ensure the satisfactory reinstatement and/or re-use of disused quarries and extraction facilities, where active use has ceased.
- ET1 Objective 2: To promote enterprise and employment development at locations that are proximate to or integrated with transportation and other urban land uses, to promote compact urban development and sustainable transport

5.3 Assessment Methodology and Significance Criteria

5.3.1 Introduction

This section presents the method used to assess the impacts and effects of the Development on soils, land and geology, and to secondary associated human health receptors. It establishes the stages of the assessment, and the qualitative criteria used to assess impact magnitude and determine the level of effect significance.

5.3.2 Qualitative Assessment Method

The assessment of potential effects has been undertaken using the qualitative assessment method outlined below, and is supported by the baseline condition information, desk-based information on land, soils and geology available from the Geological Survey of Ireland (GSI), the Environmental Protection Agency (EPA) and previous ground investigations carried out onsite. The assessment follows a staged approach. A summary of the stages involved is included below:

1) Confirm baseline conditions – determine baseline and develop conceptual site model by consideration of available records and data sets, site reports and published information. As this rEIAR covers the period from February 1990 to the present day, the baseline conditions will first be established for ca. 1990 and progress over time to now.
2) Confirm the key receptors and their value/importance, this may vary over time as new receptors are added (e.g. addition of residential housing).
3) Qualitatively characterise the magnitude of impacts on the receptors – describe what potential changes could have occurred to each receptor as a result of the Development, identify source-pathway receptor linkages, and assign the magnitudes of impact. This stage takes into account embedded design mitigation, historical and existing site practices including good practice in construction environment management and pollution prevention.
4) Determine the effect significance of each potential impact on each sensitive receptor.
5) Consider the need for additional mitigation (remedial measures) if it is considered necessary to reduce the magnitude of the impact and associated effect significance further. If remedial measures are considered necessary, a timeline will be presented in which the measures would be implemented.

6) Assess the residual impact magnitude and residual effect significance after all mitigation is applied.

Stages 1 and 2 have been completed using published literature and guidance and available information specific to the Development, which is presented in Chapter 1 of this rEIAR. For the identification of receptor value/importance that completes Stage 2, and for the description of impact magnitude (Stage 3), a common framework of assessment criteria and terminology has been used based on the EPA's draft Guidelines on the Information to be Contained in EIARs (EPA, 2017), with some modifications made to increase clarity. The descriptions for value (sensitivity) of receptors are provided in Table 5.1 and the descriptions for magnitude of impact are provided in Table 5.2.

The potential for an impact to occur at a receptor has been determined using the understanding of the baseline environment and its properties and consideration of whether there is a feasible linkage between a source of impact and each receptor (i.e. a conceptual site model). This follows the method of preliminary risk assessment that is widely presented in some of the guidance documents listed in Section 5.2.

Table 5.1: Environmental value (sensitivity) and descriptions

Value (sensitivity) of receptor / resource	Typical description
High	High importance and rarity, national scale, and limited potential for substitution. For example: Global/European/National designation Large volumes of nationally or locally important peat Well drained and highly fertile soils Proven economically extractable mineral resource Human health.
Medium	Medium or high importance and rarity, regional scale, limited potential for substitution. For example: Regionally important sites Moderately drained and/or moderate fertility soils.
Low	Low or medium importance and rarity, local scale. For example: Locally designated sites Poorly drained and/or low fertility soils.
Negligible	Very low importance and rarity, local scale.

Table 5.2: Magnitude of impact and typical descriptions

Magnitude of impact (change)		Typical description
High	Adverse	Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features or elements. Significant harm to human health - death, disease, serious injury, genetic mutation, birth defects or the impairment of reproductive functions. Significant harm to buildings/infrastructure/plant - Structural failure, substantial damage or substantial interference with any right of occupation.
	Beneficial	Large scale or major improvement of resource quality; extensive restoration; major improvement of attribute quality.
Medium	Adverse	Loss of resource, but not adversely affecting the integrity; partial loss of/damage to key characteristics, features or elements.
	Beneficial	Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality.

Magnitude of impact (change)		Typical description
Low	Adverse	Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements.
	Beneficial	Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring.
Negligible	Adverse	Very minor loss or alteration to one or more characteristics, features or elements.
	Beneficial	Very minor benefit to or positive addition of one or more characteristics, features or elements.

The assessment of magnitude of impact considers whether the change that causes the impact is positive or negative, and whether the impact is direct or indirect, short- medium- or long-term, temporary or permanent, and if it is reversible.

For the purposes of this assessment, a direct impact is one that occurred as a direct result of the Development and was likely to have occurred at or near the Development itself. Indirect impacts (or secondary/tertiary impacts) are those where a direct impact on one receptor has another knock-on impact on one or more other related receptor(s) (e.g. the Development results in a change in land quality, which then has an indirect impact on human health). Indirect impacts can occur within the study area or away from the Development.

For the purposes of this assessment, the following definitions of duration have been used:

- Temporary – effect likely to last less than 1 year without intervention (i.e. less than the construction phase);
- Short term – effect likely to last 1 to 7 years without intervention;
- Medium term – effect likely to last 7 to 15 years without intervention;
- Long term – effect likely to last 15 to 60 years without intervention; and
- Permanent – effect likely to last over 60 years without intervention.

An irreversible impact is defined as a change to the baseline that would not reverse itself naturally. Such impacts will usually be long-term and irreversible, such as the removal of best and most versatile agricultural soils. A reversible impact is defined as a change to the baseline conditions that would reverse naturally once the source of the impact is exhausted or has stopped.

5.3.3 Significance Criteria

The approach followed to derive effects significance from receptor value and magnitude of impacts (Stage 4) is shown in Table 5.3. Where Table 5.3 includes two significance categories, reasoning is provided in the text if the lower of the two significance categories is selected. A description of the significance categories used is provided in Table 5.4.

Table 5.3: Significance Matrix

	Magnitude of Impact (Degree of Change)				
Environmental value (Sensitivity)		Negligible	Low	Medium	High
	High	Slight	Slight or moderate	Moderate or large	Profound

	Medium	Imperceptible or slight	Slight or moderate	Moderate	Large or profound
	Low	Imperceptible	Slight	Slight	Slight or moderate
	Negligible	Imperceptible	Imperceptible or slight	Imperceptible or slight	Slight

Table 5.4: Significance categories and typical descriptions

Significance Category	Typical Description
Profound	An effect which obliterates sensitive characteristics.
Large	An effect which, by its character, magnitude, duration or intensity alters a significant proportion of a sensitive aspect of the environment.
Moderate	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.
Slight	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
Imperceptible	An effect capable of measurement but without significant consequences.

Residual adverse effects of 'large' or 'profound' significance are considered to be 'significant' for the purposes of this assessment.

If required following the assessment of the current level of effect significance, additional mitigation measures (remedial measures) may be presented that will be used to avoid, prevent, or reduce the magnitude of the impact (Stage 5). The significance of the effect taking into account the additional mitigation is then assessed (Stage 6) to give the residual effect significance. Any monitoring that will be required to measure the success of the mitigation is included (Stage 7) (see Section 5.10).

The effects of the Development are also considered cumulatively with those that could have been foreseen as a result of other known developments in the assessment study area.

5.4 Baseline Conditions

This Section presents baseline information on soils, land use, land quality and geology. Information about the water environment (including hydrogeology) is included in Chapter 6.

5.4.1 Land Use

The existing extent of the quarry (including extraction, plant and ancillary areas) is ca. 28.8 ha in area. The Site comprises lands which are currently used for quarrying activities.

The assessment period covers the years 1990 to 2021. A review of available aerial photography has been undertaken to assess the change in land use since 1990 and to establish the baseline during ca. 1990.

There are a number of historical maps available for the area (Ordnance Survey of Ireland, 2021, Google Earth 2021) which are relate to the operational years which are the subject of this rEIAR including:

- 19th February 1991, 30th May 1994, 6th May 2000 and 8th September 2004 aerial imagery (OSI);
- 24th March 2012, 17th March 2016 and 1st June 2020 aerial imagery (Google Earth);

- December 2019 drone survey of the quarry area (Murphy Surveys); and
- October 2020 drone survey of the quarry area (Shannon Valley).

In addition to establishing the baseline in 1990, consideration has been given to older mapping sources from both the GSI and OSI including:

- 6" historical map (1837-1842);
- 25'' OSI maps (1888-1913);
- 6" Cassini Map (1830s to 1930s); and
- GSI's (2021) aggregate potential mapping online viewer (historical quarries layer).

A review of the 6" historical map (1837 -1842) identifies two small quarries within the Site area. One was located to the west of the existing pit, along the unidentified local road and the other was located to the south of the existing pit, along the local road (L6065). Neither quarry was located within the footprint of the existing pit. Neither of these quarries are identified on the Cassini Map. The 25" inch map (1837 – 1842) identifies the western quarry only and it appears to have expanded eastwards towards what is now the existing western pit area. A review of the GSI's aggregate potential mapper identifies a cluster of four historical pits where the western pit was identified on earlier maps. Three of these quarries are considered to be Early to Mid-20th Century quarries and one is a Mid-19th Century quarry, most likely that identified on the older maps.

The oldest available aerial for the area is a 1991 OSI orthophotography survey, this has been used to approximate the 1990 baseline. The 1991 image has been superimposed on the 1994 OSI orthophotography survey, as the former image is confined to the quarry limits at the time and does not extend to cover the full Site and Study Area. The 2020 aerial imagery is a combination of the October 2020 drone survey overlying the June 2020 Google Earth image and the December 2019 drone survey. No updated surveys have yet been undertaken in 2021, however, site visits have been carried out in 2020 and 2021 by Golder and limited expansion has been observed during this period, partly due to Covid restrictions impacting production and the 2020 surveys have been used to approximate the current conditions.

Three main land uses have been identified within the Site and the study area (500 m from the Site boundary), these are agricultural and single-house residential lands, N7 road network and the quarry site. The lands to the north, west, south and east can be characterised as rural in nature, with land uses in the area being agricultural and single-house residential. Dry cattle, sheep rearing and grazing of horses are the main activities in the area, with further arable activities to the south-west.

Between the period 1990 and 2021 the N7 road and agricultural and single-house residential land use has remained unchanged. Some additional housing is accommodated in the landscape during this period but the overall land use remains unchanged. Based on available aerial imagery and contour mapping, the extraction area expanded from an initial ca. 10.1 ha in 1991 (Figure 5.2) to the current ca. 28.8 ha. The extraction area expanded over this period first in a westerly direction up to 2000, then both western and eastern expansion occurs between 2000 and 2020 (Figure 5.2 to Figure 5.8).

The Corine landcover classification (EPA, 2018) has also been considered in this assessment (Figure 5.11). This classification dataset is representative of ca. 2018. The classification for the area bears the same Level 3 classification as the adjacent N7 (Road and Rail Network), however the area of land should be classified as 'Mineral Extraction Sites' which is typical of suck rock quarries. The lands to the south, east and west are defined as 'Agricultural Areas' and 'Pastures'.

The Corine Land Cover (CLC) inventory is a Pan-European land-use and landcover mapping programme and is run in Ireland by the EPA. The Irish EPA CLC inventory is available for years commensurate with ordnance

survey aerial photography relied upon in this rEIAR to illustrate the development of the quarry since baseline. CLC data from 1990 (Figure 5.9), 2012 (Figure 5.10) and the most recent 2018 is presented at Figure 5.11.

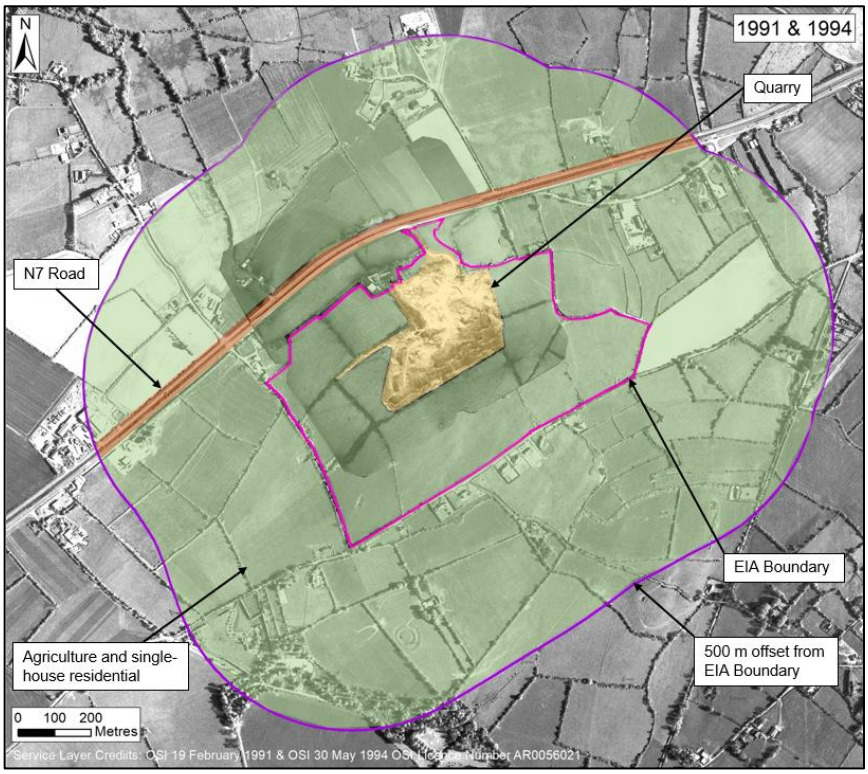

Figure 5.2: Land use during 1991 and 1994 based on OSI aerial photography.

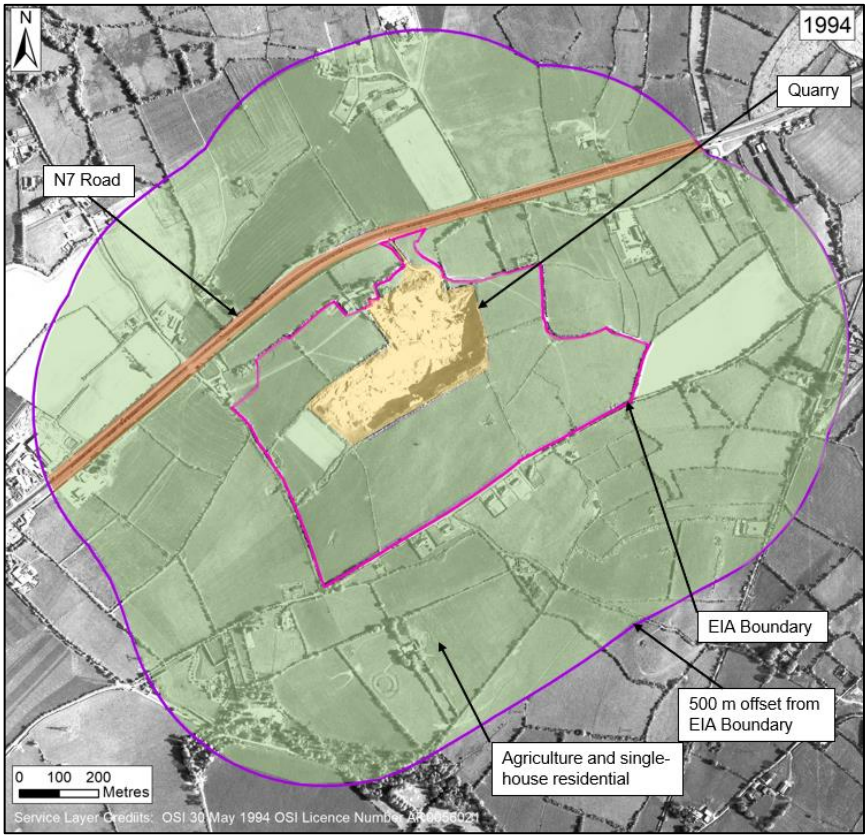

Figure 5.3: Land use during 1994 based on OSI aerial photography.

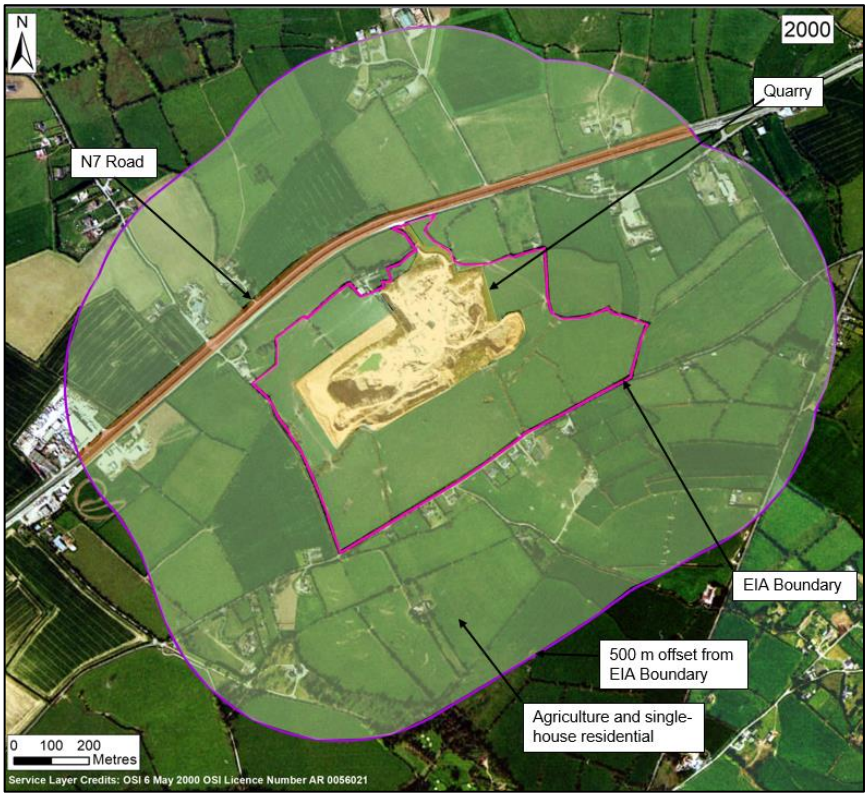

Figure 5.4: Land use during 2000 based on OSI aerial photography.

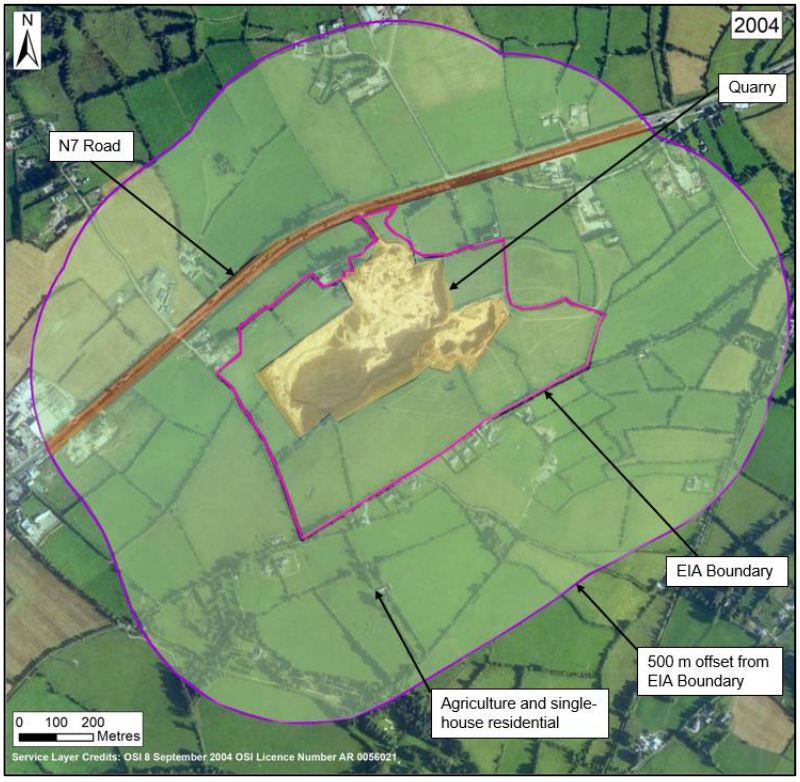

Figure 5.5: Land use during 2004 based on OSI aerial photography.

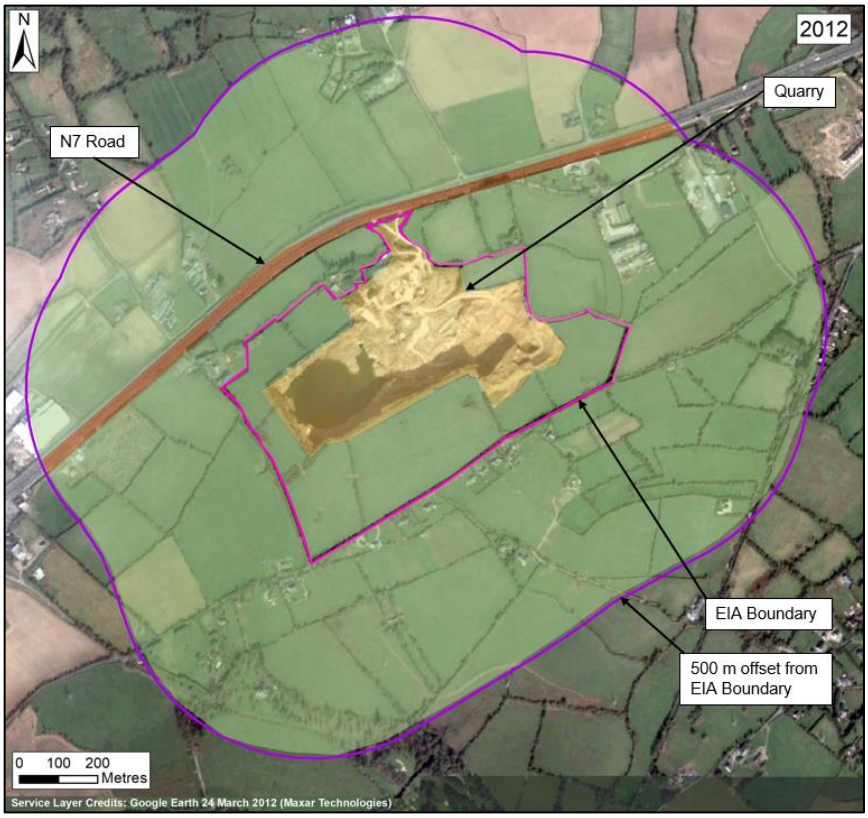

Figure 5.6: Land use during 2012 based on Google Earth aerial photography.

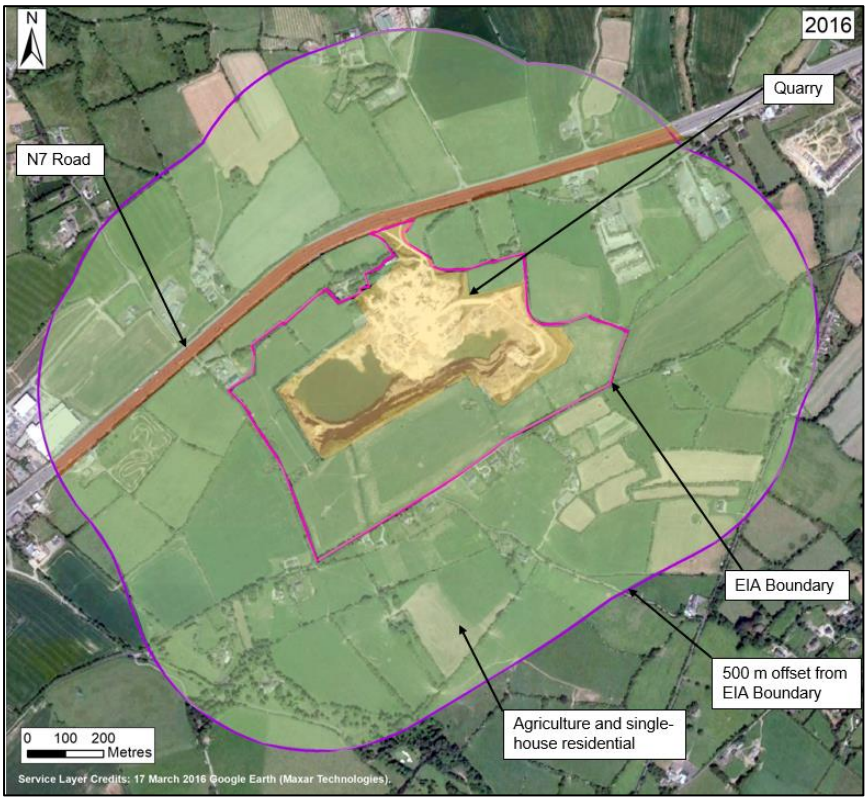

Figure 5.7: Land use during 2016 based on Google Earth aerial photography.

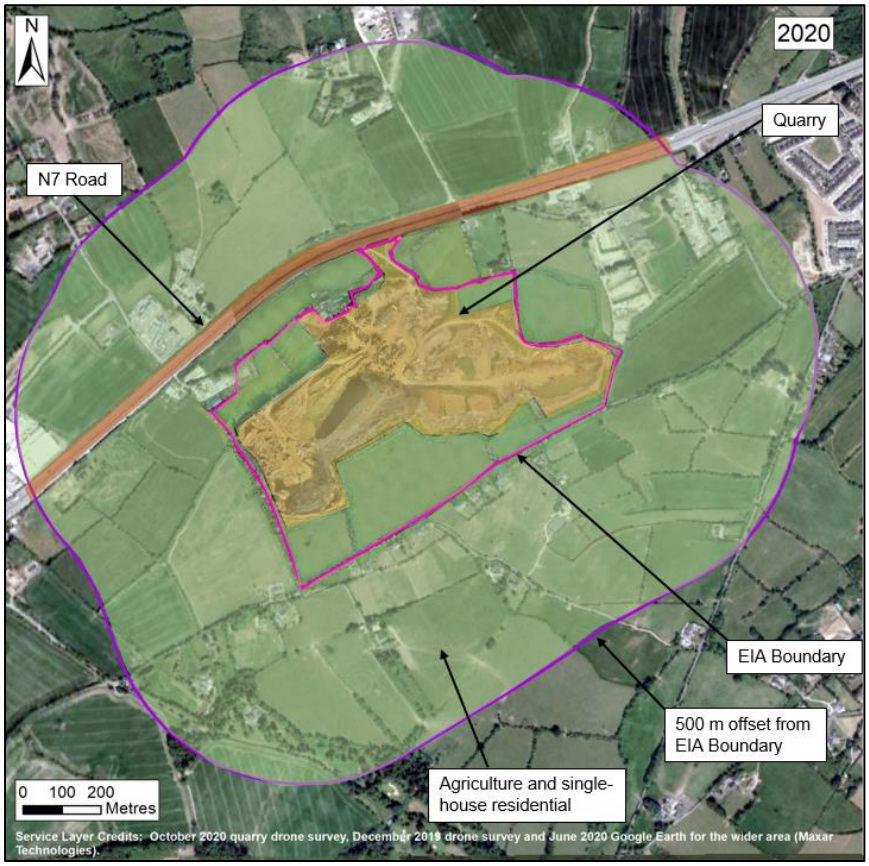

Figure 5.8: Land use during 2020 based on Google Earth aerial photography, a December 2019 drone survey of the quarry and an October 2020 drone survey of the quarry.

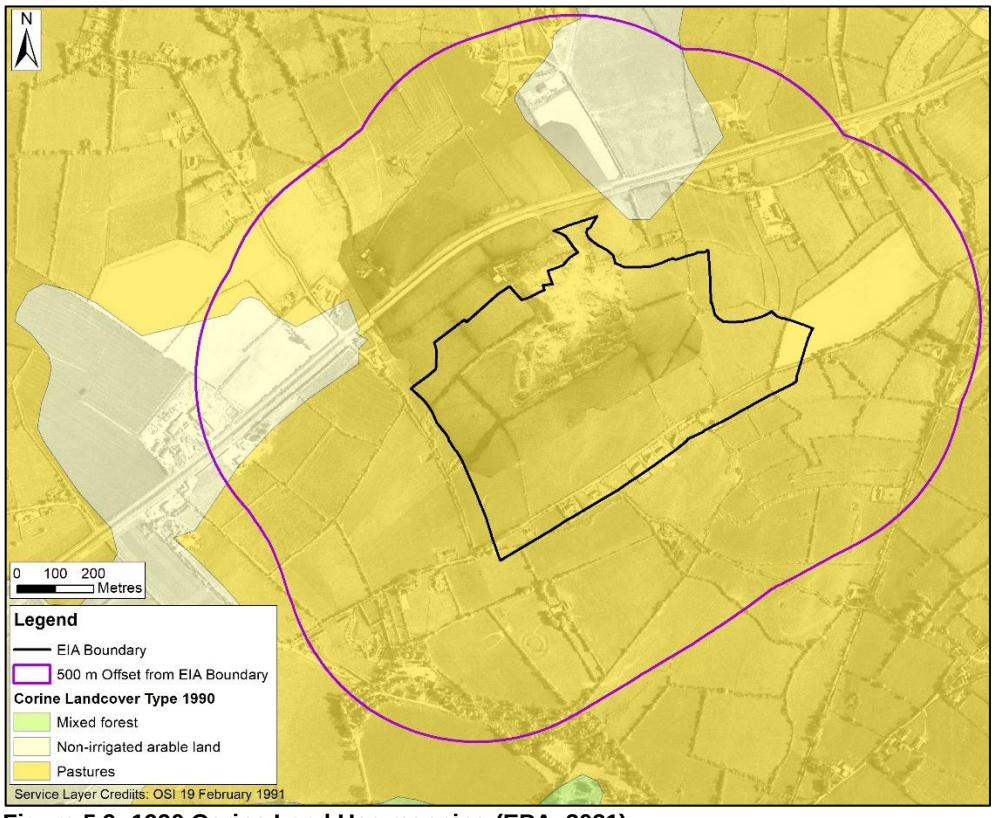

Figure 5.9: 1990 Corine Land Use mapping (EPA, 2021).

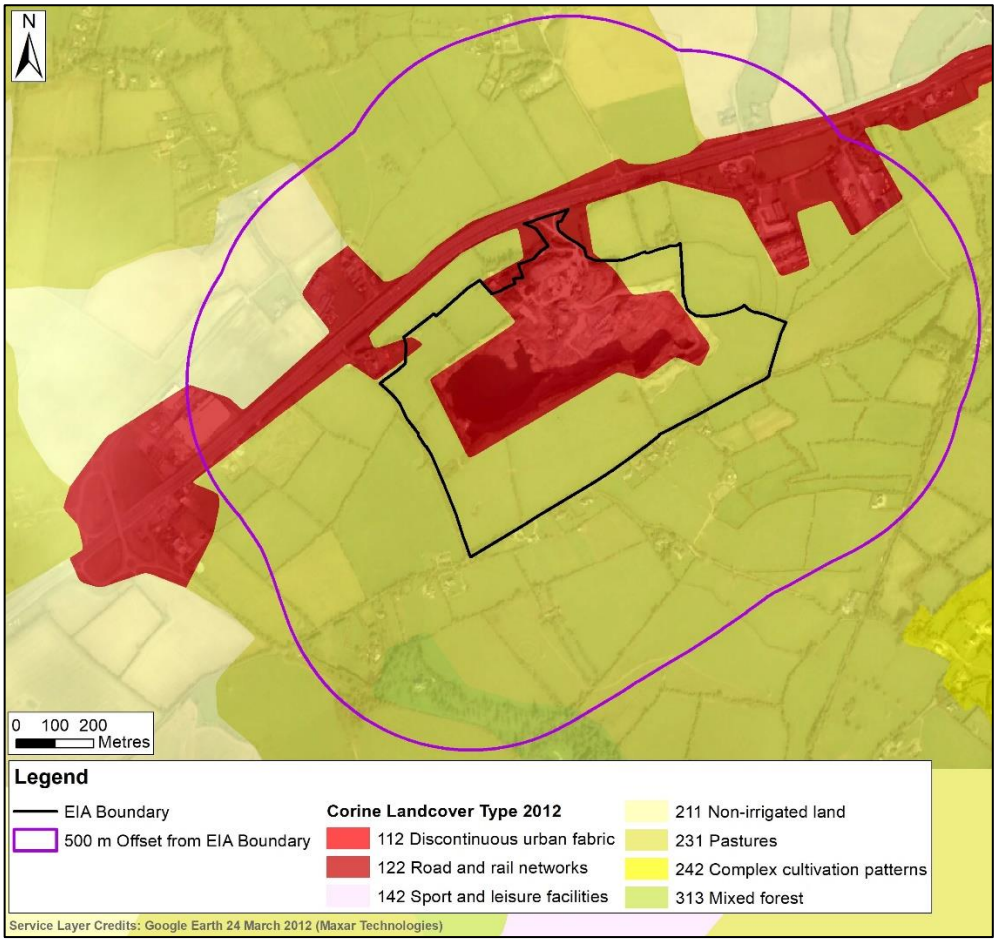

Figure 5.10: 2012 Corine Land Use mapping (EPA, 2021).

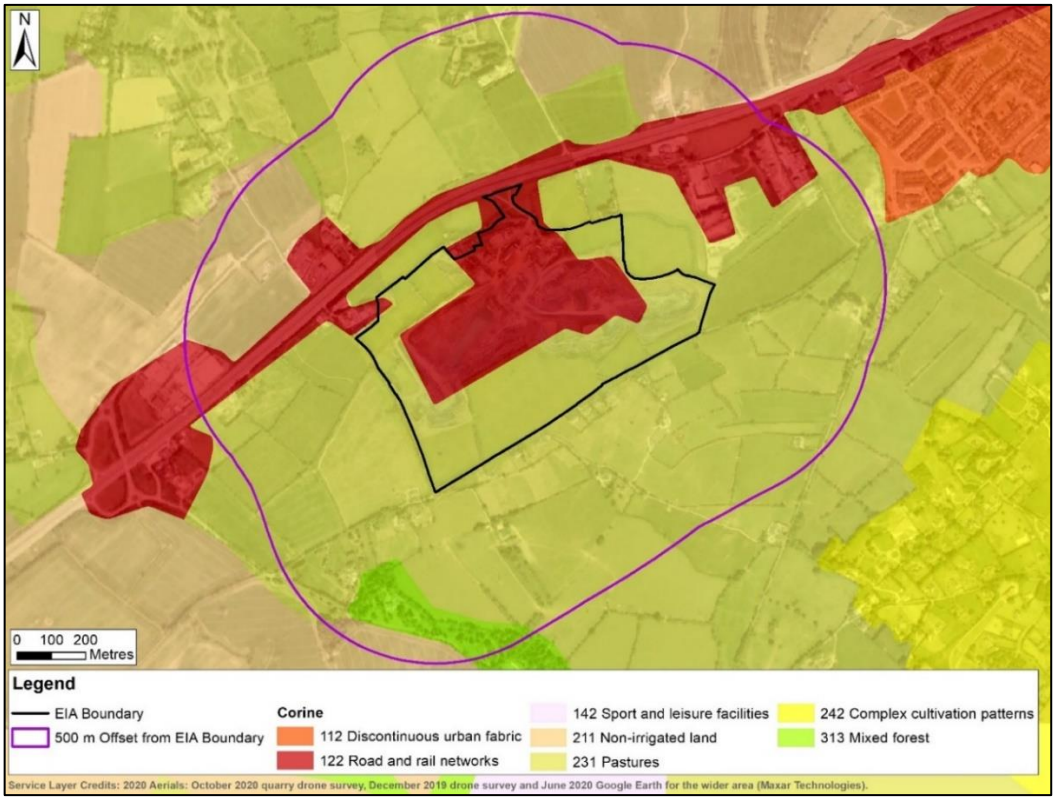

Figure 5.11: 2018 Corine Land Use mapping (EPA, 2021).

5.4.2 Superficial Geology (Soils)

There are no soils remaining in-situ in the existing extraction area due to historical extraction activities onsite. The plant site is composed of Made Ground (e.g. concrete pads, hard standing and concrete foundation areas for the plant area) overlying natural ground (soils). The north, south and west of the Site area containing agricultural fields are underlain by natural ground.

A review of the EPA's online map viewer (EPA, 2021) maps soil cover over the entire Site area, however, as stated previously some of this soil cover is no longer in-situ, therefore this soil map is more representative of the original baseline soils prior to extraction activities. The Irish Soil Information System layer (EPA, 2021) indicates that soils on the site were once compositionally uniform across much of the EIA study area, prior to extraction activities. Superficial deposits were comprised of a clayey drift with siliceous stones (Figure 5.12). These are described as having been glacial tills derived from the Silurian bedrock. Further north, by the site entrance from the N7, the soil cover is indicated as fine loamy over shale or slate bedrock.

Teagasc (2021) classifies the soils over the Site as 'Drumkeeran', which is a 'heavy' soil commonly composed of Surface-water Gleys (EPA, 2014).

A review of aerial photography in 1991 indicates that quarrying operations (including extraction, plant and ancillary areas) occupied ca.10.1 ha. A review of 2020 aerial photography indicates that this had expanded to ca. 28.8 ha.

Subsoils are mapped by the EPA (2021) as being sandstone and shale tills which had a clayey texture and is derived from Lower Paleozoic parent material around the northern perimeter of the Site and underlying the majority of the wider study area (Figure 5.13). The majority of subsoils underlying the quarry area has been mapped by the EPA (2021) as bedrock which is at surface, this extends into the south, west and east of the study area.

The GSI has created an aggregate potential map database for Ireland. This mapping database identifies overburden scores, and the database was developed during the period November 2007 and October 2013 (GSI, 2021). Within the Site the overburden score is indicated as '10', with no sand and gravel or aggregate potential identified due to the shallow depth to bedrock (noted as 0 – 1 m).

Four wells were installed in March 2020 (Figure 5.14), borehole logs for these wells identified a very thin soil cover (ca. 0.5 – 1 m thick) before encountering the bedrock interface composed of a weathered/fractured greywacke which becomes very competent with depth. The very thin soil thickness observed in the boreholes is in line with the GSI's subsoil mapping which identified bedrock at surface over the majority of the Site and it is also in line with the GSI's low score for overburden potential as no sand and gravel or aggregate potential has been identified on the Site.

The stripping of the soil cover generally took place on a phased programme in line with productivity. Approximately 18.7 ha of land has developed between 1991 and the present day, this includes extraction areas and ancillary areas (e.g. between the 2004 and 2012 aerials the entrance road was relocated along the N7 road). Using a worst-case scenario of 1 m of soil being stripped over ca. 18.7 ha during this period, ca. 187,000 m^3 has been removed. Once superficial deposits were stripped, they were reused in the creation of landscape berms to enhance screening of the quarry area.

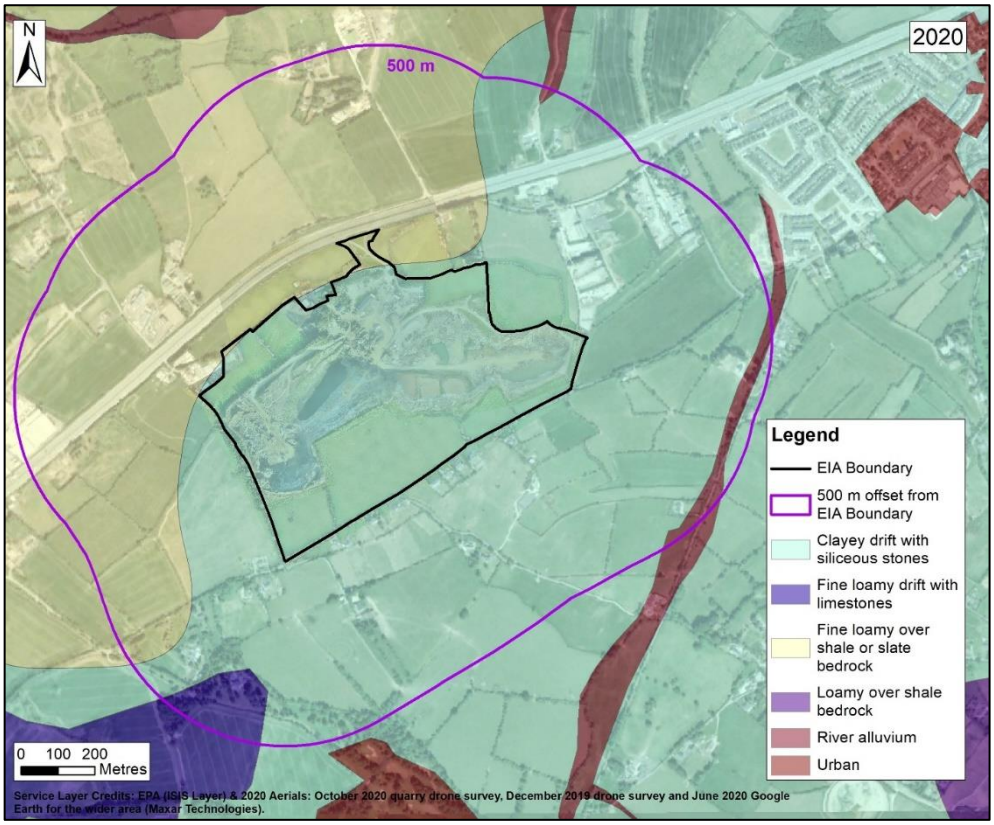

Figure 5.12: Soil mapping (EPA, 2021) overlain on the 2020 Google Earth aerial photography, a December 2019 drone survey of the quarry and an October 2020 drone survey of the quarry.

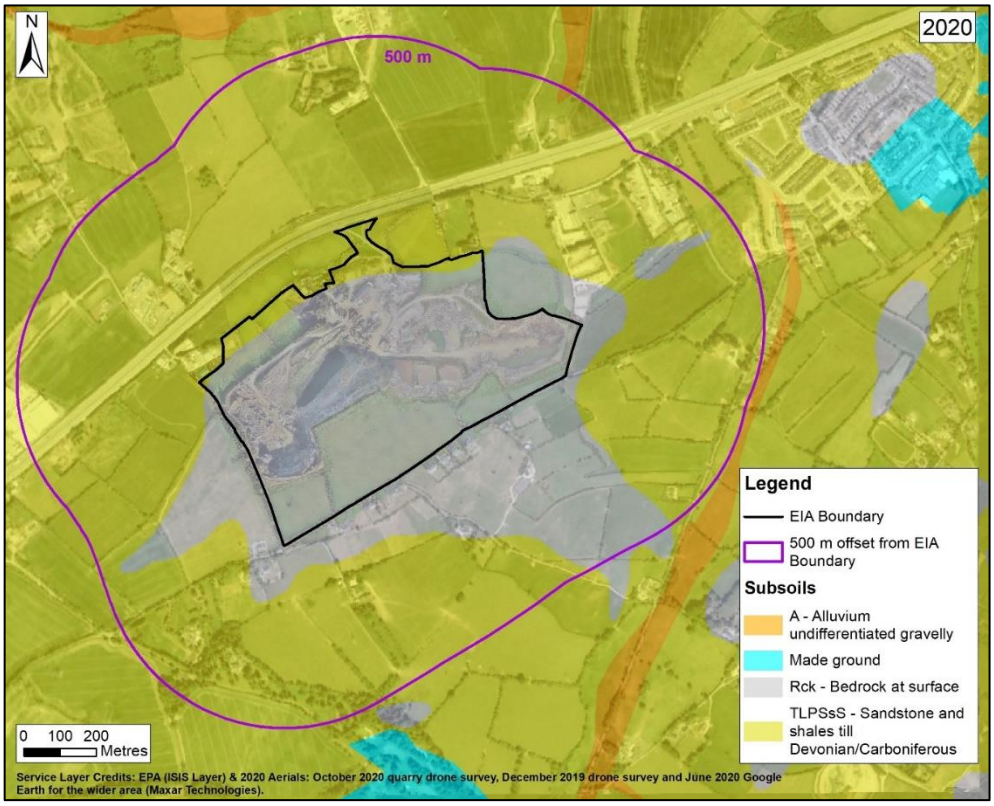

Figure 5.13: Subsoil mapping (Irish Soil Information System, EPA, 2021) overlain on the 2020 Google Earth aerial photography, a December 2019 drone survey of the quarry and an October 2020 drone survey of the quarry.

Figure 5.14: Location of boreholes drilled in March 2020 on the Site.

5.4.3 Bedrock Geology

The regional setting is one of large-scale northeast-southwest trending upward (anticline) and downward (syncline) fold features which are dissected by (predominantly) northwest-southeast trending faults. No faults are shown to cross the site (GSI, 2021).

The Site is located on the northern limb of a syncline which dips around 50° to the south east. The Site is underlain by the Carrighill formation of Silurian calcareous greywacke, siltstone and shale (Figure 5.15). This is the youngest and most fine grained of the Kilcullen group bedrock unit.

During a previous drilling programme (Cross, 2013), the rock encountered was described as a greywacke with calcite present within the quarry area and blue/brown shale within the adjoining lands. The quarry faces are described as varying from weathered in the upper faces to some slight weathering in the lower faces. The rock is described as thin to medium bedded, weathered to moderately strong, fine grained greywacke with localised inter- banding of siltstone. Zones of deformed rhyolitic rocks have been identified in the west part of the quarry.

Drilling of four water wells in March 2020 on the Site identified very shallow bedrock (ca. 0.5 – 1 mbgl) with the superficial deposit – bedrock interface composed of a weathered greywacke profile which becomes very competent and tight with depth (Appendix 5.1).

The floor of the quarry area in 1990 was ca. 158 mOD. As has been previously stated, the extraction area expanded from an initial 10.1 ha in ca. 1991 (Figure 5.2) to the current 28.8 ha. The extraction area expanded over this period first in a westerly direction up to 2000, then both western and eastern expansion occurs between 2000 and 2020 (Figure 5.4 to Figure 5.8). The current visible floor of the quarry is at ca. 150 mAOD, a water body in the western extraction has a water level of ca. 149 mAOD and a floor of 120 mAOD (Cross, 2013).

Between the period 1990 and 2020, ca. 17,500,000 tonnes of rock have been extracted with an average of 500,000 tonnes extracted per year, however, in reality annual extraction rates varied throughout the period based on economic demand. A notable high occurred during the Celtic Tiger years (2007 – 2009) with an

annual extraction rate of 1,000,000 tonnes per year. In contrast, 2010 saw annual extraction slump to ca. 50,000 tonnes and a further slump occurred in 2011 and 2012 with annual extraction rates of 10,000 tonnes each year.

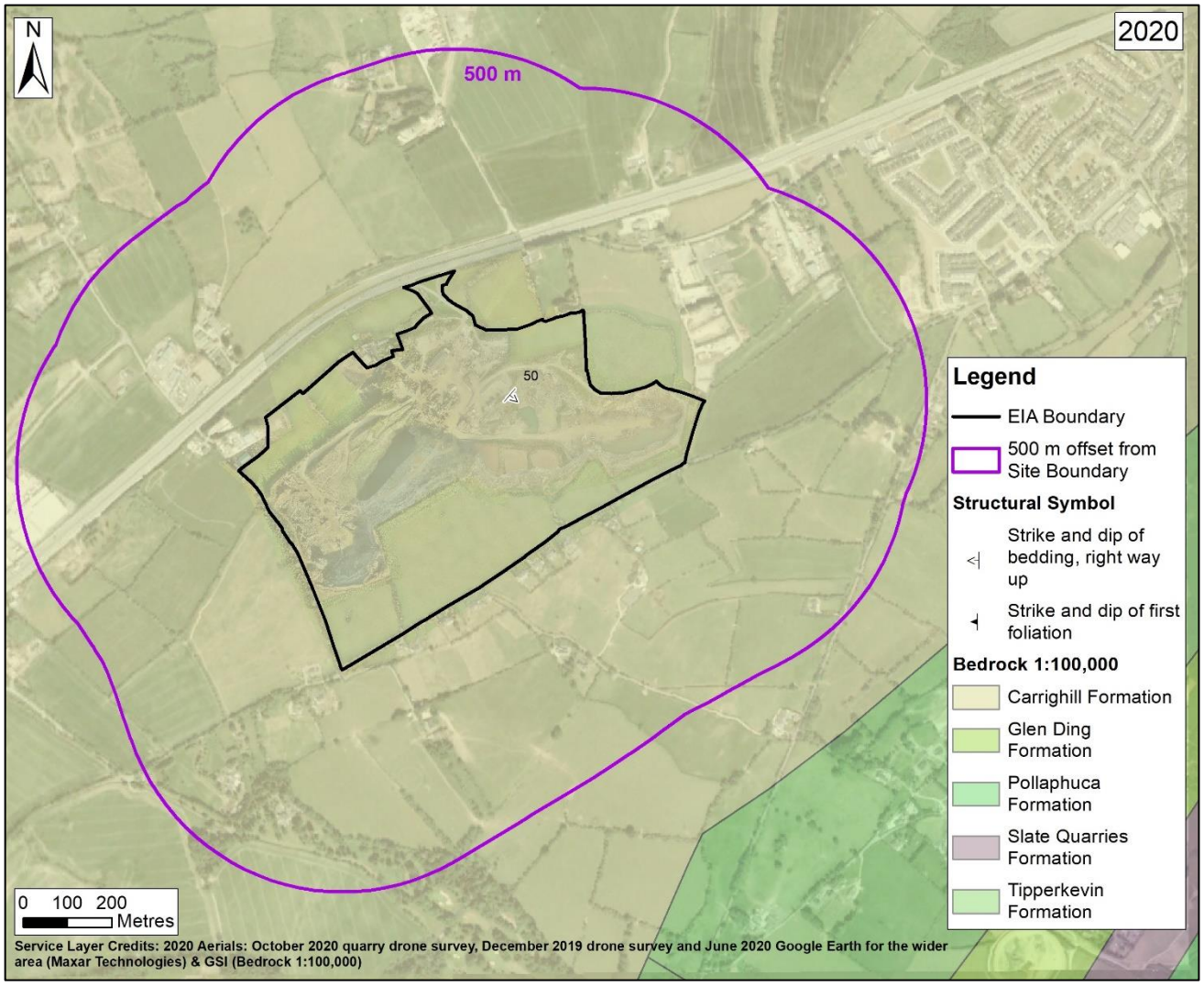

Figure 5.15: Bedrock Geology 1:100,000.

5.4.4 Geological Assets and Heritage

A review of available aerial photography for the assessment period indicates that the Site was the only extraction operation within the study area and no other designated geological assets or heritage sites were identified within the study area.

5.4.5 Geohazards

A review of the GSI's landslide susceptibility classification layer (GSI, 2021) indicates that the majority of the Site area has a classification of Moderately Low to High susceptibility. In the wider study area, the classification is Low.

The risk of instability of soils and/or bedrock which would result in a partial collapse of material can occur in a quarry environment.

Toe protection (catch-berms) is required to be put in place along the bottoms of the majority of non-active/production faces. Non-active/production faces should have their access blocked off with berms/bunds and relevant warning signage.

Silt from the water treatment plant is deposited in a series of silt lagoons located in southern part of the quarry floor. These are constructed from rock and overburden materials recovered on the Site. The lagoons are filled with silt sequentially to ensure even settlement within the ponds.

5.4.6 Radon

The Radon Map for Ireland (EPA, 2021) indicates that the Site and study area are located in an area where between 1% and 5% of homes are estimated to be above the radon reference level. A High Radon Area is classified by the EPA as any area where it is predicted that 10% or more of homes will exceed the Reference Level of 200 becquerel per cubic metre (Bq/m^3). As radon is a naturally occurring gas derived from the decay of uranium in rocks and soils which is geologically controlled, the radon reference level during the period 1990 – 2021 is unlikely to have differed from the current reference level.

5.4.7 Designated Geological Sites

There are no geological sites of interest at, or within 0.5 km of, the Site during the period 1990 - 2021 (GSI, 2021).

5.4.8 Selection of Sensitive Receptors

The changes in land use during the assessment period show that that as quarrying operations advanced, land use changed within the Site from agricultural use to extractive use and ca. 18.7 ha of agricultural land was lost during the assessment period. However, the soils are quite thin and there is limited potential for intensive farming given that much of the Site was covered by Surface-water Gleys which are considered a heavy soil for agricultural uses.

No geological heritage sites have been identified as part of the baseline. Therefore, the impacts to, and effects on, geological sites have not been considered further in this assessment.

The superficial deposits were very thin, of low importance and had low economic value. The bedrock geology beneath the Site was of medium/high economic value both locally and regionally and provided material for several developments within the area, including the N7 roadway. However, the bedrock had no special designation and was ubiquitous in the area.

Human receptors within the area (including workers onsite) had the potential to be impacted by the activities which have occurred onsite and will be considered in the context of the human health receptor.

Taking account of the above and the receptor classification method described in Section 5.3, the receptors carried forward in this assessment and their assigned importance are presented in Table 5.5.

Table 5.5: Soil, Land and Geology Receptors

Receptor	Importance and Reasoning
Superficial deposits (soil/sub-soils) at the Site and within the study area	Negligible (no designation, no rarity, local importance)
Bedrock Geology at the Site and within the study area	Medium (no designation, no rarity, medium/high economic importance)
Land (agricultural land)	Negligible (no designation, low potential and value for agricultural uses)
Human health at the Site and within the study area	High (human health receptor)

5.5 Characteristics of the Development

Historically activities carried out onsite consisted of the stripping of overburden to allow for the excavation of rock and processing onsite. During the assessment period (1990 – 2021) the extraction area expanded from an initial 10.1 ha in ca. 1991 to the 28.8 ha at present. The extraction area expanded over this period first in a westerly direction up to 2000, then both western and eastern expansion occurs between 2000 and 2020 (Figure 5.4 to Figure 5.8).

Rock was extracted by blasting and then broken up by mechanical diggers. The material was then screened, crushed and washed (when necessary) and sold as aggregate for the construction industry.

The current development application consists of a quarry over an area of 28.8 ha. with a current average working depth of approximately 173 mAOD and final floor of approximately 150 mAOD. The reserve consists of sandstone (greywacke) and is extracted by blasting and mechanical means. The excavated material is crushed at the working face by mobile plant and transported to a central plant area for washing, grading and processing. The quarry is accessed at a single location from the N7 and holds a centrally located existing administration and processing plant area over approximately 5 ha. that currently holds 2 no. office buildings, 4 no. portacabins, 4 no. containers, 2 no. storage / maintenance sheds, a storage / drying shed, water recycling unit and silt press, an asphalt plant, a concrete plant and washing, crushing, screening and bagging plants. Also, within this plant and administration area are 2 no. weighbridges, 4 no. wheel washes, fuel storage and refuelling area, 2 no. water wells and sewage holding tank. The concrete plant and the storage / drying shed within this central administration and processing plant area have been erected within the last three years and are not part of this application. They will be the subject of a separate planning application process.

5.5.1 Embedded Mitigation

The initial assessment of the significance of potential effects resulting from the Development takes into consideration any embedded design and implemented Site management practices undertaken during the assessment period of 1990 to 2021. The elements of the Development design and good working practices that reduce the potential for impacts to soils and geology included the following:

- Site operations are managed in accordance with relevant health and Safety legislation (Safety, Health & Welfare at Work Act (2005, as amended); and the Mines and Quarries Act (1965, as amended)) and subsequent Quarries Regulations relating to safety health and safety, training, appropriate site management;
- Fencing is actively maintained at the Site to ensure that the risk of injury to civilians and livestock is minimised. The entrance gate is locked and controlled by the sites' management;
- Exposed edges in the quarry are protected with safety berms;
- Blasting takes place at the Site using licenced and experienced operators. Site management give advance notification of blast events to nearby residents as is standard procedure for the existing quarry;
- The implementation of Site management practices to mitigate the impact to the water environment, as identified in Chapter 6 of this rEIAR, including:
  - Safe storage and handling of hazardous substances;
  - Maintenance of equipment and plan to ensure there are no leakages of fuels, oils and potentially contaminating substances;
- The removal of soils was conducted in phases over the period of 1990 to 2021 to reduce the overall potential impact on the land use and underlying groundwater;

- Refuelling and the addition of hydraulic oils or lubricants to vehicles or generators takes place on-site in designated areas.

5.6 Potential Effects

The main potential impacts and associated effects that will be considered in the assessment relate to the following:

- Activities or events that might have impacted land quality (e.g. leaks and spills from machinery or stored substances, or discharges);
- Change of land use/land take (i.e. loss of agricultural lands);
- Loss of superficial deposits and bedrock; and
- Destabilisation and/or subsidence of unconsolidated soils, sub-soils or rock faces;

These are considered and assessed in the following sections. Due to the nature of the rEIAR and Substitute Consent process, a 'Do Nothing Scenario' has not been considered.

5.6.1 Land Quality

Fuel and other substance leaks or spills from stored substances or from machinery/equipment used during development could have affected the chemistry of the soil (where it was still in-situ) or infiltrated the groundwater through the bedrock.

A review of water quality during the assessment period (refer to Chapter 6) indicates that groundwater quality is generally good. In this Chapter, the magnitudes associated with the potential impacts at the Site were assigned either a negligible or low value due to:

- Limited off-Site hydraulic connectivity of groundwater has limited the migration of contaminants from the Site and localised the drawdown to areas immediately adjacent to the excavated areas throughout the review period;
- Low or undetected concentrations of hydrocarbons in groundwater and surface water throughout the review period and the presence of embedded mitigation to prevent contaminant migration;
- No exceedances of surface water EQS threshold values for inland waters and generally good quality of water in the River Griffeen observed throughout the review period (Appendix 6.2 of Chapter 6.0);
- The estimated low volumes of discharge to the culvert.

The predicted potential impact on human health is **negligible (adverse).**

5.6.2 Change of Land Use/Land Take

Superficial deposits have been removed and stockpiled for future site restoration throughout the life of the quarry. Superficial deposits are primarily a very thin, Surface-water Gley which is considered a heavy soil for agricultural usage and not highly productive.

A review of the historical South Dublin County Council Development Plan during the period 2011 – 2016, states the following in relation to the rural agricultural areas and extractive industries:

"Issues arising in the rural area of the County relate primarily to balancing the need for local social and economic development with protecting the area against pressures for development generated by the proximity of the city. These include leisure activities, extractive industry and landfill. Through the zoning and development

management objectives of the Plan it is the intention of the Council to protect valuable agricultural land from pressures for development not associated with these industries."

The existing quarry area occupies an area of ca. 28.8 ha, of which ca. 18.7 ha was developed between 1990 and 2021. Given the low productivity and value of the land as an agricultural resource and the resource potential of the underlying rock for use in the extractive industry, the impact on land is considered to have been **low (adverse).**

5.6.3 Loss of Superficial Deposits and Bedrock

The nature of the development involved the removal and storage of superficial deposits. The impact on these can be considered temporary in nature, as they will be stored for reuse as a fundamental part of the Site's restoration. The superficial deposits were very thin (ca. 0.5 – 1 m) and of low value locally. The magnitude of the impacts on superficial deposits is considered to have been **low (adverse).**

By the nature of quarrying the underlying deposit of rock has been removed which has resulted in a direct and irreversible impact on the Site, and this had a medium/high resource potential and was used in construction projects, including the N7 road network during the assessment period. The magnitude of the impact of the loss of bedrock at the Site is considered to have been **medium (adverse)**.

5.6.4 Geotechnical Instability

During the assessment period 1990 – 2021, only one partial face collapse was identified, and this was isolated to within the quarry area and did not impact on the surrounding lands or human receptors within the Site or beyond.

The geotechnical appraisal of the Site undertaken in 2021 identified geohazards associated with these excavation areas and the lagoons.

The report recommended the emplacement of a catch-berm in a section to the south of the quarry where a face is structurally complex and has a number of intersecting discontinuities. Other areas in the north east require attention due to loose slopes and the lagoon requires attention to avoid possible weakening.

The stability of excavations and stockpiles is considered to be **low (adverse).**

5.6.5 Evaluation of Effects

The evaluation of effects takes into account the predicted impact magnitude combined with receptor sensitivity. The evaluation of effect significance for each of the receptors (taking account of embedded mitigation) discussed above is presented in Table 5.6. As can be seen from Table 5.3, any negligible initial impact magnitude will result in a slight, not significant or imperceptible level of effect significance, which are all 'not significant'. Therefore, Table 5.6 only includes those sources of impact that may result in a low to high initial impact magnitude.

Table 5.6: Evaluation of Initial Impacts and their Effect Significance

Receptor	Sensitivity	Source of Impact/Description of Change*	Impact Magnitude*	Level of Effect *
Superficial deposits (soil/sub-soils) at the Site and within the Study Area	Negligible	Removal of superficial deposits at the Site	Low (adverse)	Slight
Bedrock Geology at the Site and within the Study Area	Medium	Removal of bedrock at the Site	Medium (adverse)	Moderate
Geohazards	Low	Geotechnical instability of quarry faces and slopes.	Low (adverse)	Slight
Land (agricultural land)	Negligible	Change in land use by the advancement of the extraction area through time and a loss of agricultural lands	Low (adverse)	Slight

* Taking account of embedded mitigation

5.7 `Cumulative Impacts

Throughout the assessment period quarrying activities have taken place ca. 7 km to the north-east of the Site at the Belgard Quarry. This quarry has carried out similar extractive and ancillary processes as the Site and therefore has been considered in relation to potential cumulative impacts during this period. It should be noted that during the assessment period the Belgard Quarry has been a larger scale development when compared with the subject Site. Given the distances between the developments it is considered that there have been no cumulative effects of their activities on the surrounding environment in terms of land, soils and geology.

5.8 Remedial Mitigation

Remedial mitigation measures shall include:

- Toe protection (catch-berms) are required to be put in place along the bottoms of the majority of non-active/production faces. Non-active/production faces should have their access blocked off with berms/bunds and relevant warning signage;
- Recommendations in geotechnical appraisals shall be implemented accordingly; and
- Geotechnical appraisals shall be carried out at the appropriate frequency identified in the Health and Safety Authority's, 2008, 'Guidelines to the Safety, Health and Welfare at Work (Quarries) Regulations', or as identified in current appraisals.

5.9 Residual Effects

The assessment concludes that the existing Development has not given rise to significant adverse effects on the land, soil or geology at or surrounding the Site during the assessment period of 1990 to 2021. In all cases the residual adverse effect is **Not Significant and not greater than Moderate**.

5.10 Monitoring

The ongoing monitoring programme at the Site will include regular stability surveys of the quarry faces and regular monitoring of groundwater quality in monitoring wells.

5.11 References

Department of the Environment, Quarries and Ancillary Activities, Guidelines for Planning Authorities 2004.

Environmental Impact Assessments of Projects Guidance on the Preparation of the Environmental Impact Assessment Report (Directive 2011/92/EU as amended by 2014/52/EU). European Commission 2018.

Environmental Protection Agency (EPA), 2021: Online Mapping - https://gis.epa.ie/EPAMaps/ accessed 22 February 2021.

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Geological, Groundwater and Hydrological Assessment (2020). Viridus.

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South Dublin County Council Development Plan 2011 – 2016 (2011). South Dublin County Council.

South Dublin County Council Development Plan 2016 – 2022.

Teagasc Soils Guide, (2021): Online guide - http://gis.teagasc.ie/soils/soilguide.php?series_id=0700DK. Accessed 4 March 2021.

Windmill Hill Remedial Environmental Impact Statement, 2013. Cross Architect and Building Surveyor and Byrne Environmental Consulting Ltd.

APPENDIX 5.1

Borehole Logs

Drillhole ID:	**BH1**	**Client**	**Behan's Quarry**
Collar Easting	699,497.30	**Status:**	Drilling
Collar Northing	725,650.80	**Start date:**	16-Mar-20
Collar Elev_mAOD	174.75	**Finish date:**	17-Mar-20
Dip (deg)	-90	**EOH (m)**	33.0 m

Driller: Leo Dempsey

From (m)	To (m)	Interval (m)	Code	Description
0.00	0.50	0.50	OB	**OB** - clayey drift with siliceous stones
0.50	2.50	2.00	wGW	**Weathered Greywacke** - thin to medium bedded, weathered, fine grained greywacke with localised inter-banding of siltstone.
2.50	33.00	30.50	GW	**Greywacke** - thin to medium bedded, moderately strong to strong, fine grained greywacke with localised inter- banding of siltstone.
				Water make at ca. 26 m (ca. 200 gallons/hr)
				Installation: 6.5m solid at base, followed by 6m screen from 26.5m, followed by 20.5m of solid screen, backfilled with pea gravel & bentonite seal
33.00				**Final Depth**

GOLDER

Drillhole ID:	**BH2**	**Client**	**Behan's Quarry**
Collar Easting	700,126.80	**Status:**	Drilling
Collar Northing	725,954.30	**Start date:**	18-Mar-20
Collar Elev_mAOD	174.91	**Finish date:**	19-Mar-20
Dip (deg)	-90	**EOH (m)**	72.0 m

Driller: Leo Dempsey

From (m)	To (m)	Interval (m)	Code	Description
0.00	0.75	0.75	OB	**OB** - clayey drift with siliceous stones
0.75	1.50	0.75	wGW	**Weathered Greywacke** - thin to medium bedded, weathered, fine grained greywacke with localised inter-banding of siltstone.
1.50	72.00	70.50	GW	**Greywacke** - thin to medium bedded, moderately strong to strong, fine grained greywacke with localised inter- banding of siltstone.
				Water make at ca. 64 m (ca. 400 gallons/hr)
				Installation: 6m solid at base, followed by 6m screen from 66m, followed by 60m of solid screen, backfilled with pea gravel & bentonite seal
72.00				**Final Depth**

GOLDER

Drillhole ID:	**BH3**	**Client**	**Behan's Quarry**
Collar Easting	699,691.40	**Status:**	Drilling
Collar Northing	725,930.40	**Start date:**	20-Mar-20
Collar Elev_mAOD	160.64	**Finish date:**	23-Mar-20
Dip (deg)	-90	**EOH (m)**	36.0 m

Driller: **Leo Dempsey**

From (m)	To (m)	Interval (m)	Code	Description
0.00	0.00	0.00	OB	**OB** - clayey drift with siliceous stones
0.00	1.50	1.50	wGW	**Weathered Greywacke** - thin to medium bedded, weathered, fine grained greywacke with localised inter-banding of siltstone.
1.50	36.00	34.50	GW	**Greywacke** - thin to medium bedded, moderately strong to strong, fine grained greywacke with localised inter- banding of siltstone.
				Water make at ca. 22 m (ca. 300 gallons/hr)
				Installation: 11m solid at base, followed by 6m screen from 25m, followed by 19m of solid screen, backfilled with pea gravel & bentonite seal
36.00				**Final Depth**

GOLDER

Drillhole ID:	**BH4**	**Client**	**Behan's Quarry**
Collar Easting	700,211.40	**Status:**	Drilling
Collar Northing	725,611.60	**Start date:**	24-Mar-20
Collar Elev_mAOD	194.57	**Finish date:**	26-Mar-20
Dip (deg)	-90	**EOH (m)**	146.0 m

Driller: **Leo Dempsey**

From (m)	To (m)	Interval (m)	Code	Description
0.00	0.50	0.50	OB	**OB** - clayey drift with siliceous stones
0.50	2.00	1.50	wGW	**Weathered Greywacke** - thin to medium bedded, weathered, fine grained greywacke with localised inter-banding of siltstone.
2.00	146.00	144.00	GW	**Greywacke** - thin to medium bedded, moderately strong to strong, fine grained greywacke with localised inter- banding of siltstone.
				Water make between 75-80m (ca. 10-20 gallons/hr)
				Installation: No piezometer - steel casing to 6m, then OH to 146m
146.00				**Final Depth**

GOLDER