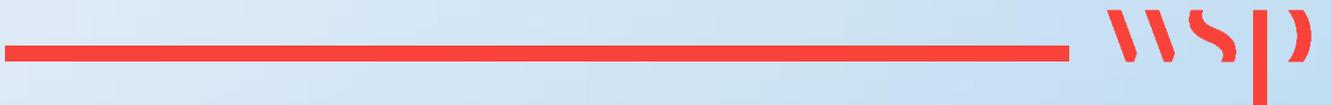


5

LAND, SOILS & GEOLOGY



5 LAND, SOILS & GEOLOGY

5.1 INTRODUCTION

This chapter of the Environmental Impact Assessment Report (EIAR) provides an assessment of potential impacts to, and the significance of effects on, soils, land and geology from the continuation and extension of quarrying activities at the Hudson Brothers Ltd Kildare quarry (the 'Site'). This EIAR is submitted in support of an application under Section 37L of the Planning and Development Act, as amended. Associated impacts to the water environment and ecology are addressed in separate chapters (Chapters 6.0 and 4.0, respectively).

The following assessment was prepared by Kit Pannell (BSc, MSc). Kit is a hydrogeologist with over 11 years experience, with focus on regulatory reporting within the mining industry.

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 can be reasonably foreseen as consequences of the normal construction and operation of the Proposed Development. This assessment considers the potential sources of change resulting from the Proposed Development activities detailed in the project description (Chapter 2.0).

The loss of agricultural soils will be considered, as will the potential geotechnical risks, 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.

The potential effects associated with hydrogeological and hydrological receptors are considered in Chapter 6.0 (Water), with reference to water quality in relation to land quality in this chapter. The effects of the Development on population and human health are addressed in Chapter 3.0 (Population & Human Health). Any secondary effects on ecology or biodiversity due to changes in land quality or habitat removal are considered in Chapter 4.0 (Ecology and Biodiversity).

5.1.2 GEOGRAPHICAL AND TEMPORAL SCOPE

The geographical study area for the assessment covers the EIA boundary (encompassing the current Site and the Section 37L application boundary) (identified on Figure 5-1) and a buffer zone of 500 m from the EIA Site boundary, because most potential effects to geological and soil receptors are anticipated to occur within the Proposed Development footprint or immediately adjacent to it. The Proposed Development area (ca. 64.0 ha.) is entirely contained within the EIA project boundary (Site) that encloses 95.8 ha. In the context of the EIAR, the Site boundary contains lands which form the existing quarry area, the proposed extension areas and some areas which extend beyond the working areas. The Section 37L application (the Planning Application) boundary is shown on the drawing set which accompanies the planning application.

The temporal scope of this assessment covers the current quarrying activities on the Site and the extension of these permitted activities into the future, with the Section 37L application boundary. Given the phased nature of the extractive industry and the similarities between the construction and

operational phases of the Proposed Development, these will be considered together in this chapter as the overall operational phase.

Under the current programme of the Proposed Development, the extraction phase will last for 13 - 15 years, which will provide for fluctuations in market demands for the aggregate extracted from the Site. The duration of the extraction phase is therefore classified as 'medium-term' by the Environmental Protection Agency's (EPA) 2022 'Guidelines on the information to be contained in environmental impact assessment reports'. The Proposed Development totals a volume of ca. 8,708,900 m³ (13,218,200 tonnes) of combined sands and gravels and rock. This is made up of ca. 5,544,900 m³ (8,317,350 tonnes) of sands and gravels and ca. 1,960,345 m³ (4,900,860 tonnes) of rock.

The restoration phase of the Proposed Development will follow the extraction phase and will be 2 - 3 years in duration, which is 'short-term' - those lasting from one to seven years (EPA, 2022).



Figure 5-1 - Location of the Site (EIA Boundary) and 500 m Buffer

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

This assessment has been made with cognisance to relevant 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.
- 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.

5.2.2 RELEVANT POLICIES AND PLANS

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”.

The Kildare County Development Plan 2023-2029 (KCDP) is the key strategy document which structures the proper planning and sustainable development of land-use across County Kildare over the six-year statutory period of the plan.

The KCDP acknowledges the potential environmental effects of the aggregate industry and importance of protecting surrounding residential and natural amenities. The KCDP also identifies that gravel resources are important to the general economy and provide a valuable source of employment in some areas of the county. There is an increasing demand for aggregates and that areas for extraction of aggregates and minerals are needed in the county. To address this the KCDP identifies that planning policies should be carefully constructed to avoid adverse effects on aggregate resources and related extractive industries. The KCDP notes that it is necessary to ensure that aggregates can be sourced without significantly damaging the landscape, environment, groundwater and aquifer sources, road network, heritage and / or residential amenities of the area. KCC has adopted policies and objectives within the development plan in relation to the protection of environs from adverse environmental impact from extractive industry.

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

- **RD P8** – (It is the policy of KCC to) Support and manage the appropriate future development of Kildare’s natural aggregate resources in appropriate locations to ensure adequate supplies are available to meet the future needs of the county and the region in line with the principles of sustainable development and environmental management and to require operators to appropriately manage extraction sites when extraction has ceased.
- **RD O42** – (It is the objective of KCC to) Ensure that development for aggregate extraction, processing and associated concrete production does not significantly impact the following:
 - *Special Areas of Conservation (SACs)*
 - *Special Protection Areas (SPAs)*
 - *Natural Heritage Areas (NHAs)*
 - *Other areas of importance for the conservation of flora and fauna.*
 - *Zones of Archaeological Potential.*
 - *The vicinity of a recorded monument.*
 - *Sensitive landscape areas as identified in Chapter 13 of this Plan.*
 - *Scenic views and prospects.*
 - *Protected Structures.*
 - *Established rights of way and walking routes.*
 - *Potential World Heritage Sites in Kildare on the UNESCO Tentative List, Ireland.*
- **RD O43** – (It is the objective of KCC to) Consult with the Geological Survey of Ireland (GSI), with regard to any developments likely to have an impact on sites of Geological Importance.
- **RD O44** – (It is the objective of KCC to) Require applications for mineral or other extraction to include (but not limited to):
 - *An Appropriate Assessment Screening where there is any potential for effects on a Natura 2000 site.*
 - *An Environmental Impact Assessment Report (EIAR).*
 - *An Ecological Impact Assessment may also be required for subthreshold developments to evaluate the existence of any protected species / habitats on site.*
- **RD O49** – (It is the objective of KCC to) Have regard to the following guidance documents (as may be amended, replaced, or supplemented) in the assessment of planning applications for quarries, ancillary services, restoration and after-use:
 - *Quarries and Ancillary Activities: Guidelines for Planning Authorities, DEHLG (2004). - Environmental Management Guidelines*
 - *Environmental Management in the Extractive Industry (Non-Scheduled Minerals), EPA (2006). - Archaeological Code of Practice between the DEHLG and ICF (2009).*
 - *Geological Heritage Guidelines for the Extractive Industry (2008).*

- *Wildlife, Habitats, and the Extractive Industry – Guidelines for the protection of biodiversity within the extractive industry, NPWS (2009).*
- **RD O50** – (It is the objective of KCC to) Ensure the satisfactory and sensitive re-instatement and/or re-use of disused quarries and extraction facilities, where active extraction use has ceased.

5.2.3 RELEVANT GUIDANCE

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

- Relevant European Commission guidance – Guidance on the Preparation of the Environmental Impact Assessment Report (2017).
- The EPA Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (May 2022) – 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.
- Department of Housing, Planning and Local Government. Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (August 2018).
- 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.
- The EPA guidelines on Environmental Management in the Extractive Industry (Non-Scheduled Minerals) (2006), for a more environmentally sustainable quarry & pit industrial sector, greater protection for the environment and human health.
The CIRIA guidance Publication C532 Control of water pollution from construction sites: guidance for consultants and contractors (2001), which provides advice on environmental good practice for the control of water pollution arising from construction activities.

5.3 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

This section presents the method used to assess the impacts and effects of the Proposed 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.

5.3.1 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 EPA and previous



ground investigations carried out onsite. The assessment follows a staged approach, which is summarised 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.
- 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 occur to each receptor because of the Proposed Development, identify source-pathway receptor linkages, and assign the magnitudes of impact. This stage considers embedded design mitigation, 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 if it is considered necessary to reduce the magnitude of any impact and associated effect.
- 6) Assess the residual impact magnitude and residual effect significance after all mitigation is applied.
- 7) Identify any monitoring that may be required to measure the success of the mitigation measures.

Stages 1 and 2 have been completed using published literature, guidance and available information specific to the Proposed Development, which is presented in Chapter 2.0 of this EIA. 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 Guidelines on the Information to be Contained in EIARs (EPA, 2022), with some modifications made to increase clarity. The descriptions for 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	<p>High importance and rarity, national scale, and limited potential for substitution. For example:</p> <ul style="list-style-type: none"> – 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: <ul style="list-style-type: none"> – Regionally important sites – Moderately drained and/or moderate fertility soils.
Low	Low or medium importance and rarity, local scale. For example: <ul style="list-style-type: none"> – 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 descriptions

Magnitude of impact (change)		Typical description
High	Adverse	<ul style="list-style-type: none"> – 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	<ul style="list-style-type: none"> – Large scale or major improvement of resource quality; extensive restoration; major improvement of attribute quality.
Medium	Adverse	<ul style="list-style-type: none"> – Loss of resource, but not adversely affecting the integrity; partial loss of/damage to key characteristics, features or elements.
	Beneficial	<ul style="list-style-type: none"> – Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality.
Low	Adverse	<ul style="list-style-type: none"> – Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements.
	Beneficial	<ul style="list-style-type: none"> – 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	<ul style="list-style-type: none"> – Very minor loss or alteration to one or more characteristics, features or elements.
	Beneficial	<ul style="list-style-type: none"> – 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 occurs as a direct result of the Proposed Development and is likely to occur at or near the Proposed 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 Proposed 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 Proposed 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 the 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.

5.3.2 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 topic chapter if a single significance category is reported. 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 level of effect significance, additional mitigation measures will be presented that will be used to avoid, prevent, or reduce the magnitude of the potential impact (Stage 5). The significance of the effect considering 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 5.11).

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 6.0.

5.4.1 LAND

The Site area is ca. 95.8 ha. and comprises lands which are currently used for quarrying activities (including extraction, plant and ancillary areas ca. 38.8 ha (0.388 km²)) and the proposed extension areas.

The S.37L Boundary covers ca. 64.0 ha. with lateral extent of the proposed voids of ca. 10.2 ha in the proposed western extraction area and ca. 21.2 ha. in the proposed northern extraction area. It is estimated that total of ca. 31.4 ha. of additional land will be disturbed in the course of this Proposed Development (combination of lateral void and formation of screening bunds). The majority of the Proposed Development relates to northern and western extension areas.

5.4.2 LAND USE

The current land usage is identified from March 2022 aerial photography for the lands surrounding the quarry and from the October 2023 survey for the quarry area. The merged aerial images are presented in Figure 5-2 below.

Three main land uses have been identified within the Site and the study area (500 m from the Site boundary). These are the agricultural and single-house residential lands, the R410 road and other quarry operations. The lands to the north and west can be characterised as rural in nature, with land

uses in the area being agricultural and single-house residential. Sheep rearing and grazing of cattle are the main activities in the area. The R410 road passes through the 500 m buffer to the southwest of the Site and the lands immediately to the east and south of the Site are largely taken up by quarrying activities operated by unrelated parties.

The Site consists of the agricultural lands within the boundary and the quarry area (including the processing plant, welfare facilities, artificial ponds for water use and the silt pond). The silt pond is constructed in an area where shallow sands and gravels had been extracted down to the competent bedrock.



Figure 5-2 - Land Use in March 2022 and October 2023 with 500 m Site Buffer

5.4.3 SUPERFICIAL GEOLOGY (SOILS AND QUATERNARY SEDIMENTS)

There are limited soils remaining in-situ in the existing extraction area due to the ongoing extraction activities onsite. The process plant is composed of made ground (e.g. concrete pads, hard standing and concrete foundation areas for the plant area) overlying natural ground (soils). The areas north and west of the Site containing agricultural fields are underlain by natural ground.

A review of the EPA’s online map viewer (EPA, 2023) maps soil cover over the entire Site area (Figure 5-3), however, as stated previously this soil map is more representative of the original baseline soils prior to activities within the extraction area.

Teagasc have designated the dominant soils underlying the Site as being shallow well drained mineral soils derived from mainly basic parent materials (BminSW).

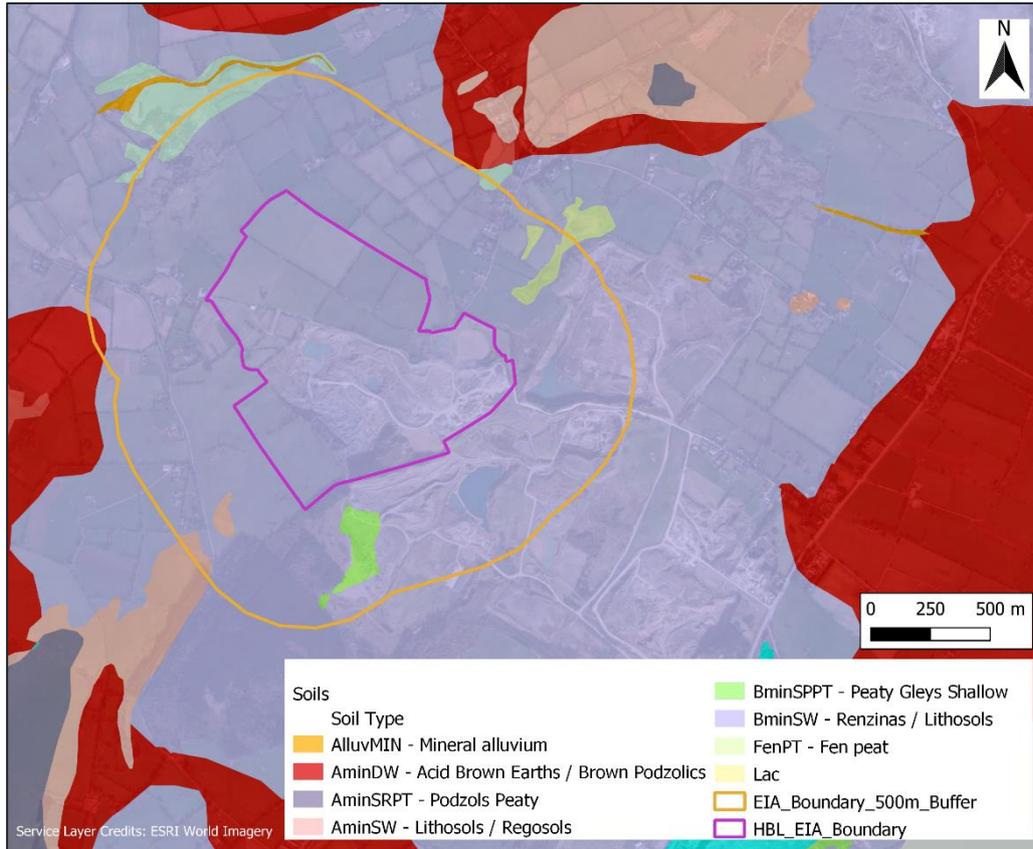


Figure 5-3 - Soil Mapping (EPA, 2023) overlain on the March 2022 Aerial

The Site and surrounding region are covered in glacial deposits (Figure 5-4) ranging from tills to glaciofluvial sands and gravels with glaciolacustrine deposits near the Poulaphouca Reservoir (GSI, 2003). The drift deposits across the Site were laid down during the Quaternary Period. The Quaternary Period is the final or upper period of the Cenozoic and marks the period of the Ice Age which began about 1.6 million years ago, and the postglacial period which extends to the present day. Most of the drift material was laid down directly from the margin of the ice sheets as they moved across the land or by glacial melt waters from the retreating ice sheets. Regionally there appears to be no pattern or trend to drift thickness.

The dominant sediment in the area is gravel; the largest accumulation of gravel occupies an area of ca. 7.5 km² on both sides of the Wicklow/Kildare county boundary, just north and west of Blessington (GSI, 2003). Glacial and fluvial deposits are generally thick in the area; deposits are commonly greater than 30 m in thickness and reach thicknesses of greater than 70 m in the Blessington and Curragh areas. North of Blessington a small area is covered by a chert-rich till, which is characterised by a clayey and silty matrix containing limestone and shale clasts. The glaciofluvial sand and gravel deposits to the north and west of the Poulaphouca Reservoir have thicknesses of up to 14 m and locally overlie gravely deposits. To the west, south and east of Blessington there are lower Palaeozoic tills characterised by a generally silty to silty sandy texture (GSI, 2003).

Locally, the Quaternary deposits across the Site increase in thickness to the southwest. Borehole logs from the Site indicate the drift thickness ranges from ca. 5 to 6 m (BH8K and BH2K)

respectively) to the north of the Site to ca. 41 to 43.5 m (BH9K and BH6K) to the southwest of the Site. The borehole logs indicate that the Quaternary deposits consist of unsorted materials, comprising sand, gravel, clay and siltstone with some limestone clasts encountered to the northeast of the Site.

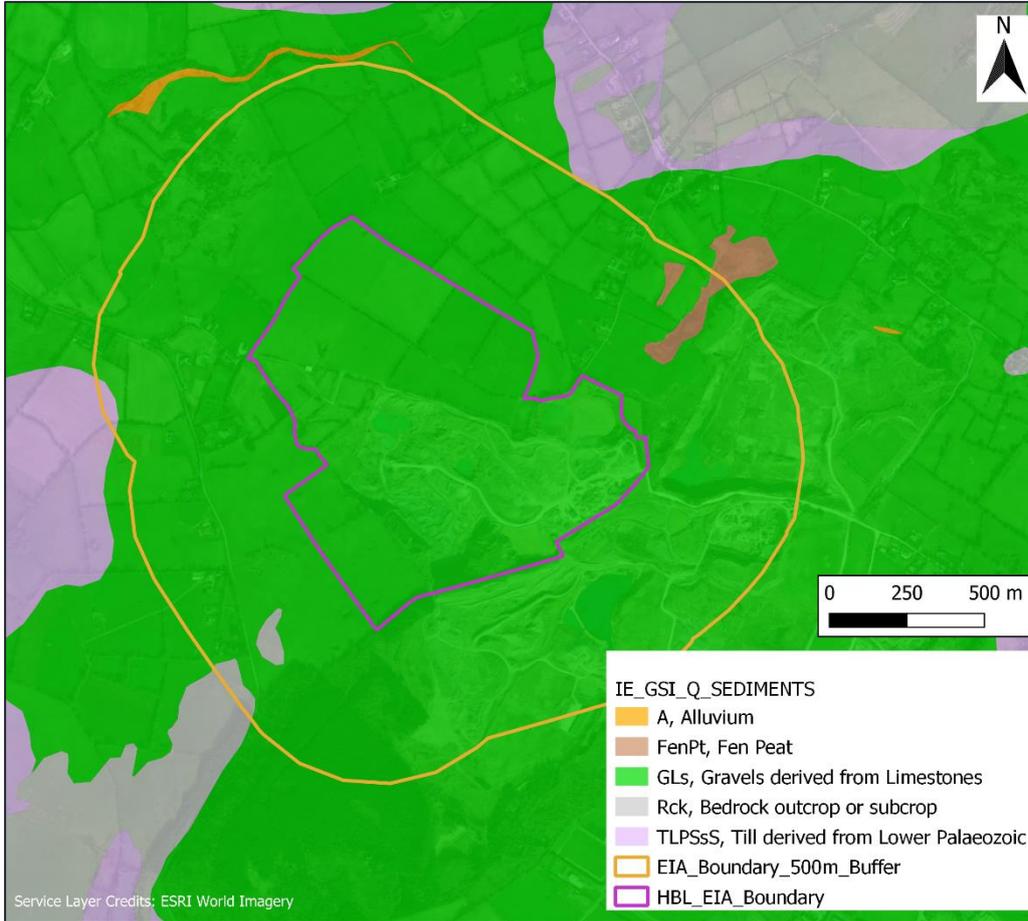


Figure 5-4 - Underlying Quaternary Sediments (subsoil) (GSI, 2022) overlain on the March 2022 Aerial

5.4.4 BEDROCK GEOLOGY

The underlying bedrock geology in the region comprises of sedimentary rocks and low-grade metamorphic rocks of the Kilcullen Group. The Kilcullen Group rocks are Silurian in age and are divided into five formations, two of which are present underlying the Site (the Glen Ding Formation to the west and Slate Quarries Formation to the east) (Figure 5-5).

The Glen Ding Formation consists of dark green to grey greywackes and shales making up Bouma 'a' and 'b' turbidite units that are distinctly more chloritic and feldspathic than the other formations, probably accounting for a regional litho-geochemical contrast across the Slate Quarries Formation-Glen Ding Formation contact.

The Slate Quarries Formation consists of predominantly dark grey slate, with minor interbedded greywackes. The greywackes consist of Bouma "ae" turbidite units, with "a" intervals generally finer-grained than in the Pollaphuca Formation which occurs further to the east.

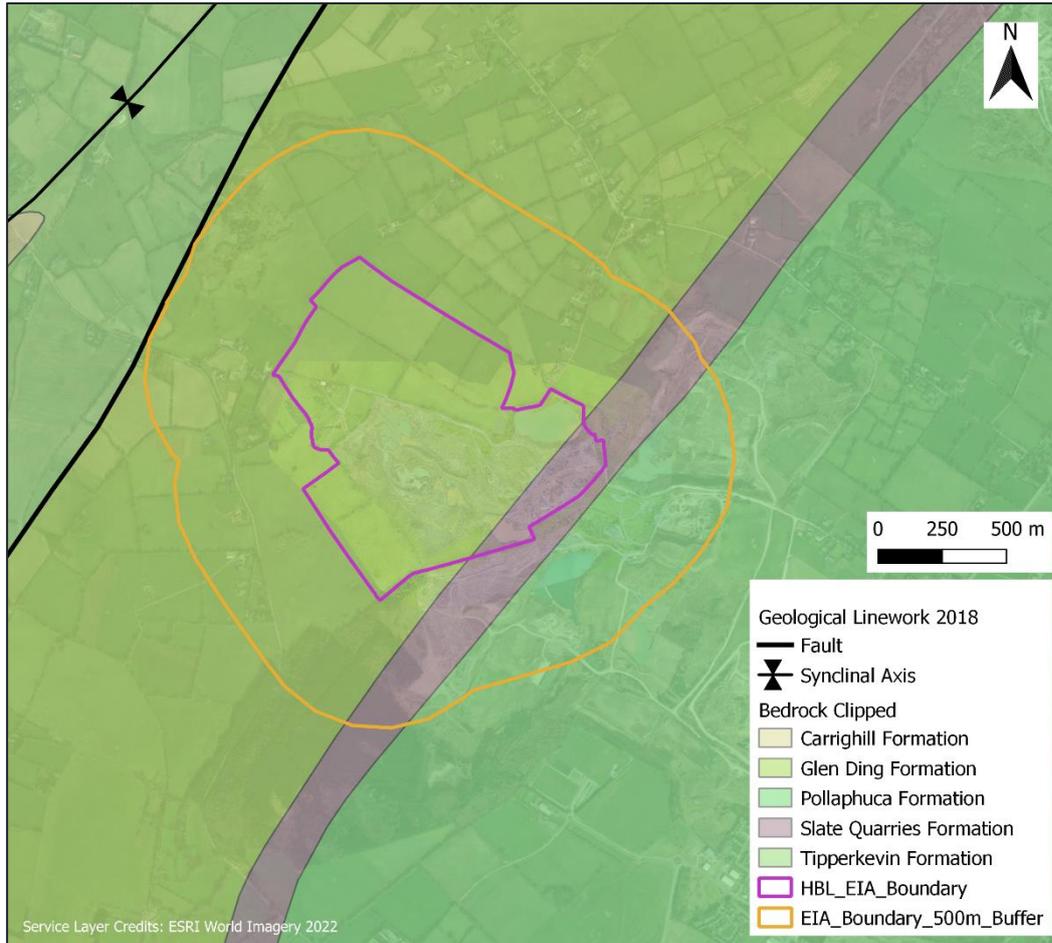


Figure 5-5 - Underlying Bedrock Geology (GSI, 2022) overlain on the March 2022 Aerial

5.4.5 SITE INVESTIGATIONS

The locations of the existing and damaged monitoring wells are presented in Figure 5-6, alongside bedrock elevations (mAOD) for each existing well. The survey details of the monitoring wells are presented in Table 5-5 and a summary of the monitoring well findings is presented in Table 5-6, with individual borehole logs provided in Appendix 5A.

Two monitoring wells (BH9K and BH10K) were installed by HBL in early September 2023. BH9K encountered a 41 m thick sand and gravel unit, indicating that the Quaternary deposits are deeper than previously understood to the west of the Site. BH10K encountered 18 m of sands and gravels above bedrock, which indicates that the thickness of the Quaternary deposits is highly variable over short distances, as they are 43.5 m thick in BH6K, 510 m to the northeast. The previous EIAR assessment (Golder, 2020), stated that the bedrock interface appears to be relatively flat, possibly dipping gently eastwards. With the addition of BH9K and BH10K, the bedrock is shown to dip in a more westerly to south-westerly direction (from BH2K and BH4K), with an elevation change of 52 m over 885 m from BH2K to BH9K. The elevation of bedrock in BH7K (218.4 mAOD) confirms that the bedrock also dips to the east (as in the previous assessment), with BH4K forming the bedrock high within the centre of the Site. The overlying quaternary deposits thicken into neighbouring developments and towards the Poulaphouca Reservoir to the southeast.



Figure 5-6 - HBL Monitoring Wells and Bedrock Elevations, (orange text, mAOD)

Table 5-5 – Monitoring Well Locations

Monitoring Well ID	Easting (ITM)	Northing (ITM)	Ground Elevation (m AOD)
BH1K (damaged)	696604	717378	236.61
BH2K	697261	717082	257.27
BH3K	696870	717024	229.24
BH4K	697151	716476	229.19
BH5K (damaged)	697620	716749	263.48
BH6K	696591	716385	242.82
BH7K - replaces BH5K	697620	716729	263.38
BH8K - replaces BH1K	696629	717408	239.48
BH9K	696381	716986	205.53
BH10K	696424	715902	224.90

Table 5-6 – Monitoring Well Construction and Lithology

Monitoring Well ID	Monitoring Well Depth (m)	Depth to Base of Overburden (m)	First Water Strike Depth (m)	Lithology Interval Summary (m)
BH1K (damaged)	19.0	< 0.3	16.0	< 0.3 Overburden < 0.3 – 3.0 Sands & Gravels 3.0 – 19.0 Siltstone
BH2K	34.0	2.0	26.0	0.0 - 2.0 Overburden 2.0 - 6.0 Sands & Gravels 6.0 - 34.0 Greywacke
BH3K	19.0	3.0	12.6	0.0 - 3.0 Overburden 3.0 - 19.0 Sands & Gravels
BH4K	>100	3.5	20.6	0.0 - 3.5 Sands & Gravels 3.5 - 100.0 Greywacke
BH5K (damaged)	34.0	2.0	N/A	0.0 - 2.0 Overburden 2.0 - 32.8 Sands & Gravels 32.8 - 34.0 Greywacke
BH6K	59.0	2.0	51.0	0 - 2.0 Overburden 2.0 - 43.5 Sands & Gravels 43.50 - 59.0 Greywacke
BH7K	63.0	2.0	48.0	0 - 2.0 Overburden 2.0 - 45.0 Sands & Gravels 45.0 - 63.0 Greywacke
BH8K	25.5	< 0.3	18.5	< 0.3 Overburden < 0.3 - 5 Sands & Gravels 5.0 - 25.5 Siltstone
BH9K	61	0.5	52	0 - 0.5 Overburden 0.5 – 41 Sands & Gravels 41 – 61 Siltstone
BH10K	36	1.0	31	0 - 1.0 Overburden 1.0 - 18.0 Sands & Gravels 18.0 - 36.0 Greywacke

5.4.6 GEOLOGICAL ASSETS AND HERITAGE

The GSI have published a list of Geological Heritage Sites in Co. Kildare, these sites are also reflected in the Kildare County Development Plan. The Site lies adjacent to 3 Geological Heritage Sites (1 in Kildare and 2 in Wicklow):

- KE006 Glen Ding: Dry Glacial Channel: A heavily wooded glacial spillway displaying a pronounced curved channel running approximately northeast-southwest along the R410 road for about 1.5 km,
- WW022 Glen Ding: Deep Channel formed by Meltwater Erosion: Glen Ding is up to 50 m deep and has a U-shaped profile, typical of meltwater channels,
- WW012 Blessington Delta: A large accumulation of sands and gravels which has been quarried extensively. A high, striking example of a dry sand and gravel ridge, standing proud of the surrounding landscape.

Further consideration has been given to the Blessington Delta as it is immediately adjacent to the Site along its southern boundary. The Blessington Delta, as defined by the GSI (2014) is approximately 5 km long and up to 1.5 km wide. It is described as a “large accumulation of sands and gravels, which has been quarried extensively”. It is noted by the GSI as a Geological Heritage site (site code WW012) and is proposed to be a Natural Heritage Area. However, a review of the National Parks and Wildlife Service (NPWS) data notes it is not yet formally classed as either a Natural Heritage Area or a proposed Natural Heritage Area. Figure 5-7 below shows the Blessington Delta in relation to the Site. The delta lies largely within neighbouring quarries and Glen Ding Woods to the south and does not extend within the Site boundary. Glen Ding is also noted as a Geological Heritage area, however, there is little exposure of this ‘dry glacial channel’ due to high levels of vegetation and the abundance of glacial sediment (GSI 2014).

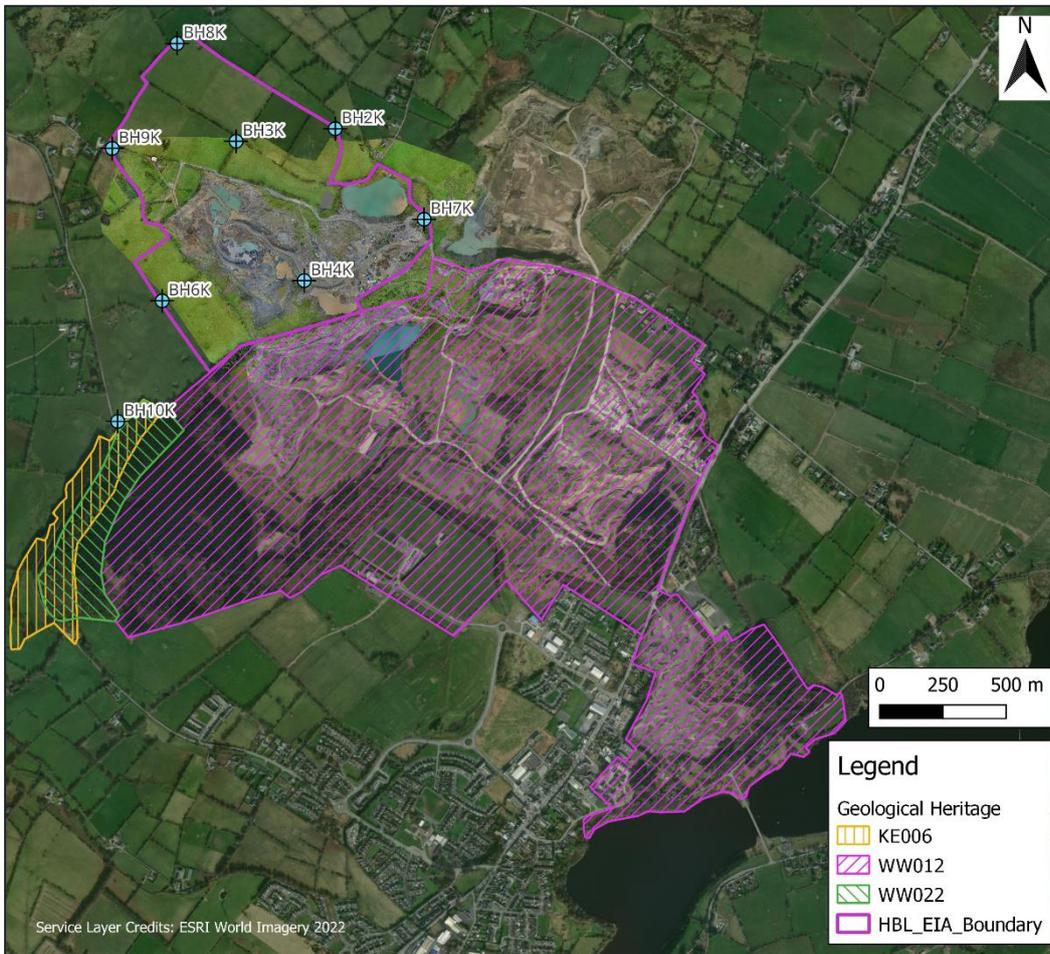


Figure 5-7 - Geological Heritage Sites (GSI 2023)

5.4.7 GEOHAZARDS

A review of the GSI’s landslide susceptibility classification layer (GSI, 2023) indicates that the Site is in an area of low seismic activity and the importance of this attribute is considered to be 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 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 silt pond located in the southern part of the quarry. The silt pond is located where the competent greywacke bedrock is at its shallowest (3.5 m deep at BH4K). The silt pond has been previously excavated down to the depth of the competent bedrock. The pond is allowed to overflow to the base of the quarry to help prevent against over-filling. The silt naturally lines the pond, preventing water from seeping into the surrounding superficial deposits or bedrock, which has the potential to lead to instability issues. The silt pond overflow is set within competent bedrock and the bedrock dips gently to the southeast, away from the quarry edge, helping to negate any instability risks.

5.4.8 RADON

The Radon Map for Ireland (EPA, 2023) indicates that the Site and study area are located in an area where 1 in 10 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/m³). 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 is unlikely to change as a result of the Proposed Development.

5.5 SELECTION OF SENSITIVE RECEPTORS

The Proposed Development involves extraction activities in northern and western extension areas. This will result in agricultural land loss in these areas, as these lands are currently used for agriculture, with grazing of sheep and cattle. However, the soils are thin so there is limited potential for farming in the areas.

The superficial deposits and bedrock geology beneath the Site are of medium/high economic value, both locally and regionally. The area is designated by Aggregate Potential Mapping (GSI, 2016) as being of 'Very High' crushed rock aggregate potential and therefore provides a valuable economic resource. Superficial and bedrock geology is removed with quarrying. However, the bedrock had no special designation and is common in the area.

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

Geological heritage areas are mapped adjacent to the Site boundary. There is potential for the units associated with these sites to extend beyond the mapped boundary. There are both positive and negative impacts in exposing geologically important sequences. A positive indirect impact is that the sequence could be recorded and studied further, bolstering existing knowledge for a site deemed to be one of the most glacially important sites in Ireland. Uncovering the sequences could also be considered a negative indirect impact, as part of the sequence would be removed and lost during extraction activities. With further extraction of sands and gravels to the south, along the edge of the heritage area, there is potential for associated sequences to be exposed or removed.

Table 5-7 – Soil, Land and Geology Receptors

Receptor	Importance and Reasoning
----------	--------------------------

Land (agricultural land) including quality and use	Low (no designation, low potential and value for agricultural uses)
Topsoil at the Site and within the study area	Negligible (no designation, no rarity, local importance)
Superficial deposits (sands and gravels) at the Site and within the study area	Medium (no designation, no rarity, medium/high economic importance)
Bedrock Geology at the Site and within the study area	Medium (no designation, no rarity, medium/high economic importance)
Human health at the Site and within the study area	High (human health receptor). Related to effects on land quality and stability.
Geological Heritage	Low (Associated with sands and gravels in designated area outside of the Site)

5.6 CHARACTERISTICS OF THE DEVELOPMENT

The current plans for the Proposed Development involve two further stages of work:

- Operational Phase - extension of the northern and western extraction areas,
- Restoration Phase - restoration of the Site in-line with the proposed restoration plan.

The Proposed Development consists of further development of the quarry over additional extension areas that will progress laterally into the sands and gravels in the northern and western extraction areas. The proposed areas for extraction are presented in Chapter 2.0 (Project Description) and summarised in Figure 5-8.

It is proposed to extend the quarry void to the north by ca. 21.2 ha. (0.212 km²), with the base of the excavated area rising from 215 mAOD in the vicinity of BH3K to 252 mAOD in the vicinity of BH2K (which is 1 m above the highest measured groundwater level). This is consistent with the anticipated bedrock elevation and orientation. Only sand and gravel is proposed to be extracted in this area. The proposed extraction will not extend all the way to the S.37L boundary and will stop at the topographical high with Safety/screening berms being constructed along the perimeter. This will screen the quarry visually and also screen operational noise from the residential properties to the east of this area. With the working face progressing in an easterly direction there will be reduced noise impact for the residential areas. This is discussed further in Chapter 9.0 Noise and Vibration.

It is proposed to extend the quarry void to the south by ca. 10.2 ha. (0.102 km²) at a final average depth of approximately 200 mAOD. The 200 mAOD is interpreted as the level below which there is increased risk of intercepting the confined aquifer within the greywacke bedrock in this area. Geophysics surveys in the proposed western extension area indicate that the bedrock is faulted, with the bedrock at a higher elevation to the south (ca. 220 mAOD) in comparison to that in the north (ca. 200 mAOD). The geophysics survey lines are presented in Appendix 5B. Sand and gravel and rock will be extracted from this area.



Figure 5-8 - Proposed Extraction Areas

Where extraction of greywacke in the centre of the quarry is already at 188 mAOD, there is to be some small lateral extension to level the area and continue extraction of the valuable rock to this depth. Extraction in this area to 188 mAOD has proven that there has been no interception of the confined aquifer.

The restoration proposal includes restoration to agricultural and amenity use upon completion of the proposed extraction. The proposal duration is 15-18 years to reflect the anticipated extraction of remaining reserve over 13 - 15 years, dependent on market conditions and a further 2 - 3 years for restoration.

Plant, ancillary storage tanks, infrastructure and buildings in the eastern area will be removed as part of the restoration works.

5.6.1 EMBEDDED MITIGATION

This initial assessment of the significance of potential effects resulting from the Proposed Development takes into consideration any embedded design and commonly undertaken good practice mitigation. The elements of the Proposed Development design and good working practices that reduce the potential for impacts to soils and geology include the following:

- Site operations are managed 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;

- Wheel wash for all vehicles exiting the quarry and sweeper cleaning the roads;
- Generators are maintained regularly, and any leakages are repaired;
- Refuelling and the addition of hydraulic oils or lubricants to vehicles or generators takes place on-site in designated areas. All plant and machinery are serviced regularly;
- 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 management to prevent unauthorised access;
- Exposed edges in the quarry are protected with safety berms, which also act to screen the Proposed Development;
- Extraction to remain above the water table to avoid the requirement for dewatering; and
- Monitoring of groundwater and surface water quality. Groundwater and surface water quality monitoring will provide assessment of the effectiveness of the mitigation measures.

5.7 POTENTIAL EFFECTS

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

- 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,
- Destabilisation and/or subsidence of unconsolidated soils, sub-soils or rock faces,
- Activities that have led to loss or exposure of geological sequences associated with heritage sites.

5.7.1 LAND QUALITY

Fuel and other substance leaks or spills from stored substances or from machinery/equipment used during the Proposed Development could affect the chemistry of the soil (where it is still in-situ) or could infiltrate to the groundwater through the sands and gravels or bedrock.

A review of the current water quality, (refer to Chapter 6.0 Water), indicates that groundwater quality is generally good. In this Chapter, the magnitudes associated with the potential impacts at the Site on land quality are assigned as *Negligible (adverse)* due to:

- Undetected concentrations of hydrocarbons in groundwater and surface water and presence of embedded mitigation to prevent contaminant migration,
- No off-site connectivity of surface water due to it being captured in Pond K2 for recycling and use on Site in processing and at the maintenance shed. Surface water is only lost to evaporation or infiltration into the sands and gravels / bedrock aquifers and not removed from the Site.
- Limited off-site connectivity of groundwater as quarrying has not encountered the significant water strikes associated with the water table within the bedrock. Isolated pockets of perched groundwater are likely to have been intercepted in the sands and gravels and bedrock.
- River Waterbody WFD Status for 2016-2021 ranging from Poor to Good for the River Morell. However, there were no exceedances of surface water EQS threshold values for inland waters and generally good quality of water in the River Morell observed.



As a result, the predicted potential impact on human health is also considered *Negligible*.

5.7.2 CHANGE OF LAND USE / LAND TAKE

Land in the immediate vicinity of the Site is either agricultural (pastoral) or used for quarrying. The Proposed Development within the Site boundary will see a void and associated disturbance (with bunding) to a total area of ca. 64.0 ha.

The Kildare County Development Plan 2023-2029 indicates that 113,765 ha of land is farmed in Kildare with a significant fall off in agricultural employment over the past number of years (Kildare County Council, 2023). The importance of this attribute is therefore considered to be *Low*.

The land that will be lost to the Proposed Development has low productivity and value as an agricultural resource. The resource potential of the underlying sands and gravels and rock for use in the extractive industry is high (beneficial). The magnitude of the impact on agricultural land use is therefore considered to be *Low (adverse)*.

5.7.3 LOSS OF SUPERFICIAL DEPOSITS AND BEDROCK

Topsoil within the Site boundary is used in the creation of screening berms and will be stored and reused during the restoration process to create biologically diverse habitats. The impact on the topsoil can therefore be considered temporary in nature and is *Low (adverse)*.

By the nature of quarrying, the sub-soil as sands and gravels and greywacke bedrock are removed, which results in a direct and irreversible impact on the Site. However, the removed material has a medium to high resource potential and will be used in future construction projects. The Proposed Development will remove ca. 13.2 Mt of sands and gravels and bedrock. The magnitude of the impact of the loss of sands and gravels and bedrock at the Site is considered to be *Medium (adverse)*.

The Site is in an area of high economic geology and the importance of this attribute is considered to be high (beneficial), in terms of provision of jobs to the local workforce and boost to the economy.

5.7.4 GEOTECHNICAL INSTABILITY

The Site is in an area of low seismic activity, however, the extraction activities will create new quarry faces within the sands and gravels and bedrock. Stability issues may arise during the excavation of the quarry faces and the construction and management of the silt ponds. Extraction activities have the potential to affect the health of workers if the ground were to become unstable. The importance of this attribute therefore is considered to be *Low* in terms of a land, soils and geology receptor and *High* in terms of human health.

The proposed extraction plan has incorporated industry standard for slope design, thus mitigating any potential geotechnical / geohazard risks and the existing quarry is well maintained and managed.

The management of the existing quarry faces, and silt pond will be carried out in accordance with the Health and Safety Authority's 'Guidelines to the Safety, Health and Welfare at Work (Quarries) Regulations 2020' (amended), and the recommendations of geotechnical appraisals carried out on site.

The stability of excavations and stockpiles will be monitored and managed, so the potential impact is predicated to be *Negligible (adverse)*.

5.7.5 GEOLOGICAL HERITAGE

The heritage sites to the south of the Site are associated with the Glen Ding Channels and Blessington Delta, comprised of deep sequences of Quaternary deposits. The Proposed Development will not extend into the Blessington Delta or Glen Ding Channels designated areas.

There have not been any indirect impacts on the heritage sites with uncovering of associated sequences within the Site boundary to date. The western extraction area will expose geological units over ca. 205 m along the edge of the Blessington Delta heritage area. The anticipated thickness of quaternary deposits in this area is <15 m, so the potential impact is predicated to be *Negligible (adverse)*.

With future progression of quarrying activities, exposed faces are to be assessed for potential heritage site sequences.

5.7.6 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 5-8. Table 5-8 only includes those sources of impact that may result in a low to high initial impact magnitude. Land quality, human health, geohazards and geological heritage are therefore not included in the table.

Table 5-8 – Evaluation of Impacts and their Effect Significance taking into account embedded mitigation

Receptor	Sensitivity	Source of Impact / Description of Change	Impact Magnitude	Level of Effect
Land (agricultural) use	Low	Change in land use by the advancement of the extraction area	Low	Imperceptible
Superficial deposits (sub-soils) at the Site and within the Study Area	Medium	Removal of superficial deposits at the Site	Medium	Moderate
Bedrock Geology at the Site and within the study area	Medium	Removal of bedrock at the Site	Medium	Moderate

5.8 MITIGATION MEASURES

Additional mitigation and/or management is intended to avoid, prevent, reduce or, if possible, offset any identified significant adverse effects on the environment. The initial assessment of potential effects (considering embedded mitigation) has not identified any significant adverse effects.

However, to further mitigate the initial effects associated with land, soils and geology, the following additional mitigation will take place:

- Future extraction is to remain above the 200 mAOD elevation or above the anticipated depth of the bedrock aquifer, for areas where borehole records confirm this depth. Note that this will require drilling additional boreholes to reduce uncertainties;
- Geotechnical appraisals to be carried out on site to assess the stability of the worked faces and silt pond;
- Future design include moving the silt pond into the base of the quarry. This will prevent the need to have controlled overflow of the silt pond over the quarry walls. There is also a larger area available for the silt pond to be constructed within the base of the quarry; and
- Soils will be reinstated on the Site during restoration works, and where possible, bedrock will be dressed with soil cover. Restored areas will be planted with native grassland species for grazing.

5.9 RESIDUAL EFFECTS

A summary of the sources of impact, predicted magnitudes of residual impact (accounting for embedded mitigation and additional mitigation) and subsequent residual effect significance is presented in Table 5-9.

In all cases the residual level of effect is no greater than *Slight*.

Table 5-9 – Evaluation of Impacts and their Effect Significance

Receptor	Source of Impact - Description of Change	Duration	Impact Magnitude / Level of Effect	Summary of Mitigation (embedded and additional)	Residual Impact Magnitude / Level of Effect
Land (agricultural) use	Change in land use by the advancement of the extraction area	Permanent, Irreversible	Low / Imperceptible	Soils will be reinstated on the Site during restoration works with native grassland for grazing.	Low / Imperceptible
Superficial deposits (sub-soils) at the Site and within the Study Area	Removal of superficial deposits at the Site	Permanent, Irreversible	Medium / Moderate	Soils will be reinstated on the Site during restoration works.	Low / Slight
Bedrock Geology at the Site and within the study area	Removal of bedrock at the Site	Permanent, Irreversible	Medium / Moderate	Soils will be reinstated on the Site during restoration works. Bedrock will be dressed with soil cover.	Low / Slight

5.10 CUMULATIVE EFFECTS

As a result of the embedded and additional mitigation measures at the Site, it is considered that any impacts on soils and geology will not contribute to cumulative impacts associated with the various quarrying activities located in the vicinity of the Site. Such local activities include sites directly adjacent to the east and southeast of the Site, and others located over a number of kilometres to the north of the Site, which follow the large glacial deposits laid down during the Quaternary Period.



The Proposed Development will extend activities into agricultural lands to the north and the south. However, given the size and direction of this extension, it is considered that there will be no cumulative land take issues with other developments that may extend their sites into the agricultural lands.

5.11 MONITORING

The ongoing monitoring programme at the Site will include regular geotechnical stability surveys of the quarry faces and the silt pond. Monitoring of the groundwater quality in monitoring wells and surface water quality within artificial ponds will be conducted in line with the requirements of the Site's environmental programme. Drone surveys will be conducted when necessary to determine whether quarried depths and extents are consistent with those planned and approved.



5.12 REFERENCES

Blessington Gravel Aquifer, Groundwater Source Protection Report, Geological Survey of Ireland, March 2003.

Geological Survey of Ireland website, www.gsi.ie; online mapping services. Accessed October 2023.

Golder 2020. Revised EIAR and NTS

Guidelines to the Safety, Health and Welfare at Work (Quarries) Regulations 2020. Health and Safety Authority.

Kildare County Development Plan 2023-2029, 2023.

Teagasc Soils website, <http://gis.teagasc.ie/soils/downloads.php>. Accessed November 2023.

Appendix 5A

BORELOGS





GOLDER

Client :

Hudson Brothers Ltd

Hole No.

BH1K

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Unknown

Contractor :

Date Started : 18/01/2006

Completed : 18/01/2006

Ground Level (mAOD) :

Co-ordinates : E 696604.2 N 717377.9

Logged by : GB

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results		SAMPLES		STRATA RECORD			
		SPT 'N'		Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description
							(3.00)	Dark brown slightly moist sandy gravelly TOPSOIL	
							3.00 (3.00)	Grey argillaceous SILTSTONE	
							(4.00) 10.00	Very weathered dark grey argillaceous SILTSTONE	
							(9.00) 19.00	Weathered dark grey SILTSTONE	
								Groundwater encountered at 16m bgl.	
								End of Hole at 19.00m	

Remarks :
 Bedrock at 3m bgl.
 Groundwater encountered at 16m bgl.
 End of hole at 19m bgl.
 Installation: 0 - 11m bgl plain, 11 - 19m bgl slots.

Checked By:
BB

Scale 1:100



GOLDER

Client :

Hudson Brothers Ltd

Hole No.

BH2K

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Unknown

Contractor :

Date Started : 16/01/2006

Completed : 16/01/2006

Ground Level (mAOD) : 257.27

Co-ordinates : E 697261.3 N 717081.8

Logged by : GB

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results		SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description	
					255.27		(2.00) 2.00	Light brown damp sandy CLAY	
					251.27		(4.00) 6.00	Grey mottled brown sandy gravelly CLAY	
							(28.00)	Light grey shattered GREYWACKE. Angular to sub-angular clasts, more rounded with depth.	

Remarks :
 Bedrock at 6m bgl.
 Groundwater encountered at 26m bgl.
 End of hole at 34m bgl.
 Installation: 0 - 24m bgl plain, 24 - 34m bgl slots.

Checked By:
BB

Scale 1:100

GALIBEN/GED(1)
April 2006



GOLDER

Client :

Hudson Brothers Ltd

Hole No.

BH2K

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Unknown

Contractor :

Date Started : 16/01/2006 Completed : 16/01/2006

Ground Level (mAOD) : 257.27

Co-ordinates : E 697261.3 N 717081.8

Logged by : GB

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results		SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description	
									Light grey shattered GREYWACKE. Angular to sub-angular clasts, more rounded with depth.
									Groundwater encountered at 26m bgl.
					223.27			34.00	End of Hole at 34.00m

Remarks :
 Bedrock at 6m bgl.
 Groundwater encountered at 26m bgl.
 End of hole at 34m bgl.
 Installation: 0 - 24m bgl plain, 24 - 34m bgl slots.

Checked By:
BB

Scale 1:100



GOLDER

Client :

Hudson Brothers Ltd

Hole No.

BH3K

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Unknown

Contractor :

Ground Level (mAOD) : 229.24

Date Started : 19/01/2006

Completed : 19/01/2006

Co-ordinates : E 696870.1 N 717023.9

Logged by : GB

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results		SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description	
					226.24		3.00	Light to dark brown sandy CLAY	
					223.24		6.00	Brown and grey SAND & GRAVEL	
							(13.00)	Light to dark brown SAND & GRAVEL with angular to sub-angular clasts	
					210.24		19.00	Groundwater encountered at 12.6m bgl.	
								End of Hole at 19.00m	

Remarks :
 Bedrock not encountered.
 Groundwater encountered at 12.6m bgl.
 End of hole at 19m bgl.
 Installation: 0 - 11m bgl plain, 11 - 19m bgl slots.

Checked By:
BB

Scale 1:100



GOLDER

Client :

Hudson Brothers Ltd

Hole No.

BH4K

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Unknown

Contractor :

Date Started :

Completed :

Logged by : Unknown

Ground Level (mAOD) : 229.19

Co-ordinates : E 697151.1 N 716476.2

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results		SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description	
					225.69		(3.50) 3.50	Brown silty sandy Gravel	
								Light grey GREYWACKE	

Remarks :
 Borehole drilled prior to Golder involvement. Log created from visual inspection of location and adjacent quarry pit geology.
 Bedrock encountered at approx. 3.5m bgl.
 Groundwater encountered at 20.6m bgl.
 End of hole at an unknown depth >100m bgl.
 Installation unknown.

Checked By:
BB

Scale 1:100

GALIBENI/GED(1)
April 2008



GOLDER

Client :

Hudson Brothers Ltd

Hole No.

BH4K

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Unknown

Contractor :

Date Started :

Completed :

Logged by : Unknown

Ground Level (mAOD) : 229.19

Co-ordinates : E 697151.1 N 716476.2

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results		SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description	
↓								Light grey GREYWACKE Groundwater encountered at 20.6m bgl.	

Remarks :
 Borehole drilled prior to Golder involvement. Log created from visual inspection of location and adjacent quarry pit geology.
 Bedrock encountered at approx. 3.5m bgl.
 Groundwater encountered at 20.6m bgl.
 End of hole at an unknown depth >100m bgl.
 Installation unknown.

Checked By:
BB

Scale 1:100

GALIBEN/GE01
April 2008



GOLDER

Client :

Hudson Brothers Ltd

Hole No.

BH4K

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Unknown

Contractor :

Date Started :

Completed :

Logged by : Unknown

Ground Level (mAOD) : 229.19

Co-ordinates : E 697151.1 N 716476.2

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results		SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description	
							(96.50)	Light grey GREYWACKE	

Remarks :

Borehole drilled prior to Golder involvement. Log created from visual inspection of location and adjacent quarry pit geology.
 Bedrock encountered at approx. 3.5m bgl.
 Groundwater encountered at 20.6m bgl.
 End of hole at an unknown depth >100m bgl.
 Installation unknown.

Checked By:
BB

Scale 1:100

GALIBEN/GE01
April 2008



GOLDER

Client :

Hudson Brothers Ltd

Hole No.

BH4K

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Unknown

Contractor :

Date Started :

Completed :

Logged by : Unknown

Ground Level (mAOD) : 229.19

Co-ordinates : E 697151.1 N 716476.2

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results		SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description	
								Light grey GREYWACKE	

Remarks :

Borehole drilled prior to Golder involvement. Log created from visual inspection of location and adjacent quarry pit geology.
 Bedrock encountered at approx. 3.5m bgl.
 Groundwater encountered at 20.6m bgl.
 End of hole at an unknown depth >100m bgl.
 Installation unknown.

Checked By:
BB

Scale 1:100

GALIBEN/GE011
April 2008



GOLDER

Client :

Hudson Brothers Ltd

Hole No.

BH4K

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Unknown

Contractor :

Date Started :

Completed :

Logged by : Unknown

Ground Level (mAOD) : 229.19

Co-ordinates : E 697151.1 N 716476.2

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results		SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description	
					129.19		100.00	End of borehole at an unknown depth >100m bgl.	

Remarks :

Borehole drilled prior to Golder involvement. Log created from visual inspection of location and adjacent quarry pit geology.
 Bedrock encountered at approx. 3.5m bgl.
 Groundwater encountered at 20.6m bgl.
 End of hole at an unknown depth >100m bgl.
 Installation unknown.

Checked By:
BB

Scale 1:100

GALIBEN/GE0(1)
April 2008



GOLDER

Client :

Hudson Brothers Ltd

Hole No.

BH5K

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Unknown

Contractor :

Date Started : 16/01/2006

Completed : 16/01/2006

Ground Level (mAOD) : 263.40

Co-ordinates : E 697619.6 N 716749.2

Logged by : GB

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results		SAMPLES		STRATA RECORD				
		SPT 'N'		Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description	
								261.40	(2.00)	Dark brown sandy gravelly CLAY
									2.00	Light to dark brown dry SAND & GRAVEL. Gravel is between 10mm and 15mm in size.
									(8.00)	
								253.40	10.00	Light to dark brown dry SAND & GRAVEL. Large gravel being returned.

Remarks :
 Bedrock at 32.8m bgl.
 Groundwater not encountered.
 End of hole at 34m bgl.
 Installation 0 - 31m bgl plain, 31 - 34m bgl slots.

Checked By:
BB

Scale 1:100

GALLENM/GED(1)
April 2006



GOLDER

Client :

Hudson Brothers Ltd

Hole No.

BH5K

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Unknown

Contractor :

Date Started : 16/01/2006

Completed : 16/01/2006

Ground Level (mAOD) : 263.40

Co-ordinates : E 697619.6 N 716749.2

Logged by : GB

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results		SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description	
					230.60		32.80	Light to dark brown dry SAND & GRAVEL. Large gravel being returned.	
					229.40		(1.20) 34.00	Dark to light grey fine grained GREYWACKE	
								End of Hole at 34.00m	

Remarks :
 Bedrock at 32.8m bgl.
 Groundwater not encountered.
 End of hole at 34m bgl.
 Installation 0 - 31m bgl plain, 31 - 34m bgl slots.

Checked By:
BB

Scale 1:100



GOLDER

Client :

Hudson Brothers Ltd

Hole No.

BH6K

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Rotary Drill Rig

Contractor : JS Drilling

Ground Level (mAOD) : 242.82

Date Started : 22/07/2019

Completed : 22/07/2019

Co-ordinates : E 696590.6 N 716384.7

Logged by : MBD

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results		SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description	
					240.82		(2.00) 2.00	Overburden comprising CLAY	
								Interlayered SAND & GRAVEL	

Remarks :
 Bedrock at 43.5m bgl.
 Groundwater encountered at 51m bgl.
 End of hole at 59m bgl.
 Installation: 0 - 38m bgl plain, 38 - 59m bgl slots.

Checked By:
BB

Scale 1:100

GALVINM/GED(1)
April 2008



GOLDER

Client :

Hudson Brothers Ltd

Hole No.

BH6K

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Rotary Drill Rig

Contractor : JS Drilling

Ground Level (mAOD) : 242.82

Date Started : 22/07/2019

Completed : 22/07/2019

Co-ordinates : E 696590.6 N 716384.7

Logged by : MBD

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results		SAMPLES		STRATA RECORD			
		SPT 'N'		Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description
							(41.50)	Interlayered SAND & GRAVEL	

Remarks :
 Bedrock at 43.5m bgl.
 Groundwater encountered at 51m bgl.
 End of hole at 59m bgl.
 Installation: 0 - 38m bgl plain, 38 - 59m bgl slots.

Checked By:
BB

Scale 1:100



GOLDER

Client :

Hudson Brothers Ltd

Hole No.

BH6K

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Rotary Drill Rig

Contractor : JS Drilling

Ground Level (mAOD) : 242.82

Date Started : 22/07/2019 Completed : 22/07/2019

Co-ordinates : E 696590.6 N 716384.7

Logged by : MBD

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results		SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description	
					199.32		43.50	Interlayered SAND & GRAVEL	
								GREYWACKE - reddish brown arisings	
							(15.50)	Groundwater encountered at 51m bgl.	
					183.82		59.00	End of Hole at 59.00m	

Remarks :
 Bedrock at 43.5m bgl.
 Groundwater encountered at 51m bgl.
 End of hole at 59m bgl.
 Installation: 0 - 38m bgl plain, 38 - 59m bgl slots.

Checked By:
BB

Scale 1:100

GALLENM/GED(1)
April 2008



GOLDER

Client :

Hudson Brothers Ltd

Hole No.

BH7K

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Rotary Drill Rig

Contractor : JS Drilling

Ground Level (mAOD) : 263.38

Date Started : 18/07/2019

Completed : 18/07/2019

Co-ordinates : E 697620.1 N 716729.3

Logged by : MBD

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results		SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description	
					261.38		(2.00) 2.00	Overburden comprising CLAY	
								Interlayered SAND & GRAVEL	

Remarks :
 Bedrock at 45m bgl.
 Groundwater encountered at 48m bgl.
 End of hole at 63m bgl.
 Installation: 0 - 43m bgl plain, 43 - 63m bgl slots.

Checked By:
BB

Scale 1:100



GOLDER

Client :

Hudson Brothers Ltd

Hole No.

BH7K

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Rotary Drill Rig

Contractor : JS Drilling

Ground Level (mAOD) : 263.38

Date Started : 18/07/2019

Completed : 18/07/2019

Co-ordinates : E 697620.1 N 716729.3

Logged by : MBD

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results		SAMPLES		STRATA RECORD			
		SPT 'N'		Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description
							(43.00)	Interlayered SAND & GRAVEL	

Remarks :
 Bedrock at 45m bgl.
 Groundwater encountered at 48m bgl.
 End of hole at 63m bgl.
 Installation: 0 - 43m bgl plain, 43 - 63m bgl slots.

Checked By:
BB

Scale 1:100

GALIBENI/GED(1)
April 2008



GOLDER

Client :

Hudson Brothers Ltd

Hole No.

BH7K

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Rotary Drill Rig

Contractor : JS Drilling

Ground Level (mAOD) : 263.38

Date Started : 18/07/2019

Completed : 18/07/2019

Co-ordinates : E 697620.1 N 716729.3

Logged by : MBD

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results		SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description	
							45.00	Interlayered SAND & GRAVEL	
					218.38		(18.00)	GREYWACKE	
								Groundwater encountered at 48m bgl.	

Remarks :
 Bedrock at 45m bgl.
 Groundwater encountered at 48m bgl.
 End of hole at 63m bgl.
 Installation: 0 - 43m bgl plain, 43 - 63m bgl slots.

Checked By:
BB

Scale 1:100



GOLDER

Client :

Hudson Brothers Ltd

Hole No.

BH7K

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Rotary Drill Rig

Contractor : JS Drilling

Ground Level (mAOD) : 263.38

Date Started : 18/07/2019 Completed : 18/07/2019

Co-ordinates : E 697620.1 N 716729.3

Logged by : MBD

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results		SAMPLES		STRATA RECORD			
		SPT 'N'		Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description
							63.00	GREYWACKE	
					200.38			End of Hole at 63.00m	

Remarks :
 Bedrock at 45m bgl.
 Groundwater encountered at 48m bgl.
 End of hole at 63m bgl.
 Installation: 0 - 43m bgl plain, 43 - 63m bgl slots.

Checked By:
BB

Scale 1:100

GALIBEN/GE011
April 2008



GOLDER

Client :

Hudson Brothers Ltd

Hole No.

BH8K

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Rotary Drill Rig

Contractor : Aidan Dempsey Drilling

Ground Level (mAOD) : 239.48

Date Started : 23/03/2020 Completed : 24/03/2020

Co-ordinates : E 696628.7 N 717407.9

Logged by : JM

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results		SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description	
							(4.00)	Slightly clayey SAND & GRAVEL. Sand is fine to coarse. Gravel is fine to medium subrounded to subangular	
					235.48		4.00	Very sandy very gravelly CLAY	
					234.48		(1.00) 5.00		
					233.98		5.50	Weathered SILTSTONE	
							(2.50)	Brown SILTSTONE	
					231.48		8.00	Brown to bluey grey SILTSTONE	
							(17.50)	Groundwater encountered at 18.5m bgl.	

Remarks :
 Bedrock at 5.5m bgl.
 Groundwater encountered at 18.5m bgl and rose to 12.25m bgl (drill bit still in hole).
 End of hole at 25.5m bgl.
 Installation: 0 - 16.5m bgl plain, 16.5 - 25.5m bgl slots.

Checked By:
BB

Scale 1:100

GALLENM/GED(1)
April 2008



Client :

Hudson Brothers Limited

Hole No.

BH09K

Site : Old Paddocks, Kildare

Project : Hudson Env Support

Project No : 41000087

Equipment & Methods : Reich Drill 650W

Contractor : Aiden Dempsey

Ground Level (mAOD) : 205.53

Date Started : 22/08/2023 Completed : 29/08/2023

Co-ordinates : E 296439.0 N 216988.0

Logged by : EG

WATER/ PROGRESS	INSTALLATION /BACKFILL	SAMPLES				STRATA RECORD			
		Sample Top (m)	SPT 'N' Value	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description
						205.03		0.50	Orangey brown slightly gravelly slightly sandy clay. Gravel was fine to coarse, mostly subrounded. Sand was medium to coarse.
						201.53		4.00	Grey-brown slightly clayey very sandy GRAVELS. Gravels are fine to coarse subrounded. Sand is medium to fine.
						194.53		7.00	Light brown silty SAND AND GRAVELS. Gravels are fine to medium subrounded. Sands are fine to coarse
						190.53		4.00	Slightly clayey gravelly SAND. Sands are fine to coarse. Gravels are fine to medium subrounded.
						181.53		15.00	Drilling becoming harder with depth from 14.0 m bGL
						164.53		9.00	Brown sandy gravelly CLAY. Gravels are medium subrounded to subangular. Sands are fine to coarse.
						161.53		24.00	Brown clayey SAND and GRAVEL. Gravels are fine to medium subrounded. Sands are fine to medium.
						145.53		17.00	Brown MUDSTONE
								3.00	Greyish blue SILTSTONE.
								44.00	Waterstrike at 54m
								60.00	Bedrock at 60m bgl

Remarks :
 Bedrock at 60m bgl.
 Groundwater encountered at 54m bgl.
 End of hole at 60m bgl.
 Installation: 1-50m bgl plain, 50-59m bgl slots

End of Hole at 60.00m

Checked By: GF

Scale 1:301

GALK ENV+GEOTECH April 2006



Client :

Hudson Brothers Limited

Hole No.

BH10K

Site : Old Paddocks, Kildare

Project : Hudson Env Support

Project No : 41000087

Equipment & Methods : Reich Drill 650W

Contractor : Aiden Dempsey

Ground Level (mAOD) : 224.90

Date Started : 29/08/2023 Completed : 31/08/2023

Co-ordinates : E 296474.0 N 215897.0

Logged by : EG

WATER/ PROGRESS	INSTALLATION /BACKFILL	SAMPLES				STRATA RECORD			
		Sample Top (m)	SPT 'N' Value	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description
						223.90		1.00	Grass over TOPSOIL comprising light orangey brown slightly gravelly slightly sandy clay.
						222.90		2.00	Slightly sandy very gravelly CLAY. Gravels are coarse subrounded. Sand is fine to coarse.
								(5.00)	Brown clayey gravelly SAND. Sand is fine to coarse. Gravels are fine to coarse subrounded.
						217.90		7.00	Grey clayey SAND AND GRAVELS. Gravels are fine to medium subrounded. Sands are fine to coarse.
						212.90		(5.00)	Light brown silty GRAVELS. Gravels are fine to medium subrounded.
						206.90		12.00	Mottled greyish black GREYWACKE.
								(6.00)	Waterstrike at 31m
						188.90		18.00	End of Hole at 36.00m

Remarks :
 Bedrock at 36m bgl.
 Groundwater encountered at 31m bgl.
 End of hole at 36m bgl.
 Installation: 1-29m bgl plain, 29-36m bgl slots

Checked By: GF

Scale 1:301

GALK ENV+GEOTECH April 2006

Appendix 5B

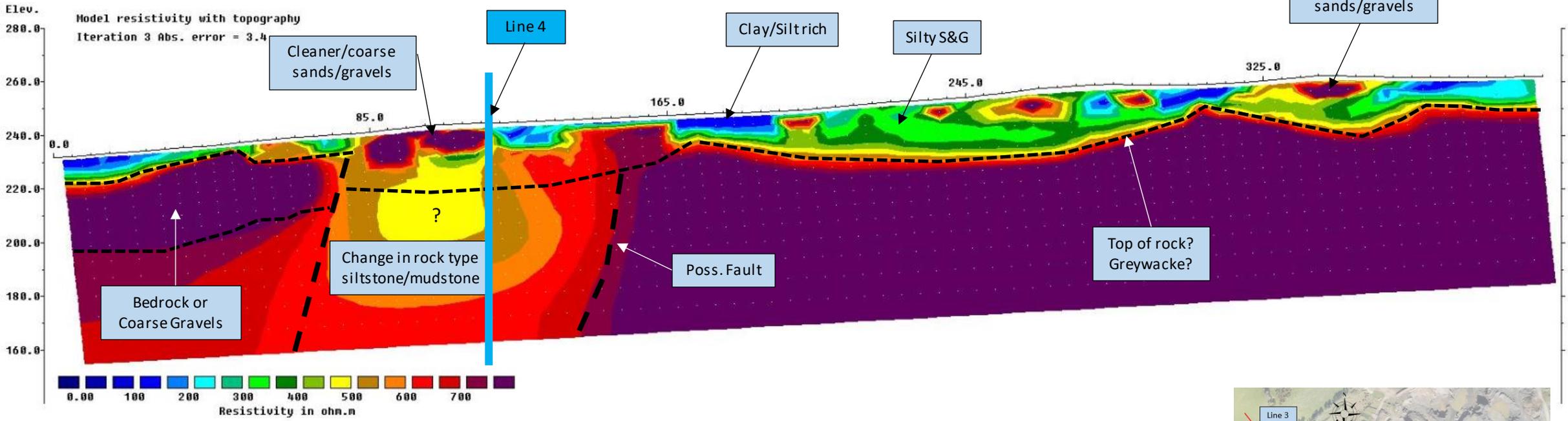
GEOPHYSICS LINES



Line 1: Looking East

North

South



Horizontal scale is 22.00 pixels per unit spacing
Vertical exaggeration in model section display = 0.72
First electrode is located at 0.0 m.
Last electrode is located at 400.0 m. Unit Electrode Spacing = 5.00 m.

