7.0 LAND, SOILS AND GEOLOGY

7.1 Introduction

This 'Lands, Soils & Geology' chapter of the Environmental Impact Assessment Report (EIAR) has been prepared for a proposed development area within an existing, operational, limestone quarry at Killaskillen, Kinnegad, Co. Meath.

The study area, as proposed for development in this application and evaluation, is already a worked limestone zone in which the limestone has been extracted from ground level to an elevation of c. 70m OD. The application site is already part of an overall site whose operations are overseen by the EPA and activities controlled in an Industrial Emissions (IE) Licence Ref. P0487-07 for Breedon Cement Ireland Ltd. (referred to in the report as Breedon). The IE Licence replaces the former IPPC licence. Therefore, operations, emissions and discharges are regulated.

7.1.1 Statement of Authority

The evaluation of lands, soils and geology and the assessment of impacts was completed collaboratively by P.Geol Pat Breheny, Dr. Colin O'Reilly and Dr. Pamela Bartley.

Pat Breheny MSc (Hydrogeology) PGeo. has 12 years of post-graduate experience in environmental consultancy specialising in hydrogeology, hydrology and contaminated land. Patrick holds a Master of Science Degree (MSc) in Hydrogeology (University of Leeds, UK). He is a member of the International Association of Hydrogeologists (IAH) and is a Chartered Geologist (IGI). Patrick's key skills and experience include site investigation, groundwater resource risk assessment and remediation, environmental permitting and groundwater remediation projects.

Dr. Colin O'Reilly has a doctorate degree in soil's systems and hydrology. He has over 20 years of professional and field-based experience as a hydrogeologist. Colin's company is Envirologic, which has key competencies in hydrogeology and hydrology with expertise in flood assessments in addition to assessment of quarries across a range of diverse hydrogeological conditions across Ireland. Colin is a current and active member of Engineers Ireland and International Association of Hydrogeologists (Irish Group).

Dr. Pamela Bartley is a water focussed civil engineer with 24 year's field-based practice in groundwater, surface water and wastewater. Pamela completed her primary degree in Civil Engineering at Queen's University, Belfast and postgraduate education at the School of Civil Engineering at Trinity College, Dublin. She completed an MSc. in Environmental Engineering at the School of Civil Engineering with geotechnical, hydrogeological and legislation specialities and later a hydrogeologically focussed Ph.D at TCD. Pamela has become a specialist in quarry and discharge evaluations in the context of enacted Irish Regulation and EU Directives. She has completed impact assessments for many regionally important quarries in SAC settings. Pamela's significant quarry assessments of note include Bennettsbridge Limestone, Co. Kilkenny, McGrath's Limestone of Cong, Cos. Galway and Mayo, Cassidy's of Buncrana, Co. Donegal, Harrington's of Turlough, Co. Mayo, Ardgaineen, Co. Galway and Mortimer's of Belclare, Co. Galway. Each of these quarries operate within SAC catchments and have successfully managed their discharge, under licence, for many years.

7.1.2 Site Location

As described in more detail in Chapter 2 of this EIAR, the subject site is located in the townland of Killaskillen, Kinnegad, Co. Meath. The application site and the entire landholding of the applicant are presented as Figure 7.1 with this Lands, Soils & Geology Chapter.

Breedon Cement Ireland Ltd. (Breedon) is the owner and operator of the site at Kinnegad. The overall landholding extends to c. 286ha and sits in the townlands of Killaskillen, Cappaboggan and Toor. The site is located directly south of the M6 Dublin-Galway motorway and 700m southwest of Junction 2, which serves the nearby town of Kinnegad at a distance of 1.5km to the northeast. The eastern boundary of the site is defined by a local road (L8021) which provides access to the small settlement of Ballinabracken, positioned 400m beyond the southern site boundary.

7.1.3 Project Description

As described in more detail in Chapter 3, the proposed development involves the deepening of c. 4.13ha of an area on the northwestern boundary of the main working floor of the existing limestone quarry. The area proposed for development is already a worked limestone zone in which the limestone has been extracted from ground level to an elevation of 70m OD (TA/900603). The proposal under consideration here is to deepen an area of 4.13ha from an elevation of 70m OD to 10m OD, which equates to 4 no. 15m extractive benches. This proposal is deemed necessary for the efficient functioning of the main quarry floor area, which is already permitted under Planning Ref. 98/2026 (An Bord Pleanála Ref. PL17.111198) to a depth of 10m OD.

7.1.4 Consultations

Breedon Cement Ireland Ltd. retained Tom Phillips + Associates (Town Planning Consultants), to prepare a planning application for proposed development at their existing quarry at Kinnegad, Co. Meath.

Tom Phillips + Associates (Town Planning Consultants) managed all pre-planning discussions with Meath County Council, as per the provisions of Section 247 of the Planning and Development Acts 2000, as amended, and all stakeholders. Hydro-G and Envirologic requested that Tom Phillips + Associates (Town Planning Consultants) issue the project description and preliminary findings to the Geological Survey of Ireland (GSI) who responded on 30th May 2022. Key points from the consultation are reproduced, as follows:

- The GSI encourages use of and reference to their publicly available datasets
- The quarry at Killaskillen is not a geological heritage site and there are no County Geological Sites (CGS's) in the vicinity of the proposed development.
- The groundwater data viewer indicates that the area is underlain by an aquifer classed as a 'Locally Important Aquifer – bedrock which is generally moderately productive only in local zones'. The GSI recommend that the groundwater viewer is used to identify areas of High to Extreme vulnerability and 'rock at or close to surface' in the assessment, as any groundwater-surface water interactions that might occur would be greatest in these areas.

The authors of this chapter hereby confirm that this EIAR chapter and Impact Assessment has utilised all relevant and publicly available datasets available from the GSI.

7.2 Assessment Methodology

The methodology adopted for this assessment is as follows:

- Review of appropriate guidance and legislation
- Characterisation of the receiving soils and geological environment
- Review of the 'Subject' development
- Assessment of Potential Effects
- Identification of Mitigation Measures and
- Assessment of Residual Impacts

7.2.1 Relevant Guidance

This report was prepared with consideration of the following legislation and guidance, listed as follows:

- *EIA Directive (2014/52/EU) DIRECTIVE 2014/52/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment.*
- *European Union (2017) Environmental Impact Assessment of Projects. Guidance on the preparation of the Environmental Impact Assessment Report (Directive 2011/92/EU as amended by 2014/52/EU).*
- *Guidelines on the Information to be contained in Environmental Impact Assessment Reports*. Environmental Protection Agency (2022).
- *Guidelines on the information to be contained in Environmental Impact Statements*. Environmental Protection Agency (2002).
- *Geology in Environmental Impact Statements: A Guide*. Institute of Geologists of Ireland (2002).
- *Quarries and Ancillary Activities: Guidelines for Planning Authorities*. Department of Environment, Heritage and Local Government (2004).
- *Reclamation Planning in Hard Rock Quarries*. Department of Civil & Structural Engineering, University of Sheffield and Edge Consultants, Mineral Industry Research Org. (2004).
- *Environmental Management Guidelines for the Extractive Industry (Non-Scheduled Minerals)*. Environmental Protection Agency (2006).
- *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes*. Transport Infrastructure Ireland (undated, c. 2009). https://www.tii.ie/technical-services/environment/planning/Guidelines-on-Procedures-for-Assessment-and-Treatment-of-Geology-Hydrology-and-Hydrogeology-for-National-Road-Schemes.pdf
- *Guidelines for the Preparation of Soils, Geology & Hydrogeology Chapters of Environmental Impact Statements*. Institute of Geologists of Ireland (2013).
- *A Quarry Design Handbook*. GWP Consultants and David Jarvis Associates Limited, UK (2014).

- *Revised guidelines on the information to be contained in Environmental Impact Statements*. Environmental Protection Agency (2015).
- *Guidelines on the information to be contained in Environmental Impact Assessment Reports*. Environmental Protection Agency (2017).
- *Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment*. Department of Housing, Planning and Local Government (2018).

7.2.2 Impact Assessment Methodology

The appraisal methodology for the EIAR is completed in accordance with "Guidelines on the Information to be contained in Environmental Impact Statement Reports" (EPA, 2022), the Institute of Geologists of Ireland (IGI) "Geology in Environmental Impact Statements, a Guide", (IGI, 2002) and "Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements" (IGI 2013). In addition, "Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes" by the National Roads Authority (NRA, 2009) is referenced where the methodology for assessment of impact is appropriate.

The procedure for determination of potential impacts on the receiving land, soil and geological environment is to identify potential receptors within the site boundary and surrounding environment and use the information gathered during the desk study and field work to assess the degree to which these receptors will be impacted upon.

Criteria for assessing importance of site attributes and their magnitude of importance were taken from the NRA Guidelines (NRA, 2009) (as included in 'Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements' (IGI, 2013)).

The rating of potential environmental impacts on the land, soils and geology environment is based on the quality, significance, duration and type of impact characteristic identified. Consideration is given to both the importance of an attribute and the magnitude of the potential environmental impacts of the proposed activities on that cited attribute.

7.2.3 Assessment of Magnitude and Significance of Impact on Land, Soils and Geology

An impact rating has been developed for each of the phases of the proposed development based on the Institute for Geologists Ireland (IGI) Guidance for the preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements. In line with the IGI Guidance the receiving environment (Geological Features) was first identified. Using the NRA rating criteria in Appendix C of the IGI Guidance the importance of the geological features is rated (Table 7.1) followed by an estimation of the magnitude of the impact (Table 7.2). This determines the significance of the impact prior to application of mitigation measures as set out in Table 7.3 of this report.

Table 7.1: Criteria for Rating Site Importance of Geological Features (NRA, 2009)

Magnitude	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 the site is significant on a national or regional scale	• Geological feature 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 the 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 the 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 the 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 • Uneconomic extractable mineral resource

The assessment of the magnitude of an impact incorporates the timing, scale, size and duration of the impact. The magnitude criteria for geological impacts are defined in Table 7.2.

Table 7.2: Criteria for Estimating Magnitude of Impact on Geology Attribute (NRA, 2008)

Magnitude	Criterion	Description and Example
Large Adverse	Results in loss of attribute	• Loss of high proportion of future quarry or pit reserves • Irreversible loss of high proportion of local high fertility soils • Removal of entirety of geological heritage feature • Requirement to excavate / remediate entire waste site

Magnitude	Criterion	Description and Example
		• Requirement to excavate and replace high proportion of peat, organic soils and/or soft mineral soils beneath alignment
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	• Loss of moderate proportion of future quarry or pit reserves • Removal of part of geological heritage feature • Irreversible loss of moderate proportion of local high fertility soils • Requirement to excavate / remediate significant proportion of waste site • Requirement to excavate and replace moderate proportion of peat, organic soils and/or soft mineral soils beneath alignment
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	• Loss of small proportion of future quarry or pit reserves • Removal of small part of geological heritage feature • Irreversible loss of small proportion of local high fertility soils and/or • high proportion of local low fertility soils • Requirement to excavate / remediate small proportion of waste site • Requirement to excavate and replace small proportion of peat, organic soils and/or soft mineral soils beneath alignment
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	No measurable changes in attributes
Minor Beneficial	Results in minor improvement of attribute quality	Minor enhancement of geological heritage feature
Moderate Beneficial	Results in moderate improvement of attribute quality	Moderate enhancement of geological heritage feature
Major Beneficial	Results in major improvement of attribute quality	Major enhancement of geological heritage feature

The matrix in Table 7.3 determines the significance of the impacts based on the site importance and magnitude of the impacts as determined by Tables 7.1 and 7.2.

Table 7.3: Criteria for Rating of Significant Environmental Impacts (NRA, 2008; IGI, 2013)

Importance of Attribute	Magnitude of impact			
	Negligible	**Small**	**Moderate**	**Large**
Extremely High	Imperceptible	Significant	Profound	Profound
Very High	Imperceptible	Significant/moderate	**Profound/significant**	Profound

High	Imperceptible	Moderate/slight	Significant/moderate	Severe/significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight/moderate

7.3 Existing Environment

The receiving environment is described here. Firstly, desktop mapping and published information is presented to describe the land, soils, underlying quaternary and bedrock geology, areas of geological heritage, areas of economic interest with respect to geological resources and potential for soil contamination.

Mapped information and databases for the site and wider region were used, as follows:

- Finch, T.F., Gardiner, M.J., Comey, A., Radford, T. 1983. *Soils of Co. Meath*. National Soil Survey of Ireland, An Foras Taluntais.
- Gardiner, M.J., Radford, T, 1980. *Soil associations of Ireland and their land use potential.* National Soil Survey of Ireland.
- GSI, 2004. Athboy Groundwater Body Report 1st Draft.
- GSI, 2004. Meath Groundwater Protection Scheme.
- GSI On-line Groundwater database. Aquifer Classification, Aquifer Vulnerability, Teagasc Soil Classification. https://dcenr.maps.arcgis.com/apps/MapSeries/
- McConnell, B., Philcox, M.E., Geraghty, M. 2001. *Sheet 13: Geology of Meath.* 1: 100,000 Bedrock Geology Map Series, Geological Survey of Ireland.
- Ordnance Survey of Ireland, 1:50,000 Discovery Map Series.
- EPA mapping https://gis.epa.ie/EPAMaps/
- EIA portal @ https://housinggovie.maps.arcgis.com/
- Google Earth Pro Historic Photography series

In addition to national available datasets and desktop available published information, this section also presents an overview of the significant body of historic site investigations at the site and the results of the current site investigation works, completed in 2021 and 2022, to support the development of the baseline environment.

Desk study, historic and current site investigation results were then used to complete an Impact Assessment, identification of required mitigation measures and presentation of residual effects, if found.

7.3.1 Land, Land Use & Topography

EPA mapping for Corine 2018 presents as follows:

- The site under consideration lies within an area mapped as "Artificial Surfaces" with the sub category Level 3 Description as "Mineral extraction sites"
- Lands surrounding the applicant's overall landholding to the north, west and east are mapped as "Agricultural", "Pasture" areas.
- Immediately south of the main quarry area and associated cement factory are mapped as "Forest and semi-natural areas"

The site under consideration sits in an existing overall landholding of c. 286ha in the townlands of Killaskillen, Cappaboggan and Toor. It lies directly south of the M6 Dublin-Galway motorway and 700m southwest of Junction 2, which serves the nearby town of Kinnegad at a distance of 1.5km to the northeast. The eastern boundary of the site is defined by a local road (L8021) which provides access to the small settlement of Ballinabracken, positioned 400m beyond the southern site boundary.

Regional topography is relatively flat and the land's surface has a general elevation in the range 70-80m OD. The relatively flat landscape is interrupted with numerous small hills but none extend higher than 100m OD. Lands higher than 100m OD tend not to be present within 10km of the site, only rising at Rhode, Gaybrook and Tyrellspass but even these hills do not exceed 150m OD. The exception is Croghan Hill, 12km to the southwest, which is a volcanic mound that rises to 234m OD.

The immediate local landscape follows this pattern with flat, low-lying areas generally being below 80m OD and small hills and ridges reaching only 95m OD. One such shallow ridge runs east-west through the centre of the site, reaching 94-95m OD prior to commencement of activities at the site. Lands north of this ridge fall very gradually towards the Kinnegad River whereas lands to the south of this ridge cover a large, flat expanse, with a slight southward gradient draining to the Castlejordan River. The Kinnegad River defines the northern site boundary while the Castlejordan River passes the site 2km to the south.

Land in the area is generally farmed as moderate intensity agricultural grassland supporting livestock production. This description applies to field plots adjoining the western, northern and eastern boundaries of ownership. Low-lying lands immediately south of the site host a narrow tract of peat bog (Toor Bog) which has an east-west length of 2km and north-south width of approximately 300m. Peat harvesting appears to have taken place in this area in the past. Relatively small pockets of forestry plantation abut parts of this peat deposit, most notably at the southwestern end. Larger bogs where peat has been mechanically stripped on in the past are present 1km to the east (Bogtown Bog) and 1.3km to the west (Derryhinch Bog).

There is a relatively low-moderate density of one-off single residences in the area, mostly aligned along local roads, with some of these having farmsteads attached. The highest cluster of dwellings occur as a linear ribbon consisting about 20 residential dwellings close to the south eastern boundary of the overall landholding at a distance of c. 1km from the application site.

Historical land uses were reviewed using Ordnance Survey (OS) maps and aerial photography, which are detailed in Table 7.4 of this report. The only features of note appear to be large country houses: (i) Lansdowne House which existed on the application site prior to any quarrying activities at the site, and (ii) Killaskillen House, to the east.

Table 7.4: Historical Land-use at the site and its surroundings

Ordinance Survey Map Reference & / or dates	On Site	Immediate Surroundings
OS 6 inch colour (1837-1842)	Small agricultural land parcels, small structures shown within current ownership boundary.	Residential and small farm holding agglomeration of buildings. Low density development. Killaskillen House shown to the east.
OS 6 inch Cassini (1845)	Landsdown Lodge shown in northern end of current limestone quarry. The site under consideration in this evaluation is the historic site of Lansdown Lodge. Gate Lodge shown at Killaskillen Crossroads, east of limestone quarry.	There are houses on all side roads and Killaskillen House to the south east.
OS 25 inch (1888-1913)		Very low density of structures.
Aerial Map 2000	Moderate intensity grassland plots around Landsdown Lodge.	Linear cluster of dwellings to southeast.
Aerial Map 2005	Limestone and shale quarrying has commenced, construction of cement plant.	Addition of several dwellings to southeast.
OSI Ortho Photo 2010	Large floor area in the main working quarry, dry floor. Cement factory is evident. Application area is partially stripped for storing vehicles on hard rock. Some vegetation remains in the application area. The site's IE Licence Settlement Ponds and final lagoons exist. Two small ponds on the floor in the southern zones.	No significant change in domestic housing density in the immediate surroundings. Large tracts of peatland have been worked and stripped at distances ~2 and 1km to the west and east of the site. Bord na Mona apply for Substitute Consent for many Bogs in the area [Application documentation suggests extraction since 2012 (EIA Portal ID 2020077). Extraction evident on 2010 aerial photo.
Aerial Photo 2014	Application area has been stripped completely and has stockpiles of broken rock. Central area of the floor of the main quarry has a large groundwater sump.	No change from above information
Aerial Photos 2017 and 2018	Same as above	Same as above wrt to local area residential development density. Small water at Gravel Pit.
Aerial Photo 2019	Application area working is finished. Bare limestone rock. Central floor is reworked and only one small sump exists.	No significant change in domestic housing density in the immediate surroundings. Gravel Pit pond is larger.

7.3.2 Soils

The primary soil types in the area are presented as Figure 7.2. Deep, well-drained grey-brown podzolics of calcareous origin lie on local ground which is slightly raised or sloping. These mineral soils were originally in-situ across much of the limestone quarry area, extending across the shale quarry and through the central part of the overall site.

Soils, as mapped in the Teagasc publication Soils of County Meath (Conry, 1987), are presented as Figure 7.3. Grey-brown podzolics belonging to the Patrickswell Series are mapped on the application area and these have been stripped already as part of quarry preparation. These soils are typically up to 0.75m deep though they tend to be thinner on the crests of kames, kettles and ridges. They are generally well-drained and well structured.

Soils tend to be poorer progressing south towards more depressed ground. Soils at the southern end of the limestone quarry are mapped as gley mineral soils (Mylerstown Series), as shown on shown in Figure 7.3.

Continuing south, the soils are mapped as peats, which are characterised by a high organic carbon content (greater that 30%) and a minimum depth of 0.3m. A distinct area of raised bog is also present to the south of the site. Raised bog peat, as found in the area, is a basin peat with a profile generally consisting of a basal layer fen or woody fen peat overlain by a layer of acid ombrogenous peat characterised by its high content of mosses and bog cotton. The majority of raised bog in the area has been cut-over and large tracts to the east and west of the site have been processed for milled peat by Bord na Mona.

7.3.3 Quaternary Geology

The parent material of the Patrickswell Soil Series is a gravelly glacial till derived predominantly from limestone with an admixture of shale (Figure 7.4). Isolated pockets of gravel are also present in the area though none are mapped within the site boundary.

Streams and drains that outfall to the Kinnegad River, along with the Kinnegad River itself, are not underlain and flanked by alluvial deposits, which infers that they may not be natural channels. In contrast the Castlejordan River to the south is underlain by alluvial deposits.

7.3.4 Bedrock Geology

According to the GSI 1:100,000 Sheet 13 Geology of Meath the limestone quarry lies almost entirely within Waulsortian (Reef) Limestone (Figure 7.5). Waulsortian limestones are massive in structure with bedding absent and are relatively free of impurities which makes them desirable for cement manufacture. They are typically pale grey and formed from mounds of calcareous mud in deep to moderate depths of water. These limestones can have steep depositional dips reflecting their original mound-form topography on the scale of a few meters to over 100 m. The mounds can be continuous or discontinuous and are referred to as ‘reefs’ or ‘mud-mounds’. Data from the GSI would suggest that the limestone is many hundreds of meters thick in this part of County Meath.

The southern extremity of the ownership boundary is underlain by the Ballysteen Formation, a limestone/shale formation which contains mudstone impurities.

Just north of the limestone quarry the Waulsortian limestones give way to the overlying Tober Colleen Formation which consists of both the Colleen Shale and Shaley Limestone seen in the Lucan Formation. The Tober Colleen is a weak, silty shale more prone to weathering than limestone and as a result is often a repository for significant amounts of organic carbon. The Tober Colleen has variable thickness and in some areas is seen to overlie the Waulsortian Reef Limestone. Near Castlerickard the Tober Colleen is approximately 100 m thick.

The northern part of the site and the region extending north is underlain by the Lucan Formation, a dark-grey, well-bedded limestone which contains chert bands and shale.

Structural faulting is mapped 2.7 km northwest, 3.5 km south and southeast of the application site.

7.3.5 Aquifer Classification

The regional bedrock aquifer classification is almost entirely a locally important aquifer which is moderately productive only in local zones (Ll).

Information relating to the aquifer classification, vulnerability, groundwater usage, wells and springs and other water related characteristics are discussed more fully in the Water Chapter. The same team completed the Lands, Soils and Geology and Water Assessments.

7.3.6 Slope Stability

No evidence of slope instability is present on the site. The nearest recorded landslide is located approximately 13km to the southeast of the site, on the North bank of the Grand Canal Edenderry.

Landslide susceptibility for the area in and around the application site is rated as “low” on the GSI mapping database. Given the gentle topography and essentially sandy soils, the area would not be expected to be affected by slope instability. As previously mentioned, the site under consideration has already been excavated by one bench and the walls present competent slopes for most of the perimeter. There is a small portion of sloped infill on the western face of the application area, but it is stable.

7.3.7 Geological Heritage

The quarry at Killaskillen is not a Geological Heritage site.

7.3.8 Minerals and Quarries

There are no active mines on or near the site.

There are no other quarries within 5km. PL2/19/25 describes an application for an 87.6ha extension to a sand and gravel pit at to apply for planning Derrygreenagh, Knockdrin, Garr and Carrick townlands, Rhode, Co. Offaly. Given the distance and different geological resource being extracted at a sand and gravel pit relative to the proposal here for bedrock extraction, sand and gravel pit sites need not be considered in this assessment.

Peat extraction occurs in the wider region.

The ‘mining’ of solar energy is becoming popular in the area. An Bord Pleanála granted permission for a substation and associated works at 5km to the south at Harristown, Castlejordan and Clongall Co. Meath (ABP-307136) and the adjacent, associated, solar farm was granted permission by Meath County Council (TA181225).

An application for planning permission for a solar farm has been lodged by the applicant to the east (PL 22/958). Given the nature of solar farm developments being positioned on the land surface, there is no potential for in combination effects with the hard rock application area that is already c. 15m underground.

7.3.9 Soil Contamination

Emissions from the machinery and vehicles may enter the ground. Mitigation measures presented in the following section will ensure that bedrock and groundwater is adequately protected from operations at the site. The site is already one bench below ground level and hence there are no soils or subsoils that could get contaminated.

7.3.10 Baseline Existing Historical Site Investigation Information

Several environmental impact assessments have been carried out in connection with various planning applications at the site over the past 20 years. Substantive historical site investigation works have been carried out to support these assessments. It is not intended to present a comprehensive summary of all previous works herein but rather aspects deemed relevant to the current application. Hence focus was given to historical investigations in the northern part of the limestone quarry to assist with the assessment of the development works currently proposed.

The locations of selected historic boreholes drilled to support previous planning applications have been superimposed onto Figure 7.6. These historic SI locations were installed for in 1998 for PL98/2026 and TA/900603 in 2009. Of the wells drilled in 1998, LANS4 and LANS5 were within the current application site. Of the wells drilled in 2008 BH01 and MW05 were within the current application site. The majority of boreholes drilled in 1998 and 2008 have since been decommissioned. The reported information remains usable.

7.3.10.1 Historical Site Investigation: Soils & Subsoils

Prior to development of the application area, the mineral soils at the site were described as a peaty sandy clay with depths of 0.5 to 0.75m and overlying a sticky boulder clay. Superficial deposits of boulder clay across the limestone quarry area were continuous and noted as being between 1.5 to 7.5 m thick, being deepest at the southern end of the site. Overburden depth was logged as being only 1.71m thick at BH ID LANS4 (refer to Figure 7.6).

Subsoil depths in the shale quarry area, which is north to northeast of the application area, were logged as 10.6m thick. Peats are present at depths of up to 4m at the southern end of the overall main working quarry site and at a distance of 1km, approximately, from the application area.

Some sand and gravel deposits are present in the northern portion of the overall landholding and at a distance of 0.75km, approximately, to the northeast of the application area. These have been partially worked out with material mainly used in the construction of internal roads.

With respect to the current application the area, where deepening is proposed, it has already been stripped of overburden and the rock has been extracted by one bench, hence there will be no impact to soils and subsoils.

7.3.10.2 Historical Site Investigation: Bedrock

Historical site investigations and mapping suggests that there are three types of primary bedrock formations across the site, as follows:

- Very high-quality Reef Limestone (Waulsortian Limestones) [south of internal access road]
- Silty Shale (Tober Colleen Formation) to the north of the internal access road
- Shaley Limestones (Lucan Formation) to the north of the internal access road.

Records for the boreholes drilled in 1998 across the application area report Waulsortian Limestone only. Refer to Figure 7.6 for locations of all historic boreholes. No clay bands or silts were identified in the Waulsortian Limestones during geological coring. The limestones are therefore considered to be homogenous.

Of those boreholes drilled in 2008, MW05A, MW05B and BH01 were drilled within the current application area. Summary details are presented in Table 7.5. A column in Table 7.5 provides the elevation of the base of the drilled holes and the information suggests that MW05B was drilled to beneath the target depth within the application area and five BHs were drilled to beneath the proposed development elevation outside the application area. Logs for the 2008 boreholes located in the application area are included as Appendix 7.A. Lithological profiles of other wells drilled across the entire landholding in 2008 were evaluated, integrated into this assessment, and are also summarised in Table 7.5. Information suggests that all but BH01 provide bedrock information to elevations significantly deeper than the 10m OD proposed elevation of the application area. It is therefore concluded that there are sufficient data for the area surrounding the application area.

The log for MW05 (Appendix 7.A) shows that the upper 3 m of limestone bedrock was broken. Beneath this, competent limestone to a depth of 84m was present. The historic SI information for the BHs relates to drilling in virgin land for permission to extract the bedrock that is now gone and the land elevation for the well head was 85m OD, approximately. For example, the 84m drilled depth for MW05B would describe the proposed application area from the BH log depths of 14m bgl, approximately, to 74m bgl. The Log for MW05B describes the rock to below the proposed final elevation of the floor in this application area (Appendix 7A). No water strikes are reported. Solid limestone is reported.

The locations of long-term monitoring wells are shown in Figure 7.7. Borehole logs are not available for many of these locations because they are private domestic wells predating the applicant's time. The long-term monitoring wells are therefore not useful for the Lands, Soils and Geology Section but are important for the Water Assessment.

Table 7.5: Summary of Geological Information reported in 2008 well drilling programme

Well Ref.	Easting	Northing	Location	Ground Level (m OD)	Top of Casing (m OD)	Drilled Depth (m)	Base Elev (m OD)	Lithology
MW05A	657,000	743,335	Adjacent to western side of Balancing Pond	86.80	87.44	39	47.8	Dark grey limestone
MW05B	657,000	743,335	Inside the application area, NE corner. Adjacent to western side of Balancing Pond	86.80	87.44	84	2.8	Dark grey limestone
BH01	657,053	743,177	Within the application area	84.97	85.76	36	48.97	Medium grey limestone
MW01	656,320	744,083	1km NW of the application area	77.86	78.30	84	-6.14	0 – 36m = Gravelly shale 36 – 69m = limestone 69 – 84m = limestone/ shale Well collapsed 33m
MW02	657,427	743,571	<500m NE of the application area and lies between the limestone and shale quarries	77.1	77.77	84	-6.9	Medium grey limestone
MW03	658,021	742,445	SE corner of overall ownership boundary. ~1km SE of the application area.	85.35	85.89	84	1.35	Medium grey limestone
MW04	657,392	741,697	Southern end of ownership boundary. >1km to the south of the application area and across other side of peats.	85.47	86.31	84	1.47	0 – 66m = Dark grey limestone 66 – 84m = Black shale
PW01	657,788	742,407	southern end of main limestone quarry	85.34	85.85	90	-4.66	Medium grey limestone with calcite. Sticky clay @ 48-51m & 75-89m

(Driller: Dunnes Drilling; Supervisor: TMS)

7.3.11 Site Investigations

Having performed a desktop study and analysis of all the relevant historical site investigation data, a programme of works was developed to carry out supplementary intrusive site investigation works. A thorough site walkover informed intrusive field investigation studies, which are now described.

7.3.11.1 Quarry Bedrock Exposures

Along with the quarry manager, the project hydrogeologists inspected the quarry faces in various seasons and rainfall recharge events on numerous occasions in 2021/2022.

The application area has previously been excavated by a single bench (Plate 7.1) and as such current quarry floor elevations are c. 70m OD across this area.

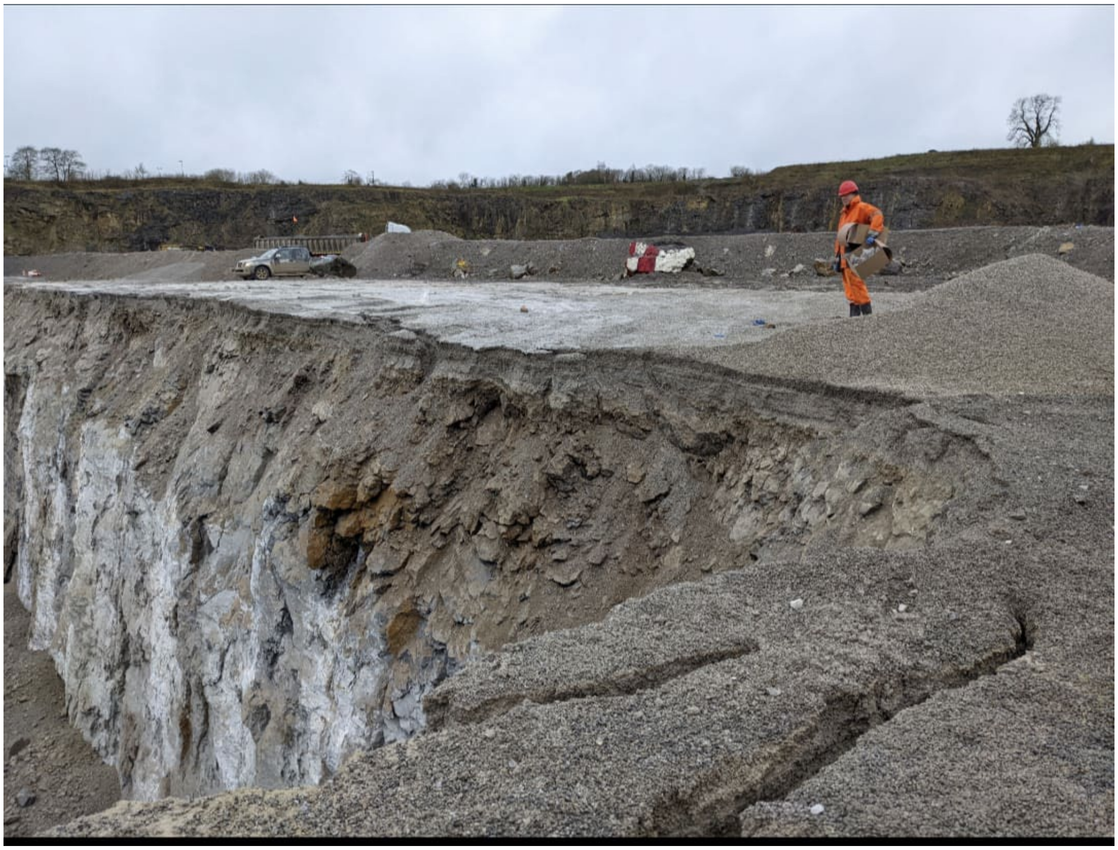
The exposed faces revealed relatively clean, competent limestone, generally massive in structure. Bedrock just below undisturbed ground level displays slightly more weathering but no epikarst was observed. No regular bedding or jointing is present. Some deformation is shown in the centre of Plate 7.1. Apex geologists refer to the structure of this wall as evidence of faulting in this area.

The floor of the application area was always dry, which is expected because it sits elevated and adjacent to the main working area of the limestone quarry. Direct observation shows that the floor of the application area is loose and broken rock to a depth of approximately 3 metres, which understood to be a result of traffic and material’s stockpiling at the site.

Plate 7.1 Exposure on northeastern face of application area (facing NE towards balancing pond)

The area to the southeast of the application area is the main operational working quarry and therefore, it is possible to observe the bedrock in an additional bench below the application area (Plate 7.2).

Plate 7.2 Exposure on southern edge of application area (facing west)



With reference to Plate 7-2, the wall of rock, that separates the application area from the main quarry, is completely dry, massive limestone with no clay bands and no evidence of water bearing zones.

7.3.11.1 Monitoring Well Drilling (2021)

Seven small diameter monitoring wells were drilled across the entire landholding between 21st October – 8th November 2021 for the purposes of geological confirmation and hydrogeological testing and monitoring.

Borehole locations are shown in Figure 7.8. Lithology and construction logs from monitoring well drilling are included as Appendix 7B. Construction details and summary findings are also provided in a Table(table number?) in Appendix 7B.

The Monitoring Well labelled 'ONGW14' was drilled in the centre of the application area. The drilling purpose was to clarify bedrock homogeneity and facilitate a bedrock permeability test. A significant water strike was experienced at 1.2m below ground level (mbgl), which corresponds to the broken rock zone on the floor of the application area (Plate 7.2). A zone of weathered limestone containing clay infill was logged from 4.8m – 7.5m. No water ingress was reported in the clay stratum. Competent strong to very strong limestone bedrock was reported from 7.5m to the base of hole, equivalent to the target depth of 10m OD, approximately. Groundwater ingress was estimated at ~84m3/d, airlifting at 4m. The actual magnitude and sustainability of the water strike in the 3m bgl zone was tested with specifically targeted Production Wells that were subsequently installed. Detailed information is presented in the Water Chapter and a summary overview is given at the end of the SI detail of this Section. In summary, the water strike was not sustained in Pumping Tests and it was concluded that the water had accumulated in the broken quarry floor.

The Monitoring Well labelled 'ONGW12' was drilled in the Gravel & Sand Pit area, located to the north of the shale quarry. It will serve as a long-term groundwater level monitoring point outside the application area.

The Monitoring Well labelled 'ONGW13' was drilled to the south of the application area, on the western side of the existing limestone quarry. This borehole was drilled as close as was feasible to the current sump with the objective of long-term level and quality monitoring. It also clarified bedrock homogeneity and will facilitate a bedrock permeability test.

The Monitoring Wells labelled ONGW15(S&D), ONGW16 and ONGW17 were drilled to chase the contact between the Waulsortian Limestones and Tober Colleen Formation. ONGW16 will also serve as a long-term groundwater level monitoring point to supplement monitoring at nearby third-party dwellings.

Results of monitoring well drilling revealed the following key findings:

- ONGW16 is drilled within the shales & ONGW12 is drilled in the Gravel & Sand Pit.
- Overburden on ground that has not been quarried (ONGW17) show 0.3 m of soft, brown topsoil underlain by a firm to stiff limestone till to 3.5 m.
- Drilling at the Monitoring Well location ONGW14 revealed a layer of brown weathered limestone between 4.8 – 7.5 m. The driller notes repeated borehole collapse around 7 m below ground. Significant water was encountered during the monitoring well drilling in the application area's ONGW14. This is in the application area.
- Aside from the broken rock encountered close to surface, the application site was proven by drilling to be underlain by very strong, massive limestone to below the target depth of 10m OD.

The logs obtained from monitoring well drilling show that the desk study's GSI bedrock geology map presented as Figure 7.5 is not entirely accurate. For example, ONGW17 is drilled entirely within limestone but is mapped on the Tober Colleen shales when superimposed onto the GSI bedrock map. A bedrock geology map generated in the 1998 application (named then as Figure 2.2.1) proves to be more accurate and has been included herein as Figure 7.9.

7.3.11.2 Geophysics 2021 & 2022

Monitoring well drilling carried out in 2021 revealed a highly weathered and water-bearing zone close to surface in the application area (estimated water strike at the time of drilling = 84m3/d). Considering that the application area's floor elevation is already 14 to 16m bgl, the finding did not concur with observations in the walls or other Site Investigation and Desk Top study information. The conceptual understanding of the site is that the Waulsortian Limestones are unbedded and massive in structure, which should result in no anomalies and very low hydraulic conductivity.

There was also uncertainty surrounding the presence of a possible structural fault traversing the application site, based on observations on exposed faces (see Plate 7.1).

Two options were considered with a view to better understanding the nature and areal extent of this water-bearing zone, as follows:

(1) Drilling a high density of SI BHs across the application floor.
(2) Geophysical surveying.

Given the unknown extents of the water-bearing zone, and the possibility that this was controlled by geological structures it was agreed the optimal approach would be to undertake a geophysical survey.

Apex Geophysics were commissioned to carry out a preliminary geophysical survey in October 2021, which was followed up with supplementary fieldwork in February 2022. The final interpretive report was issued on 7th February and is included as Appendix 7C.

Overall, the survey involved 13 ERT profiles, 8 seismic refraction totals and EM conductivity data, though some of these were to cover other parts of the limestone quarry outside the application area. The 2D resistivity lines penetrate to a maximum depth of 30 m at the centre and this is deemed adequate because the zone requiring evaluation was the water in the top 3m and the extent of it across the application area.

The plan view of geophysics interpretation shows that there is negligible variation in electrical resistivity through bedrock across the application area. This would reinforce that bedrock in this area is competent, massive in structure and homogenous.

Closer inspection of the cross sections shows that competent bedrock only reaches surface at a couple of isolated locations (*e.g.* c. 20 m at SE end of R1, 10 m just SW of centre point of R2, 40 m just NE of centre point of R3). The remainder of each section shows very weak material in the upper 5 m. This material is broken rock and this is a common finding on the floors of working quarries.

The ERT profiles confirmed 1-4 m thickness of weathered or fractured limestone over slightly weathered to fresh limestone on top of a massive/thickly bedded, very strong rock. Resistivities are typical of Waulsortian Limestone. Weak indications of localised weathering or a change in lithology were detected at 30 m below ground. There is no suggestion that this is a transition to Tober Colleen or Lucan Formation.

Karst infill zones were identified in the geophysics data, but these features are all outside the application area where deepening is proposed. The clay infill feature closest to the area where deepening is proposed has been partially excavated in 2022 as part of making good other parts of the working quarry. The excavations of the karst features, trending NW to SE and to the south east of the application area, revealed wet sticky impermeable CLAYS with no water transmission properties.

Geophysics showed no evidence of structural faulting in the application area. The Apex (2022) geophysics report recommended drilling confirmatory boreholes at locations within the application area, which they label 'PBH8' and 'PBH9'. Dr. Pamela Bartley supervised the drilling of the Production Wells.

7.3.11.3 Production Well Drilling & Testing 2022

There is more detail on the Production Wells in the Water Chapter because they were drilled to evaluate future water management needs and bedrock permeability.

In summary, the aims of the production well drilling programme were:

(1) To explore and validate the findings of the geophysical survey, as per the recommendations outlined by Apex (2022).
(2) To investigate possible structural faulting based on visually observed features on the western and eastern exposed faces of the walls of the application area.
(3) To facilitate pumping test(s) to better understand the hydrogeology in the application area, namely the amount of water perched on the competent bedrock.

Briody Well Drilling Ltd. drilled 3 wells to Production Well specification in February 2022. Dr. Pamela Bartley of Hydro-G was in attendance for the full duration of drilling and cement grouting. Summary details are included in Table 7.3. The Production Wells are named ONGW18S, ONGW18D and ONGW19. Production Well drill Logs accompany the Water Chapter.

A. ONGW18S

Production Well ID '**ONGW18S**' was the first target suggested by Apex Geophysics (2022) and they label the Proposed BH as PBH9. It is in the same place as ONGW14 drilled by Petersen Drilling, where a water-bearing zone had been encountered very close to surface.

Drilling commenced using a Symmetric shoe on 8" diameter mild steel casing. Very loose rock was encountered to a depth of 3 m below ground. Competent limestone bedrock between 3 to 7m bgl and underlain by a pocket of gravels with some clay between 7 to 8.5m bgl. Drilling was terminated at 9m bgl, upon reaching competent bedrock beneath the clayey gravel. The steel casing was retracted to sit with its base in the clayey gravel. The purpose of this hole was to provide a Production Well that could be pump tested to evaluate the long-term sustainable yield of water close to the floor of the application area. Therefore, the steel was pulled back and manually slotted with an angle grinder from 1m to 4m bgl, approximately.

B. ONGW18D

A second Production Well diameter borehole was drilled at 6m distance from ONGW14 and 4m distance from ONGW18S. The purpose of this hole was to create a BH that cement grouted off the upper water bearing shallow floor zone and obtain knowledge of hydraulic properties of the competent bedrock beneath the application area.

Drilling was opened at 10" diameter and 10" ID steel casing was inserted to 3 m below ground level (mbgl). Similar to the drilling experience at the adjacent ONGW14 and ONGW18S, a very broken rock was encountered from 0 to 2 m. The dry clay infill zone observed at 4.8 – 7.5 m in

ONGW14 and from 7 – 8.5 m in ONGW18S was not detected in this borehole. This would suggest the previous detection was an isolated pocket.

Drilling was continued at 10” to 12 m whereupon 6” diameter steel casing was installed. A tremie pipe was used to pump cement into the annulus between the inner and outer steel. An accelerator was added to the cement grout and samples were collected during the grouting process. The cement was left to cure for 18 hrs and samples confirmed the grout had set. Drilling was continued inside the 6” casing to a depth of 63 m below ground, equivalent to c.7m OD.

On the whole, dry drilling was encountered in the limestone bedrock beneath the shallow cement grouted zone. This confirmed the achievement of a competent seal between the upper broken rock and the underlying competent limestone bedrock. Small clay bands between 0.5 – 1.0 m thick were logged at 19 m, 31 m and 48 mbgl. Very small ingresses of water were associated with each clay band.

C. ONGW19

The third large diameter well, ONGW19, was installed at a location corresponding with PBH8 in the Apex Geophysics report (2022). This borehole was drilled under the structural feature observed in the eastern face of the application area and along the orientation towards the structural feature on the southwestern face. This borehole, ONGW19, penetrated through competent limestone bedrock to the final drilled depth of 64m, equivalent to 6m OD, which is beneath the proposed 10m OD elevation of the application area’s quarry floor level.

7.3.12 Synopsis of 2021/2022 Site Investigation Results

Results from drilling in 2021 and 2022 are consistent with the drilling conducted in 1998 and 2008. The application area is underlain entirely by Waulsortian Limestones which appear to be homogenous to the target floor elevation of 10m OD. The competent bedrock is covered in a layer of infill material composed of quarry screenings and stone. The quarry manager confirmed this material was left over from when this area was used for crushing and screening activities.

A pocket of weathered bedrock containing clay infill was encountered at 4.8 to 7.5m in ONGW14. A similar zone was reported between 7.5 to 8.5m at ONGW18S. These yielded negligible water and similar features were not detected in ONGW18D or ONGW19 during drilling or by the 2022 geophysical survey (Apex, 2022).

This concludes the Site Investigation phase of the assessment.

7.4 Direct Impacts of Development on Receiving Environment

Overall, when the Impact Assessment methodology outlined in Tables 7.1 to 7.3 of this report? are applied to this study, the impact envisaged could fall into the **‘Profound/Significant’** classification.

However, the application of the framework and methodologies of Tables 7.1 to 7.3 of this report? provide a general screening of the likely impact to the land, soils and geology environment.

The procedure for determination of more specific potential impacts to the receiving land, soils and geology environment was to first characterise the land, soils and geological (receptors) environment within the site boundary and surrounding environs. This information was gathered during the desk study, site walkover and site investigation stages. The potential impacts to these receptors are described in terms of quality, significance, duration and type in accordance with the terminology given by Table 3.4 of Description of Effects from the document 'Guidelines on the information to be contained in EIAR (EPA, 2022).

The primary activity with potential to impact the land, soil and geological environment is the extraction of limestone bedrock. As the area to be deepened has already been worked to a depth of c. 70m OD, there are no construction phase works required such as stripping of overburden, stockpiling of overburden, etc. Site entrance, wheelwash and other necessary infrastructure are already in place. The operational phase will involve blasting of bedrock followed by loading of broken rock onto crushers prior to delivery to the on-site cement manufacturing facility for blending.

A detailed assessment of impacts is presented in Table 7.6 of this report. Only likely or significant impacts are included in the analysis. The impacts are divided into the three primary project phases:

(i) Construction (enabling) phase
(ii) Operational phase and
(iii) Restoration phase.

Mitigation measures and Residual Impacts are detailed in Table 7.7 of this report. Cumulative Impacts and the potential for Transboundary Impacts are also discussed in this Impact Assessment Section.

7.4.1 Construction Phase Impacts

No construction is required. The site is already sitting in limestone bedrock at 15m, approximately, below local natural land surface.

All necessary infrastructure is in place. Road access is established. There will be no intensification of rock extraction in the application area. The area has already been extracted to its permitted elevation. Therefore, no direct impacts are identified as likely to occur during the construction (enabling) Phase. This is because overburden has already been stripped from the application area in accordance with existing planning permission.

7.4.2 Impacts - Operation

The primary direct impact identified as likely to occur during the operational stage is the removal of limestone bedrock. This impact is permanent by its nature. The limestone quarry currently operates on a footprint of 77.25 ha. The central portion occupies an area of 24.8 ha and has permission to excavate down to 10 mOD under Planning Ref. 98/2026. Three peripheral areas connected to the north, south and east of this central area have an additional combined footprint of 52.5 ha and have permission to excavate one bench down to 70 mOD under Planning Ref. TA/900603.

The extraction of bedrock will remove the capacity of these lands to provide agricultural production. As overburden has already been stripped the application site is not in a state capable of supporting agricultural production. Soils in the area are not regarded as having high fertility status.

There are no European designated sites, with respect to geological features, within the application area or within radius of influence of the proposed development.

The use of plant and machinery during operation will require the storage and use of fuels and oils. Their storage and use present the potential for spills and leaks which could contaminate soils and groundwater. However, the site has mitigation measures and Standard Operation Procedures that include a trained dedicated person employed to refuel vehicles and machinery on the quarry and bunded systems at refuelling stations near the offices.

Quarrying presents a risk of potential impact on the stability of the bedrock environment. Subsidence, slope stability, compaction and slope failure are fully considered in the design of all extraction phases at this site, which ensures that impacts will be prevented.

The significance of these impacts on the land, soils and geology is assessed in the Table 7.6.

The raw materials extracted and processed on site bring benefits in the production of construction aggregates and products. The use of the geological resource, *i.e.*, limestone, as a raw material is necessary for the on-site manufacture of cement. Cement cannot be reasonably manufactured by other means. Breedon manufactures 700,000 tonnes of cement each year at the site. Crushed bedrock sourced from the limestone quarry and the shale quarry is blended and then milled before being thermally treated in a kiln to produce clinker. Gypsum is added to the clinker and these combined products are then milled to produce the final cement product which is stored and dispatched in bulk or bag form.

7.4.3 Impacts - Restoration

The restoration stage of the project describes the aftercare phase that follows the cessation of activities. The restoration plan will involve allowing water to accumulate in the quarry void. This confirms that the long-term land use will have changed from quarrying to biodiversity/amenity.

Table 7.6: Significance of Impacts on Land, Soils and Geology

Scenarios where impacts may arise	Activity	Attribute	Importance of attribute	Nature and description of the effect	Quality of effect	Significance / magnitude of effect	Extent & Context of effect	Probability of effects (pre-mitigation)	Duration and frequency	Type of effect
Construction Phase	none	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Operational Phase	Opencast extraction of limestone bedrock	Bedrock	Very high	Blasting of bedrock. Bedrock crushed and blended with shale	Negative	Significant	Removal over 4.13ha footprint from 70 mOD to 10 mOD = ~2,100,000 m3 or 725,000 tonnes of limestone rock	Likely	Permanent	Direct
	Opencast extraction of limestone bedrock	Bedrock	Very high	Raw material for on-site cement production, used in construction industry	Positive	Significant	Local, Regional & National Resource Generation	Likely	Long-term	Direct
Restoration Phase	Landscaping. movement of infrastructure and stockpiles necessary to facilitate site restoration	Crushed Bedrock	Very high	Restoration of land to water-filled void	Positive	Significant	Confined to Limestone Quarry	Likely	Permanent	Direct
Unplanned Events	Hydrocarbon Spillage	Exposed Bedrock	Very high	Hydrocarbon contamination	Negative	Significant	Within application site boundary	Unlikely	Brief	Direct

7.4.4 Impacts - Indirect

Indirect impacts (or secondary impacts) are those which are not a direct result of the proposed activity, often produced away from the project site or because of a complex pathway. Throughout the considerable duration of quarrying activities at the site there has no identifiable indirect impact on the soils and geology in the area. No indirect impacts are foreseen as part of proposed activities on the application site.

7.4.5 Impacts - Transboundary

The EIA Directive 2014-52-EU invokes the Espoo Convention on Environmental Impact Assessment in a Transboundary Context, 1991, and applies its definition of transboundary impacts. Given the location (>70km from the border with N. Ireland), the nature, size and scale of the proposed development, it is expected that the impacts of the development would not have any significant transboundary effects with respect to water bodies.

7.4.6 Impacts – Cumulative

The aim of the cumulative impact assessment is to examine whether any other proposed developments have the potential to act in-combination with the proposed application, subsequently giving rise to effects that would not otherwise be significant. The assessment considers the phasing of the proposed project.

The cumulative impact assessment considered selected activities within a 5 km radius. The activities included in the cumulative impact assessment include the existing limestone quarry and existing shale quarry at Breedon, the cement manufacturing facility and associated services, the asphalt production facility and a proposed solar farm to the immediate northeast.

Proposed works will involve removal of limestone bedrock in addition to that previously removed within the area defined as a limestone quarry. The current application will not increase the footprint of exposed bedrock, or the approved limestone quarry footprint. The current application will give access to bedrock in the northern part of the limestone quarry and make the quarry layout more efficient to manage in terms of blasting, benching and vehicular routes.

There will be no cumulative impact to soil/subsoil reserves or quality in the area as the application area has already been stripped under a previous permission.

The potential for cumulative impacts to the Waulsortian Limestone reserves in the local and regional area is imperceptible.

It is considered more appropriate to supply Breedon with raw material from a site in close proximity to the cement manufacturing site and areas previously worked. Sourcing of material at a greenfield site at a further remove from the manufacturing plant would significantly increase impacts linked to traffic such as increased combustion of fossil fuels. Quarrying in the local area is established and the manufacturing plant has been integrated into the local environment. There will be no increase in cumulative haulage rates associated with extraction and processing of limestone bedrock in the locality.

7.4.7 Impacts – Depletion of Natural Resources

Natural resources of limestone bedrock will be extracted at the site. Extracted resource is required for the on-site manufacture of cement. Cement has a wide use range in the construction industry, including the production of precast concrete, readymix concrete, readymix mortar, blocks and bricks and ultimately the building of homes, offices and businesses. The destination of the material manufactured from the limestone bedrock will most be at a local, regional and national scale.

7.5 Mitigation Measures

The following mitigation measures will be adopted for the proposed extraction activities to reduce any potential impacts of the receiving land, soils and geology environment.

The potential impacts identified in Table 7.6 are resolved under the mitigation measures set out under Table 7.7 of this report. There are no likely significant impacts on the land, soil and geological environment.

As a result of the mitigation measures implemented at the site, it is considered that any impacts associated with the quarrying related activities undertaken at the site will not contribute to the cumulative impacts of any surrounding developments in the area. Potential cumulative impacts on other environmental elements such as surface water quality, ecology, noise and dust are examined in other chapters of this EIAR.

7.6 Residual Impacts

Residual impacts refer to the degree of environmental change that will occur after the proposed mitigation measures have taken effect. At the onset of the operational stage the development will involve excavation of bedrock by blasting and mechanical means. The direct and negative impact associated with the permanent loss of bedrock material cannot be resolved by mitigation.

The mitigating factor is that the overall resource area is large and homogenous. The impact of the extraction of the proposed 4.13ha footprint of limestone is small relative to the magnitude of limestone reserves in the area region or nation. The most common rock underlying Ireland is limestone and it underlies the majority of the island. Coastal regions in Donegal, Mayo, Clare, Cork, Waterford and Wicklow are underlain by different rock types but the majority of Ireland is underlain by limestone.

With the implementation of the mitigation measures described in Table 7.7 the residual impacts on the land, soil and geological environment during the operational and restoration stages are assessed to be permanent and significant.

Table 7.7 Mitigation Measures

	POTENTIAL IMPACT			MITITGATION MEASURES	RESIDUAL EFFECT FOLLOWING MITIGATION	
Scenarios where impacts may arise	Activity	Attribute	Character of Potential Impact	Description of Mitigation	Significance or quality of Effect	Probability
Construction Phase	none	n/a	n/a	n/a	n/a	n/a
Operational Phase	Opencast extraction of limestone bedrock	Bedrock	Removal over 4.13ha footprint from 70 mOD to 10 mOD	There is no measure to mitigate against loss of bedrock. The amount to be extracted is considered a minor portion of the overall limestone quarry, of which 25 ha has permission to excavate to 10m OD and 52.5ha has permission to excavate to 70 mOD. Overburden has already been removed from the application area.	Negative, Significant	Likely
	Opencast extraction of limestone bedrock	Bedrock	Local, Regional & National Resource Generation	No mitigation required for the supply of materials because it is the planned, positive, activity for the development	Positive, Significant	Likely
Restoration Phase	Landscaping. movement of infrastructure and stockpiles necessary to facilitate site restoration	Crushed Bedrock	Restoration of land to water filled void	No mitigation required for restoration as it is a planned part of the development.	Positive, Moderate	Likely
Unplanned Events	Hydrocarbon Spillage	Exposed Bedrock	Potential for contamination of exposed bedrock as a result of spillages/leakages .	There will be no storage of fuels or hydrocarbons on the application site. Fuelling and lubrication of machinery and transport vehicles is carried out be a trained, dedicated, operative and control measures exist as standard in the overall quarry, and cement factory, IE licensed site.	Neutral	Unlikely

7.7 Interaction with other impacts

The EIAR guidelines (EPA, 2022) highlight that the interaction of impacts to the land, soils and geological environment, arising from proposed activities, must be given due consideration alongside potential receptors identified in other EIAR sections. The likely interactions have been identified as follows:

- The movement of bedrock by blasting and mechanical means can give rise to increased dust emissions.
- The operation of plant associated with extraction and haulage can give rise to increased traffic movements.
- The operation of plant associated with extraction and haulage can give rise to increased noise emissions.
- The extraction of bedrock can impact upon surface and groundwater quality and flow patterns.
- The extraction of bedrock can impact upon biodiversity and cause disturbance to habitats in the area.

Each of these issues and the mitigation measures proposed are addressed in detail in the relevant sections of this EIAR. These impacts are considered to be negative but with suitable measures in place, their significance can be mitigated, with the exception of the extraction of limestone bedrock, the removal of which is permanent.

7.8 Do Nothing Scenario

The proposed development works do not involve any new land take or any land use change. The proposed development has been designed so as to propose continuation of quarrying in bedrock that is already excavated. The proposed development is designed so as to avoid breaking into greenfield lands and avoid proposals for expanding quarrying laterally into farmlands or areas that could have residential or business development potential.

In the case of the proposed development not taking place, the application site would remain at its current elevation on the margin of the central area of the limestone quarry, vehicular access to the floor of the quarry would be more difficult and the limestone bedrock resource available to the nation, in support of development, would be limited because of the need to use some of the planning approved area of the main quarry site, which has permission to 10m OD under Planning Ref: 98/2026), for haul roads.

In the case of the proposed development not taking place, the on-site cement manufacturing plant could require a new source of crushed limestone to be hauled from a further distance, requiring haulage by road, increased traffic and the associated increased emissions. In the absence of new materials being sourced at an alternative location, the manufacturing site would close with a resultant increase in pressure on the construction supply chain, loss of economic activity, loss of employment and reduction in the potential for building homes and industrial units.