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6.0 LAND, SOILS & GEOLOGY

6.1 Background and Objectives

Hydro-Environmental Services (HES) has carried out an impact assessment of any potential significant and likely effects of a proposed sand and gravel pit at Ballymullen, Abbeyleix, Co. Laois on land, soil and geology aspects of the receiving environment.

This chapter of the EIAR provides a baseline assessment of the environmental setting of the proposed sand and gravel pit in terms of land, soils and geology and discusses the potential likely effects that the proposed aggregate extraction will have. Where required, appropriate mitigation measures to limit any identified significant effects to land, soils and geology are recommended.

6.2 Proposed Development Overview

The proposed development is a new sand and gravel pit within a greenfield site at Ballymullen, Abbeyleix, Co. Laois. The estimated volume or material to be extracted from the application site is approximately 787,310m^3 of material of which 23,500m^3 consists of overburden which will be used to construct berms and restore the site. Therefore, the volume of material to be transported to the manufacturing facility is approximately 763,810m^3 or 1.53million tonnes using a conversion factor of 2m^3/tonne.

The extraction will be carried out over 8 no. phases. Phases 1-3 will essentially be the northern half of the site and Phases 4-8 the southern half of the site. The proposed development will require the erection of minor infrastructure to include a porta-loo toilet and a wheelwash. These facilities will be located on a hardcore gravel area close to the entrance to the site. Please note, the southern portion of Phase 4 (the portion directly upslope/upstream of the mapped petrifying spring area in Abbeyleix Bog) has been removed from the previously proposed extraction plan as presented in the withdrawn application (LCC Reg. Ref. 21/694) (i.e. there will be no extraction of aggregate upslope/upstream of the petrifying spring area).

Extracted material will be transported from the site to the existing Booth Precast Products Ltd manufacturing facility located approximately 1.3km to the south of the site. Refer to Figure 6.1 below which shows the proposed site layout and extraction plan.

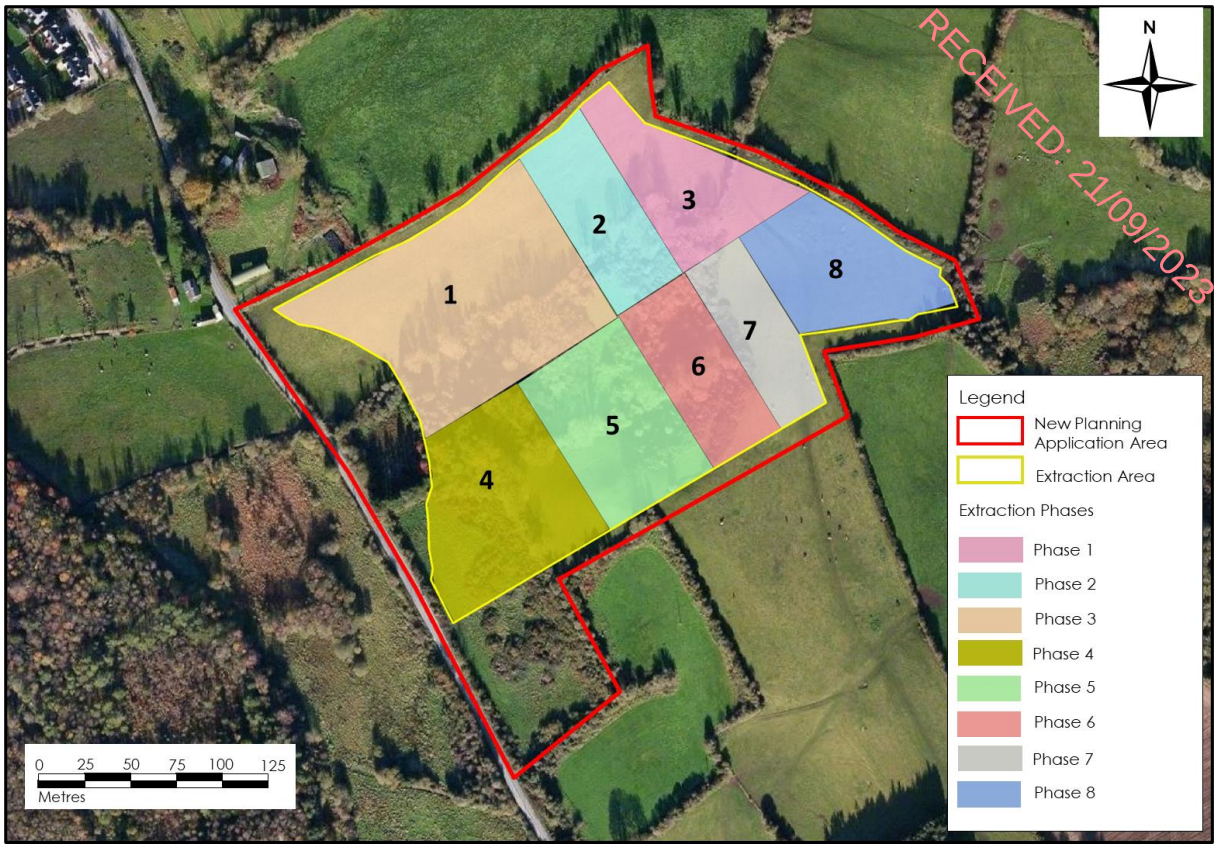

Figure Error! No text of specified style in document.**.1:** Proposed Site Layout and Extraction Plan.

6.3 Relevant Legislation

The Land, Soils and Geology Chapter of the EIAR is prepared in accordance with the requirements of European Union Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (the 'EIA Directive') as amended by Directive 2014/52/EU. Regard has also been taken of the requirements of the following legislation.

- *European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2001 – 2019*;
- The *Planning and Development Acts 2000*, as amended;
- *Planning and Development Regulations 2001*, as amended;
- S.I. No. 4/1995: The Heritage Act 1995, as amended; and,
- Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment, including Circular Letter PL 1/2017: Implementation of Directive 2014/52/EU on the effects of certain public and private projects on the environment (EIA Directive).

RECEIVED: 21/09/2023

6.4 Relevant Guidance

The Land, Soils and Geology Chapter of the EIAR is carried out in accordance with guidance contained in the following:

- Environmental Protection Agency (May 2022): Guidelines on the Information to be Contained in Environmental Impact Assessment Reports;
- Institute of Geologists Ireland (2013): Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements;
- National Roads Authority (2005): Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (NRA, 2005);
- Department of the Environment, Heritage and Local Government; Quarries and Ancillary Activities – Guidance for Authorities (April, 2014);
- Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended by 2014/52/EU), (European Union, 2017); and,
- Environmental Protection Agency (2006): Environmental Management in the Extractive Industry (Non-Scheduled Minerals).

6.5 Schedule of Works

6.5.1 Desk Study

A desk study of the proposed site and surrounding area was completed prior to the undertaking of field mapping, walkover assessments and site investigations. The desk study involved collecting all relevant geological and hydrogeological data for the study area. This included consultation with the following:

- Environmental Protection Agency database (www.epa.ie);
- Geological Survey of Ireland (GSI) - Groundwater Database (www.gsi.ie);
- Met Eireann Meteorological Databases (www.met.ie);
- National Parks & Wildlife Services Public Map Viewer (www.npws.ie);
- EPA/Water Framework Directive “Catchments” Map Viewer (www.catchments.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 16 (Geology of Kildare - Wicklow); Geological Survey of Ireland (GSI, 1994); and,
- Geological Survey of Ireland (GSI) - Groundwater Body Characterisation Reports.

6.5.2 Baseline Surveys and Investigations

To complete the Land, Soils and Geology Chapter of the EIAR, the following surveys and investigations were carried out:

- A walkover survey to assess the ground conditions and layout of the proposed site including surveys of adjacent lands;
- Drilling of 5 no. investigation holes/monitoring wells to assess overburden lithology, depth to the bedrock and for groundwater level monitoring and sampling;

RECEIVED: 21/09/2023

- Particle Size Distribution analysis was undertaken on material samples which were taken at 3m depth intervals;
- 3 no. peat augers were completed on the edge of Abbeyleix Bog adjacent to the application site;
- Previous studies of the geology of Abbeyleix Bog were also reviewed and summary data have been presented in the baseline characterisation of local geology; and,
- Mineral soils and subsoils were logged according to BS: 5930:2015 Code of Practice for Ground Investigations.

6.5.3 Impact Assessment Methodology

Please refer to Chapter 1.0 of the EIAR for details on the impact assessment methodology (EPA, 2022). In addition to the above methodology, the importance of the land, soils and geological environment receptors was assessed on completion of the desk study and baseline study.

Using the National Roads Authority (2008) guidance, an estimation of the importance of the land, soils and geological environments within the study area are quantified, using the criteria set out in Table 6.1.

Table Error! No text of specified style in document.**.1:** Estimation of Importance of Geology Attributes (NRA, 2008)

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

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

RECEIVED: 21/09/2023

The guideline criteria for the assessment of likely significant effects require that likely effects are described with respect to their extent, magnitude, type (i.e. negative, positive or neutral) probability, duration, frequency, reversibility, and transfrontier nature (if applicable).

The impact descriptors used in this assessment are those set out in (the EIA Directive, and EPA (2022)) in the Glossary of effects as shown in Chapter 1.0 of this EIAR.

6.6 Existing Environment

6.6.1 Site Description and Topography

The proposed development site is situated at Ballymullen townland which is located ~1km south of Abbeyleix town, Co. Laois. The application site, which is currently a greenfield site, has an area of approximately 8.5ha.

The site is located at the topographic transition between the Castlecomer Plateau to the east and Laois Central Lowlands to the west. Much of the site area has a characteristic hummocky, hilly terrain, which is typical of a glaciofluvial deposition area. The land then flattens westward towards the River Nore which is located 2.2km west of the site.

The site, which has an elevation range of between approximately 92 and 130m OD (Ordnance Datum), is located on a hillside that steadily slopes in a westerly direction towards the lower lying and flatter peatlands (Abbeyleix Bog) that exists to the west of the site.

The proposed development site, which comprises mainly grassland with some woodland and scrub in the central area, is bordered by agricultural grassland to the east, north and south and

by a local public road to the west which defines the western site boundary. West of the local public road, the land is low-lying and slightly boggy before it transitions into peatland.

The site is made up of several grazing fields which are separated by hedgerows. Access to the site is from the public road to the west.

RECEIVED: 21/09/2023

6.6.2 Land-use

Based on the Corine (2018) mapping the proposed site and most of the local area is mapped as Agricultural Areas/Pastures.

Abbeyleix Bog is located immediately to the southwest of the site and this is mapped by Corine (2018) as Mixed Forests and Peat Bogs.

The proposed site currently comprises mainly grassland (6.4ha) with some tree coverage/scrub (2ha) over sand and gravel deposits with a thickness of up to 37.2m being confirmed above bedrock (described below). The ground elevation ranges between approximately 94m OD on the west and 130m OD on the east. The landuse is agricultural and mainly for animal grazing.

Land-use in the surrounding area is largely agricultural with a scattered rural pattern of residential dwellings along the local roads to the west. Further north (~200m) along the public road to the west, there are a number of housing estates on the outskirts of Abbeyleix. There are a number of existing sand and gravel pits in the area, the closest one is a small disused pit located approximately 500m to the southeast of the site. This is currently used as a Defence Forces and An Garda Síochána Firing Range. The existing Booth Precast Products manufacturing facility is located approximately 1.3km to the south of the site.

The closest EPA licensed facility is located approximately 500m to the northwest of the application site. Stonearch previously manufactured Vitamin K3 for use as a supplement in animal feed until closure in the early 2000s. The facility is still licensed by the EPA (P0332).

6.6.3 Local Soils and Subsoils

The published soils map (www.epa.ie) for the area shows that the majority of the proposed development site (and surrounding area) is mapped to be overlain by shallow well-drained mineral soil while the western low-lying side of the site is mapped to be overlain by shallow poorly drained soil. Immediately west of the local road (which defines the western boundary of the site) cutover peat is mapped. Down in a hollow immediately to the east of the site lacustrine clays are mapped in an area where a pond forms during wet periods.

Based on the GSI subsoil map (www.gsi.ie), glaciofluvial sands and gravels are mapped within the site boundary and these deposits are mapped to extend to the north, south and east of the site. Cutover bog, as described above, is mapped to the west of the site. A local subsoil geology map is shown in Figure 6.2.

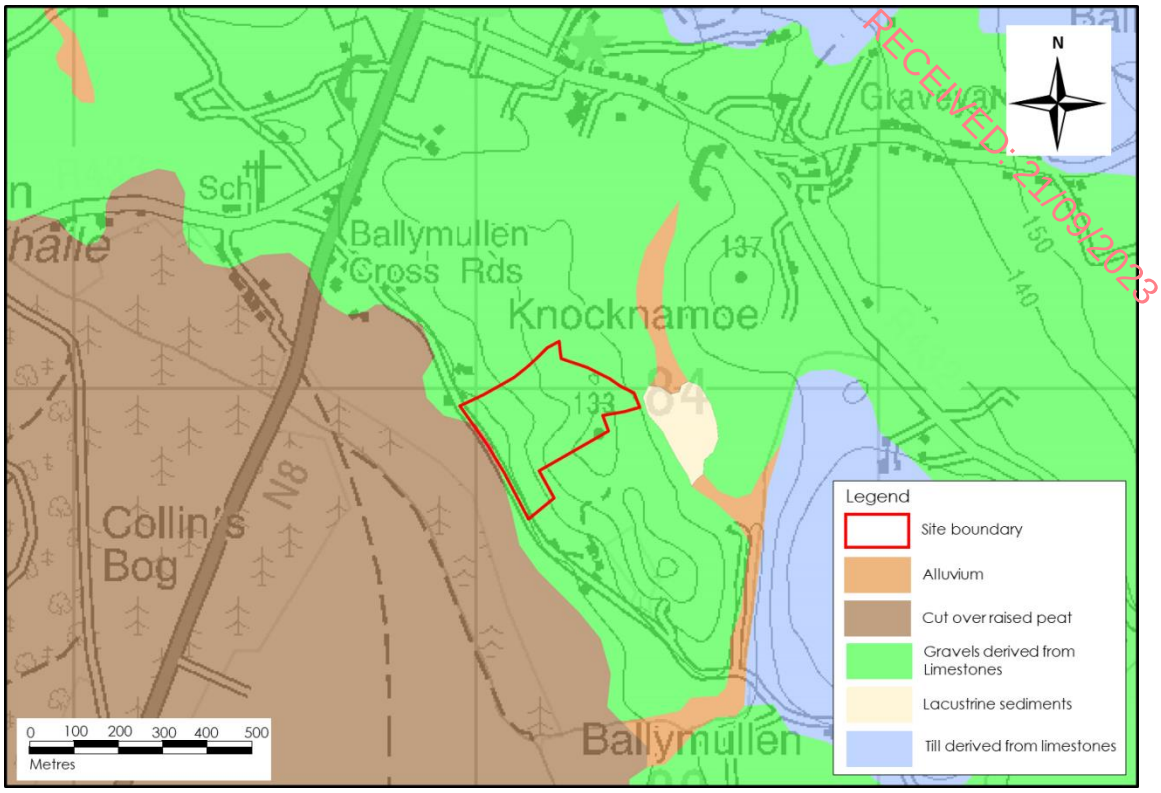

Figure Error! No text of specified style in document.**.2:** GSI Local Subsoils Map

6.6.4 Local Bedrock Geology

Based on the GSI bedrock geology map (www.gsi.ie), Dinantian Pure Bedded Limestones are mapped to underlie the proposed development and these comprise two bedrock formations in the area of the site, namely; the Ballyadams Formation and the Clogrenan Formation with the former underlying the majority of the site.

The Ballyadams Formation, which is mapped to underlie the central, western and northern sections of the site comprise crinoidal wackestone / packstone LIMESTONE. The Clogrenan Formation, which is mapped to underlie the eastern section of the site comprise cherty, muddy, calcarenitic LIMESTONE. A local bedrock geology map is shown as Figure 6.3.

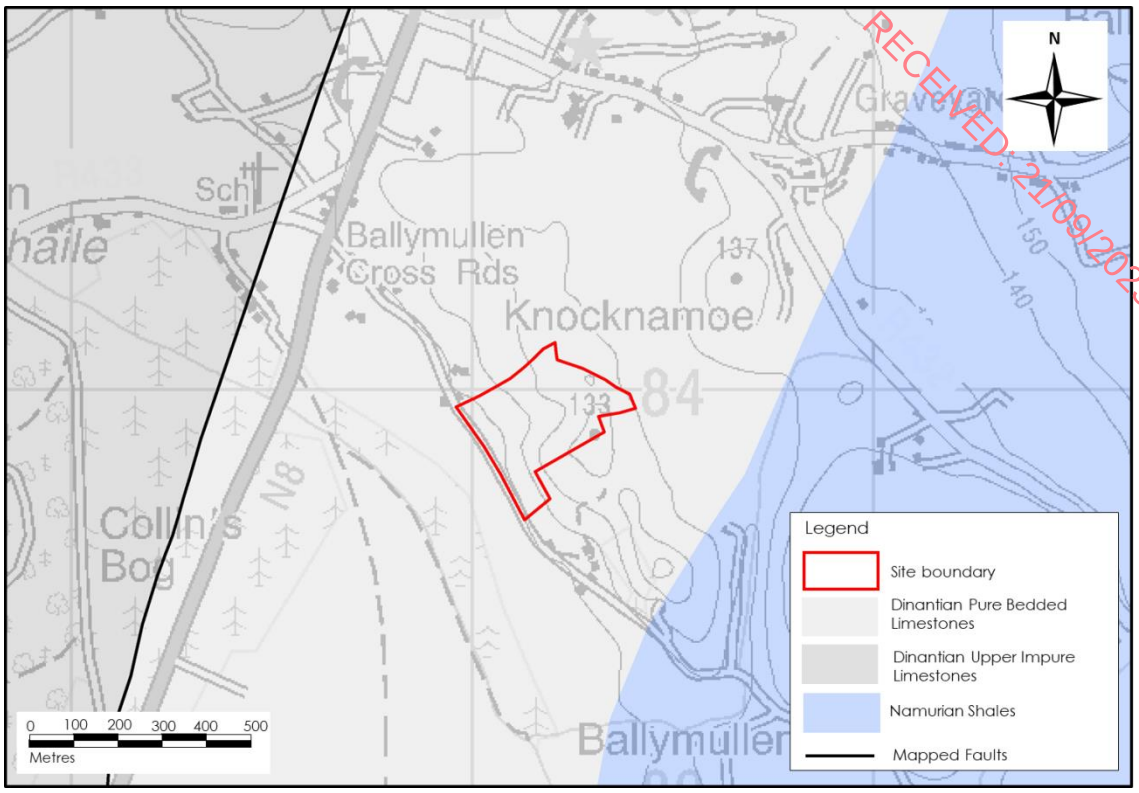

Figure Error! No text of specified style in document.**.3:** GSI Local Bedrock Map

6.6.5 Site Geology

Five investigation holes/monitoring wells (MW01 to MW05) were drilled by Peterson Drilling Services Ltd at the site under the supervision of HES between the 29th July and 2nd August 2019. Refer to Appendix 6.1 for drilling logs.

Based on the site investigations undertaken for the proposed development, the subsoil deposits on the more elevated eastern side of the site (@ MW01 and MW02) comprised mainly dense, medium to fine coarse, brown SAND (gravelly and/or silty) with infrequent layers (1-2) of dense, medium coarse, brown SAND & GRAVEL (with frequent cobbles) or GRAVEL (sandy). The SAND & GRAVEL/GRAVEL layers are typically 3-4m in thickness. The above described profile was confirmed down to 37.2m below ground level (89.2 m OD) in MW01 where the top of bedrock was met and to 37mbgl (92.36m OD) in MW02 where the hole was terminated before meeting bedrock.

In the lower-lying central (@ MW03 and MW04) and western side (@ MW05) of the site the SAND & GRAVEL/GRAVEL layers are more frequent and are interbedded with the SAND layers. SAND & GRAVEL and GRAVEL then become more dominant with depth (>17 – 20mbgl or <90 – 95m OD in the central area and >8mbgl or <87m OD at the western side).

The base of the sand and gravel was proven to be at 37.2mbgl (89.2m OD) at monitoring well location MW01 and at 30.6mbgl (84.7m OD) at MW03 when dark grey LIMESTONE was

RECEIVED: 21/09/2023

encountered. The variation in the top of bedrock elevation at these two locations suggests that the limestone bedrock formation is dipping southwesterly.

6.6.6 Bog Geology

HES completed 3 no. hand augers on land adjacent to Abbeyleix Bog. These hand augers were completed to allow logging of the geology, and also to allow the installation of shallow piezometers at the edge of Abbeyleix Bog. The locations of these investigation points are illustrated in Figure 7.8, and geological logs are attached in Appendix 6.2. The 3 no. deep sub peat piezometers (P1, P2 and P3) were installed into wet SAND which was found to underlie the PEAT. The 2 no. shallow standpipes (PH1 and PH3) were installed to the base of the peat only.

Peat depths at the 3 no. Auger locations ranged between 0.52 to 1.0m in depth.

The SAND (mineral subsoil) encountered below the peat at P1 and P3 was well sorted and coarse while the SAND at P2 was slightly gravelly.

Swanson (2017)[1] completed a wider survey (refer to Figure) of the geology and hydrogeology of Abbeyleix Bog. His findings with regard to geology can be summarised as follows:

- 29 piezometers were installed. The peat depth and sub-peat geology were recorded at those 29 locations across the bog.
- 6 no. boreholes were drilled around the bog.
- Peat depth ranged between 1.00 to 8.45m.
- 14 no. locations were underlain by grey SAND.
- 7 no. locations were underlain by shell Marl.
- 6 no. locations were underlain by clay (probably lacustrine clay)
- 1 no. location, the sub-peat geology could not be determined as the peat was too hard to auger through.

Swanson (2017), also noted generally deeper sub-soil north and east of the bog than south and west of the bog, and that the subsoils below the eastern part of the bog (BH1 and BH2) were located on an esker complex and contained sand with between 10–21% fine-grained materials (passing through a 0.063 mm sieve) by dry mass. He also determined that to the west of the bog (BH4 and BH5), a stiff clay layer was observed at 5-5.5m depth.

The HES sub-peat geological data corresponds well with the information presented by Swanson (2017).

Swanson (2017) also recorded bedrock depths below the bog of between 3.0m (BH6) and 12.8 (BH2)

[1] *Greenhouse Gas Emissions and Eco-hydrology of a Raised and Cutover Bog* (Swanson, 2017).

RECEIVED: 21/09/2023

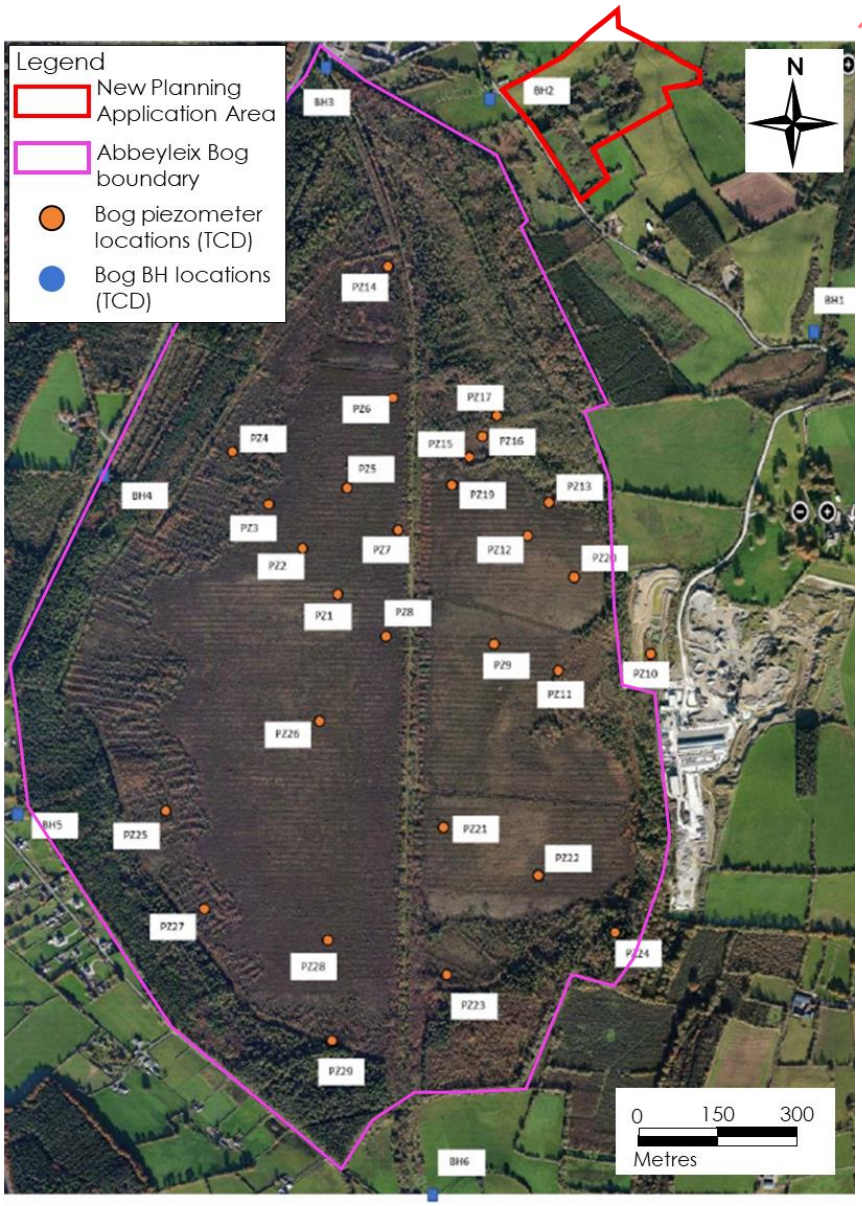

Figure Error! No text of specified style in document..**4:** Abbeyleix Bog – Geological Data Locations (after Swanson, 2017)

6.6.7 Economic Geology

The GSI database[2] shows that the site is located in an area of Very High Potential for granular aggregate.

The sand and gravel at the site could be classified as high importance (refer to Table 6.1). The sand and gravel deposits are a proven economically extractable mineral resource for

[2] Source: GSI online Aggregate Potential Mapping Database.

construction purposes, and this is supported by the long history of aggregate extraction in the area.

RECEIVED: 21/09/2023

6.6.8 Geological Heritage and Designated Sites

The proposed development is not located within any geological heritage site. The closest geological heritage site is Abbeyleix Bog (site code LS001). This bog is referred to as Coffin's Bog and Killamuck on the OSI mapping.

Abbeyleix Bog comprises an extensive area of peatland south of Abbeyleix town. The bog peat is Quaternary in age having formed in marshy conditions since deglaciation. The bog covers an area of approximately 4km^2 (400Ha).

Designated sites include National Heritage Areas (NHAs), proposed National Heritage Areas (pNHAs), Special Areas of Conservation (SACs), candidate Special Areas of Conservation (cSAC) and Special Protection Areas (SPAs). The closest designated site to the proposed site is the River Barrow and River Nore SAC and the River Nore SPA which is located approximately 2.2km west of the proposed site.

No impacts on local geological heritage sites or designated sites are expected from a land, soils and geology perspective. Indirect hydrological effects are assessed in Chapter 8.0 – Water.

6.6.9 Soil Contamination

There are no known areas of soil contamination at the site or in the surrounding area. During the site walkover and drilling investigations, no areas of contamination concern were identified and the results from the groundwater sampling (refer to Chapter 7.0 – Water) also indicate no contamination issues. As the proposed site is a greenfield site, no historical contamination issues would be expected. There are no known historic mines at or in the immediate vicinity of the proposed development, that could potentially have contaminated tailings.

6.7 Potential Impacts of the Proposed Development

6.7.1 Characteristics of the Proposed Development

Development proposals include the extraction of approximately 1.53m tonnes of sand and gravel material. The proposed extraction depth varies between 97.3m OD on the west of the site and 102.5m OD on the east of the site. This is just over 3m above the monitored groundwater levels to allow for higher groundwater levels in winter.

There will also be a requirement to remove approximately 23,500m^3 of topsoil to access the underlying sand and gravel. The topsoil from Phase 1 and some of the sand and gravel will use to create berms along the western boundary of the site with topsoil from subsequent phases used to restore the previous phases. The material in the berm will be used to restore the final phase of extraction once completed and for restoration of the pit upon completion of extraction of material. There will be no aggregate extraction below the groundwater table.

RECEIVED: 21/09/2023

It also should be noted that there will be no discharge of wastewater at the site, as wastewater will be contained within a Portaloo and moved off-site to a licenced facility for disposal. Fuel and oil will be delivered to a licensed facility and moved off-site for disposal.

Fuel and oil will be delivered to site by a bowser and dispensed directly into plant and equipment. There will be no storage of oils and fuels on-site.

6.7.2 "Do Nothing" Scenario

If the proposed development does not go ahead, the site will remain as a greenfield site.

6.7.3 Potential Construction Phase Impacts

6.7.3.1 Initial Excavation of Soil and Subsoils including Berm and Entrance Construction

The initial site development construction works will include creation of the site entrance, stripping of topsoil and creation of screening berms.

These activities will require the movement and excavation of soils and subsoils and the creation of screening berms. The volume of material involved is small. The removal of vegetative cover and topsoil will be over small localised area (~0.34Ha) and will likely be completed in a short amount of time.

Receptor: Local Soil and Subsoils
Pathway/Mechanism: Aggregate extraction, movement and placement in berms
Pre-mitigation Impact: Negative, irreversible, slight, direct, likely, permanent effect on soil and subsoils.

Impact Assessment:

As outlined above, these works are small-scale, and they will be completed over a small area (~0.34Ha), and also over a short period. These works are an essential part of the initial site development, and allow entrance creation, and screening berms to be established.

Mitigation Measures:

Initial site earthworks and entrance/berm creation will result in a direct impact on the local geological environment, albeit this is an acceptable and unavoidable part of the proposed sand and gravel pit development. These impacts will be localised (i.e. only at the point of extraction/placement) and will be mostly mitigated through the adoption of a suitable landscape and restoration plan which will be undertaken following completion of extraction phase.

The soil and subsoil which will be removed are not notable from a geological heritage point of view and are widely abundant in the area. The stripped topsoil will be used to form a berm along the western boundary and for the ultimate restoration of the site.

RECEIVED: 21/09/2023

Residual Effect:

The soil and subsoil which will be removed are not notable from a geological heritage point of view and are widely abundant in the area. The works area will be small, and the volume of material excavated and used in berm construction is relatively small. The stripped topsoil will be used to form a berm along the western boundary and for the ultimate restoration of the site.

The residual effects are considered to be - negative, irreversible, slight, direct, likely, permanent effect on soils and subsoils.

Significance of Effects:

For the reasons outlined above, and with the implementation of the outlined mitigation, no significant effects on the soils and geology environment will occur during the construction phase.

6.7.4 Potential Extraction Phase Impacts

6.7.4.1 Excavation of Soil and Subsoils (Aggregate)

As stated in Section 6.2 above, the proposed development will involve the extraction of approximately 763,130m^3 /1.53 million tonnes of sand and gravel aggregate down to a level of between 97.3 and 102.5m OD.

In order to extract the aggregate, approximately 23,500m^3 of topsoil will be removed in phases and this will be used to construct a temporary berm along the western boundary and then ultimately used in the restoration of the site post extraction. For example overburden material removed from Phase 2 will be used to restore the pit floor of Phase 1. This will continue to be the case with further phases of extraction.

Receptor: Soil and subsoils
Pathway/Mechanism; Aggregate extraction
Pre-mitigation Impact: Negative, irreversible, moderate, direct, likely, permanent effect on soil and subsoils.

Mitigation Measures:

Site earthworks and aggregate extraction will result in a direct impact on the local geological environment, albeit this is an acceptable and unavoidable part of the proposed sand and gravel pit development. These impacts will be localised (i.e. only at the point of extraction) and will be mostly mitigated through the adoption of a suitable landscape and restoration plan which will be undertaken during the operational phase and on completion of extraction.

The soil and subsoil which will be removed are not notable from a geological heritage point of view and are widely abundant in the area. The stripped topsoil will be used to form a berm along the western boundary and for the ultimate restoration of the site.

RECEIVED: 21/09/2023

Residual Effect:

Site earthworks and aggregate extraction will result in a direct impact on the local geological environment, however, the excavated area will be progressively restored as excavation advances. The area of ground exposed at any one time will be minimized. The residual effects are considered to be - negative, irreversible, slight, direct, likely, permanent effect on soils and subsoils.

Significance of Effects:

For the reasons outlined above, and with the implementation of the recommended mitigation measures, no significant effects on soils and subsoils will occur.

6.7.4.2 Contamination of Soil and Subsoils from Oil / Fuel Spills and Leaks

Excavation, processing and transporting of aggregate at the site will be completed using machinery. Such machinery is powered by diesel engines and operated using hydraulics. Unless managed carefully such plant and machinery have the potential to leak hydraulic oils or cause fuel leaks during refuelling operations.

Only small volumes of fuel/oils will be present (in the machines) on-site and therefore no significant effects are expected as long as standard mitigation is implemented.

Receptor: Soil and Subsoils
Pathway: Soil and bedrock pore space
Pre-mitigation Impact: Negative, reversible, slight, direct, likely, long-term effect on soil and subsoils.

Mitigation Measures:

The following mitigation is proposed:

- All plant and machinery will be serviced before being mobilised to site;
- Refuelling will be carried out on a proposed refuelling pad at all times;
- Only designated trained operators will be authorised to refuel plant on site;
- Procedures and contingency plans will be set up to deal with emergency accidents or spills; and,
- An emergency spill kit with oil boom, absorbers etc. will be kept on-site for use in the event of an accidental spill.

Residual Effect:

The use of hydrocarbons is a standard risk associated with all construction sites. Proven and effective measures to mitigate the risk of spills and leaks have been proposed above and will break the pathway between the potential source and the receptor. The residual effect will be - negative, reversible, imperceptible, direct, likely, long term effect on soil and subsoil.

RECEIVED: 21/09/2023

Significance of Effects:

For the reasons outlined above, and with the implementation of the recommended mitigation measures, no significant effects on soils and subsoils will occur.

6.7.4.3 Effects on Land and Landuse

The proposed site currently comprises mainly grassland (6.4ha) with some tree coverage/scrub (2ha) over sand and gravel deposits with a thickness of up to 37.2m being confirmed above bedrock (described below). The ground elevation ranges between approximately 94m OD on the west and 130m OD on the east. The landuse is agricultural and mainly for animal grazing. The land post restoration is described below.

Receptor: Land and Landuse
Pathway: Aggregate Extraction
Pre-mitigation Impact: Negative, reversible, significant, direct, likely, long-term effect on land and landuse.

Mitigation Measures:

Post extraction phase a landscape and restoration plan will be implemented. This will involve previously stripped overburden being placed on the pit floor to establish grassland which will provide a level of protection to groundwater. Post restoration, the site will be returned to agriculture which will reduce the risk of illegal activities such as fly-tipping.

The restoration plan involves returning the pit to grassland by spreading/contouring previously stripped overburden over the extraction area. The site contouring will slope to the west as it currently does with the restored elevation ranging between ~94m OD on the west of the site and between 102.5 – 103m OD on the east.

The tree/scrub area currently present at the site will not be replanted and therefore there will be a ~2ha increase in grassland area post-restoration.

Residual Effect:

The site will be restored to allow for use as agricultural land. The residual effects are considered to be - negative, irreversible, moderate, direct, likely, permanent effect on land and landuse.

Significance of Effects:

For the reasons outlined above, and with the implementation of the recommended mitigation measures, no significant effects on soils and subsoils will occur.

RECEIVED: 21/09/2023

6.7.5 Restoration Phase and Post Restoration Phase

The restoration plan involves returning the pit to grassland by spreading the topsoil/overburden that was previously stripped and stored at the site. No negative impacts on the land, soil and geological environments are expected during the restoration or post-restoration phase. The restoration will have a positive effect in terms of returning the site back to agricultural use.

Residual Effect:

Positive, reversible, moderate, direct, likely, permanent effect on land and landuse.

Significance of Effects:

For the reasons outlined above, and with the implementation of the recommended mitigation measures, no significant effects on soils and subsoils will occur.

6.7.6 Human Health Effects

Potential health effects in relation to soils and geology mainly occur due to direct and indirect (dust) contact with contaminated soil. However, as stated in Section 6.7.3.2 there will be best practice controls in place to ensure any potential sources of contamination on the site will be managed appropriately. Also, the site will not be open to the public and therefore direct contact is unlikely.

Hydrocarbons, in the form of fuels and oils, will be used on-site during extraction works. However, the volumes will be small in the context of the scale of the project and will be handled in accordance with best practice mitigation measures. The potential residual impacts associated with soil and geology contamination and subsequent health effects are imperceptible.

6.7.7 Cumulative Effects on Land/Soils & Geology

Other developments assessed for potential geological cumulative impacts within ~5km of the proposed development site are listed in Table 3.2 of the EIAR. A total of 21 no. developments were assessed for potential cumulative geological impacts. The other developments assessed are in the following industrial sectors – windfarms (2 no.), EPA licenced facilities (2 no.), quarries/pits/extractive (15 no.) and public wastewater treatment plants (2 no.).

The other land use activities in the area are plantation forestry, existing farming operations and residential land uses, and the existing manufacturing facility which is located 1.3km to the south of the site.

There will be no increase in daily processing rates/quantities at the manufacturing facility/processing plant. Aggregate from the proposed pit will replace the material that is being currently hauled in from remote pits.

In summary, due to the relatively small scale of the proposed development and the lack of significant residual impacts from the development that would affect the wider environment, there will be no significant cumulative impacts to land, soils and geology resulting from this project, and other local existing developments, projects and plans. All potential impacts on land, soils and geology relating to the proposed project will be localised and within the proposed development footprint.

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6.8 Monitoring

An inspection of the geological environment will be undertaken by a competent Geologist and Geotechnical Engineer on a biannual basis (i.e. every two years).

APPENDIX 6.1: Monitoring Wells – Drilling and Construction Logs.

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petersen drilling services ltd. on behalf of **Booth Concrete** Rotary Drilling Log

Depth of Stratum Top (m)	Driller's Stratum Description	Sample / Hole / Test Details: No	Type	Insitu test	From (m)	To (m)	Drilling Details: Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour	Standard Penetration Test: Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)
0.00	Firm sandy TOPSOIL		RO		0.00	38.00	0000		100	brown												30.00
0.40	Dense brown medium coarse SAND & GRAVEL frequent cobbles																					
3.50	Medium dense brown SAND																					
11.00	Dense brown silty fine SAND																					
14.50	Dense brown gravelly SAND with frequent cobbles and boulders																					
37.20	Strong dark grey LIMESTONE																					

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
0910			
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1635	0.00		

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Bit serial No	Flush	Polymer
C	140.00	0.00	38.00							
RO	154.00	0.00	38.00				DTH	115	Air	No

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)
1240	30.00	30.00	Slow	0.00	0.00	0.00	0.00	N/S

Backfill (m)

Type	From (m)	To (m)

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks
		General; mobilisation to site near Abbeyleix Co. Laois

SPT I.D. Number	pd1	Calibration Date	18/09/2017
SPT Rod Type	2 3/8 Regular	SPT Energy Ratio	0.00
Drilling Crew Details			CSCS No
Support Operative	john whyte		
Lead Driller	stephan petersen		
Site category	Green		
Project Engineer	D Brotherick		
Lead Driller's signature			

Project Title

Ballymullen Abbeyleix

Weather	Sunny	Project No	13/12,
Date	29/07/2019	Day	Monday
Rig type	kaebel hy79	Borehole Number	
Inclination	Orientation	MW 1	
Sheet	1 of 1	Completed	Y

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Summary of Standpipe Installation

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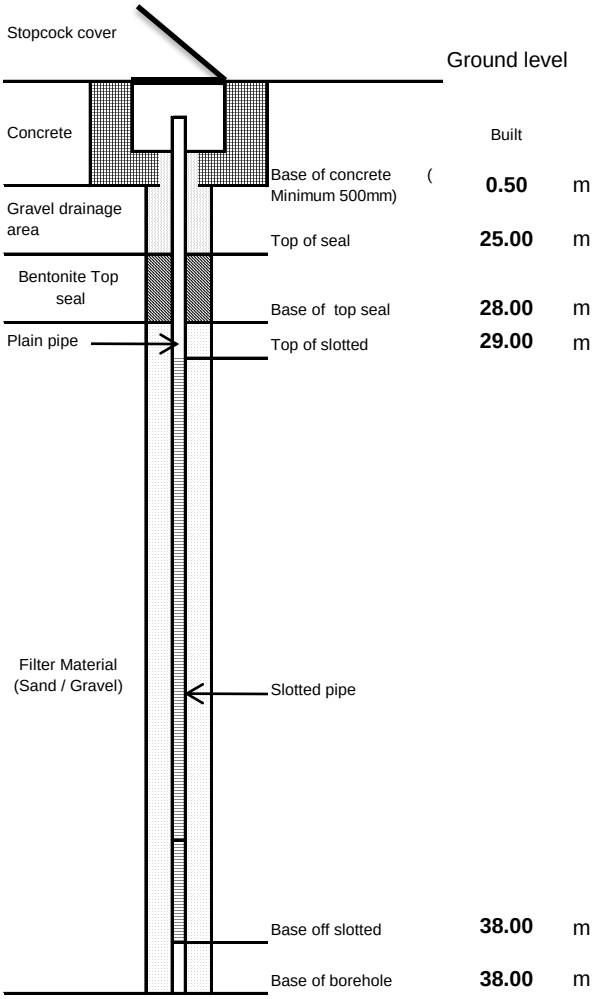
Schematic Diagram (not to scale)



Installation Details

Standpipe diameter (id)	50	mm
Borehole diameter	154	mm
Slot size	1	mm
Geosock	Yes	
Gas tap	None	
Filter type	Gravel	
Type of cover	Upright	
Initial reading	30.50	m
Time of Initial reading	1530	hhmm

	Base (m)	Top (m)
Concrete	0.50	GL
Gravel drainage	25.00	0.50
Borehole seal top	28.00	25.00
Filter zone	38.00	28.00
Plain pipe	29.00	GL
Slotted zone	38.00	29.00
Base of borehole	38.00	

Remarks

Rig type	knebel hy79	**Project Title**			
Drilling Crew Details		Ballymullen Abbeyleix			
Support Operative	john whyte				
Lead Driller	stephan petersen	**Project No**		13/12,	
Site category	Green	**Day**	Monday	**Date**	July 29, 2019
Engineer	D Brotherick			**Borehole Number**	
Lead Driller's signature				**MW 1**	

petersen drilling services ltd. on behalf of **Booth Concrete** Rotary Drilling Log

Depth of Stratum Top (m)	Driller's Stratum Description	Sample / Hole / Test Details: No	Type	Insitu test	From (m)	To (m)	Drilling Details: Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour	Standard Penetration Test: Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)
0.00	Firm sandy TOPSOIL		RO		0.00	42.00	0000		100	brown												29.00
0.20	Dense to very dense brown medium coarse SAND & GRAVEL with frequent cobbles and boulders																					
4.50	Medium dense brown gravelly SAND																					
7.20	Dense brown greyish sandy coarse GRAVEL with frequent cobbles and boulders																					
11.00	Medium dense brown gravelly SAND																					
23.50	Medium dense brown very silty SAND																					

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
1030			
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1705	0.00		

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Bit serial No	Flush	Polymer
C	140.00	0.00	42.00							
RO	154.00	0.00	42.00				DTH	115	Air	No

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)

Backfill (m)

Type	From (m)	To (m)

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks

SPT I.D. Number	pd1	Calibration Date	18/09/2017
SPT Rod Type	2 3/8 Regular	SPT Energy Ratio	0.00
Drilling Crew Details			CSCS No
Support Operative	john whyte		
Lead Driller	stephan petersen		
Site category	Green		
Project Engineer	D Brotherick		
Lead Driller's signature			

Project Title

Ballymullen Abbeyleix

Weather	Fine	Project No	13/12,
Date	31/07/2019	Day	Wednesday
Rig type	kiebel hy79	Borehole Number	
Inclination	Orientation	MW 2	
Sheet	1 of 2	Completed	Y

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petersen drilling services ltd. on behalf of **Booth Concrete** Rotary Drilling Log

Depth of Stratum Top (m)	Driller's Stratum Description	Sample / Hole / Test Details					Drilling Details				Standard Penetration Test												
		No	Type	Insitu test	From (m)	To (m)	Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour	Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)
30.00	Dense grey very silty SAND																					
37.00	Medium dense brown becoming gravelly SAND																					

Shift details				Drilling Equipment Details										Ground Water Record								Backfill (m)		
Start time (hhmm)	Hole (m)	Water (m)	Casing (m)	Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Bit serial No	Flush	Polymer	Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)	Type	From (m)	To (m)
1030															1310	28.00	28.00	Very Slow	0.00	0.00	0.00	0.00	N/S			
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)												1505	38.00	38.00	Slow	0.00	0.00	0.00	0.00	N/S			
1705	0.00																									

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks

SPT I.D. Number	pd1	Calibration Date	18/09/2017
SPT Rod Type	2 3/8 Regular	SPT Energy Ratio	0.00
Drilling Crew Details			CSCS No
Support Operative	john whyte		
Lead Driller	stephan petersen		
Site category	Green		
Project Engineer	D Brotherick		
Lead Driller's signature			

Project Title

Ballymullen Abbeyleix

Weather	Fine	Project No	13/12,
Date	31/07/2019	Day	Wednesday
Rig type	kiebel hy79	Borehole Number	
Inclination	Orientation	MW 2	
Sheet	2 of 2	Completed	Y

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Summary of Standpipe Installation

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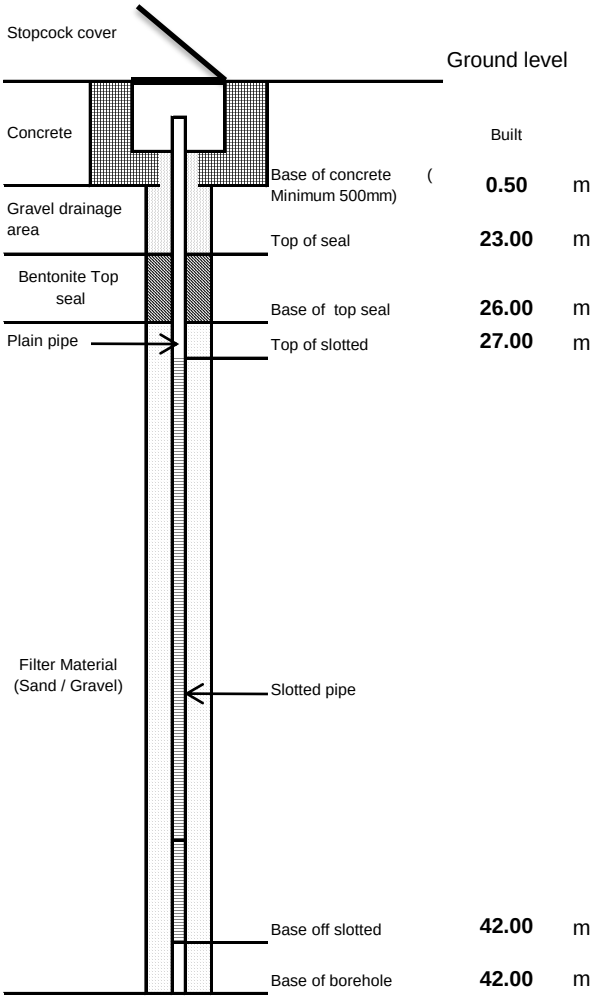
Schematic Diagram (not to scale)



Installation Details

Standpipe diameter (id)	50	mm
Borehole diameter	154	mm
Slot size	1	mm
Geosock	Yes	
Gas tap	None	
Filter type	Gravel	
Type of cover	Upright	
Initial reading	29.00	m
Time of Initial reading	1705	hhmm

	Base (m)	Top (m)
Concrete	0.50	GL
Gravel drainage	23.00	0.50
Borehole seal top	26.00	23.00
Filter zone	42.00	26.00
Plain pipe	27.00	GL
Slotted zone	42.00	27.00
Base of borehole	42.00	

Remarks

Rig type	knebel hy79	**Project Title**			
Drilling Crew Details		Ballymullen Abbeyleix			
Support Operative	john whyte				
Lead Driller	stephan petersen	**Project No**		13/12,	
Site category	Green	**Day**	Wednesday	**Date**	July 31, 2019
Engineer	D Brotherick			**Borehole Number**	
Lead Driller's signature				**MW 2**	

petersen drilling services ltd. on behalf of **Booth Concrete** Rotary Drilling Log

Depth of Stratum Top (m)	Driller's Stratum Description	Sample / Hole / Test Details: No	Type	Insitu test	From (m)	To (m)	Drilling Details: Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour	Standard Penetration Test: Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)
0.00	Firm sandy TOPSOIL		RO		0.00	32.00	0000		100	brown												20.00
0.30	Dense brown SAND & GRAVEL with occasional cobbles and boulders																					
4.30	Medium dense brown slightly gravelly SAND																					
20.50	Dense grey very silty sandy GRAVEL with occasional cobbles and boulders																					
30.60	Strong dark grey LIMESTONE																					

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
0810			
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1455	0.00		

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Bit serial No	Flush	Polymer
C	140.00	0.00	32.00							
RO	154.00	0.00	32.00				DTH	115	Air	No

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)
1150	20.00	20.00	Slow	0.00	0.00	0.00	0.00	N/S
1250	30.00	30.00	Medium	0.00	0.00	0.00	0.00	N/S

Backfill (m)

Type	From (m)	To (m)

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks
1430	0230	Dayworks: Airlift developing of all 5 wells

SPT I.D. Number	pd1	Calibration Date	18/09/2017
SPT Rod Type	2 3/8 Regular	SPT Energy Ratio	0.00
Drilling Crew Details			CSCS No
Support Operative	john whyte		
Lead Driller	stephan petersen		
Site category	Green		
Project Engineer	D Brotherick		
Lead Driller's signature			

Project Title

Ballymullen Abbeyleix

Weather	Fine	Project No	13/12,
Date	01/03/2019	Day	Thursday
Rig type	kiebel hy79	Borehole Number	
Inclination	Orientation		MW 3
Sheet	1 of 1	Completed	Y

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petersen drilling services ltd.

Summary of Standpipe Installation

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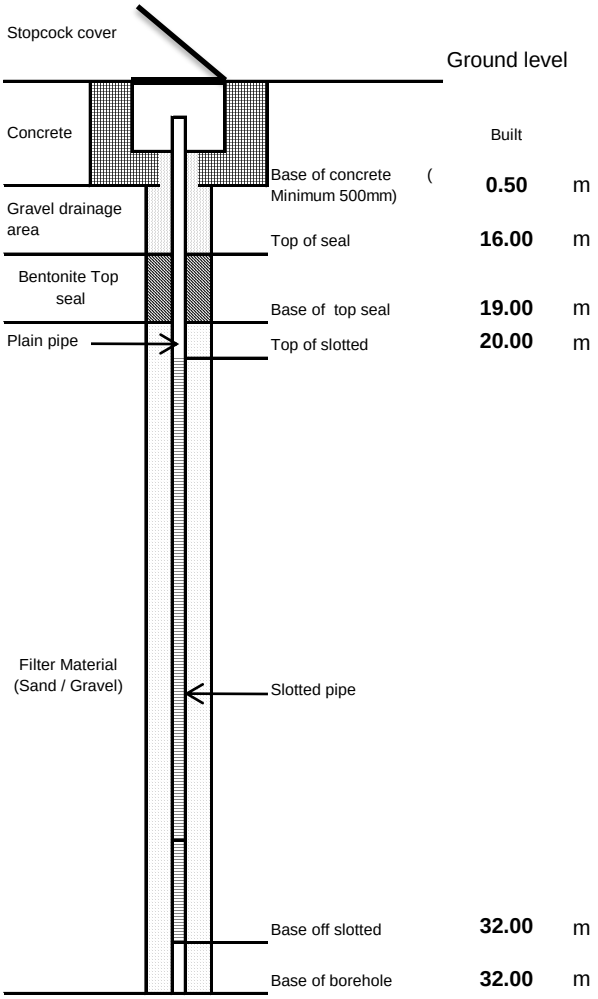
Schematic Diagram (not to scale)



Installation Details

Standpipe diameter (id)	50	mm
Borehole diameter	154	mm
Slot size	1	mm
Geosock	Yes	
Gas tap	None	
Filter type	Gravel	
Type of cover	Upright	
Initial reading	20.50	m
Time of Initial reading	1450	hhmm

	Base (m)	Top (m)
Concrete	0.50	GL
Gravel drainage	16.00	0.50
Borehole seal top	19.00	16.00
Filter zone	32.00	19.00
Plain pipe	20.00	GL
Slotted zone	32.00	20.00
Base of borehole	32.00	

Remarks

Rig type	knebel hy79	**Project Title**			
Drilling Crew Details		Ballymullen Abbeyleix			
Support Operative	john whyte				
Lead Driller	stephan petersen	**Project No**		13/12,	
Site category	Green	**Day**	Thursday	**Date**	August 1, 2019
Engineer	D Brotherick			**Borehole Number**	
Lead Driller's signature				**MW 3**	

petersen drilling services ltd. on behalf of Booth Concrete — Rotary Drilling Log

Depth of Stratum Top (m)	Driller's Stratum Description	Sample / Hole / Test Details: No	Type	Insitu test	From (m)	To (m)	Drilling Details: Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour	Standard Penetration Test: Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)
0.00	Firm sandy gravelly TOPSOIL		RO		0.00	30.00	0000		100	brown												12.70
0.40	Medium dense brown gravelly SAND																					
3.90	Dense brown SAND & GRAVEL with frequent cobbles and boulders																					
5.50	Medium dense brown gravelly SAND																					
17.00	Dense brown rounded SAND & GRAVEL with cobbles and boulders																					
18.50	Dense light grey silty SAND & GRAVEL with frequent limestone boulders																					

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
0805			
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1405	0.00		

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Bit serial No	Flush	Polymer
C	140.00	0.00	30.00							
RO	154.00	0.00	30.00				DTH	115	Air	No

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)
1025	14.00	14.00	Very Slow	0.00	0.00	0.00	0.00	N/S

Backfill (m)

Type	From (m)	To (m)

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks

SPT I.D. Number	pd1	Calibration Date	18/09/2017
SPT Rod Type	2 3/8 Regular	SPT Energy Ratio	0.00
Drilling Crew Details			CSCS No
Support Operative	john whyte		
Lead Driller	stephan petersen		
Site category	Green		
Project Engineer	D Brotherick		
Lead Driller's signature			

Project Title

Ballymullen Abbeyleix

Weather	Fine	Project No	13/12,
Date	30/07/2019	Day	Tuesday
Rig type	koebel hy79	Borehole Number	
Inclination	Orientation		MW 4
Sheet	1 of 2	Completed	Y

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petersen drilling services ltd. on behalf of Booth Concrete — Rotary Drilling Log

Depth of Stratum Top (m)	Driller's Stratum Description	Sample / Hole / Test Details: No	Type	Insitu test	From (m)	To (m)	Drilling Details: Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour	Standard Penetration Test: Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)
27.50	Very dense light grey angular coarse sandy GRAVEL with abundant limestone boulders possible highly weathered karst limestone																					

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
0805			
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1405	0.00		

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Bit serial No	Flush	Polymer

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)
1140	19.00	19.00	Medium	0.00	0.00	0.00	0.00	N/S
1145	27.50	27.50	Fast	0.00	0.00	0.00	0.00	N/S

Backfill (m)

Type	From (m)	To (m)

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks

SPT I.D. Number	pd1	Calibration Date	18/09/2017
SPT Rod Type	2 3/8 Regular	SPT Energy Ratio	0.00
Drilling Crew Details			CSCS No
Support Operative	john whyte		
Lead Driller	stephan petersen		
Site category	Green		
Project Engineer	D Brotherick		
Lead Driller's signature			

Project Title

Ballymullen Abbeyleix

Weather	Fine	Project No	13/12,
Date	30/07/2019	Day	Tuesday
Rig type	kiebel hy79	Borehole Number	
Inclination	Orientation		MW 4
Sheet	2 of 2	Completed	Y

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petersen drilling services ltd.

Summary of Standpipe Installation

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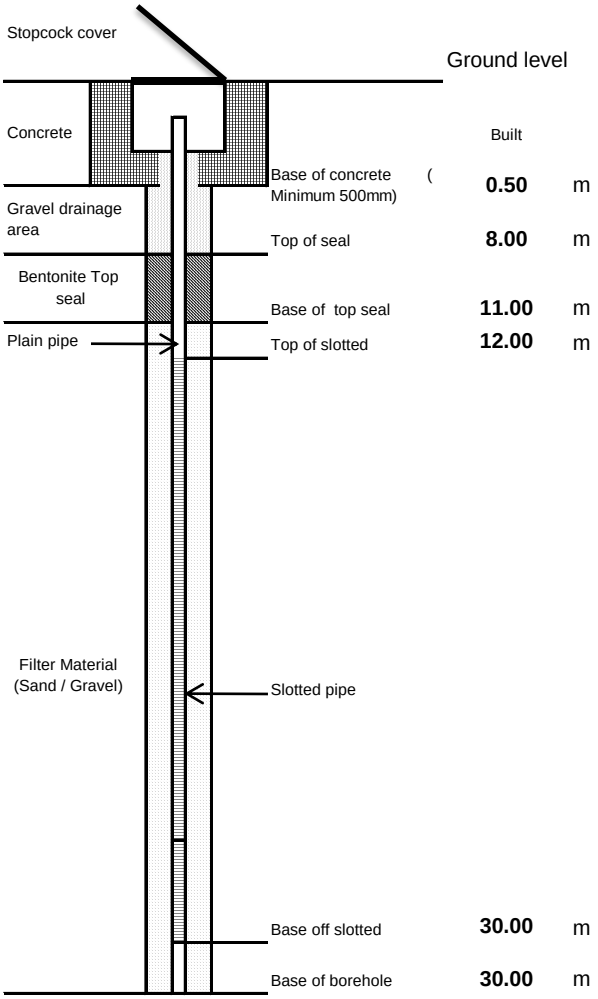
Schematic Diagram (not to scale)



Installation Details

Standpipe diameter (id)	50	mm
Borehole diameter	154	mm
Slot size	1	mm
Geosock	Yes	
Gas tap	None	
Filter type	Gravel	
Type of cover	Upright	
Initial reading	12.70	m
Time of Initial reading	1400	hhmm

	Base (m)	Top (m)
Concrete	0.50	GL
Gravel drainage	8.00	0.50
Borehole seal top	11.00	8.00
Filter zone	30.00	11.00
Plain pipe	12.00	GL
Slotted zone	30.00	12.00
Base of borehole	30.00	

Remarks

Rig type	knebel hy79	**Project Title**			
Drilling Crew Details		Ballymullen Abbeyleix			
Support Operative	john whyte				
Lead Driller	stephan petersen	**Project No**		13/12,	
Site category	Green	**Day**	Tuesday	**Date**	July 30, 2019
Engineer	D Brotherick			**Borehole Number**	
Lead Driller's signature				**MW 4**	

petersen drilling services ltd. on behalf of **Booth Concrete** Rotary Drilling Log

Depth of Stratum Top (m)	Driller's Stratum Description	Sample / Hole / Test Details					Drilling Details				Standard Penetration Test												
		No	Type	Insitu test	From (m)	To (m)	Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour	Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)
0.00	Firm sandy TOPSOIL		RO		0.00	20.00	0000		100	brown												2.50
0.30	Loose brown gravelly SAND																					
6.40	Loose dark brown silty GRAVEL																					
8.00	Dense light brown sandy GRAVEL with cobbles and boulders																					
9.80	Dense light grey brownish silty sandy GRAVEL with frequent cobbles and boulders																					
15.30	Dense to very dense light grey very silty sandy GRAVEL with frequent limestone boulders																					

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
1405			
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1710	20.00	3.00	20.00

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Bit serial No	Flush	Polymer
C	140.00	0.00	20.00							
RO	154.00	0.00	20.00				DTH	115	Air	No

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)
1455	2.00	2.00	Slow	0.00	0.00	0.00	0.00	N/S
1515	6.50	6.50	Medium	0.00	0.00	0.00	0.00	N/S

Backfill (m)

Type	From (m)	To (m)

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks

SPT I.D. Number	pd1	Calibration Date	18/09/2017
SPT Rod Type	2 3/8 Regular	SPT Energy Ratio	0.00
Drilling Crew Details			CSCS No
Support Operative	john whyte		
Lead Driller	stephan petersen		
Site category	Green		
Project Engineer	D Brotherick		
Lead Driller's signature			

Project Title

Ballymullen Abbeyleix

Weather	Variable	Project No	13/12,
Date	30/07/2019	Day	Tuesday
Rig type	kaebel hy79	Borehole Number	
Inclination	Orientation		MW 5
Sheet	1 of 2	Completed	Y

RECEIVED: 21/09/2023

petersen drilling services ltd. on behalf of **Booth Concrete** Rotary Drilling Log

Depth of Stratum Top (m)	Driller's Stratum Description	Sample / Hole / Test Details					Drilling Details				Standard Penetration Test											
		No	Type	Insitu test	From (m)	To (m)	Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour	Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
0800	20.00	1.60	20.00
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1030	0.00		

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Bit serial No	Flush	Polymer

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)

Backfill (m)

Type	From (m)	To (m)

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks

SPT I.D. Number	pd1	Calibration Date	18/09/2017
SPT Rod Type	2 3/8 Regular	SPT Energy Ratio	0.00
Drilling Crew Details			CSCS No
Support Operative	john whyte		
Lead Driller	stephan petersen		
Site category	Green		
Project Engineer	D Brotherick		
Lead Driller's signature			

Project Title

Ballymullen Abbeyleix

Weather	Cloudy	Project No	13/12,
Date	31/07/2019	Day	Wednesday
Rig type	kiebel hy79	Borehole Number	
Inclination	Orientation		MW 5
Sheet	2 of 2	Completed	Y

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petersen drilling services ltd.

Summary of Standpipe Installation

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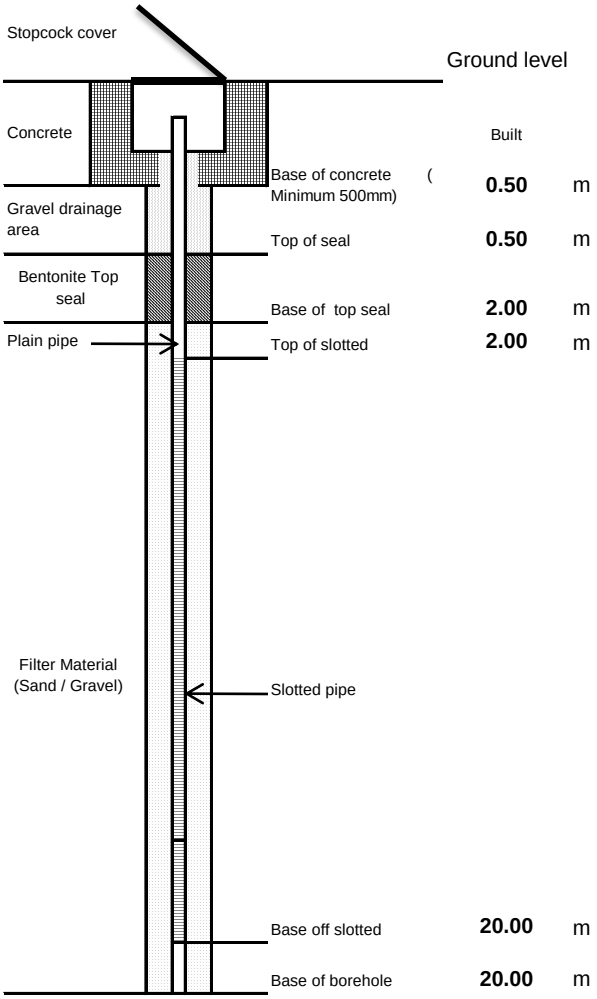
Schematic Diagram (not to scale)



Installation Details

Standpipe diameter (id)	50	mm
Borehole diameter	154	mm
Slot size	1	mm
Geosock	Yes	
Gas tap	None	
Filter type	Gravel	
Type of cover	Upright	
Initial reading	1.80	m
Time of Initial reading	0930	hhmm

	Base (m)	Top (m)
Concrete	0.50	GL
Gravel drainage	0.50	0.50
Borehole seal top	2.00	0.50
Filter zone	20.00	2.00
Plain pipe	2.00	GL
Slotted zone	20.00	2.00
Base of borehole	20.00	

Remarks

Rig type	knebel hy79	**Project Title**			
Drilling Crew Details		Ballymullen Abbeyleix			
Support Operative	john whyte				
Lead Driller	stephan petersen	**Project No**		13/12,	
Site category	Green	**Day**	Wednesday	**Date**	July 31, 2019
Engineer	D Brotherick			**Borehole Number**	
Lead Driller's signature				**MW 5**	

APPENDIX 6.2: Peat Auger Logs.

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Peat Auger Log

Core No: P1 & PH1

Project No: P1486-3 | **Date:** 21/07/2022 | **Easting:** 643909

Site: Ballymullen, Co. Laois | **Method:** Hand Auger | **Northing:** 683793

Client: Booth Concrete | **Hole DIA:** 60mm | **Elevation:** 92.552mOD

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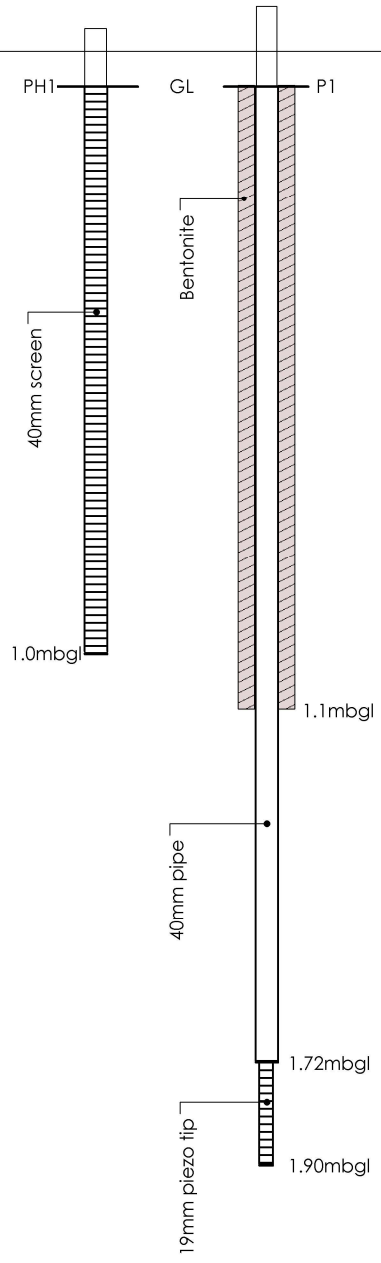
SUBSURFACE PROFILE

Depth	Symbol	Description	Depth/Elev.	Shear Vane kPa 20 40 60 80	Shear Vane (kPa)	Humification Scale	Water Levels	Comments	Piezometer Details
0		Ground Surface	92.552						
		Soft wet, black PEAT with reeds (H6 / H7)	0.000						
1		Soft brown, amorphous PEAT (H8 / H9)	91.552 1.000 91.452						
		Dense, wet, well sorted coarse SAND	1.100						
			90.652						
2			1.900						



Remarks:

Upstands: P1 (0.72m)
PH1 (0.54m)

Final depth: 1.9mbgl

Logged by: M. Gill

Scale as shown

Sheet: 1 of 1

HYDRO-ENVIRONMENTAL SERVICES

Peat Auger Log

Core No: P2

Project No: P1486-3

Date: 21/07/2022

Easting: 644005

Site: Ballymullen, Co. Laois

Method: Hand Auger

Northing: 683813

Client: Booth Concrete

Hole DIA: 60mm

Elevation: 93.277mOD

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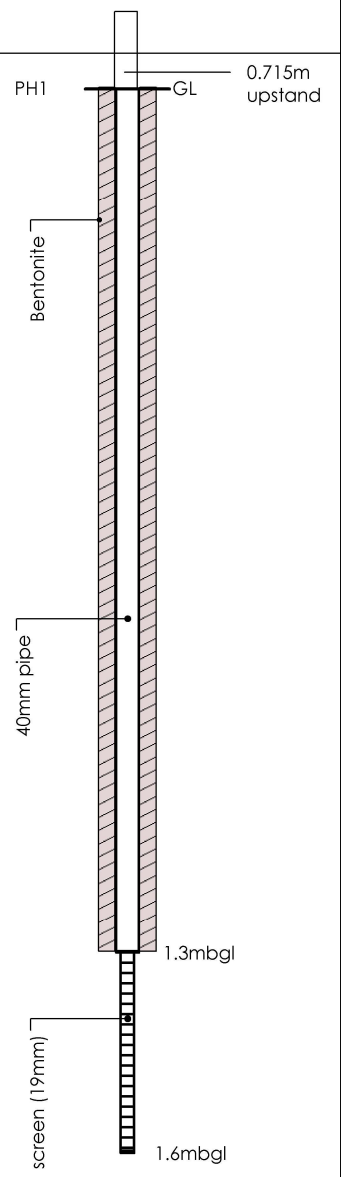
SUBSURFACE PROFILE

Depth	Symbol	Description	Depth/Elev.	Shear Vane kPa 20 40 60 80	Shear Vane (kPa)	Humification Scale	Water Levels	Comments	Piezometer Details
0		Ground Surface	93.277						
		Soft, dry, brown PEAT (H4 / H5)	0.000						
			92.757						
		Beige, damp, slightly gravelly SAND	0.520						
1			91.677						
			1.600						



Remarks:

Upstands: P2 (0.715m)

Final depth: 1.6mbgl

Logged by: M. Gill

Scale as shown

Sheet: 1 of 1

Peat Auger Log

Project No: P1486-3
Site: Ballymullen, Co. Laois
Client: Booth Concrete

Date: 21/07/2022
Method: Hand Auger
Hole DIA: 60mm

Core No: P3 & PH3
Easting: 643959
Northing: 683874
Elevation: 92.679mOD

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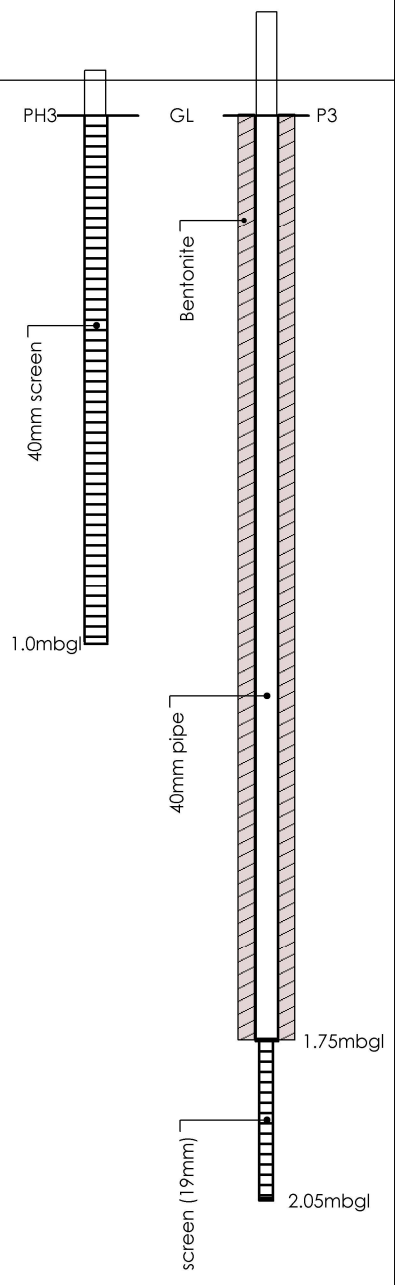
SUBSURFACE PROFILE

Depth	Symbol	Description	Depth/Elev.	Shear Vane kPa 20 40 60 80	Shear Vane (kPa)	Humification Scale	Water Levels	Comments	Piezometer Details
0		Ground Surface	92.679						
		Soft wet, brown PEAT. Tall reeds at ground level.	0.000						
1		Grey/beige wet, coarse well sorted SAND	91.639 1.040						
2			90.629 2.050						



Remarks:

Upstands: P3 (1.365m)
PH3 (0.6m)

Final depth: 2.05mbgl
Logged by: M. Gill

Scale as shown
Sheet: 1 of 1

HYDRO-ENVIRONMENTAL SERVICES 22 Lower Main Street Dungarvan Co. Waterford Tel: 058-44122 Email: info@hydroenvironmental.ie

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7.0 WATER

7.1 Background and Objectives

Hydro-Environmental Services (HES) has carried out an impact assessment of any potential significant and likely effects of a proposed sand and gravel pit at Ballymullen, Abbeyleix, Co. Laois on water aspects (hydrology and hydrogeology) of the receiving environment.

The objectives of the assessment are:

- Produce a baseline study of the existing water environment (surface water and groundwater) in the area of the proposed development;
- Identify any likely effects of the proposed development on surface water and groundwater receptors during the construction phase, operational phase and restoration phase of the development;
- Identify mitigation measures to avoid, remediate or reduce likely significant negative effects and,
- Assess whether there are any likely significant residual effects and cumulative effects of the proposed development with other local developments.

7.2 Proposed Development Overview

The proposed development is a new sand and gravel pit within a greenfield site at Ballymullen, Abbeyleix, Co. Laois. The development proposes to extract c. 763,810m^3/1.53 million tonnes of sand and gravel aggregate from an area of approximately 8.5 Ha. This does not include 23,500m3 of overburden, which will also be extracted but used to construct berms and restore the site and so will not be transported off-site. All other material will be excavated and transported off-site to the manufacturing facility. There will be no processing of material at the application site.

The following design measures are proposed as surface water and groundwater protection measures in response to third party concerns relating to Abbeyleix Bog:

- All aggregate extraction will be undertaken above the local groundwater level. There are no proposed surface water discharges to local watercourses from the extraction area. A proposed wheel wash (close to the site entrance) will discharge to ground via a full retention oil interceptor. Refer to Chapter 3.0 of the EIAR and the accompanying planning application documents for the proposed site layout and extraction plan.
- There will be no processing of the extracted material on site (i.e., there will be no separation of fines from the sand and gravel excavated at the site and therefore there will be no requirement for management of spoil waste/residual material at the site).
- The applicant proposes to extract the sand and gravel material and transport the material to the applicants existing manufacturing facility located approximately 1.3km to the south of the application site.

- The only proposed infrastructure at the site is a new site entrance, wheel wash, refuelling area and full retention oil interceptor and a Portaloo toilet. With regard to surface water drainage control there will be infiltration trenches/swales installed at each phase of the extraction (the purpose of these is described further below in the chapter).
- A ~30m undisturbed greenfield buffer will remain along the western portion of the site. This area will provide a natural infiltration area/buffer for any localised site runoff.

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In addition to be above measures, the southern portion of originally proposed (LCC Reg. Ref. 21/694) Phase 4 (the portion directly upslope/upstream of the mapped petrifying spring area) has been reduced in extent (i.e. there will be no extraction of aggregate upslope/upstream of the petrifying spring area). This is discussed in more detail below.

7.3 Relevant Legislation

The Water Chapter of the EIAR is prepared in accordance with the requirements of European Union Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (the 'EIA Directive') as amended by Directive 2014/52/EU. Regard has also been taken of the requirements of the following legislation:

- S.I. No. 349/1989: *European Communities (Environmental Impact Assessment) Regulations*, and subsequent Amendments (S.I. No. 84/1995, S.I. No. 352/1998, S.I. No. 93/1999, S.I. No. 450/2000 and S.I. No. 538/2001), S.I. No. 30/2000, the *Planning and Development Act*, and S.I. 600/2001 *Planning and Development Regulations* and subsequent Amendments. These instruments implement EU Directive 85/373/EEC and subsequent amendments, on the assessment of the effects of certain public and private projects on the environment;
- Directives 2011/92/EU and 2014/52/EU on the assessment of the effects of certain public and private projects on the environment, including Circular Letter PL 1/2017: *Implementation of Directive 2014/52/EU on the effects of certain public and private projects on the environment* (EIA Directive);
- *Planning and Development Act, 2000*, as amended;
- S.I. No. 94/1997: *European Communities (Natural Habitats) Regulations*, resulting from EU Directives 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive) and 79/409/EEC on the conservation of wild birds (the Birds Directive);
- S.I. No. 293/1988: *Quality of Salmon Water Regulations*, resulting from EU Directive 78/659/EEC on the *Quality of Fresh Waters Needing Protection or Improvement in order to Support Fish Life*;
- S.I. No. 272/2009: *European Communities Environmental Objectives (Surface Waters) Regulations 2009* and S.I. No. 722/2003 *European Communities (Water Policy) Regulations* which implement EU Water Framework Directive (2000/60/EC) and provide for implementation of 'daughter' Groundwater Directive (2006/118/EC). Since 2000 water management in the EU has been directed by the Water Framework Directive (WFD). The key objectives of the WFD are that all water bodies in member

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states achieve (or retain) at least 'good' status by 2015. Water bodies comprise both surface and groundwater bodies, and the achievement of 'Good' status for these depends also on the achievement of 'good' status by dependent ecosystems. Phases of characterisation, risk assessment, monitoring and the design of programmes of measures to achieve the objectives of the WFD have either been completed or are ongoing. In 2015 it will fully replace a number of existing water related directives, which are successively being repealed, while implementation of other Directives (such as the Habitats Directive 92/43/EEC) will form part of the achievement of implementation of the objectives of the WFD;

- S.I. No. 41/1999: *Protection of Groundwater Regulations*, resulting from EU Directive 80/68/EEC on the protection of groundwater against pollution caused by certain dangerous substances (the Groundwater Directive);
- S.I. No. 122/2014: *European Communities Environmental Objectives (Drinking Water) Regulations 2014*;
- S.I. No. 272/2009: *European Communities Environmental Objectives (Surface Waters) Regulations 2009*;
- S.I. No. 9/2010: *European Communities Environmental Objectives (Groundwater) Regulations 2010*;
- S.I. No. 296/2009: *European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009*; and
- S.I. No. 349/1989: *European Communities (Environmental Impact Assessment) Regulations*, and subsequent Amendments (S.I. No. 84/1995, S.I. No. 352/1998, S.I. No. 93/1999, S.I. No. 450/2000 and S.I. No. 538/2001), S.I. No. 30/2000, the *Planning and Development Act*, and S.I. 600/2001 *Planning and Development Regulations* and subsequent Amendments. These instruments implement EU Directive 85/337/EEC (EIA Directive) and subsequent amendments, on the assessment of the effects of certain public and private projects on the environment.

7.4 Relevant Guidance

The Water Chapter of the EIAR is carried out in accordance with guidance contained in the following:

- *Guidance on the preparation of the EIA Report* (Directive 2011/92/EU as amended by 2014/52/EU);
- Environmental Protection Agency (May 2022): *Guidelines on the Information to be Contained in Environmental Impact Assessment Reports*;
- Institute of Geologists Ireland (2013): *Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements*;
- National Roads Authority (2008): *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes*;
- CIRIA 2006: *Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors. CIRIA C532. London, 2006*;
- Department of the Environment, Heritage and Local Government; *Quarries and Ancillary Activities – Guidance for Authorities (April, 2014)*; and,

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- Environmental Protection Agency (2006): *Environmental Management in the Extractive Industry (Non-Scheduled Minerals)*.

7.5 Schedule of Works

7.5.1 Desk Study

A desk study of the proposed site and surrounding area was completed prior to the undertaking of field mapping, walkover assessments and site investigations. The desk study involved collecting all relevant geological, hydrological, hydrogeological and meteorological data for the study area. This included consultation with the following:

- Environmental Protection Agency database (www.epa.ie);
- Geological Survey of Ireland (GSI) - Groundwater Database (www.gsi.ie);
- Met Eireann Meteorological Databases (www.met.ie);
- National Parks & Wildlife Services Public Map Viewer (www.npws.ie);
- EPA/Water Framework Directive "Catchments" Map Viewer (www.catchments.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 16 (Geology of Kildare - Wicklow); Geological Survey of Ireland (GSI, 1994);
- Geological Survey of Ireland (GSI) - Groundwater Body Characterisation Reports;
- OPW Indicative Flood Maps (www.floodmaps.ie);
- Environmental Protection Agency – "Hydrotool" Map Viewer (www.epa.ie);
- CFRAM Preliminary Flood Risk Assessment (PFRA) maps (www.cfram.ie); and,
- Department of Environment, Community and Local Government on-line mapping viewer (www.myplan.ie).

7.5.2 Baseline Surveys and Investigations

To complete the Water Chapter of the EIAR, the following surveys and investigations were carried out:

- Walkover surveys and hydrological mapping of the proposed site and the surrounding area were undertaken whereby surface water flow directions and drainage patterns were recorded;
- A preliminary assessment of flood risk was completed for the proposed development area and local watercourses;
- Drilling of 5 No. investigation holes/monitoring wells to assess overburden lithology, depth to the bedrock and groundwater level monitoring and sampling;
- Groundwater sampling (3 no.) to assess baseline groundwater quality up-gradient and down-gradient of the site;
- Groundwater level monitoring by means of in-situ dataloggers (pressure transducers);
- Field hydrochemistry measurements (electrical conductivity, pH and temperature) were taken to determine the origin and nature of surface water flows; and,

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- Visit to Abbeyleix Bog on 11th March 2021 to monitoring petrifying spring discharge and hydrochemistry along with sampling (in the company of a member of the Abbeyleix Bog Project) and,
- 3 No. piezometer couples/sets (3 no. deep sub peat piezometers, and 2 no. shallow standpipes) were installed along the north-eastern boundary of Abbeyleix Bog in July 2022 between the proposed site and the petrifying spring. Water level monitoring in these piezometers, and all 5 no. on-site monitoring wells, was completed during July and August 2022.

7.5.3 Impact Assessment Methodology

Please refer to Chapter 1.0 of the EIAR for details on the impact assessment methodology (EPA, 2022). In addition to the above methodology, the importance of the water environment receptors was assessed on completion of the desk study and baseline study. Using the National Roads Authority (2008) guidance, an estimation of the importance of the hydrological and hydrogeological environments within the study area are quantified, using the criteria set out in Table 7.1 and Table 7.2.

Table 7.1: Estimation of Importance of Hydrology Attributes (NRA, 2008)

Importance	Criteria	Typical Example
Extremely High	Attribute has a high quality or value on an international scale.	• River, wetland or surface water body ecosystem protected by EU legislation, e.g. 'European sites' designated under the Habitats Regulations or 'Salmonid waters' designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations,
Very High	Attribute has a high quality or value on a regional or national scale.	• River, wetland or surface water body ecosystem protected by national legislation – NHA status. • Regionally important potable water source supplying >2500 homes. • Quality Class A (Biotic Index Q4, Q5). • Flood plain protecting more than 50 residential or commercial properties from flooding. • Nationally important amenity site for wide range of leisure activities.
High	Attribute has a high quality or value on a local scale.	• Salmon fishery Locally important potable water source supplying >1000 homes. • Quality Class B (Biotic Index Q3-4). • Flood plain protecting between 5 and 50 residential or commercial properties from flooding. • Locally important amenity site for wide range of leisure activities.

Medium	Attribute has a medium quality or value on a local scale	• Coarse fishery. • Local potable water source supplying >50 homes Quality Class C (Biotic Index Q3, Q2-3). • Flood plain protecting between 1 and 5 residential or commercial properties from flooding.
Lo w	Attribute has a low quality or value on a local scale.	• Locally important amenity site for small range of leisure activities. • Local potable water source supplying <50 homes. • Quality Class D (Biotic Index Q2, Q1) Flood plain protecting 1 residential or commercial property from flooding. • Amenity site used by small numbers of local people.

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Table 7.2: Estimation of Importance of Hydrogeology Attributes (NRA, 2008)

Importance	Criteria	Typical Example
Extremely High	Attribute has a high quality or value on an international scale.	Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation, e.g. SAC or SPA status.
Very High	Attribute has a high quality or value on a regional or national scale.	Regionally Important Aquifer with multiple wellfields. Groundwater supports river, wetland or surface water body ecosystem protected by national legislation – NHA status. Regionally important potable water source supplying >2500 homes Inner source protection area for regionally important water source.
High	Attribute has a high quality or value on a local scale.	Regionally Important Aquifer Groundwater provides large proportion of baseflow to local rivers. Locally important potable water source supplying >1000 homes. Outer source protection area for regionally important water source. Inner source protection area for locally important water source.
Medium	Attribute has a medium quality or value on a local scale.	Locally Important Aquifer Potable water source supplying >50 homes. Outer source protection area for locally important water source.
Low	Attribute has a low quality or value on a local scale.	Poor Bedrock Aquifer Potable water source supplying <50 homes.

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7.6 Existing Environment

7.6.1 Site Description and Topography

The proposed development site is situated at Ballymullen townland which is located ~1km south of Abbeyleix town, Co. Laois. The application site, which is currently a greenfield site, has an area of approximately 8.5ha.

The site is located at the topographic transition between the Castlecomer Plateau to the east and Laois Central Lowlands to the west. Much of the site area has a characteristic hummocky/hilly terrain, which is typical of a glacial sand and gravel deposition area. The land then generally flattens out to the west, towards the River Nore.

The site, which has an elevation range of between approximately 92 and 130m OD (Ordnance Datum), is located on a hillside that steadily slopes westerly towards the lower-lying and flatter boglands (Abbeyleix Bog) that exists to the west of the site. The River Nore flows in a southerly direction approximately 2.2km west of the site (further west of Abbeyleix Bog).

The site, which comprises mainly grassland with some woodland and scrub in the central area, is bordered by agricultural grassland to the east, north, and south, and by a local public road to the west. This public road defines the western boundary of the site. West of the local public road, the land is low-lying and boggy before transitioning into peatland at Abbeyleix Bog.

The site is made up of several grazing fields which are separated by hedgerows. Access to the site is from the public road to the west.

7.6.2 Land-Use

Landuse in the surrounding area is largely agricultural with scattered rural pattern of residential dwellings along the local roads to the west. Further north (~200m) along the public road to the west, there are a number of housing estates on the outskirts of Abbeyleix. Abbeyleix Bog to the west of the site has been planted in areas with coniferous forestry. The closest EPA licensed facility is located approximately 500m to the northwest of the application site. At that licenced facility Stonearch previously manufactured Vitamin K3 for use as a supplement in animal feed until closure in the early 2000s. The facility is still licensed by the EPA (P0332).

There are a number of existing sand and gravel pits in the area, the closest one is a small disused pit located approximately 500m to the southeast of the site. The existing Booth Precast Products Ltd manufacturing facility is located 1.3km to the south of the application site.

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7.6.3 Water Balance

Long-term rainfall and evaporation data was sourced from Met Éireann. The 30-year annual average rainfall (AAR) recorded at Abbeyleix (Blandsfort), ~5km northeast of the site, is presented in Table 7.3 below.

Table 7.3: Annual Average Long-Term Rainfall Data (mm).

Station		**X-Coord**		**Y-Coord**		**Ht (MAOD)**		**Opened**		**Closed**		
Abbeyleix						**164**		**1943**		**-**		**Total**
Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	
93.5	67.4	72	63.3	63	67	70.1	86.6	73.5	105.1	91.4	90.1	943

The closest synoptic station where the average potential evapotranspiration (PE) is recorded is Kilkenny, approximately 27km south of the site. The long-term average PE for this station is 460mm/year. This value is used as the best estimate of the site PE. Actual Evaporation (AE) at the site is estimated as 437mm/year (which is 0.95 × PE).

The effective rainfall represents the water available for surface water runoff and groundwater recharge. The effective rainfall for the site is calculated as follows:

Effective rainfall = AAR – AE
= 943mm/year – 437mm/year
ER = 506mm/year

Based on recharge coefficient estimates from the Geological Survey of Ireland (GSI), an annual conservative groundwater recharge coefficient of 85% is used for the site hydrogeological setting which is *"sand & gravels aquifer, overlain by well-drained soil".* The hydrogeology of the area is discussed in more detail below. Therefore, annual recharge and runoff rates for the site are estimated to be 430mm/year and 76mm/year respectively. Based on a site landholding area of 8.5ha, annual average recharge and runoff volumes for the site are estimated to be 36,550m^3/year and 6,460m^3/year respectively (or ~100 and ~17.7m^3/day).

7.6.4 Regional and Local Hydrology

Regionally the proposed site is located in the River Nore surface water catchment within Hydrometric Area 15 of the south-eastern River Basin District. The River Nore flows in a southerly direction approximately 2.2km west of the proposed site. A regional hydrology map is shown in Figure 7.1.

On a more local scale, the proposed site is located within the Ballymullen Stream surface water catchment. The Ballymullen stream flows in a northerly direction through Abbeyleix Bog approximately 250m to the west of the application site. The Ballymullen Stream rises in higher hills to the east of the application site before passing to the south of the site and

flowing north/northwest towards the River Nore which exists approximately 3km downstream of the site. A local hydrology map is shown in Figure 7.2.

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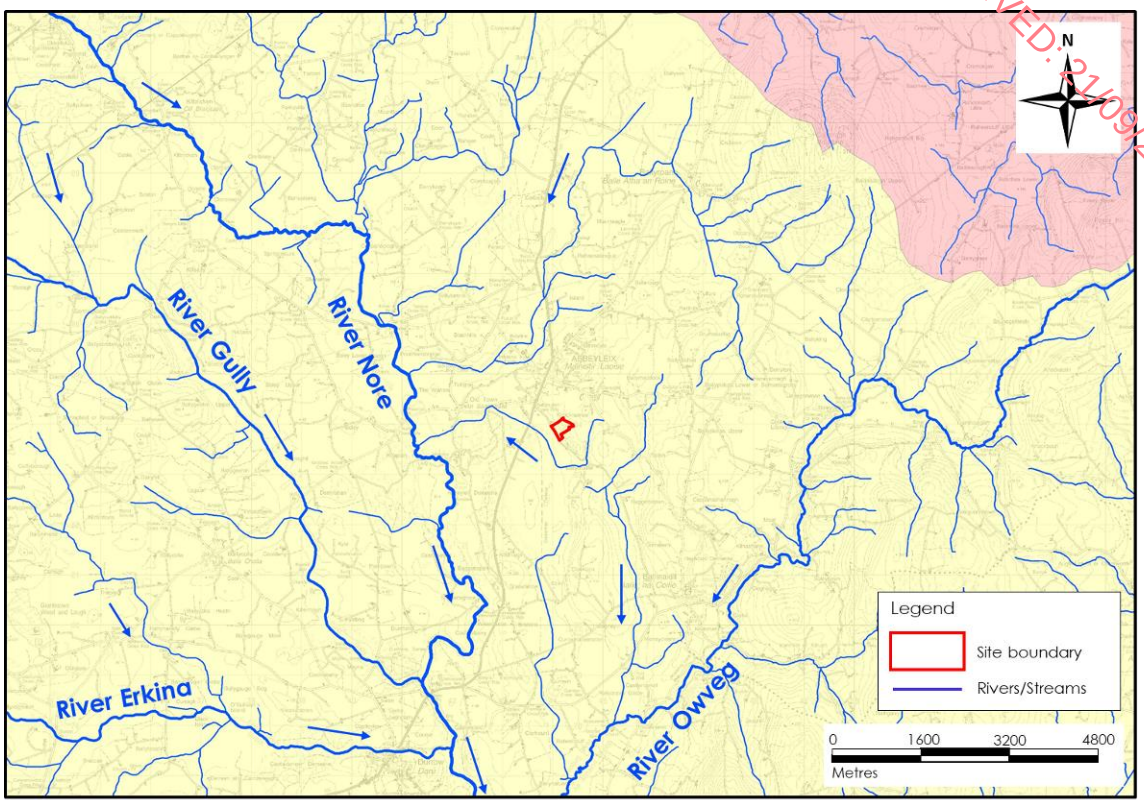

Figure 7.1: Regional Hydrology Map

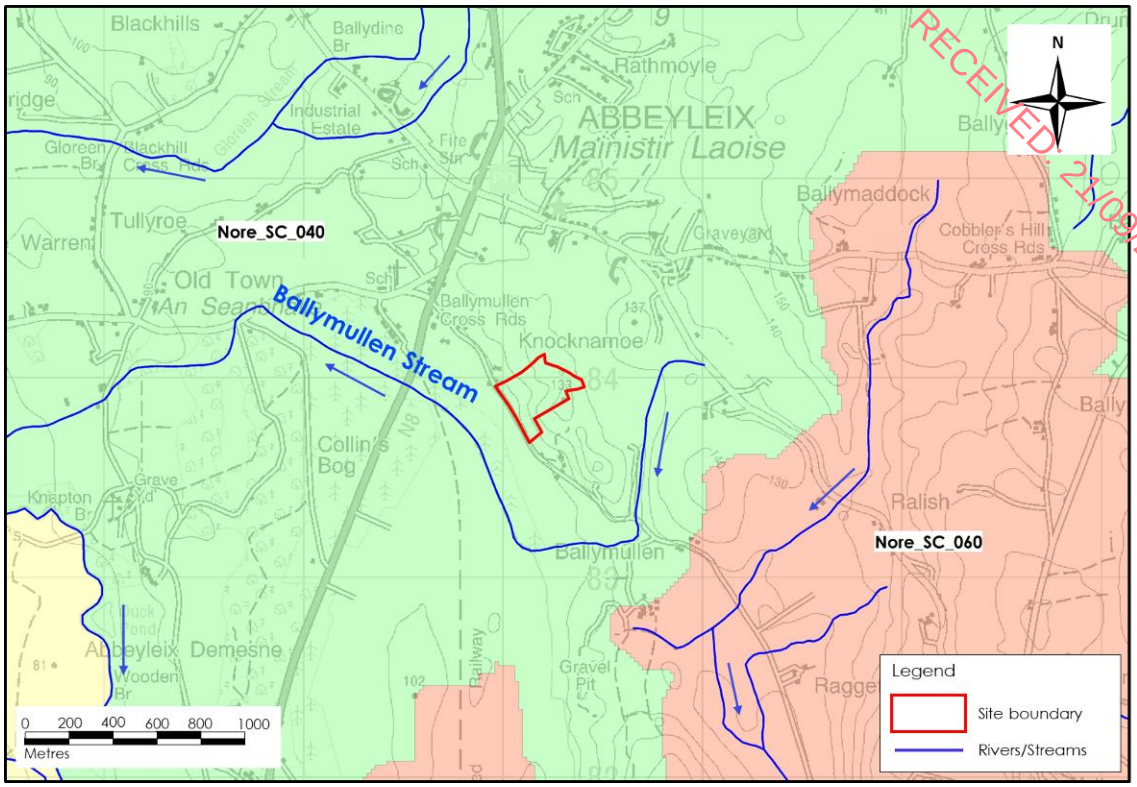

Figure 7.2: Local Hydrology Map

7.6.5 Existing Site Drainage

There are no natural permanent surface water features within the site or adjacent to the site. The closest natural surface water feature to the site is a seasonal pond which is located in a hollow approximately 30m to the east of the site. On the OSI 6-inch and 1:5,000 scale mapping (Figure 7.3) this feature is referred to as a "turlough". A turlough is a groundwater fed lake that is typically found in a karst limestone geological setting and not on sand and gravel deposits.

This feature was fully dried up during the period when the walkover surveys and site investigations for this project were being carried out (June – September 2019, but there was some water in it in July/August 2022). A walkover of the pond area and its catchment along with the intrusive site investigations (discussed below) confirm that this feature is surface water fed and not groundwater fed. The pond area and its catchment area to the north and east are underlain by poorly draining soils (lacustrine silts and clay) which retain water during wet periods (typically over the winter). Based on the investigation drilling, the pond is perched over the underlying sand and gravel deposits. This is discussed further below.

There are a number of drains on the land to the east of the pond that drains into the pond. The pond does not have any apparent surface water outfall which suggests there is some infiltration into the underlying sand and gravel deposits.

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Overall, the proposed development site is largely well drained with good ground conditions as would be expected in a sand and gravel setting.

The western, low-lying side of the site adjacent to the public road is slightly boggy and can experience localised surface water ponding over the winter, particularly the southwestern corner of the most northerly field. This can be attributed to a shallow groundwater table during winter.

Based on the fact that there are no drainage outfalls from the site, all effective rainfall landing on the site has to percolate/recharge to the ground. The GSI recharge coefficient of 85% is likely to be closer to 100% in reality.

West of the public road (which runs along the western boundary) there are numerous land drains in the adjacent field. There is no drainage outfall (i.e. culvert below the road) from the site towards these drains. Refer to Figure 7.3 for an existing site drainage map.

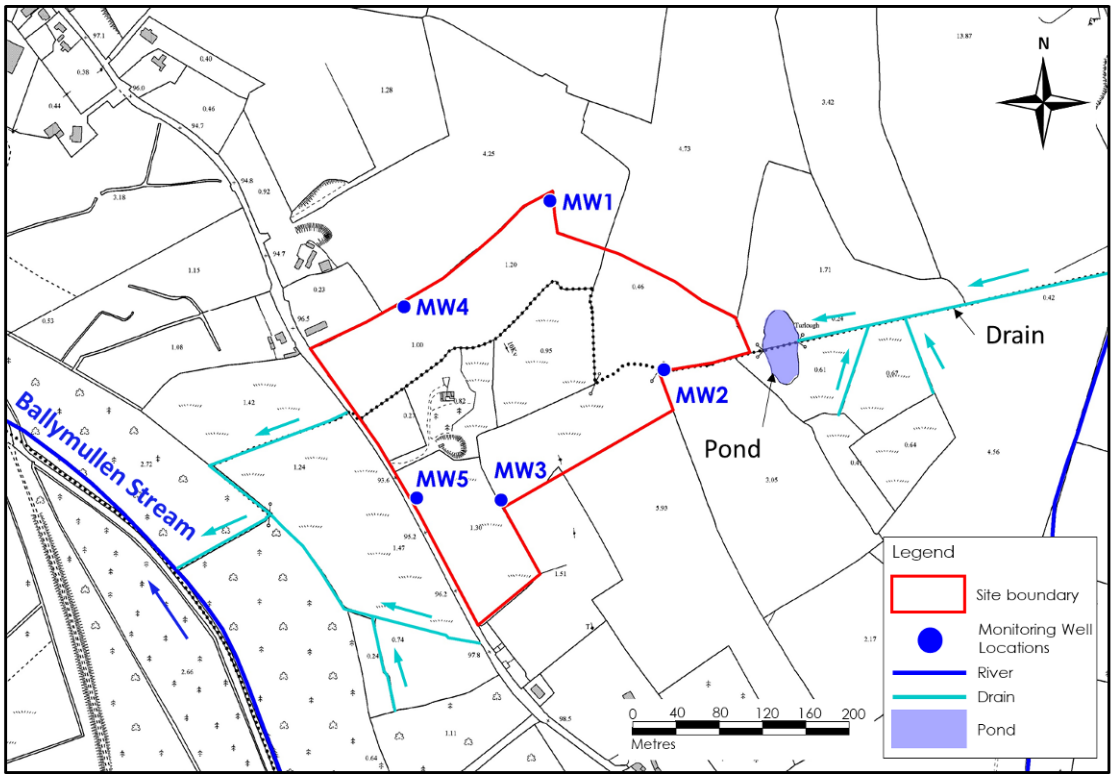

Figure 7.3: Site Drainage Map.

7.6.6 Flood Risk Identification

CFRAM Flood Extents Mapping, National Indicative Fluvial Mapping (NIFM), Past Flood Event Mapping and historical mapping (i.e. 6" & 25" base maps) were consulted to identify those local areas as being at risk of flooding.

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CFRAM Flood Extents Mapping is available for the River Nore to the west of the site. The site is significantly above (>4m) the 100-year and 1000-year flood zone of the River Nore which is what would be expected given the site's much higher elevation.

CFRAM Flood Extents Mapping for the area is shown as Figure 7.4. There are no flood zones mapped in the immediate area of the site. The NIFM does not cover the area of the proposed site.

OPW's Past Flood Events mapping (Figure 7.5) was consulted to identify those areas as being at risk of flooding. There were no reports of flooding at the site location or along the Ballymullen Stream downstream of the site.

There is no text on local available historical 6" or 25" mapping for the proposed site that identifies areas that are "prone to flooding" within the site boundary, or downstream of the site.

There are no proposed surface water discharges from the proposed development site. There will be no alternation of the drainage at the site.

Based on the above there is no potential risk of fluvial flooding at the development site, and there is no flood risk in downstream watercourses.

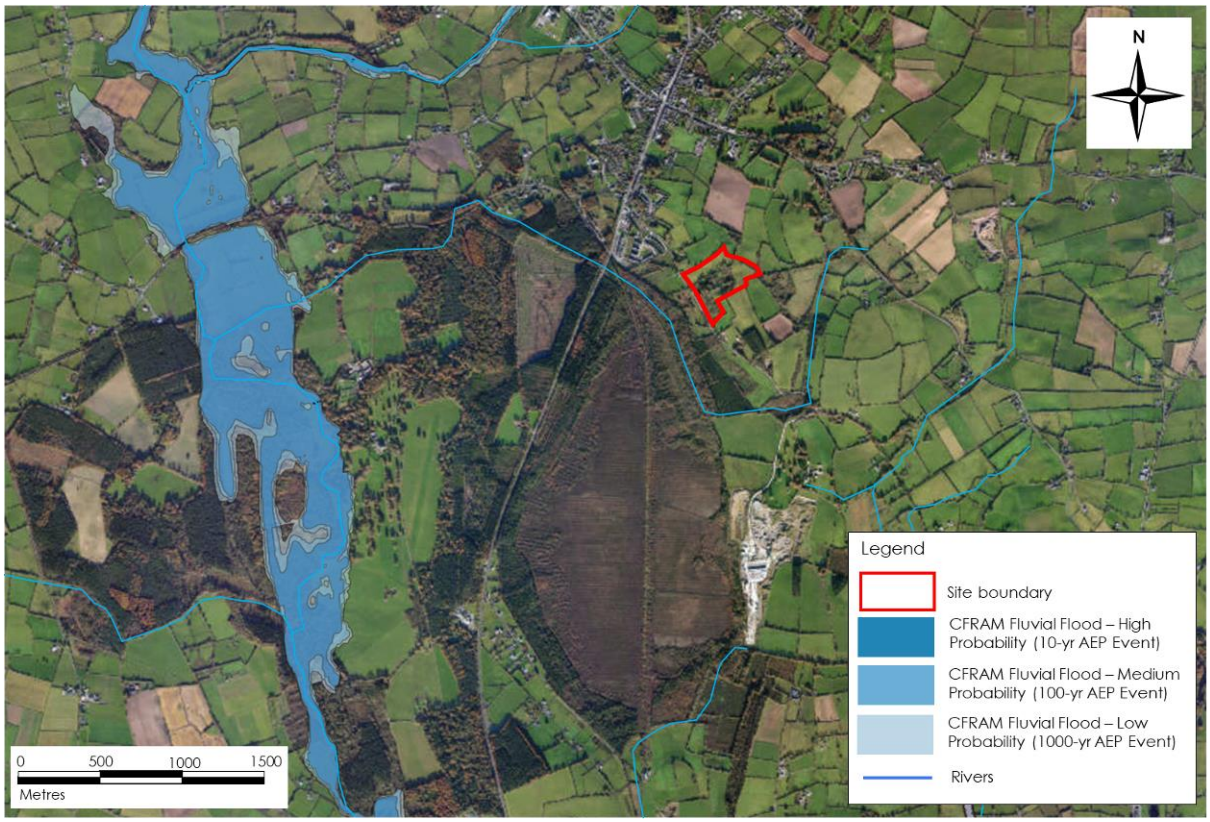

Figure 7.4: CFRAM Flood Mapping (www.floodinfo.ie).

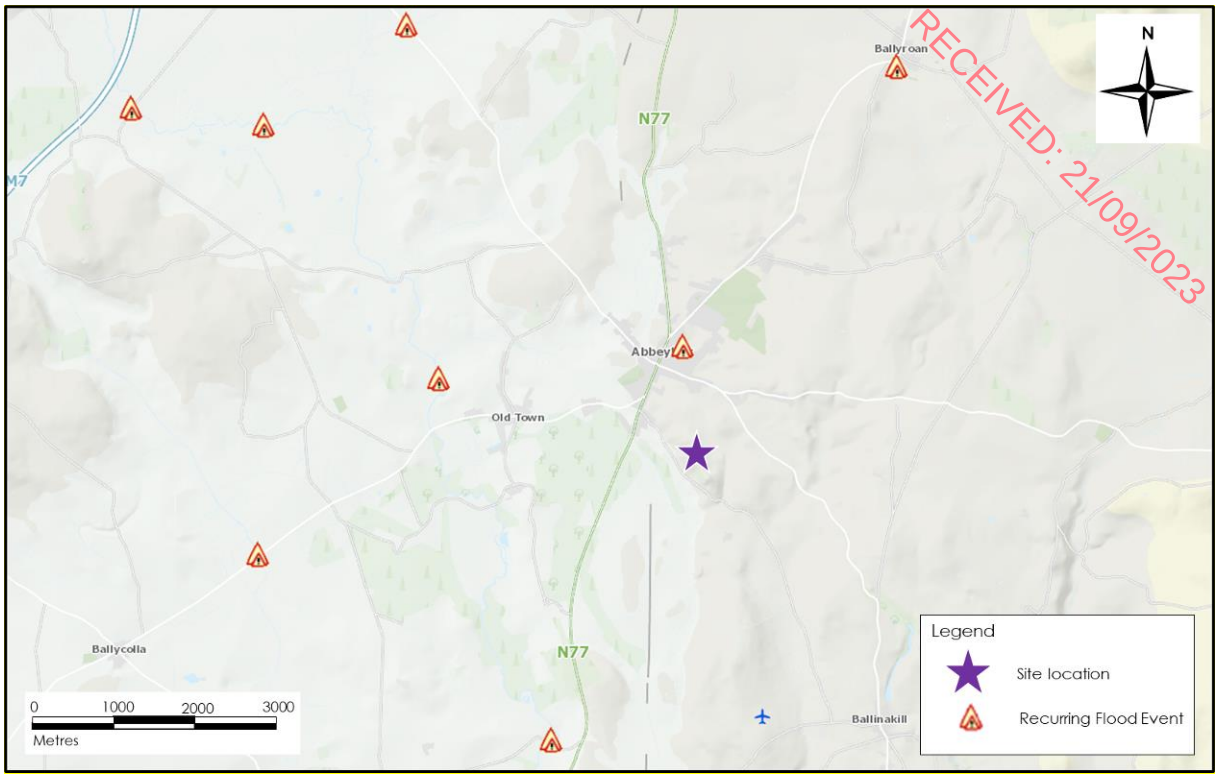

Figure 7.5: OPW Flood Hazard Mapping.

7.6.7 Surface Water Quality

EPA Q-rating data are available for the River Nore upstream and downstream of the proposed site location. Long-term water quality data records (1971 - 2018) show that the upstream monitoring point has a Q4 rating (Good Status) and the downstream monitoring location has a Q4 – 5 rating (High Status). No Q-rating data are available for the Ballymullen Stream.

7.6.8 Local Hydrogeology

The Groundwater Body (GWB) in which the proposed site is located is called the Abbeyleix Gravels GWB (IE_SE_G_171).

The sand and gravel deposits which overlie the bedrock in this GWB are classified by the GSI as a Locally Important Gravel Aquifer (Lg). The total area of the gravel aquifer is mapped at approximately 7km^2.

In the vicinity of the site the sand and gravels are also underlain by the following bedrock aquifer type:

- The Dinantian Pure Bedded Limestones (as described fully in Chapter 7 – Land, Soils and Geology), which are mapped to underlie the majority of the site, are classified by

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the GSI as a Regionally Important Karstified Aquifer (RKd). Faults and joints can be enlarged by karstification as groundwater moves through the limestones (GSI, 2004).

The GSI bedrock and gravel aquifer map for the area is shown in Figure 7.6 below. The recharge to the sand and gravel aquifer in this area is direct from precipitation landing on the ground surface and also possibly from streams that emerge from the more elevated, less permeable lands/hills to the east.

Discharge from the sand and gravel aquifer is expected to be to the River Nore as baseflow. There are known spring locations present along the east of the River Nore which are likely to be discharge zones from the gravels and/or underlying limestone aquifer. With respect the underlying karstified limestone bedrock aquifer most groundwater flow is likely to be concentrated in the upper 20m or so (GSI, 2004).

Recharge to the karstified limestone bedrock is likely to occur by a combination of three mechanisms (GSI, 2004):

- Directly by rainfall recharge in upland areas to the east (where overburden depths are thinner);
- At the contact with the Namurian shales (further east of the site) where there are likely to be streams flowing over bedrock outcrop (such rivers may not sink completely but will lose some flow as they cross the boundary onto the limestones); and,
- By indirect recharge from the overlying sand and gravel aquifer.

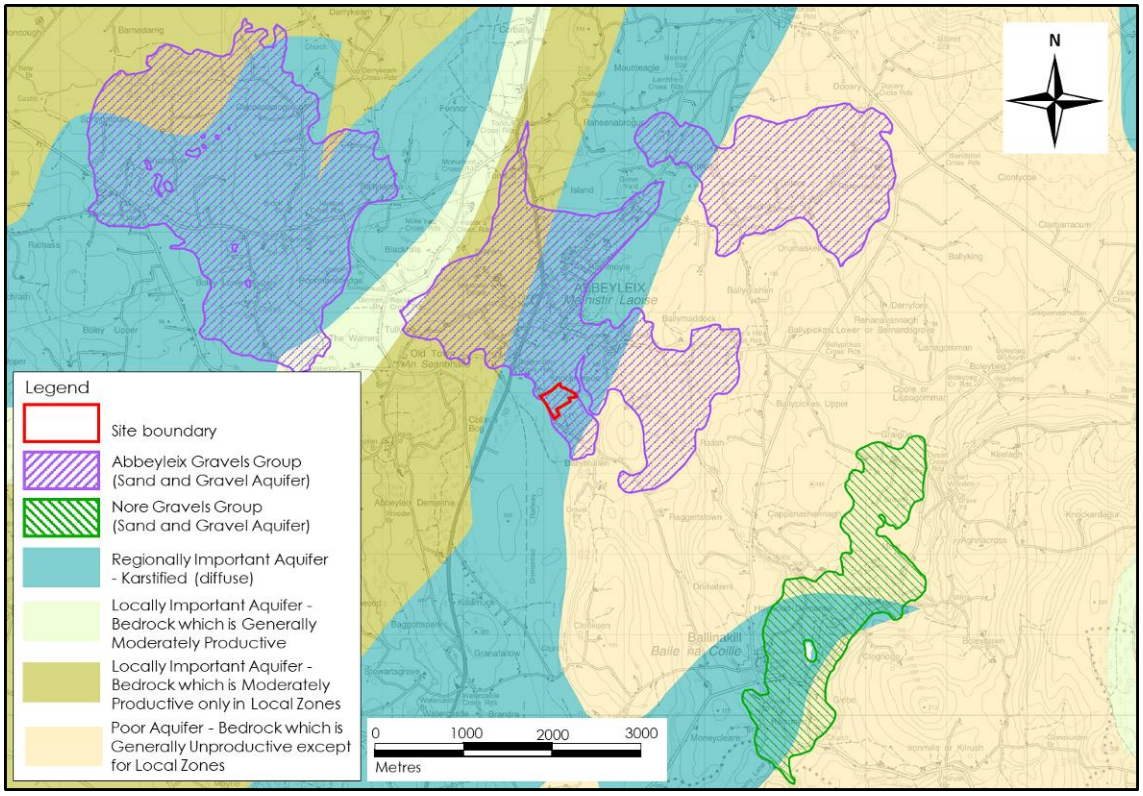

Figure 7.6: Bedrock and Gravel Aquifer Mapping.

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7.6.9 Site Hydrogeology

Five investigation holes/monitoring wells (MW1 to MW5) were drilled by Peterson Drilling Services Ltd at the site under the supervision of HES between the 29th July and 2nd August 2019. Refer to Chapter 6.0 – Land, Soils and Geology for details and Appendix 6.1 for drilling logs.

The site is directly underlain by a locally Important Gravel Aquifer (Lg) made of glaciofluvial deposits. Based on the site investigation works undertaken for the proposed development, the deposits were generally found to comprise mainly of SAND with some interbedded SAND & GRAVEL and GRAVEL layers (described fully in Chapter 6.0 Land, Soils and Geology). GRAVELS with boulders and cobbles were becoming more abundant at the base of the investigation holes in the central and western sides of the site. There were very few little clays or silts noted in the sand and gravel during the investigation drilling.

The base of the sand and gravels was proven to be at 37.2mbgl (89.2m OD) at monitoring well location MW1 and at 30.6mbgl (84.7m OD) at MW3 when dark grey LIMESTONE was encountered. The variation in the top of bedrock elevation at these two locations suggests that the bedrock formation is dipping southwesterly towards the River Nore valley.

Data loggers for automated groundwater monitoring were only installed in MW2, MW4 and MW5 between 8th August and 4th December 2019. Groundwater levels in the remaining wells (MW1 & MW3) were manually measured on several occasions over this period. All wells were then manually dipped again on 4 no. occasions between 29th July and 19th August 2022.

Data loggers were purposely only installed in these 3 wells to get representative groundwater level variations in the upper (east), middle and lower (west) parts of the proposed site. Groundwater level variations and flow patterns in sand and gravel aquifers are generally more subdued than in bedrock aquifers and therefore the installation of 3 no. loggers in the pattern described were deemed sufficient to monitor overall groundwater level fluctuations at the site.

Figure 7.7 below as provided in the original EIAR includes all the available continuous groundwater level monitoring data. No updated graph is required for the reason outlined above (i.e. no data exists).

Groundwater levels measured in the on-site monitoring wells are shown in Table 7-4 below. Groundwater levels across the site during the monitoring period varied spatially between 1.027m (94.4m OD) and 29.961m (99.398m OD) with the gradient flowing from east to the west.

During the initial monitoring period (August – December 2019), the depth to the groundwater table on the easterly, more elevation side of the site, was approximately 30 metres below ground level (mbgl), in the central area the depth to groundwater was between 11.5 and 20mbgl and on the westerly low-lying section it was approximately only 1m.

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The groundwater level difference across the site from west to east is approximately 5m (gradient – 0.017). The gradient is as a result of the hilly, sloping nature of the site and the direct recharge into the relatively fine SAND deposits which results in groundwater table mounding.

Table 7.4. Proposed Site Groundwater Levels/Elevations

Monitoring Well No.	Ground Level (m OD)	WL (m bgl)	WL (m OD)	WL (m bgl)	WL (m OD)	WL (m bgl)	WL (m OD)
		08/08/2019		25/08/2019		04/12/2019	
MW1	126.419	29.821	96.958	29.926	96.493	30.71	96.193
MW2	129.359	29.961	99.398	30.026	99.333	30.58	99.257
MW3	115.301	20.412	94.889	20.472	94.829	20.9	94.869
MW4	105.902	11.482	94.42	11.547	94.335	12.03	94.312
MW5	95.067	0.982	94.085	1.027	94.04	1.54	94.085

Automated groundwater level (by means on in-situ dataloggers) was undertaken between 8th August and 4th December 2019 (Figure 7.7). The variation in the groundwater level in each borehole across the site during this continuous monitoring period was <0.3m, with further seasonal variation (from dipping data presented in Table 7.4) in MW1 of between up to ~0.46 to ~0.76m.

3 no. piezometer couples/sets (3 deep sub peat piezometers, and 2 no. shallow standpipes) were installed along the northeastern boundary of Abbeyleix Bog in July 2022 between the proposed site and the petrifying spring. The area where the 3 no. piezometers sets are located is classified ecologically as wet grassland.

Refer to Figure 7.8 below for the bog piezometer locations. The piezometer logs are attached as Appendix 6.2 (Land, Soils and Geology Chapter).

The 3 No. deep sub peat piezometers (P1, P2 and P3) were installed into wet SAND which was found to underlie the PEAT at the 3 no. piezometers locations. The 2 no. shallow standpipes (PH1 and PH3) were installed to the base of the peat only. No PH2 piezometer was installed due to the shallow depth, and dry nature, of peat at the P2 location (0.52m).

The SAND (mineral subsoil) encountered below the peat at P1 and P3 was well sorted and coarse while the SAND at P2 was slightly gravelly.

Water level monitoring at the 3 No. piezometer sets, and at all 5 no. on-site monitoring wells were completed during July and August 2022. The data is presented in Table 7.5

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below. The water level recorded in the deep sub-peat piezometers (P1, P2 & P3) is representative of the regional groundwater table while the water level in the shallow piezometer reflects the phreatic surface of the water in the peat. The 5 no. on-site monitoring wells also measure the regional groundwater level below the application site.

Based on the measured groundwater levels (Table 7.5), the SAND below the peat is saturated, but the potentiometric groundwater level is below the bog surface which means there is no potential for upwelling of groundwater onto the ground surface (as springs/seepages) as seen at the petrifying spring area which is located further to the southwest.

It may be the case that the upwelling that feeds the mapped petrifying spring is a discrete and localised phenomenon.

Table 7.5. Proposed Site and Abbeyleix Bog Groundwater Levels/Elevations

Monitoring Well Location	Ground Level (m OD)	WL (m OD)	WL (m OD)	WL (m OD)	WL (m OD)
		29/07/2022	04/08/2022	11/08/2022	19/08/2022
MW1	126.419	96.26	96.25	96.23	96.23
MW2	129.359	99.17	99.15	99.15	99.15
MW3	115.301	95.08	95.07	95.09	95.09
MW4	105.902	94.18	94.16	94.15	94.15
MW5	95.067	94.01	93.96	93.93	93.93
PH1	92.552	92.29	92.32	92.25	92.25
PH3	92.679	92.52	92.54	92.49	92.49
P1	92.552	92.26	92.29	92.24	92.24
P2	93.277	92.28	92.55	92.69	92.69
P3	92.679	92.50	92.52	92.47	92.47

Groundwater levels were measured on 11th August 2022 in the deep sub peat piezometers (P1, P2 and P3) and the 5 no. site monitoring wells. This data was used to create a groundwater level contour map as shown in Figure 7.9 below.

Based on the groundwater levels measured as part of these investigations, the groundwater gradient (flow direction) within the sand and gravel aquifer in the area of the

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site is westerly (Figure 7.9), with groundwater likely discharging into the Ballymullen Stream as baseflow (also as springs at Abbeyleix Bog) and into the River Nore via the Ballymullen Stream and/or via baseflow/springs.

There is a mapped petrifying (calcified) spring located on the edge of Abbeyleix Bog to the southwest of the proposed development. The proposed development site is located to the northeast of the spring. However, due to the revised extraction plan (i.e. reduced area at Phase 4 as described in Section 7.2 above), there is now no proposed aggregate extraction directly up-gradient of the spring location (refer to Figure 7.9 below with the revised extraction area and groundwater flow direction and contour mapping).

Based on the groundwater levels measured at the proposed development site wells and in the bog area piezometers near the spring area, groundwater flow feeding the main petrifying spring area to the southwest does not originate from within the revised area proposed for extraction (i.e. the area proposed for extraction is not a recharge zone for the main petrifying spring area located to the southwest of the proposed development site.

Abbeyleix Bog and the spring are discussed further in Section 7.6.13 below.

On the OSI 6-inch and 1:5,000 scale mapping, a “turlough” is mapped approximately 30m to the east of the site. A turlough is a groundwater fed lake that is typically found in a karst limestone geological setting and not on sand and gravel deposits. The base of the pond was surveyed to be at 110.9m OD. The groundwater level measured in the nearby monitoring well (MW2) is approximately 99.4m OD which is 11.5m below the base of the pond. This suggests that the pond is surface water fed and is perched on a lens of lower permeability deposits (lacustrine silts/clays) which sit on top of the sand and gravels. Refer to Figure 7.9 for site groundwater levels and flow directions.

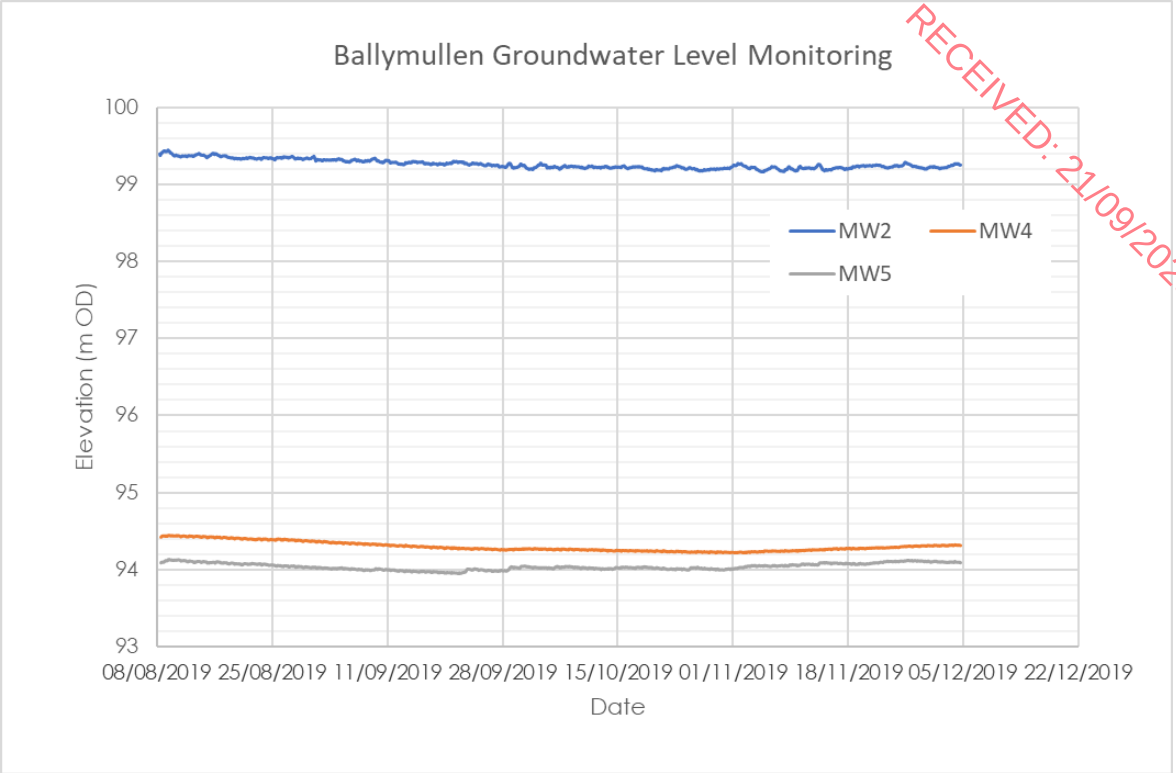

Figure 7.7: Groundwater Level Plots.

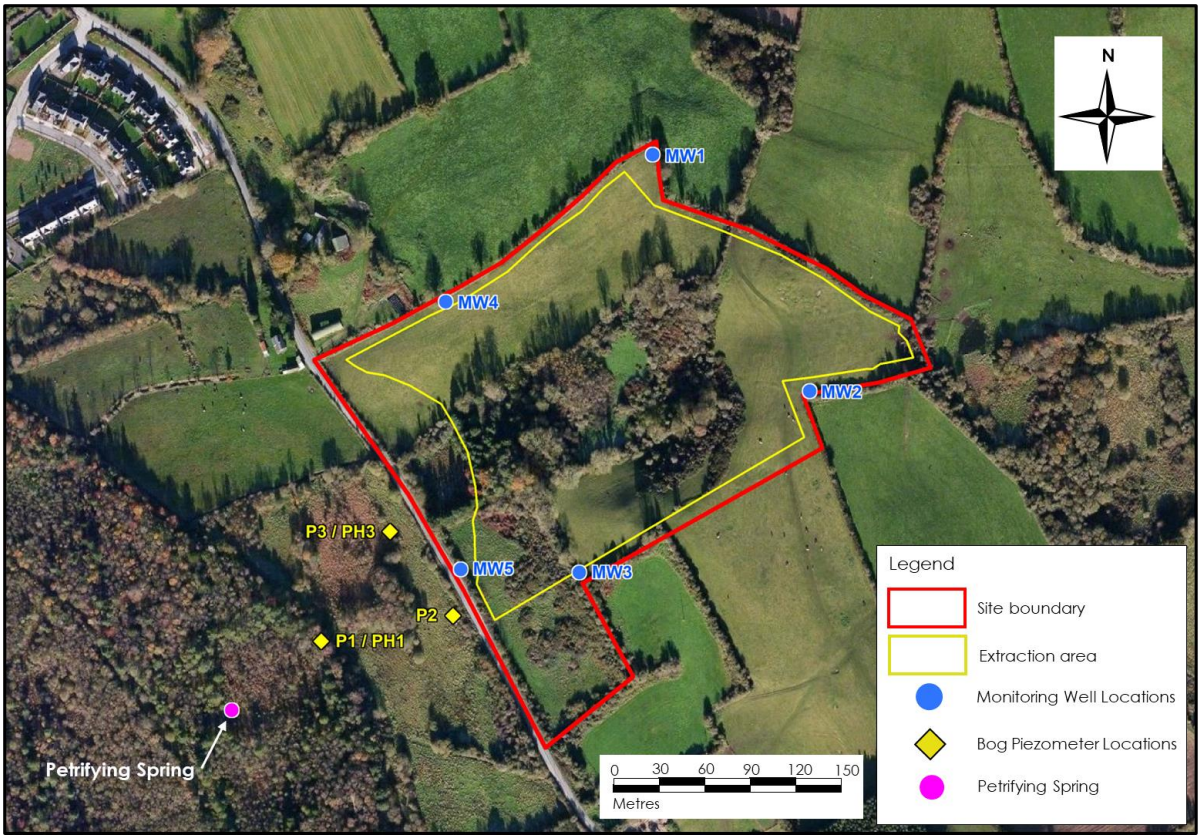

Figure 7.8: Abbeyleix Bog Piezometer Sets & Site Monitoring Well Locations

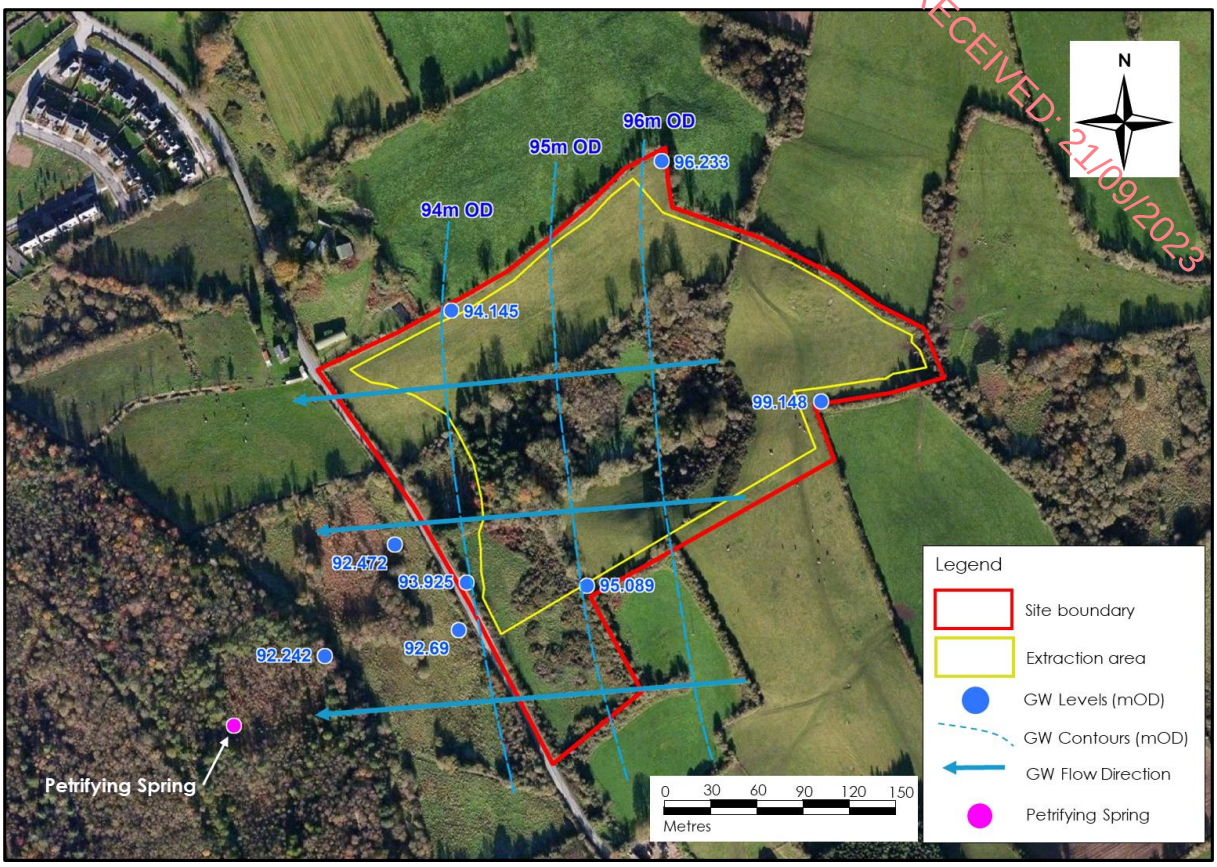

Figure 7.9: Groundwater Levels and Flow Directions (11/08/2022).

7.6.10 Groundwater Vulnerability

Based on the GSI mapping, the sand and gravel aquifer in the area of the site has a "High" groundwater vulnerability rating (All of Abbeyleix Gravels GWB is assigned a "High" rating) which is relatively consistent with the hydrogeological conditions at the site (refer to the hydrogeological conditions presented in Table 7-6 with respect to the site groundwater levels in Table 7-4 and Table 7-5).

Table 7.6. Site Groundwater Vulnerability Criteria.

Vulnerability Rating	Hydrogeological Conditions				
	Subsoil Permeability (Type) and Thickness			Unsaturated Zone	Karst Features
	High permeability (sand/gravel)	Moderate permeability (e.g. Sandy subsoil)	Low permeability (e.g. Clayey subsoil, clay, peat)	(Sand/gravel aquifers only)	(<30 m radius)
Extreme (E)	0 - 3.0m	0 - 3.0m	0 - 3.0m	0 - 3.0m	-
High (H)	>3.0m	3.0 - 10.0m	3.0 - 5.0m	>3.0m	N/A
Moderate (M)	N/A	>10.0m	5.0 - 10.0m	N/A	N/A
Low (L)	N/A	N/A	>10.0m	N/A	N/A

Notes: (1) N/A = not applicable.
(2) Precise permeability values cannot be given at present.
(3) Release point of contaminants is assumed to be 1-2 m below ground surface.

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7.6.11 Groundwater Quality

Groundwater sampling of MW2, MW4 and MW5 was undertaken on 8th August 2018.

Certificates of analysis are shown in Appendix 7.1 (Groundwater Quality). In terms of the local groundwater gradients and flow directions, MW2 and MW5 are located up-gradient and down-gradient of the site respectively and MW4 is located across-gradient to the site along the northern boundary.

There were no exceedances with respect to the groundwater regulation values. The only exceedances with respect to the drinking water regulation values were for iron and manganese which are likely to be naturally elevated due to the local geology. Iron and Manganese were only elevated in MW4. Levels of nutrients (i.e. nitrate, ortho-phosphate, ammonia) are relatively low which indicates that the use of surrounding land for agricultural is not affecting groundwater quality at the site.

The electrical conductivity varies between 620 and 633µs/cm and the pH were approximately 7.2.

7.6.12 Water Framework Directive Status and Risk Result

Local Groundwater Body (GWB) and Surface water Body (SWB) status and risk result information are available for view from (www.catchments.ie).

The WFD Status and Risk Result for the Nore River (Nore_SC_040) upstream and downstream of the proposed site is reported to be “Good Status” and “Not at Risk” respectively. The Nore_SC_040 sub-catchment also includes the Ballymullen Stream.

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The Abbeyleix Gravels GWB (GWB: IE_SE_G_171) underlies the proposed development site. It is assigned 'Good Status'[1], this applies to both quantitative status and chemical status.

7.6.13 Designated Sites and Habitats

Designated sites include National Heritage Areas (NHAs), proposed National Heritage Areas (pNHAs), Special Areas of Conservation (SACs), candidate Special Areas of Conservation (cSAC) and Special Protection Areas (SPAs). A designated site map for the area of the proposed development is shown in Figure 7.10.

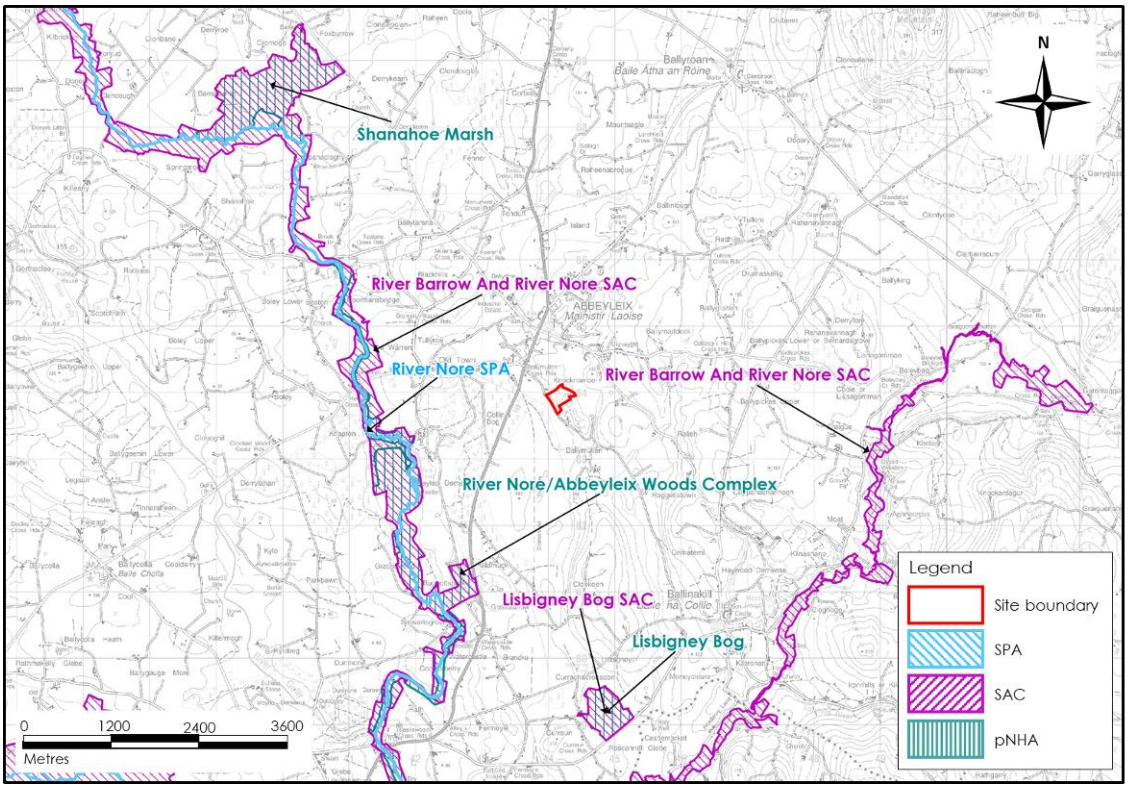

Figure 7.10: Designated Site Map.

The closest designated site to the proposed site is the River Barrow and River Nore SAC and the River Nore SPA which is located approximately 3km downstream of the site via the Ballymullen Stream and ~2.2km downstream via groundwater flow paths.

However, there are no surface water discharges or runoff from the proposed site and therefore there are no direct surface water linkages between the proposed site and the SAC/SPA via the Ballymullen Stream.

[1] 'Status' means the condition of the water in the waterbody. It is defined by its chemical status and its ecological status, whichever is worse. Waters are ranked in one of 5 classes: High, Good, Moderate, Poor and Bad (WFD, 2010).

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As discussed above, it is expected that groundwater flows in the area of the proposed development discharge into the River Nore via the Ballymullen Stream or via spring discharges close to the River Nore channel itself.

Abbeyleix Bog, which is located immediately to the west (Figure 7.11), is currently not designated but is a prospective pNHA. Abbeyleix Bog also contains a number of Annex 1 Priority Habitats including a Petrifying Spring and Bog Woodland. These are discussed further below regarding the proposed development.

The location of the mapped Petrifying Spring area adjacent to the proposed development site is shown in Figure 7.12 below.

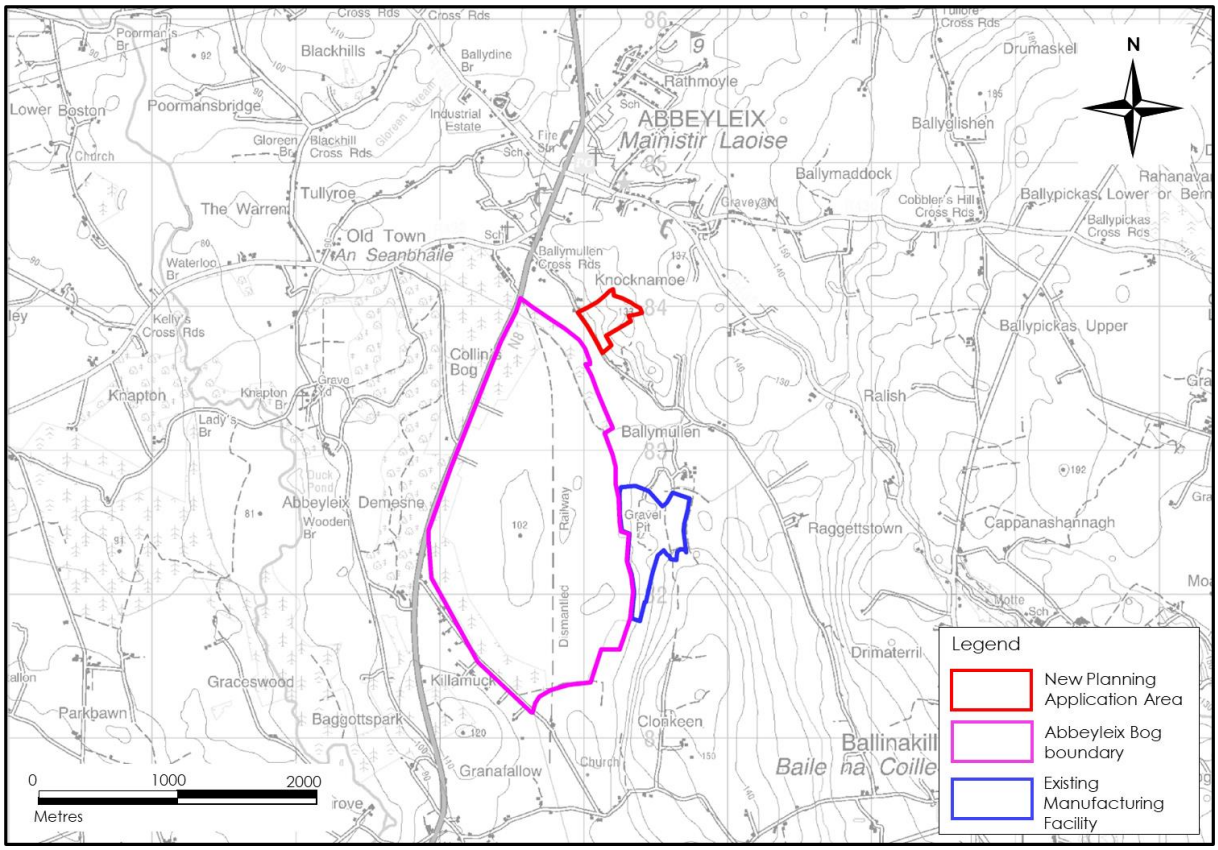

Figure 7.11: Abbeyleix Bog Location.

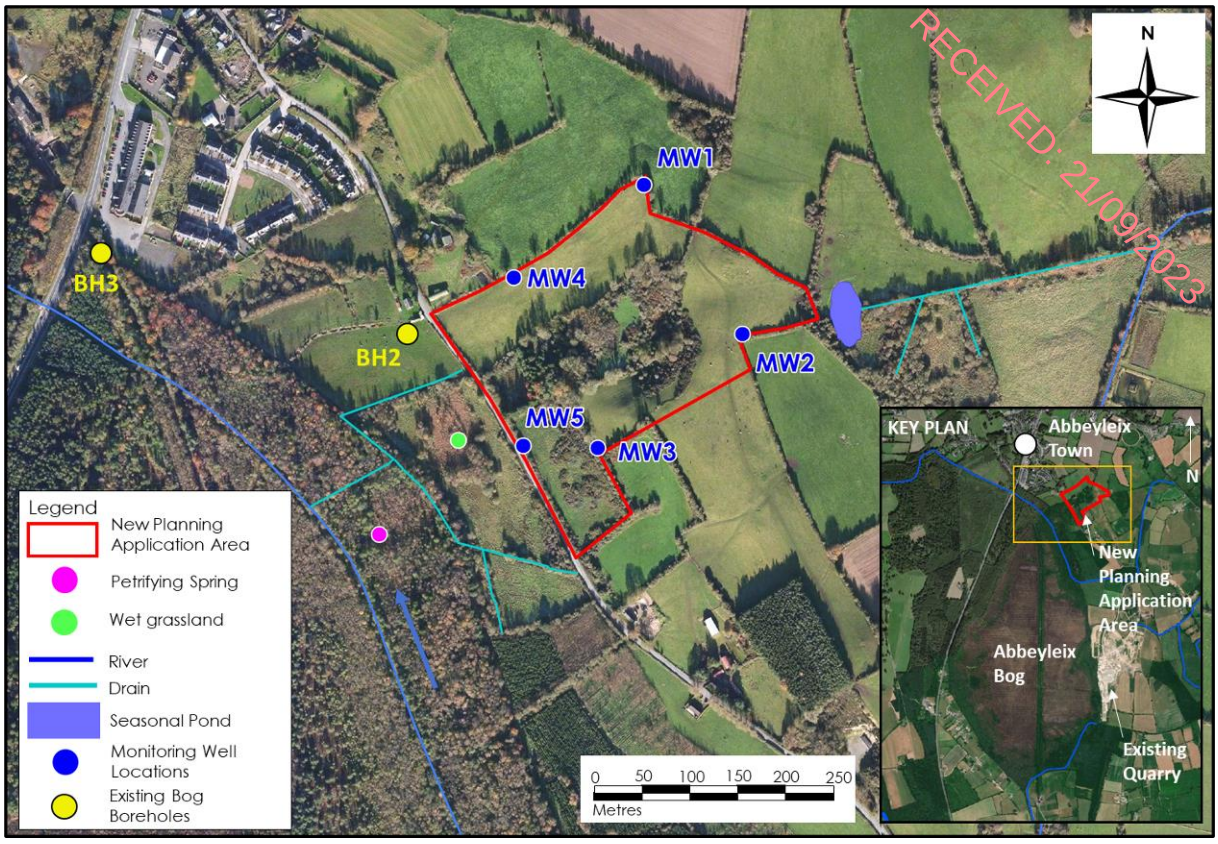

Figure 7.12: Abbeyleix Bog Area of Interest.

A number of hydrological /hydrological investigations have been undertaken on Abbeyleix Bog and the most extensive of these is a PhD Thesis by Michael Swenson of Trinity College (2017).

The PhD investigated the regional scale hydrology and hydrogeology at Abbeyleix Bog to characterise the catchment scale hydrology and water balance. The underlying hydrogeology was largely found to have relatively little impact on the majority of the bog surface eco-hydrology and this was due to the raised nature of the bog and the fact that the bog is underlain by shell marl, particularly the north-eastern section of the bog (section adjacent to the proposed development site). Thus, the surface eco-hydrology was more strongly controlled by local topography.

The investigation determined a shallow marl lake was likely present at the north-eastern section of the bog as there are still calcified springs (petrifying spring area) and seepages along the north-eastern edge of Abbeyleix Bog adjacent to sand-gravel esker complex on which the proposed development site is located. These spring area and seepages are fed by a groundwater head and elevation gradient from the esker complex (i.e. sand and gravels at the site) down to the bog which is ultimately driven by rainfall recharge.

A geological cross-section of the esker ridge and Abbeyleix Bog at the application site is shown in Figure 7.13 below.

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Based on the groundwater level monitoring completed, only the most southerly end of the proposed application site is located in the recharge area of the spring area. However, there is no proposed extraction in the area of the proposed site that is located within the groundwater catchment to the spring area.

The proposed extraction area is located further to the north of any groundwater flowpaths that potentially feed the petrifying spring area from the east.

HES visited Abbeyleix Bog on 11th March 2021 and again between 29th July and 19th August 2022 and confirmed that the spring discharge is mineralised (i.e., pH 7.6 – 8 and EC 500 – 600µs/cm). The discharge volume from the spring is also relatively small (<1L/s). Sampling of the spring also indicate mineralised groundwater (total alkalinity 244mg/L $CaCO_3$). The spring discharge is likely emerging from the calcareous sand deposits below the peat.

The hydrochemistry of the spring discharge is similar to the hydrochemistry of the groundwater below the proposed development site. MW05 at the proposed development site and the spring were both sampled on 11th March 2021 and sent for laboratory analysis. Laboratory reports are included in Appendix 7-1.

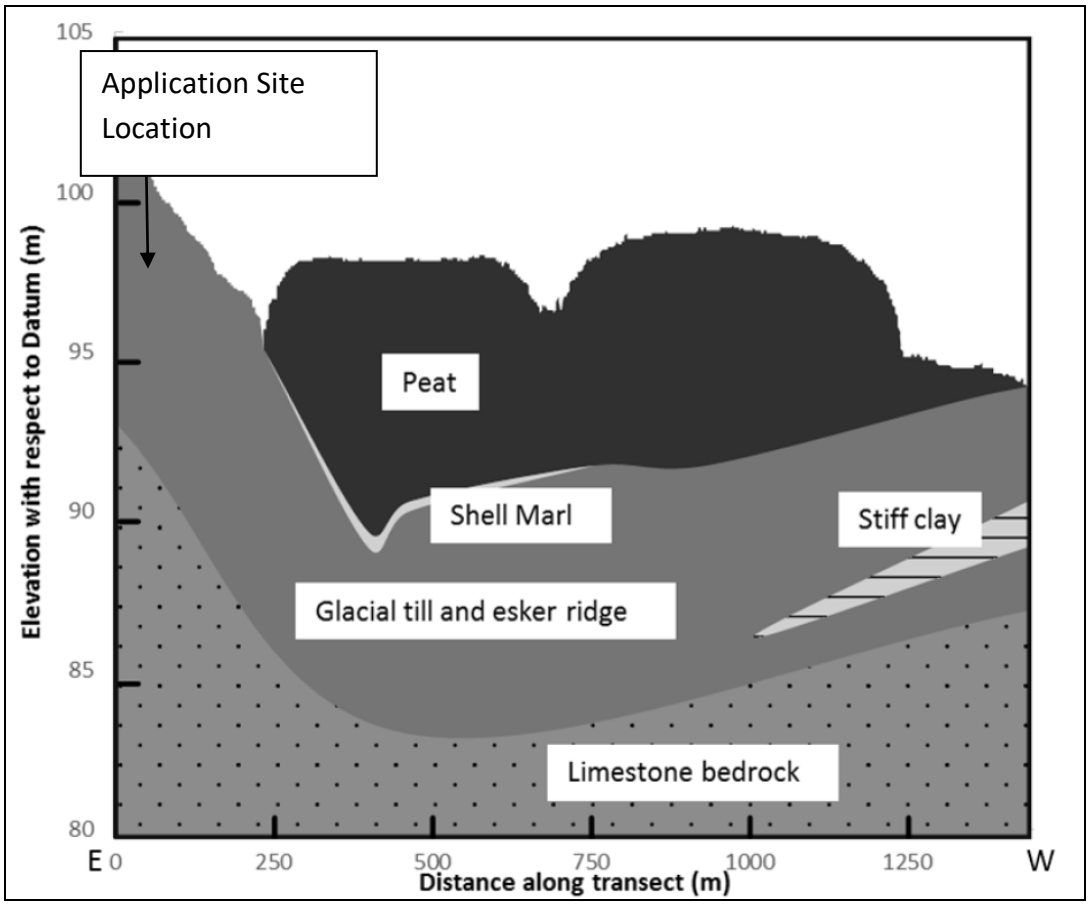

Figure 7.13: Abbeyleix Bog – Geological Cross-Section (Swenson, 2017).

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7.6.14 Local Water Supplies

There are no public water supply or National Federation Group Water Scheme groundwater protection zones mapped in the area of the proposed site.

The Geological Survey of Ireland (GSI) well database (www.gsi.ie) has no mapped wells within 1km of the application site (refer to Figure 7.14 below). There are several wells located beyond the 1km radius.

As the GSI well database is not exhaustive in terms of the locations of all wells in the area (as the database relies on the submission of data by drillers and the public, etc.) a door-to-door well survey of dwellings in close proximity (300m of site boundary) was carried out on 15th August 2019 and no private wells were identified.

A 300m set-back distance was considered a large enough distance for the private well survey because due to the sand and gravel's ability to effectively filter groundwater as it flows through the deposits, no impacts on groundwater quality (i.e. namely turbidity) would be expected at distances more than 300m from the proposed development site. Also, there is no proposed dewatering, wet extraction or abstraction of groundwater for processing purposes at the proposed site, therefore groundwater level/flow impacts on local wells will not occur.

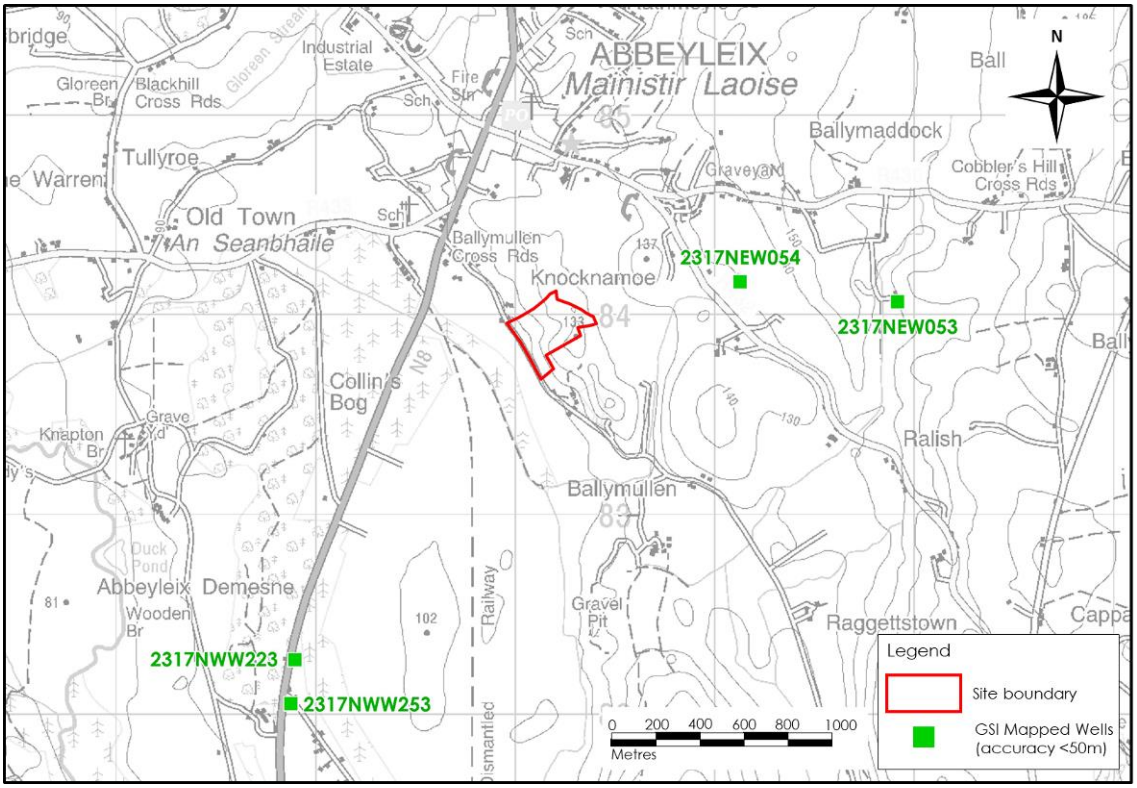

Figure 7.14: GSI Mapped Groundwater Supplies.

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7.6.15 Hydrogeological Conceptual Model

A hydrogeological conceptual model was developed for the site based on the information gathered from both the desk survey and site investigation works previously outlined.

The proposed development site is directly underlain by a Locally Important Sand and Gravel Aquifer. The glaciofluvial deposits in the area of the site comprise mainly of SAND with some interbedded SAND & GRAVEL and GRAVEL layers. GRAVELS with boulders and cobbles were becoming more abundant at the base of the investigation holes in the central and western sides of the site.

Underneath the sand and gravel aquifer, a regionally karstified limestone aquifer is mapped (the investigation drilling indicates limestone is present below the site depths ranging between 30.6mbgl (central area) and 37.2mbgl (eastern area). The depth to bedrock on the western area of the site is likely to be between 15 – 20mbgl.

Based on surveys and groundwater level monitoring undertaken at the site to date, the groundwater level in the area of the proposed development varies spatially between 1.027m (94.04m OD) and 29.961m (99.398m OD) with temporal variations of <0.3m over the monitoring period.

Based on groundwater levels measurements, the groundwater flow direction in the area of the site is westerly with discharge likely to the Ballymullen Stream as groundwater baseflow or petrifying spring discharge and into the River Nore via the Ballymullen Stream itself and also possibly as springs/baseflow.

At the wet grassland on the edge of Abbeyleix Bog, the SAND below the peat is saturated, but there is no potential for upwelling of groundwater onto the ground surface (as springs/seepages) as seen at the petrifying spring area which is located further to the southwest.

With regard the main petrifying spring area (located to the southwest of the proposed development site), the groundwater level monitoring shows that groundwater catchment/recharge area to the spring area exists to the south of the proposed extraction area. The most southerly end of the proposed application site is located in this recharge area, but the southerly end of the proposed application site is now not proposed for extraction as part of the revised extraction plan.

7.6.16 Receptor Sensitivity/Importance

Based on the criteria set out in Table 7.1 above, groundwater at the site is classed as Medium Importance because the Abbeyleix Gravels GWB is classified as a Locally Important Aquifer (Lg). Due to the fact that no dewatering or groundwater abstraction is proposed, no impacts on groundwater quantity (levels or flows) are expected. Groundwater quality impacts and recharge effects are discussed further below.

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Surface waters such as the Ballymullen Stream and the River Nore could be considered to have an Extremely High Importance due to the SAC/SPA designated status of the latter. The Ballymullen Stream drains directly into the River Nore so the importance can be considered the same as the River Nore. However, there are no proposed surface water discharges or surface water runoff from the site therefore impacts on surface water quality from potentially contaminated runoff (sediments/oils/fuels etc) is not expected.

The River Barrow / River Nore SAC and the River Nore SPA have an Extremely High Importance classification. However, as there are no direct surface water linkages/pathways between the proposed site and these designated sites, no significant effects are expected.

The only potential pathway for downstream receptors (surface waters/SPA/SAC) can only be indirect via groundwater flow and emerging baseflow.

Abbeyleix Bog itself, which can be considered Very High Importance, is not sensitive to impact from the proposed development as there is no surface water connection between the bog and the proposed development site. Also, as discussed above, the underlying hydrogeology was found to have relatively little influence on the bog surface eco-hydrology and therefore the proposed development has little or no potential to impact on the bog via groundwater pathways. The associated wet woodland and petrifying spring area, which can be considered of Extremely High Importance, are directly connected to the site via groundwater linkages and are therefore very sensitive.

There is no proposed aggregate extraction directly up-gradient of the spring location. (refer to Figure 7.9 above with the extraction area and groundwater flow direction.

Groundwater quality will be the main sensitive receptor with respect to potential oil/fuel leaks and spills from plant and machinery.

All potential contamination sources are to be carefully managed at the site during the extraction phase of the development and mitigation measures are proposed within the EIAR to deal with these potential minor impacts.

No third-party wells were identified within a 300m distance down-gradient of the site and therefore impacts on groundwater supplies are not expected.

7.7 Potential Impacts of the Proposed Development

7.7.1 Characteristics of the Proposed Development

The estimated volume or material to be extracted from the application site is approximately 787,310m^3 of material of which 23,500m^3 consists of overburden which will be used to construct berms and restore the site. The volume of material to be transported to the manufacturing facility is approximately 763,810m^3/1.53 million tonnes.

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The development will be completed over 8 No. phases and each phase will be reinstated before the next phase commences. The high number of phases will ensure only a small section of the site is being worked on at any one time.

The overburden removed at each phase will be used to create a berm along the northern boundary of the site and for restoration of the pit on completion of the phase. There will be no aggregate extraction below the groundwater table.

There will be no processing of the extracted material on site. All material will be transported to the applicants existing manufacturing facility located approximately 1.3km to the south of the site. There will be no requirement to store spoil/residual fines at the proposed site.

The proposed extraction depth varies between 97.3m OD on the west of the site and 102.5m OD on the east of the site. This is just over 3m above the monitored groundwater levels to allow for higher groundwater levels in winter.

It also should be noted that there will be no discharge of domestic wastewater at the site, as wastewater will be contained and moved off-site. Groundwater quality impacts from wastewater will therefore not occur. The proposed refuelling area and wheel wash will discharge to ground via a full retention oil interceptor.

Fuel and oil will be delivered to the site and dispensed directly into plant and equipment. There will be no storage of oils and fuels on-site.

7.7.2 "Do Nothing" Scenario

If the proposed development does not go ahead, the site will remain as a greenfield agricultural land.

7.7.3 Potential Construction Phase Impacts

7.7.3.1 Impacts on Groundwater due to Initial Site Development Works

The initial site development construction works will include creation of the site entrance, stripping of topsoil and creation of screening berms.

These activities have the potential to generate the release of suspended solids to surface watercourses and could result in an increase in the suspended sediment load, resulting in increased turbidity which in turn could affect the water quality and fish stocks of downstream water bodies. However, the removal of vegetative cover will be over small localised areas (~0.34Ha) and will likely be completed in a short amount of time. There is no direct hydraulic connection between the application site and any downstream drain, stream, or watercourse. Therefore, the only potential receptor is the underlying groundwater system (in terms of vulnerability and groundwater quality.

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Receptor: Groundwater vulnerability and groundwater quality
Pathway/Mechanism; Aggregate extraction, movement and placement in berms
Pre-mitigation Impact: Negative, irreversible, slight, direct, likely, permanent effect on groundwater vulnerability rating.
Negative, slight, indirect, unlikely, temporary effect on groundwater quality below the site.

Impact Assessment:

As outlined above, these works are small-scale, and they will be completed over a small area (~0.34Ha), and over a short period. There is no direct connection to any downstream drain, stream or watercourse, and the main potential receptor is the underlying groundwater system.

Albeit there will be a slight increase in groundwater vulnerability due to the removal of overburden, there will be no extraction within 3m of the groundwater table and therefore there will be no effect on the current GSI groundwater vulnerability rating which is "High".

Mitigation Measures:

The main mitigation with respect to groundwater quality protection during the construction phase will be the employment of best practice measures with respect to oil usage and refuelling of plant and machinery which are dealt with in Section 7.7.4.3 below.

Post construction and extraction phase a landscape and restoration plan will be implemented. This will involve previously stripped overburden being placed on the pit floor to establish grassland which will provide a level of protection to groundwater. Post restoration, the site will be returned to agriculture.

Residual Effect:

The thickness of sand and gravel will be altered by the construction works, however, a depth of 3m will be maintained above the water table and the site will be reinstated with topsoil and will be reseeded. Any potential compaction issues will be removed by removing the berms and ploughing the underlying subsoils. Also, the potential for the release of hydrocarbons is a risk to groundwater, and also to downstream surface water bodies. However, proven and effective measures to mitigate the risk of releases of hydrocarbons have been proposed above and will break the pathway between the potential source and the underlying groundwater system, and the associated downstream surface water bodies.

The residual effects are considered to be - negative, irreversible, slight, direct, likely, permanent effect on groundwater vulnerability rating; Negative, imperceptible, indirect, unlikely, temporary effect on groundwater quality below the site.

Significance of Effects:

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For the reasons outlined above, and with the implementation of the outlined mitigation, no significant effects on groundwater vulnerability, nor groundwater quality, will occur during the construction phase.

7.7.4 Potential Extraction / Operation Phase Impacts

7.7.4.1 Impacts on Groundwater Vulnerability Rating due to Aggregate Extraction

The proposed development will involve the extraction of material down to a depth of between 97.3 and 102.5mOD which will increase the vulnerability of the aquifer which is currently rated as "High".

Receptor: Groundwater vulnerability rating
Pathway/Mechanism; Aggregate extraction
Pre-mitigation Impact: Negative, irreversible, slight, direct, likely, permanent effect on groundwater vulnerability rating.

Mitigation Measures:

Albeit there will be a slight increase in groundwater vulnerability due to the removal of overburden, there will be no extraction within 3m of the groundwater table and therefore there will be no effect on the current GSI groundwater vulnerability rating which is "High".

The main mitigation with respect groundwater quality protection during the extraction phase will be employment of best practice measures with respect to oil usage and refuelling of plant and machinery which are dealt with in Section 7.7.4.3 below.

Post extraction phase a landscape and restoration plan will be implemented. This will involve previously stripped overburden being placed on the pit floor to establish grassland which will provide a level of protection to groundwater. Post restoration, the site will be returned to agriculture.

Residual Effect:

The thickness of sand and gravel will be altered by the extraction works, however a depth of 3m will be maintained above the water table and the site will be reinstated with topsoil and will be reseeded. Any potential compaction issues will be removed by removing the berms and ploughing the underlying subsoils. Also, the potential for the release of hydrocarbons is a risk to groundwater, and also to downstream surface water bodies. However, proven and effective measures to mitigate the risk of releases of hydrocarbons have been proposed above and will break the pathway between the potential source and the underlying groundwater system, and the associated downstream surface water bodies. The residual effect is considered to be - negative, irreversible, imperceptible, direct, likely, permanent effect on groundwater vulnerability.

Significance of Effects:

No significant effects on groundwater vulnerability will occur.

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7.7.4.2 Effects on Groundwater Recharge

This section assesses the potential for effects on groundwater recharge due to the removal of vegetation/topsoil, alteration of the site ground surface/levels as a result of the proposed aggregate extraction and potential compaction of the pit floor by plant and machinery.

The proposed development will require the removal of the grass vegetation /topsoil layer and then the excavation of up to 10m of the underlying sand and gravel deposits.

Receptor: Groundwater Recharge
Pathway/Mechanism; Unsaturated zone recharge flowpaths
Pre-mitigation Impact: Negative, imperceptible, direct, likely, permanent effect on groundwater recharge.

Assessment / Mitigation Measures:

Section 7.6.5 discusses the greenfield baseline drainage regime at the site. Due to the lack of surface drainage features within the site and the absence of drainage outfalls from the site, all effective rainfall landing on the site must currently recharge to the ground.

Typically, the removal of vegetation cover has the potential to increase surface water runoff, however, due to the well-drained nature of the underlying sand and gravel deposits at the site a significant increase in runoff will not occur. Sand and gravel pits that operate above the groundwater table, generally have a dry pit floor with maybe some very localised ponding (measures are proposed below to deal with potential ponding). This is HES's experience from visiting many sand and gravel pits across the country.

However, it is proposed that the extraction of aggregate will be done in 8 No. phases and therefore all the vegetation will not be stripped at once. Once each phase is extracted, the ground will be reinstated with topsoil and reseeded before the next phase commences. This will mitigate against the risk of increased runoff at the site.

There is no proposed aggregate extraction directly up-gradient of the spring location. Therefore, there will be no alternation of the recharge/runoff regime directly up-gradient of the mapped petrifying spring area.

In addition, as a surface water control measure, it is proposed to excavate an infiltration drain/swale along the perimeter of each phase bench level within the pit to ensure all potential runoff is collected and diverted to the ground. This will ensure there will be no reduction in groundwater recharge at the site. Currently, at the greenfield site, there are no drainage outfalls and this will continue to be case at the proposed developed site.

The proposed development at each phase will initially require the stripping of vegetation cover which will expose the underlying sand and gravel deposits. Therefore, in the absence

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of vegetation, during the operational /extraction phase of the development, there is actually the potential for slightly increased groundwater recharge during the spring/summer months due to a reduction in evapotranspiration. However, due to the fact that the site will be extracted in 8 no. phases as described above, the effect would not be significant.

Compaction of the pit floor due to quarry traffic/machinery (leading to increased surface water runoff and reduced recharge) is not expected as the material proposed for extraction was found to be dense with no significant fines (i.e. silts/clays) and regular course layers (i.e. clay/silt) proportions. Therefore, the material by its nature has very limited ability to compact and seal. Any areas of minor pockets of surface water ponding that might occur will be drained into the proposed infiltration trenches/swales as outlined above. Also, once each phase is completed, the exposed deposits will be ploughed before reinstating the topsoil layer to ensure good drainage / percolation is maintained.

There will be no processing of aggregate at the application site, therefore there will be no requirement to manage or store fines (clay and silts) at the site. The fact that fines will not be separated and will not require management at the application site will prevent the risk of increased runoff as a result of storage of such material.

Finally, a greenfield corridor (approx. 30m wide) will remain along the low-lying western side of the application site. This is the lowest point on the site, particularly the northwestern section/field of the site, where runoff collects naturally during very wet periods and percolates to the ground over a period time. This section of the site will remain as grassland as it acts as a natural soakaway for the existing site. This will act as a natural drainage buffer between the proposed extraction area and Abbeyleix Bog.

Therefore, even in the absence of mitigation, the proposed development would have no significant potential to impact on groundwater recharge at the application site. However, the proposed mitigation measures outlined above will maintain the existing drainage regime at the application site and ensure no negative effects on groundwater recharge.

Residual Effect:

The thickness of sand and gravel will be altered by the extraction works, however, a depth of 3m will be maintained above the water table and the site will be reinstated with topsoil and will be reseeded. Any potential compaction issues will be removed by ploughing. Therefore, the recharge mechanisms that exist in the baseline scenario will be maintained post-restoration. As a result, the residual effect is considered to be - neutral, imperceptible, direct, likely, permanent effect on groundwater recharge.

Significance of Effects:

For the reasons outlined above, and with the implementation of the listed mitigation, no significant effects on groundwater recharge will occur.

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7.7.4.3 Surface Water and Groundwater Contamination from Oil / Fuel Spills and Leaks

Excavation of aggregate at the site will be completed using machinery. Such machinery is powered by diesel engines and operated using hydraulics. Unless managed carefully such plant and machinery have the potential to leak hydraulic oils or cause fuel leaks during refuelling operations.

Only small volumes of fuel/oils will be present on-site (in the machines) and therefore no significant effects are expected as long as standard mitigation is implemented. There will be no storage of fuel at the site. The only plant which will be refuelled at the site will be excavators. Road trucks will be refuelled off-site.

Also, runoff from the site entrance and water in the wheel wash has the potential to become contaminated by oil/fuel leaks and spills.

The IFI in their submission requested that surface water runoff from the entire site (including the infiltration trenches/swales) be discharged through the wheel wash area and associated treatment system.

The proposed development is a sand and gravel pit and it would therefore be near to impossible to convey all surface water runoff from the site and discharge it through the wheel wash area and associated treatment system as recommended by IFI. Sand and gravel pits typically have a dry floor as rainfall/surface runoff percolates to the ground.

Similarly, infiltration trenches/swales by nature of design collect/hold water and let it seep into the underlying ground. They are not designed to convey water as the water will be lost through the base/sides of the trenches/swales.

Across the site, best practice measures for managing oils and fuels will be employed. This would be standard practice in a sand and gravel pit where unlike in a bedrock quarry the majority of the water can be pumped and treated.

No fuel or hydrocarbon products will be stored at the proposed development and plant and machinery will be serviced regularly to prevent potential leakages. Refuelling of plant will take place over the proposed refuelling area with all fuel dispensed by competent and authorised fuel distributors.

Sand and gravel pits also have the benefit of an underlying natural filter and therefore treatment of fine in runoff is not required.

Receptor: Groundwater and surface water (indirectly via groundwater system)
Pathway: Groundwater flowpaths

Pre-mitigation Impact: Negative, reversible, slight, indirect, unlikely, long-term effect on surface water and groundwater quality.

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Mitigation Measures:

The following mitigation is proposed:

- All plant and machinery will be serviced before being mobilised to the site;
- Refuelling will be completed at the dedicated refuelling area, with a controlled drainage system that drains via a hydrocarbon interceptor;
- Only designated trained operators will be authorised to refuel plant on site;
- Procedures and contingency plans will be set up to deal with emergency accidents or spills;
- An emergency spill kit with oil boom, absorbers etc. will be kept on-site for use in the event of an accidental spill; and,
- Runoff from the site entrance and overflows from the wheel wash will be directed to a silt trap and full retention hydrocarbon interceptor* prior to discharge to the ground.

*The full retention hydrocarbon interceptor will be sized to cope with a 10-year storm return period.

Residual Effect:
The potential for the release of hydrocarbons is a risk to groundwater, and also to downstream surface water bodies. However, proven and effective measures to mitigate the risk of releases of hydrocarbons have been proposed above and will break the pathway between the potential source and the underlying groundwater system, and the associated downstream surface water bodies. The residual effect is considered to be - Negative, imperceptible, indirect, unlikely, long term effect on groundwater quality, and downstream surface water quality.

Significance of Effects:
For the reasons outlined above, and with the implementation of the listed mitigation measures, no significant effects on surface water or groundwater quality are expected.

7.7.4.4 Groundwater Quality Impacts on Local Wells

As discussed in Section 7.6.14 above, no wells were identified within 300m of the site. Due to the fact that no dewatering or groundwater abstraction are proposed, no impacts on groundwater quantity (levels or flows) are expected. Mitigation measures with respect to oils/fuels and groundwater quality are dealt with in Section 7.7.4.3 above.

Receptor: Local wells
Pathway: Groundwater flowpaths
Impact: No impacts on local groundwater wells are anticipated.

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7.7.4.5 Hydrological Impacts on Downstream Designated Sites

Groundwater flow from the local sand and gravel aquifer in the vicinity of the proposed development site is expected to discharge in a westerly direction and enter the River Barrow and River Nore SAC indirectly (either via the Ballymullen Stream, spring discharge or as baseflow).

The River Barrow and River Nore SAC is located approximately 2.2km west and downstream (groundwater flow) of the proposed development site and since there will be no surface water discharges from the site, no significant effects are expected.

Also, for the reasons explained in Section 7.7.4.2, there will be no potential to significantly alter the local hydrogeology in the area of the proposed development site. Therefore, effects on the regional hydrogeological regime and groundwater-dependent designated sites further downstream of the proposed development site such as the River Barrow and River Nore SAC will not occur.

All other designated sites are located remote from the site therefore there is no hydrogeological connection to the proposed development and therefore they cannot be impacted by the proposed development. The other remote designated sites are in separate groundwater catchments from the proposed development site.

Mitigation measures with respect oils/fuels and groundwater quality are dealt with in Section 7.7.4.3 above.

Receptor: Local SAC/SPA
Pathway: Groundwater flowpaths
Impact: No impacts on local designated sites are anticipated.

7.7.4.6 Hydrological/Hydrogeological Impacts on Abbeyleix Bog and Related to Designated Habitats

The proposed application site is located to the east and immediately up-gradient of Abbeyleix Bog (prospective pNHA). The proposed site is also located close to the groundwater catchment of petrifying spring and bog woodland which are water dependent habitats associated with Abbeyleix Bog. Therefore, activities at the proposed application site have the potential for indirect hydrogeological effects (groundwater quantity and quality). There are no surface water connections between the proposed site and Abbeyleix Bog nor the designated habitats.

Receptor: Abbeyleix Bog and Designated Habitats
Pathway: Groundwater flowpaths
Impact: Negative, irreversible, imperceptible, indirect, likely, long term effect on Abbeyleix Bog and related designated habitats.

Assessment / Mitigation Measures:

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With regard to Abbeyleix Bog itself, the investigations carried out as part of a PhD Thesis found that the underlying hydrogeology was largely found to have relatively little impact on the surface eco-hydrology and this was due to the raised nature of the bog and the fact that the bog is underlain by shell marl, particularly the north-eastern section of the bog adjacent to the application site. In addition, due to the fact that there are no surface water connections between Abbeyleix Bog and the proposed site, no significant effects on the hydrology of Abbeyleix Bog can occur.

The petrifying spring and bog woodland, which are both water dependent habitats, are located to southwest/west respectively of the proposed site.

Based on the groundwater levels measured at the proposed development site wells and in the wet grassland area piezometers near the spring area, groundwater flow feeding the main petrifying spring area does not originate from within the area proposed for extraction (i.e. the area proposed for extraction is not a recharge zone for the main petrifying spring area located to the southwest of the proposed development site.

The proposed extraction area is located further to the north of any groundwater flowpaths that potentially feed the petrifying spring from the east.

Nevertheless and as discussed/assessed in Section 7.7.4.2 above, there will be no impact on groundwater flow volumes/quantity to the spring area/wet woodland as the proposed development will have no effect on groundwater levels and no significant effect on groundwater recharge at the application site. There will also be no alteration to the surface water flowpaths/drainage around the wet woodland.

A number of measures are proposed to ensure the drainage regime at the application site is maintained and these include the following:

- No groundwater dewatering is required. Sand and gravel extraction will be by dry working, and will occur above the groundwater table;
- Removal of vegetation/Extraction and restoration of the site in 8 phases therefore only a small section of the site will be worked at any one time;
- Due to the revised extraction plan (i.e. reduced area at Phase 4) there is now no proposed aggregate extraction within the groundwater catchment to the main spring area. The catchment area to the important spring has been avoided;
- Therefore, there will be no alternation of the recharge/runoff regime directly up-gradient of the spring area;
- Installation of temporary perimeter swales/drains to ensure all rainfall is collected and percolated to the ground;
- Ploughing of the pit ground level at the end of each phase prior to reinstating topsoil to ensure good drainage percolation is maintained; and,
- Maintaining a greenfield/grassland corridor on the lower lying western side of the site which acts as a natural drainage buffer between the proposed extraction area and Abbeyleix Bog.

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Best practice measures for managing oils and fuels at the site, which are present in Section 7.7.3.3 above, will ensure no significant impacts on groundwater quality will occur. Runoff from the site entrance and overflows from the wheel wash will be discharged via a hydrocarbon interceptor.

Good practice measures with regard oils and fuels will be employed around the rest of the site area.

Residual Effect:
No residual effects on Abbeyleix Bog or its designated habitats will occur.

Significance of Effects:
No significant effects on Abbeyleix Bog or its designated habitats will occur.

7.7.5 Restoration Phase and Post Restoration Phase

The restoration plan involves returning the pit to grassland by spreading/contouring previously stripped overburden over the extraction area.

No impacts on the hydrological or hydrogeological regime are expected during the restoration or post-restoration phase. The restoration phase itself will have a positive effect in terms of reduced groundwater vulnerability and reduced risk of illegal activities such as fly-tipping. Albeit, the required restoration is borne out of the proposed excavation works.

7.7.6 Monitoring

Continuous automated groundwater level monitoring (by means of data loggers) and quarterly groundwater quality monitoring will be undertaken at the 5 no. monitoring well locations within the proposed development. The proposed list of parameters to be analysed for is attached as Appendix 7.2.

In the very unlikely event that hydrocarbons are detected during routine groundwater quality monitoring, all refueling at the application site will be prohibited and refueling will then have to be undertaken at the applicants existing manufacturing facility located approximately 1.3km to the south of the application site.

Regular inspections of the full retention hydrocarbon interceptor from the wheel wash, including sampling of overflow water from the interceptor, will ensure the system is operating at its highest standard.

Daily visual inspections and monitoring of the effectiveness of the infiltration, and the drainage swale will be included in the overall Environmental Management Plan (EMP) for the site during construction and operation. Discharge into the infiltration, and the

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drainage swale will be via check dams/silt traps and these elements will also require regular weekly monitoring and cleaning.

With regard Abbeyleix Bog, a proposed Hydrological Monitoring Plan is attached at Appendix 7.3 and is summarised in Table 7.7 below. This proposed hydrological monitoring plan is subject to agreement with Abbeyleix Bog Committee.

Table 7.7. Summary of the Abbeyleix Bog Hydrological Monitoring Plan.

Location	Automated	Monthly	Quarterly	Annual
Development Site Monitoring Wells (5 no.) & Bog Piezometers Sets (3 no.), and BH2 and BH3 from existing bog monitoring network.	Data loggers installed in MW1 – MW5	Manual Water level Measurement (mbtoc)(1)	-	-
Bog Piezometer Set 3 no. (at petrifying Spring)	-	Estimation of discharge/flow (L/s) & Manual Water level Measurement	-	-
MW5, and Bog Piezometers Sets (3 no.)	-	-	Field Hydrochemistry (pH, Electrical Conductivity & Temperature)(2)	-
MW5, and Bog Piezometers Sets (3 no.)	-	-	-	Laboratory Hydrochemistry Analysis (refer to **Appendix I** of plan for suite of parameters) (2)

7.7.7 Human Health Effects

Potential health effects arise mainly through the potential for groundwater contamination and impacts on local wells. Hydrocarbons, in the form of fuels and oils, will be used on-site during aggregate extraction.

There are no wells down-gradient of the proposed site within 300m as described in Section 7.6.14 above.

Regardless, in terms of groundwater protection measures as stated in Section 7.7.4.3 above, there will be best practice controls in place to ensure any potential sources of contamination on the site will be managed appropriately and the volumes present will be

small in the context of the scale of the project. The potential residual impacts associated with groundwater contamination and subsequent health effects are not likely.

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7.7.8 Cumulative Hydrological Effects

The other developments assessed for potential hydrological/hydrogeological cumulative impacts within ~5km of the proposed development site are listed in Chapter 3 of this EIAR. A total of 21 no. developments were assessed for potential cumulative impacts. The other developments assessed are in the following industrial sectors – windfarms (2 no.), EPA licenced facilities (2 no.), quarries/pits/extractive (15 no.) and public wastewater treatment plants (2 no.).

All the other developments are located in the same regional catchment (i.e. River Nore) as the proposed development and therefore the pathway for potential impacts exists.

The industry with the most developments in the area of the application site is quarries/pits/extractive. The potential for significant cumulative hydrological impacts with other quarries/pits is unlikely the proposed development has no proposed discharge to surface water, and therefore no downstream interactions can occur.

There is no potential for cumulative effects with public wastewater treatment plants or EPA licenced facilities, as the proposed development will not discharge organic or process wastewater.

The 2 no. proposed wind farms are the furthest removed from the proposed development site location. Construction phase activities in particular (at the wind farm sites) have the potential to generate turbid runoff, however, both developments have proposals for robust drainage control measures and therefore the potential for significant cumulative impacts is unlikely. In addition, the proposed development at Ballymullen has no proposed discharge to surface water, therefore no downstream interactions can occur.

However, most importantly, there will be no licenced surface water or groundwater discharges from the proposed development itself and therefore the potential for significant cumulative effects do not exist. The other more local land use activities in the area are plantation forestry, existing farming operations and residential land uses, and the existing manufacturing facility which is located 1.3km to the south of the site. Both the proposed pit and the manufacturing facility (1.3km away) are located in separate groundwater catchments, and therefore no cumulative impacts on hydrology/hydrogeology can occur.

Other factors which will prevent hydrological/hydrogeological cumulative effects on local surface water/groundwater bodies, Abbeyleix Bog and River Nore SAC are outlined as follows:

- There are no groundwater level effects occurring at the existing manufacturing facility/processing plant;

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- There are no surface water discharges from the existing manufacturing facility/processing plant; and
- There will be no increase in daily processing rates/quantities at the existing manufacturing facility/processing plant. Aggregate from the proposed development will replace the material that is being currently hauled in from remote pits at a greater distance away from the application site.

Also, for the reasons explained above there will be no potential to significantly alter the local hydrogeology in the area of the proposed development site. Therefore, effects on the regional hydrogeological regime and groundwater-dependent designated sites further downstream of the proposed development site such as the River Barrow and River Nore SAC will not occur. In the absence of dewatering, and given the small footprint/scale of the proposed development, the potential for generating hydrological/hydrogeological impacts at catchment scale (>2.2km from the site to the River Barrow and River Nore SAC) is imperceptible.

7.8 Assessment Summary

Our assessment is summarised as follows:

- A comprehensive hydrological and hydrogeological assessment with respect to the proposed development is presented above;
- The impact assessment is underpinned by desk study data and site-specific geological and hydrogeological data (water level and water quality data);
- The hydrological and hydrogeological assessment has been completed by competent and experienced hydrogeologists (David Broderick and Michael Gill). Also note, that Michael Gill has been working on wetland characterisation and impact assessments for 25 years. This is particularly relevant to the assessment relating to Abbeyleix Bog;
- The potential for the proposed development to impact on the Water Environment has been mitigation through design, including:
    - No extraction below the groundwater table is proposed;
    - No dewatering is proposed;
    - There is no proposed surface water discharge from the Ballymullen site. A proposed wheel wash (close to the site entrance) will discharge to ground via a full retention oil interceptor;
    - 3m of subsoil will remain in-situ above the groundwater table;
    - Processing of the excavated material will be completed at the existing permitted facility;
    - The extraction works will be phased, and each phase will be reinstated as works progress;
    - As such, the potential area of exposed ground will at all times be minimised;
    - The potential for rainfall to recharge the underlying groundwater system across the site will not be altered in any significant manner;
    - The direction of groundwater flow below the site has been recorded and is illustrated in Figure 7.9; and,

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- The proposed extraction phasing has been altered to ensure the groundwater flow towards the identified petrifying spring is not affected.

- The findings of the Water Section are unambiguous and are underpinned by a geological and hydrogeological dataset.
- Having spent my career protecting wetlands of all sorts, Michael Gill of HES would never support or defend any development that had the potential to generate a significant impact on any peatland site, designated or not.
- This development proposal simply does not have the potential to impact on the Water Environment nor Abbeyleix Bog in any significant manner.

APPENDIX 7.1: Groundwater Quality Laboratory Reports.

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Contact Name	David Broderick	**Report Number**	**161522 - 1**
Address	Hydro-Environmental Services 22 Lower Main Street, Dungarvan,	**Sample Number**	161522/001
		Date of Receipt	09/08/2019
		Date Started	09/08/2019
Tel No	058 44122	**Received or Collected**	Hand
Customer PO	P1486	**Date of Report**	28/08/2019
Quotation No	QN009167	**Sample Type**	Ground Waters
Customer Ref	Ballymullen MW2	**Condition on receipt**	Satisfactory

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
BOD									
	BOD		EW001	1.0		<1.0	mg/L	INAB	
COD-Chemical Oxygen Demand									
	COD		EW184	8		<8	mg/L	INAB	
Gallery Plus-Suite A									
	Ammonia as NH3 (Calc)		EW175	0.006		<0.006	mg/l NH3	INAB	
	Total Oxidised Nitrogen (TON) as N		EW175	0.15		4.6	mg/l N	INAB	
	Nitrate as N		EW175	0.15		4.6	mg/l N	INAB	
	Nitrate as NO3 (Calc)		EW175	0.66		21	mg/l NO3	INAB	
	Nitrite as N		EW175	0.005		<0.005	mg/l N	INAB	
	Nitrite as NO2 (Calc)		EW175	0.016		<0.016	mg/l NO2	INAB	
	Phosphate (Ortho/MRP) as µg/L P		EW175	5		<5	µg/L P		
	Chloride mg/L		EW175	1.0		15	mg/L	INAB	
	Sulphate mg/L		EW175	1.0		7.4	mg/L	INAB	
GCFID-(LVI) EPH C8 to C40 (Mineral Oil C8-C40)									
	EPH-C8 to C40 (Calc ug/l)		EO063	10		150	µg/L	INAB	
	EPH->C8 to <C40		EO063	0.01		0.15	mg/L	INAB	
	EPH >C8 - C10 (Petrol Range)		EO063	0.01		<0.01	mg/L		
	EPH >C10 - C20 (Diesel Range)		EO063	0.01		0.04	mg/L		
	EPH >C20 - <C40 (Motor Oil Range)		EO063	0.01		0.11	mg/L		
Metals-Dissolved									
	Iron-Dissolved		EW188	20		<20	ug/L	INAB	
	Manganese-Dissolved		EW188	1.0		42	ug/L	INAB	
	Cadmium-Dissolved		EW188	0.1		<0.1	ug/L	INAB	
	Chromium-Dissolved		EW188	1.0		<1.0	ug/L	INAB	
	Copper-Dissolved		EW188	0.003		<0.003	mg/L	INAB	
	Lead-Dissolved		EW188	0.3		<0.3	ug/L	INAB	
	Magnesium-Dissolved		EW188	0.3		15.4	mg/L	INAB	
	Nickel-Dissolved		EW188	0.5		1.0	ug/L	INAB	
	Zinc-Dissolved		EW188	1.0		1.1	ug/L	INAB	
	Mercury-Dissolved		EW188	0.02		<0.02	ug/L	INAB	
	Potassium-Dissolved		EW188	0.2		1.1	mg/L	INAB	
	Sodium-Dissolved		EW188	0.5		16.0	mg/L	INAB	
Suspended Solids									

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Web: www.elsltd.com
email:info@elsltd.com

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Contact Name	David Broderick	**Report Number**	**161522 - 1**
Address	Hydro-Environmental Services 22 Lower Main Street, Dungarvan,	**Sample Number**	161522/001
		Date of Receipt	09/08/2019
		Date Started	09/08/2019
Tel No	058 44122	**Received or Collected**	Hand
Customer PO	P1486	**Date of Report**	28/08/2019
Quotation No	QN009167	**Sample Type**	Ground Waters
Customer Ref	Ballymullen MW2	**Condition on receipt**	Satisfactory

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
Suspended Solids									
	Suspended Solids		EW013	5		121	mg/L	INAB	
Total Dissolved Solids (TDS)									
	Total Dissolved Solids (TDS)		EW046	15		392	mg/L	INAB	
Total Kjeldahl Nitrogen-TKN (CalcGallery)									
	Total Kjeldahl Nitrogen-TKN (CalcGallery)		EW010	1.0		<1.0	mg/l N		
Total Nitrogen									
	Total Nitrogen		EW140	1.0		5.1	mg/L	INAB	

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Cork
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Contact Name	David Broderick	**Report Number**	**161522 - 1**
Address	Hydro-Environmental Services 22 Lower Main Street, Dungarvan,	**Sample Number**	161522/002
		Date of Receipt	09/08/2019
		Date Started	09/08/2019
Tel No	058 44122	**Received or Collected**	Hand
Customer PO	P1486	**Date of Report**	28/08/2019
Quotation No	QN009167	**Sample Type**	Ground Waters
Customer Ref	Ballymullen MW4	**Condition on receipt**	Satisfactory

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
BOD									
	BOD		EW001	1.0		<1.0	mg/L	INAB	
COD-Chemical Oxygen Demand									
	COD		EW184	8		9	mg/L	INAB	
Gallery Plus-Suite A									
	Ammonia as NH3 (Calc)		EW175	0.006		<0.006	mg/l NH3	INAB	
	Total Oxidised Nitrogen (TON) as N		EW175	0.15		<0.15	mg/l N	INAB	
	Nitrate as N		EW175	0.15		0.15	mg/l N	INAB	
	Nitrate as NO3 (Calc)		EW175	0.66		0.67	mg/l NO3	INAB	
	Nitrite as N		EW175	0.005		<0.005	mg/l N	INAB	
	Nitrite as NO2 (Calc)		EW175	0.016		<0.016	mg/l NO2	INAB	
	Phosphate (Ortho/MRP) as µg/L P		EW175	5		<5	µg/L P		
	Chloride mg/L		EW175	1.0		15	mg/L	INAB	
	Sulphate mg/L		EW175	1.0		17	mg/L	INAB	
GCFID-(LVI) EPH C8 to C40 (Mineral Oil C8-C40)									
	EPH-C8 to C40 (Calc ug/l)		EO063	10		277	µg/L	INAB	
	EPH->C8 to <C40		EO063	0.01		0.28	mg/L	INAB	
	EPH >C8 - C10 (Petrol Range)		EO063	0.01		<0.01	mg/L		
	EPH >C10 - C20 (Diesel Range)		EO063	0.01		0.10	mg/L		
	EPH >C20 - <C40 (Motor Oil Range)		EO063	0.01		0.18	mg/L		
Metals-Dissolved									
	Iron-Dissolved		EW188	20		2400	ug/L		
	Manganese-Dissolved		EW188	1.0		350	ug/L		
	Cadmium-Dissolved		EW188	0.1		<0.1	ug/L	INAB	
	Chromium-Dissolved		EW188	1.0		<1.0	ug/L	INAB	
	Copper-Dissolved		EW188	0.003		<0.003	mg/L	INAB	
	Lead-Dissolved		EW188	0.3		<0.3	ug/L	INAB	
	Magnesium-Dissolved		EW188	0.3		17.9	mg/L	INAB	
	Nickel-Dissolved		EW188	0.5		2.2	ug/L	INAB	
	Zinc-Dissolved		EW188	1.0		15	ug/L	INAB	
	Mercury-Dissolved		EW188	0.02		<0.02	ug/L	INAB	
	Potassium-Dissolved		EW188	0.2		1.0	mg/L	INAB	
	Sodium-Dissolved		EW188	0.5		9.0	mg/L	INAB	
Suspended Solids									
	Suspended Solids		EW013	5		290	mg/L	INAB	

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Address	Hydro-Environmental Services 22 Lower Main Street, Dungarvan,	**Sample Number**	161522/002
		Date of Receipt	09/08/2019
		Date Started	09/08/2019
Tel No	058 44122	**Received or Collected**	Hand
Customer PO	P1486	**Date of Report**	28/08/2019
Quotation No	QN009167	**Sample Type**	Ground Waters
Customer Ref	Ballymullen MW4	**Condition on receipt**	Satisfactory

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
Total Dissolved Solids (TDS)									
	Total Dissolved Solids (TDS)		EW046	15		392	mg/L	INAB	
Total Kjeldahl Nitrogen-TKN (CalcGallery)									
	Total Kjeldahl Nitrogen-TKN (CalcGallery)		EW010	1.0		1.3	mg/l N		
Total Nitrogen									
	Total Nitrogen		EW140	1.0		1.4	mg/L	INAB	

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Contact Name	David Broderick	**Report Number**	**161522 - 1**
Address	Hydro-Environmental Services 22 Lower Main Street, Dungarvan,	**Sample Number**	161522/003
		Date of Receipt	09/08/2019
		Date Started	09/08/2019
Tel No	058 44122	**Received or Collected**	Hand
Customer PO	P1486	**Date of Report**	28/08/2019
Quotation No	QN009167	**Sample Type**	Ground Waters
Customer Ref	Ballymullen MW5	**Condition on receipt**	Satisfactory

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
BOD									
	BOD		EW001	1.0		<1.0	mg/L	INAB	
COD-Chemical Oxygen Demand									
	COD		EW184	8		<8	mg/L	INAB	
Gallery Plus-Suite A									
	Ammonia as NH3 (Calc)		EW175	0.006		<0.006	mg/l NH3	INAB	
	Total Oxidised Nitrogen (TON) as N		EW175	0.15		4.8	mg/l N	INAB	
	Nitrate as N		EW175	0.15		4.8	mg/l N	INAB	
	Nitrate as NO3 (Calc)		EW175	0.66		21	mg/l NO3	INAB	
	Nitrite as N		EW175	0.005		<0.005	mg/l N	INAB	
	Nitrite as NO2 (Calc)		EW175	0.016		<0.016	mg/l NO2	INAB	
	Phosphate (Ortho/MRP) as µg/L P		EW175	5		<5	µg/L P		
	Chloride mg/L		EW175	1.0		15	mg/L	INAB	
	Sulphate mg/L		EW175	1.0		10	mg/L	INAB	
GCFID-(LVI) EPH C8 to C40 (Mineral Oil C8-C40)									
	EPH-C8 to C40 (Calc ug/l)		EO063	10		109	µg/L	INAB	
	EPH->C8 to <C40		EO063	0.01		0.11	mg/L	INAB	
	EPH >C8 - C10 (Petrol Range)		EO063	0.01		<0.01	mg/L		
	EPH >C10 - C20 (Diesel Range)		EO063	0.01		0.03	mg/L		
	EPH >C20 - <C40 (Motor Oil Range)		EO063	0.01		0.08	mg/L		
Metals-Dissolved									
	Iron-Dissolved		EW188	20		<20	ug/L	INAB	
	Manganese-Dissolved		EW188	1.0		13	ug/L	INAB	
	Cadmium-Dissolved		EW188	0.1		<0.1	ug/L	INAB	
	Chromium-Dissolved		EW188	1.0		<1.0	ug/L	INAB	
	Copper-Dissolved		EW188	0.003		<0.003	mg/L	INAB	
	Lead-Dissolved		EW188	0.3		<0.3	ug/L	INAB	
	Magnesium-Dissolved		EW188	0.3		13.7	mg/L	INAB	
	Nickel-Dissolved		EW188	0.5		<0.5	ug/L	INAB	
	Zinc-Dissolved		EW188	1.0		6.8	ug/L	INAB	
	Mercury-Dissolved		EW188	0.02		<0.02	ug/L	INAB	
	Potassium-Dissolved		EW188	0.2		1.1	mg/L	INAB	
	Sodium-Dissolved		EW188	0.5		10.1	mg/L	INAB	
Suspended Solids									
	Suspended Solids		EW013	5		35	mg/L	INAB	

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		Date of Receipt	09/08/2019
		Date Started	09/08/2019
Tel No	058 44122	**Received or Collected**	Hand
Customer PO	P1486	**Date of Report**	28/08/2019
Quotation No	QN009167	**Sample Type**	Ground Waters
Customer Ref	Ballymullen MW5	**Condition on receipt**	Satisfactory

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
Total Dissolved Solids (TDS)									
	Total Dissolved Solids (TDS)		EW046	15		409	mg/L	INAB	
Total Kjeldahl Nitrogen-TKN (CalcGallery)									
	Total Kjeldahl Nitrogen-TKN (CalcGallery)		EW010	1.0		1.1	mg/l N		
Total Nitrogen									
	Total Nitrogen		EW140	1.0		5.9	mg/L	INAB	

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APPENDIX 7.2: Groundwater Monitoring Parameters.

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Groundwater Laboratory Analysis Suite

Parameters	**Units**
Alkalinity Total	mg/l $CaCO_3$
Alkalinity Total	mg/l HCO_3
Sulphate	mg/l SO_4
Chloride	mg/l Cl
Nitrate	mg/l NO_3N
Orthophosphate	mg/l P
Ammonia N	mg/l NH_3-N
Total Calcium	mg/l
Magnesium	mg/l
Sodium	mg/l
Potassium	mg/l
Iron	mg/l
Manganese	mg/l

APPENDIX 7.3: Ballymullen Proposed Hydrological Monitoring Plan.

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HYDRO ENVIRONMENTAL SERVICES

22 Lower Main St
Dungarvan
Co.Waterford
Ireland

tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

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PROPOSED HYDROLOGICAL MONITORING PLAN FOR ABBEYLEIX BOG

Prepared for:
Booth Precast Products Ltd

Prepared by:
Hydro-Environmental Services

DOCUMENT INFORMATION

RECEIVED: 21/09/2023

Document Title:	**PROPOSED HYDROLOGICAL MONITORING PLAN FOR ABBEYLEIX BOG**
Issue Date:	**05th September 2022**
Project Number:	**P1486-2**
Project Reporting History:	**None**
Current Revision No:	**P1486-2_Rev F1**
Author(s):	**MICHAEL GILL** **DAVID BRODERICK**
Signed:	 **Michael Gill B.A., B.A.I., M.Sc., MIEI** **Managing Director – Hydro-Environmental Services**

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FIGURES IN TEXT

1. INTRODUCTION

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1.1 BACKGROUND

Hydro-Environmental Services (HES) were requested by Booth Precast Products Ltd to prepare a Hydrological Monitoring Plan for Abbeyleix Bog with regard to the proposed development of a sand and gravel pit at Ballymullen, Abbeyleix, Co. Laois.

The monitoring plan defines hydrological monitoring proposals within Abbeyleix Bog and at the proposed development site during the planning application stage along with post-consent stages if the planning application is successful.

The proposed development site is shown in **Figure A.** Abbeyleix Bog is located immediately to the west/southwest of the proposed development site.

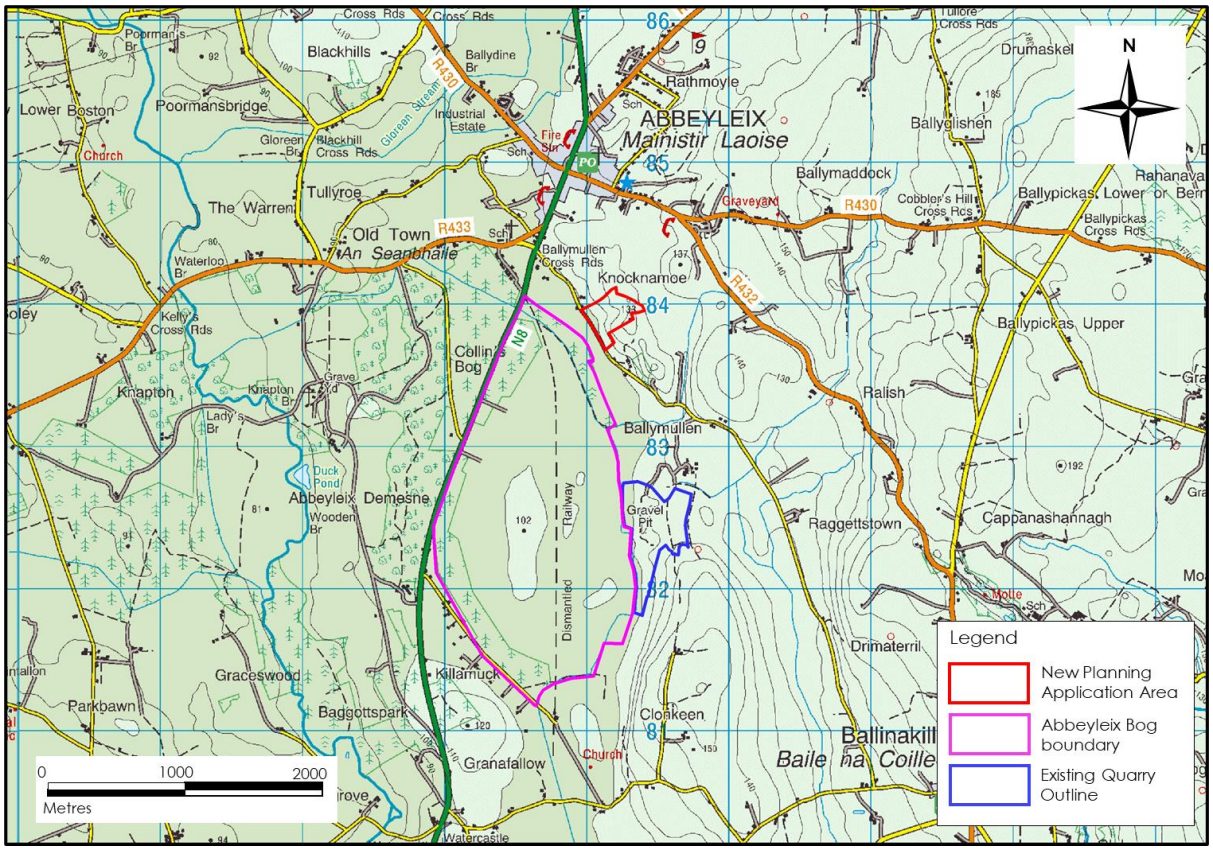

Figure A: Site Location Map

1.2 STATEMENT OF EXPERIENCE

Hydro-Environmental Services ("HES") are a specialist hydrological, hydrogeological and environmental practice which delivers a range of water and environmental management consultancy services to the private and public sectors across Ireland and Northern Ireland. HES was established in 2005, and our office is located in Dungarvan, County Waterford.

Our core area of expertise and experience is in hydrology and hydrogeology. We routinely work on surface and groundwater monitoring and prepare monitoring plans.

Michael Gill is an Environmental Engineer with 18 years of environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological assessments for various developments across Ireland. Michael has worked on bog hydrology

projects since 1996 and has extensive experience in terms of characterisation and hydrological management of raised bogs.

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David Broderick is a Hydrogeologist with 13 years of environmental consultancy experience in Ireland. David has completed numerous hydrological and hydrogeological assessments for various developments across Ireland. David has significant experience in extraction pit and quarry development, and also has completed many hydrological assessments of bogs and sensitive wetlands.

1.3 PROPOSED DEVELOPMENT

The proposed development is a new sand and gravel pit within a greenfield site at Ballymullen, Abbeyleix, Co. Laois. The development proposes to extract 762,3101m^3/1.52 million tonnes of sand and gravel aggregate from an area of approximately 8.0 Ha. The proposed application area is shown in **Figure A**.

The applicant proposes to extract the sand and gravel material and transport the material to the applicants existing manufacturing facility located approximately 1.3km to the south of the application site. There will be no processing of the extracted material on site (i.e., there will be no separation of fines from the sand and gravel excavated at the site and therefore there will be no requirement for management of spoil waste/residual material at the site). The only proposed infrastructure at the site is a new site entrance, wheel wash, and full retention oil interceptor.

All aggregate extraction will be undertaken above the local groundwater level. There are no proposed surface water discharges. The proposed wheel wash will discharge to the ground via a full retention oil interceptor.

1.4 KEY ISSUES REGARDING HYDROGEOLOGY

Abbeyleix Bog is located to the west/southwest and immediately down-gradient of the proposed development site. The proposed development site is located within the groundwater and surface water catchment of petrifying springs and bog woodland which are water dependent habitats located at the edge of Abbeyleix Bog. Therefore, activities at the proposed application site have the potential to create indirect hydrogeological effects (groundwater quantity and quality) at those locations.

The main concern raised by Paul Johnston (Trinity College Dublin) in his previous planning submission mainly relates to impacts on groundwater flow volumes to the petrifying springs and wet woodland by way of altering recharge (i.e., reducing rainfall recharge) at the proposed development site due to extraction works.

A number of mitigation measures are proposed to ensure that there will be no alteration of the groundwater recharge regime at the proposed development site:

- The extraction works will be dry workings (i.e., above the water table), and there will be no washing or processing of the material at the Ballymullen site;
- All material processing and washing will be completed at the existing facility;
- Removal of vegetation/extraction and restoration of the site in 8 phases and not all at once. The Phasing has been altered to remove extraction from the area directly east of the petrifying spring area;
- Installation of temporary perimeter swales/drains to ensure all rainfall is collected and percolated to the ground;
- Ploughing of the pit ground level at the end of each phase prior to reinstating topsoil to ensure good drainage percolation is maintained; and,

- Maintaining a greenfield/grassland corridor on the lower lying western side of the site which acts as a natural drainage (recharge) buffer between the proposed extraction area and Abbeyleix Bog.

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2. SITE SETTING AND BASELINE CONDITIONS

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2.1 INTRODUCTION

This section provides summary details on the existing environment and the hydrological/hydrogeological characteristics in the area of the proposed development site and Abbeyleix Bog.

2.2 PROPOSED DEVELOPMENT SITE

The proposed development site (i.e., sand and gravel pit) is directly underlain by a Locally Important Sand and Gravel Aquifer. The glaciofluvial deposits in the area of the site comprise mainly of SAND with some interbedded SAND & GRAVEL and GRAVEL layers. GRAVELS with boulders and cobbles were becoming more abundant at the base of the investigation holes on the central and western sides of the site.

Underneath the sand and gravel aquifer, a regionally karstified limestone aquifer is mapped (the investigation drilling indicates limestone is present below the site depths ranging between 30.6mbgl (central area) and 37.2mbgl (eastern area). The depth to bedrock on the western area of the site is likely to be between 15 – 20mbgl.

Based on surveys and groundwater level monitoring undertaken at the site to date, the groundwater level in the area of the proposed development varies spatially between 1.027m (94.04m OD) and 29.961m (99.398m OD) with temporal variations of <0.3m over the monitoring period.

Based on groundwater level measurements, the groundwater flow direction in the area of the site is westerly towards Abbeyleix Bog with discharge likely to the Ballymullen Stream as groundwater baseflow or petrifying spring discharge.

2.3 ABBEYLEIX BOG

Abbeyleix Bog is a prospective pNHA (i.e., it's neither a SAC/NHA). The bog is heavily modified by manmade drainage. However, the manmade drainage is there for a long time and now forms part of the hydrological baseline. The bog is mentioned in the 2017 – 2023 Laois County Development Plan but is not mentioned in the new 2021 – 2027 CDP. The bog is also mentioned in the National Peatland Strategy (NPWS, 2015), but it is only mentioned in the context of a Bord na Mona owned site where some bog restoration works have been undertaken.

Ecological mapping and hydrological studies of the bog confirm the presence of wet woodland and petrifying springs which are both Annex I Priority Habitats.

A number of hydrological /hydrological investigations have been undertaken on Abbeyleix Bog and the most extensive of these is a PhD Thesis by Michael Swenson of Trinity College (2017). See the map of the existing hydrological monitoring network on Abbeyleix Bog below in **Figure B**.

The PhD investigated the regional scale hydrology and hydrogeology at Abbeyleix Bog to characterize the catchment scale hydrology and water balance. The underlying hydrogeology was found to have relatively little impact on the surface eco-hydrology, and this was due to the raised nature of the bog and the fact that the bog is underlain by shell marl, particularly the north-eastern section of the bog (section adjacent to the proposed development site). Thus, the surface eco-hydrology was more strongly controlled by local topography.

The investigations (by Swanson, 2007) determined a shallow marl lake was likely present at the north-eastern section of the bog as there are still calcified springs (petrifying springs) and seepages along the north-eastern edge of Abbeyleix Bog adjacent to sand-gravel esker complex on which the proposed development site is located. These springs and seepages are fed by a groundwater head and elevation gradient from the esker complex (i.e., sand and gravel at the site) down to the bog which is ultimately driven by rainfall recharge. The proposed application site is potentially located in the recharge area of these springs (The alteration of the proposed extraction phasing has limited this potential overlap as explained in Section 7.6.9 of the EIAR).

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HES visited Abbeyleix Bog on 11th March 2021 and confirmed that the spring discharge is mineralised (i.e., pH 7.6 – 8 and EC 500 – 600µS/cm). The discharge volume from the spring is also relatively small (<1L/s). We were accompanied during the site visit by Mr Chris Uys of the Abbeyleix Bog Project.

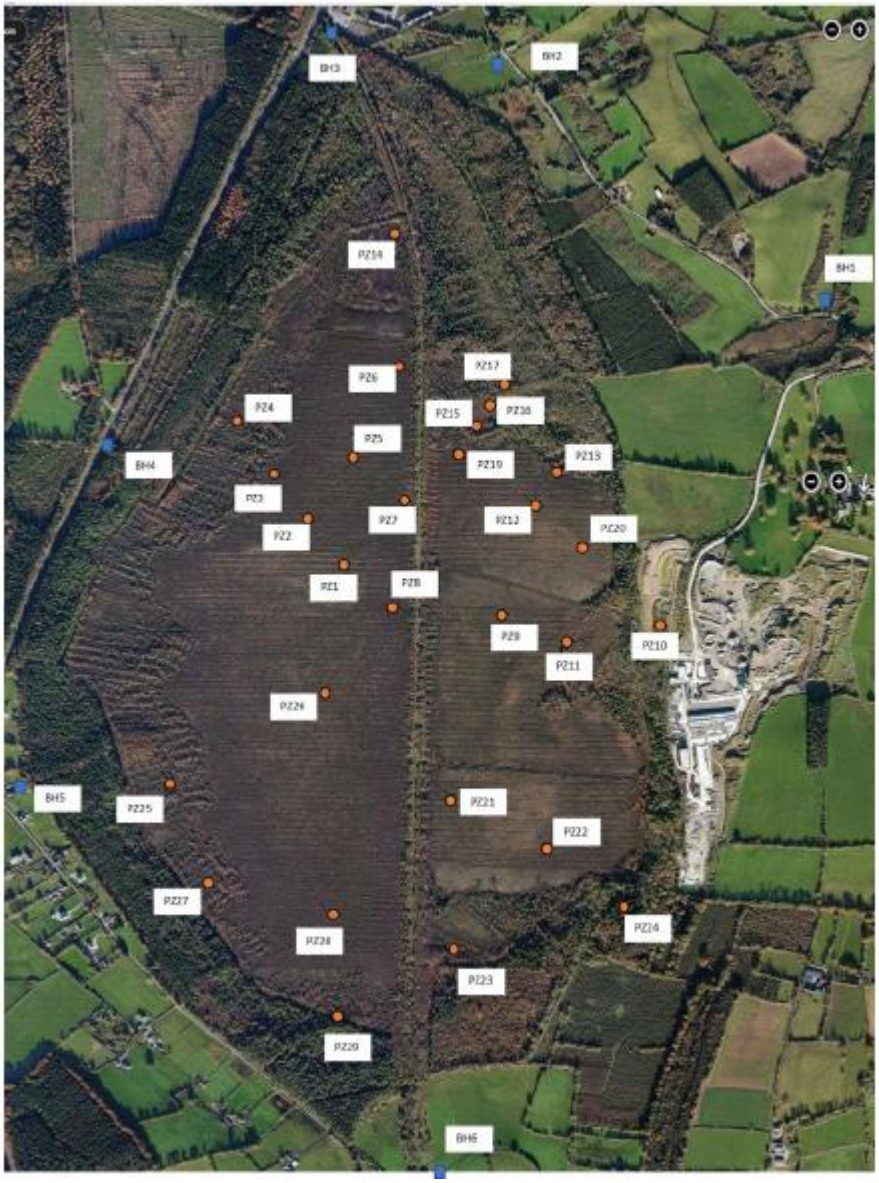

Figure B: Existing Borehole and Piezometer Monitoring Network at Abbeyleix Bog (after Swenson, 2017)[1]

[1] *Greenhouse Gas Emissions and Eco-hydrology of a Raised and Cutover Bog (PhD by Swenson M, 2017)*

3 no. piezometer couples/sets (3 deep sub peat piezometers, and 2 no. shallow standpipes) were installed along the northeastern boundary of Abbeyleix Bog in July 2022 between the proposed site and the petrifying spring. The area where the 3 no. piezometers sets are located is classified ecologically as wet grassland.

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Refer to Figure C below for the bog piezometer locations. The piezometer logs are attached as Appendix 6-2 (Land, Soils and Geology Chapter).

The 3 no. deep sub peat piezometers (P1, P2 and P3) were installed into wet SAND which was found to underlie the PEAT at the 3 no. piezometers locations. The 2 no. shallow standpipes (PH1 and PH3) were installed to the base of the peat only. No PH2 piezometer was installed due to the shallow depth, and dry nature, of peat at the P2 location (0.52m).

These piezometers can be used in the proposed hydrological monitoring plan.

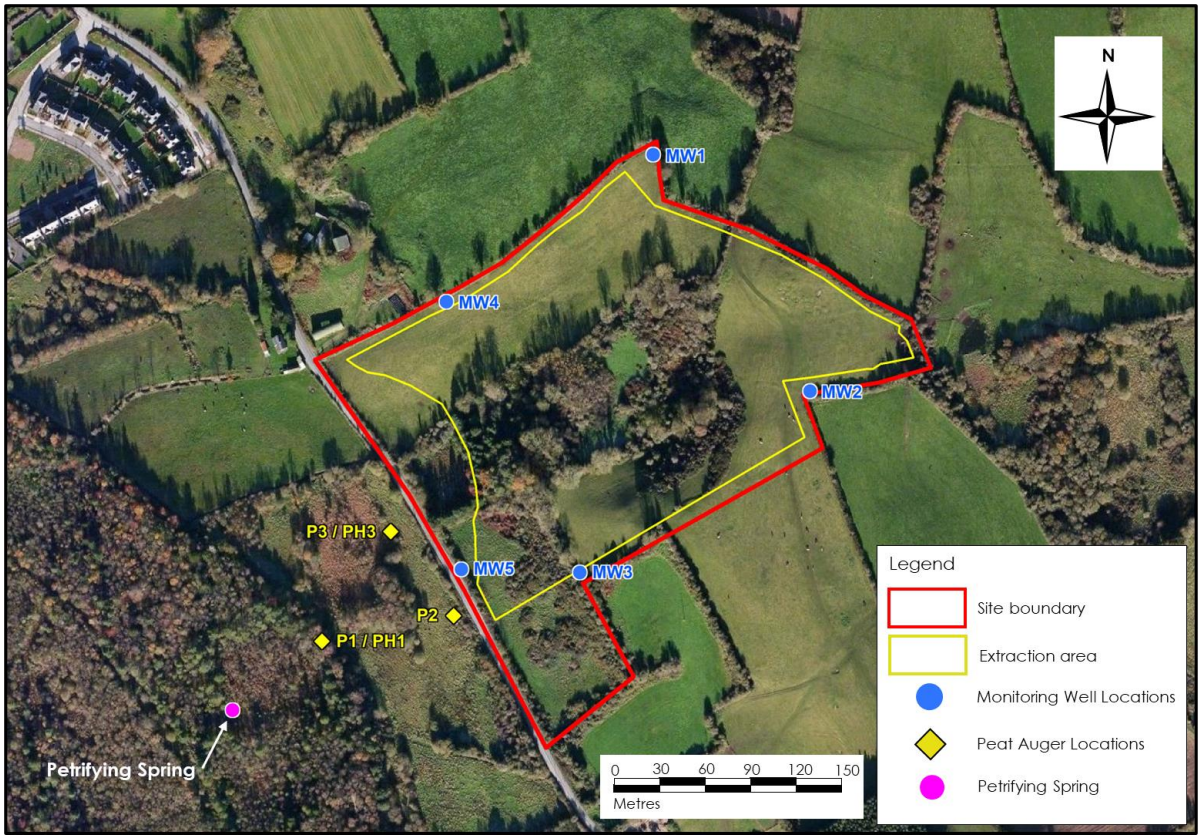

Figure C: Abbeyleix Bog Piezometer Sets & Site Monitoring Well Locations

3. PROPOSED HYDROLOGICAL MONITORING PLAN

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3.1 INTRODUCTION

This section sets out the hydrological related monitoring plan and timeframes to be completed at Abbeyleix Bog in respect of the proposed development over a period of 5 years.

3.2 PROPOSED MONITORING LOCATIONS

Groundwater monitoring at the proposed development site will be carried out at 5 no. existing monitoring wells (MW1 – MW5) which were drilled at the site in July/August 2019. Refer to **Figure D** below for these monitoring well locations.

As outlined above, 3 no. sets of piezometers have been installed within the lag zone at Abbeyleix Bog.

It is also proposed to monitor water levels in two of the existing boreholes on the bog network. These are BH2 and BH3, and these locations are also shown in **Figure D**.

3.3 MONITORING DURATION, FREQUENCY AND PARAMETERS

The monitoring plan will have a duration of 5 years. This will include the monitoring completed during the RFI stage of the current planning application and a minimum of 1-year pre-commencement (subject to planning approval) and 4 years post-planning consent. Monitoring will continue through the planning process. The proposed monitoring plan is summarised in **Table A** below.

Table A: Summary of Proposed Hydrological Monitoring Plan

Location	Automated	Monthly	Quarterly	Annual
Development Site Monitoring Wells (5 no.) & Bog Piezometers Sets (3 no.), and BH2 and BH3 from the existing bog monitoring network.	Data loggers installed in MW1 – MW5	Manual Water level Measurement (mbtoc)(1)	-	-
Bog Piezometer Set 3 no. (at petrifying Spring)	-	Estimation of discharge/flow (L/s) & Manual Water level Measurement	-	-
MW5, and Bog Piezometers Sets (3 no.)	-	-	Field Hydrochemistry (pH, Electrical Conductivity & Temperature)(2)	-
MW5, and Bog Piezometers Sets (3 no.)	-	-	-	Laboratory Hydrochemistry Analysis (refer to **Appendix I** of the plan for the suite of parameters) (2)

1) mbtoc – metres below the top of the piezometer casing
2) Note that during the pre-commencement phase monitoring period, 2 no. rounds of Field Hydrochemistry, and 1 no. round of Laboratory Hydrochemistry Analysis will be completed.

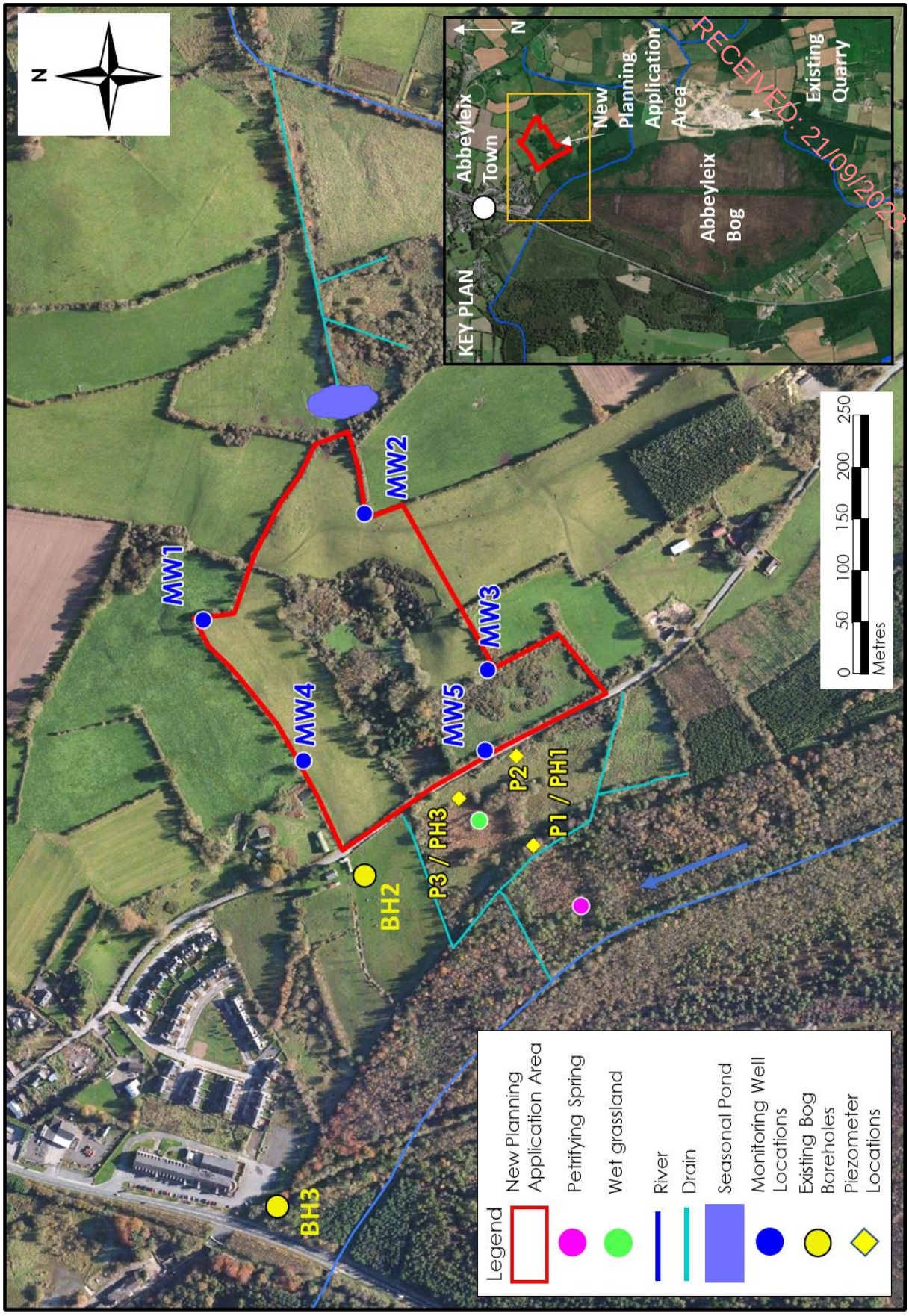

Figure D: Proposed Hydrological Monitoring Locations

3.4 REPORTING

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All currently available monitoring data is included in the EIAR for the proposed development.

Subject to planning approval future monitoring reports will be completed by HES on an annual basis, with a trend analysis undertaken on a quarterly basis. The annual report will include the presentation of water level hydrographs for the piezometers and a discussion/analysis of the hydrochemistry data. The trend analysis will determine if there is any significant quarterly variation in water levels that requires action/investigation in advance of the annual report.

Annual monitoring reports will be shared with all Stakeholders as defined by Abbeyleix Bog Committee.

4. MONITORING PLAN SUMMARY

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A proposed hydrological monitoring plan has been proposed for a 5-year period. The plan includes:

- Monitoring groundwater levels and hydrochemistry at appropriate monitoring locations at the proposed sand and gravel pit and Abbeyleix bog;
- The piezometer sets (3 no.) are located in the lagg zone of the bog between the proposed development site and the petrifying spring area and within the wet grassland area. Discharge/flow measurements will be undertaken at the spring location (if possible and subject to agreement on the method with the Abbeyleix Bog Committee); and,
- The monitoring plan will have a duration of 5 years. This will include the RFI monitoring period and a minimum of 1-year pre-commencement (subject to planning approval) and 4 years post-planning consent. Monitoring will continue through the planning process. Trend analysis will be completed on a quarterly basis, and annual monitoring reports will be shared with with all Stakeholders as defined by Abbeyleix Bog Committee.

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Appendix I
Groundwater Laboratory Analysis Suite

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Groundwater Laboratory Analysis Suite

Parameters	Units
Alkalinity Total	mg/l $CaCO_3$
Alkalinity Total	mg/l HCO_3
Sulphate	mg/l SO_4
Chloride	mg/l Cl
Nitrate	mg/l NO_3N
Orthophosphate	mg/l P
Ammonia N	mg/l NH_3-N
Total Calcium	mg/l
Magnesium	mg/l
Sodium	mg/l
Potassium	mg/l
Iron	mg/l
Manganese	mg/l

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8.0 CLIMATE

8.1 Introduction

This section of the EIAR assesses the development in terms of climate and climate change and assesses potential impacts that the development may have with regards to climate. Climate can be thought of as the 'average weather' over an extended period of time and so refers to temperature, precipitation and wind.

The topic of 'Climate' is more often discussed with reference to 'Climate Change' which is any significant change in the measures of climate lasting for an extended period of time. In other words, climate change includes major changes in temperature, precipitation, or wind patterns, among others, that occur over several decades or longer.

8.2 Methodology

The methodology for the description of the current climate in the region of the proposed development included a desk study review of the data available from Met Éireann, EPA and other bodies which have responsibility for the Climate of Ireland. Met Éireann Data for the Kilkenny Station was used to assess the climate in the region of the application site.

8.3 Climate Change

Climate change is a significant change in the average weather or climate that a region experiences. Climate change can be caused by natural factors such as variations in solar intensity or volcanic eruptions. The term climate change is now generally used to refer to changes in our climate due to the build-up of Greenhouse Gases (GHGs) in the atmosphere. This build-up of GHGs is caused by excess emissions due to certain human activities, like burning fossil fuels for energy, transport and heating.

8.3.1 Kyoto Protocol

The Kyoto Protocol was adopted in Kyoto, Japan on the 11th December, 1997, but not enacted or enforced until the 16th February, 2005. The protocol was adopted to help combat the adverse effects of climate change, or global warming.

Recognizing that developed countries were principally responsible for the current high levels of GHG emissions in the atmosphere as a result of more than 150 years of industrial activity, the Protocol placed a heavier burden on developed nations under the principle of "common but differentiated responsibilities."

Under the Kyoto Protocol, Ireland was required to limit total national greenhouse gas emissions to 314.2 Mtonnes of CO2eq over the five year period 2008 – 2012 which is equivalent to 62.8 Mtonnes of CO2eq per annum. The Kyoto Protocol limit was calculated

as being 13% above Ireland's 1990 baseline value which was established and fixed at 55.61 Mtonnes of CO2eq following an in-depth review of Ireland's 2006 greenhouse gas inventory submission to the UNFCCC (United Nations Framework Convention on Climate Change).

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8.3.2 Paris Agreement 2015

A legally binding, global agreement on climate change was agreed in Paris on 12th December 2015. It is a legally binding, global agreement on climate change which aims to strengthen the ability of countries to deal with the impacts of climate change. It sets out a long-term goal to limit global warming to below 2°C above pre-industrial levels, and to pursue efforts to limit the temperature increase to 1.5°C. The Agreement requires each Party to prepare and communicate a Nationally Determined Contribution (NDC) that it intends to achieve. NDCs are submitted every five years to the United Nations Framework Convention on Climate Change (UNFCCC). Ireland will contribute to the Agreement through the NDC tabled by the EU on behalf of Member States in 2016, which commits to a 40% reduction in EU-wide emissions by 2030 compared to 1990. All Parties are required to submit new or updated NDCs in 2020.

8.3.3 EU Emissions Trading System (EU ETS)

The EU emissions trading system (EU ETS) is the world's first major carbon market and remains the biggest one. The system was first introduced in 2005 and has undergone several changes since then. The implementation of the system has been divided up into distinct trading periods over time, known as phases which are detailed below.

- Phase 1 (2005-2007)
- Phase 2 (2008-2012)
- Phase 3 (2013-2020)
- Phase 4 (2021-2030)

The EU ETS:

- operates in all EU countries plus Iceland, Liechtenstein and Norway.
- limits emissions from more than 11,000 heavy energy-using installations (power stations & industrial plants) and airlines operating between these countries.
- covers around 40% of the EU's greenhouse gas emissions.

The EU ETS works on a 'cap and trade' basis, so there is a 'cap' or limit set on the total greenhouse gas emissions allowed by all participants covered by the system and this cap is converted into tradable emission allowances.

Within the cap, participants receive or buy emission allowances, which they can trade with one another as needed. They can also buy limited amounts of international credits from emission-saving projects around the world. The limit on the total number of allowances available ensures that they have a value.

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The system covers the following sectors and gases, focusing on emissions that can be measured, reported and verified with a high level of accuracy:

- Carbon dioxide (CO2) from
  - Power and heat generation
  - Energy-intensive industry sectors including oil refineries, steel works and production of iron, aluminium, metals, cement, lime, glass, ceramics, pulp, paper, cardboard, acids and bulk organic chemicals
  - Commercial aviation
- Nitrous oxide (N2O) from production of nitric, adipic and glyoxylic acids and glyoxal
- Perfluorocarbons (PFCs) from aluminium production

8.3.4 Effort Sharing Legislation

The Effort Sharing legislation establishes binding annual greenhouse gas emission targets for Member States for the periods 2013–2020 and 2021–2030. These targets concern emissions from most sectors not included in the EU Emissions Trading System (EU ETS), such as transport, buildings, agriculture and waste.

The Effort Sharing legislation forms part of a set of policies and measures on climate change and energy that will help move Europe towards a low-carbon economy and increase its energy security. Under the current Regulation, the national targets will collectively deliver a reduction of around 10% in total EU emissions from the sectors covered by 2020 and of 30% by 2030, compared with 2005 levels.

8.3.4.1 Effort Sharing Regulation – 30% Emission reductions by 2030

The Regulation on binding annual emission reductions by Member States from 2021 to 2030 (Effort Sharing Regulation) adopted in 2018 is part of the Energy Union strategy and the EU's implementation of the Paris Agreement. It sets national emission reduction targets for 2030 for all Member States, ranging from 0% to -40% from 2005 levels.

National Action Needed

In contrast to sectors in the EU ETS, which are regulated at EU level, Member States are responsible for national policies and measures to limit emissions from the sectors covered by Effort Sharing Legislation. Examples of potential policies and measures include:

- reducing transport needs.
- promoting public transport.
- a shift away from transport based on fossil fuels.
- support schemes for retrofitting buildings.
- more efficient heating and cooling systems.
- renewable energy for heating and cooling.
- more climate-friendly farming practices.
- conversion of livestock manure to biogas.

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EU-wide Measures Will Help

Measures taken at EU level will help Member States to reduce emissions. For example:

- CO2 emission standards for new cars and vans will cut emissions from road transport.
- Emission reductions from buildings will be aided by measures to improve the energy performance of buildings, eco-design requirements for energy-related products, and energy labelling systems to inform consumers.
- Restrictions on fluorinated industrial gases (F-gases) and implementation of other EU environmental policies, e.g. on soil protection and waste, will also contribute to reaching the national targets.

Gases and Sources

The Effort Sharing Decision covers the six greenhouse gases controlled by the Kyoto Protocol during its first commitment period (2008-2012):

- carbon dioxide (CO2)
- methane (CH4)
- nitrous oxide (N2O)
- hydrofluorocarbons (HFCs)
- perfluorocarbons (PFCs)
- sulphur hexafluoride (SF6).

The Effort Sharing Regulation adds to those nitrogen trifluorides (NF3), which is a very small source in the EU. The targets apply to domestic greenhouse gas emissions from IPCC source categories of energy, industrial processes and product use, agriculture and waste.

They do not apply to emissions covered by the EU ETS and emissions and removals from land use, emission and removals from land use change and forestry (LULUCF), which are covered by the Kyoto Protocol and from 2021 by the LULUCF Regulation.

8.3.5 The *Climate Action Plan 2019*

The *Climate Action Plan 2019* is Ireland's all of Government Plan to tackle climate break down and achieve net zero greenhouse gas emissions by 2050. Ireland will support the ambition emerging within the European Union to achieve a net zero target by 2050, the plan commits to evaluate in detail the changes required to adopt such a goal in Ireland. It includes a pathway to 2030 which would be consistent with a net zero target by 2050.

By 2030:

- 70% of all electricity generated to be from renewable sources
- 950,000 electric vehicles on the road
- 500,000 existing homes to be upgraded to B2 Building Energy rating (BER)
- All plastic packaging should be reusable or recyclable
- 50% reduction in food waste

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- Specific single-use plastic convenience items banned including polystyrene food and drinks 1,200 low-emissions buses in cities for public transport
- Homeowners to generate their own electricity and sell back to the grid under scheme for micro-generation
- 600,000 heat pumps installed (400,000 in existing buildings)
- Carbon proofing all Government decisions and major investments
- CO2 emissions from the public sector to be reduced by 30%
- 8,000 ha of newly planted forest per year.

In July 2022 the Irish Government signed off on precise sectoral ceilings with a view to halving our greenhouse gas emissions by 2030. The Sectoral Emissions Ceilings for 2030 have been set for the electricity, transport, buildings and industry sectors. The targets for reductions in each area are as follows:

Electricity: 75%
Transport: 50%
Buildings (Commercial and Public) 45%
Buildings (Residential) 40%
Industry: 35%
Agriculture: 25%
Other (gases, petroleum refining and waste): 50%

In addition, the agreement commits additional resources for solar (more than doubling the target to 5,500 MW), off-shore wind (moving from a target of 5,000 MW to 7,000 MW), green hydrogen (an additional 2,000 MW), agro-forestry and anaerobic digestion (up to 5.7 TWh of biomethane).

8.3.6 Ireland's Projected Emissions 2021-2030

The EPA published information in June2022with regards Ireland's latest projections for the period of 2021 – 2030. The projections show total emissions (without LULUCF) decreasing from the Inventory (2020) levels by 11% by 2030 under the With Existing Measures (WEM) scenario and by 28% under the With Additional Measures (WAM) scenario.

The gap between both scenarios is largely attributed to significant reductions in key sectors such as power generation, residential, transport, commercial and public services and agriculture as a result of the Climate Action Plan. Three key sectors; agriculture, transport and energy industries consistently have the largest share of emissions. Under the WEM scenario, emissions from agriculture and transport are projected to increase by 1.8% and 0.6% respectively over the period 2020 to 2030. Emissions from energy industries are projected to decrease by 38% over the same period. When we look at the more ambitious WAM scenario, emissions from agriculture, transport and energy reduce by 20%, 28% and 49% respectively.

Full and early implementation of the Climate Action Plan is needed if the savings projected in the With Additional Measures are to materialise. The scale and pace of the changes

needed are significant, requiring much greater reliance on renewables, cross-cutting measures such as an €100 per tonne of CO_2 carbon tax by 2030 and further ambitious measures in sectors such as transport, agriculture and power generation.

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8.3.7 Local & Regional Climate

The Irish climate is subject to strong maritime influences, the effects decreasing with increasing distance from the Atlantic coast. The climate in the area of the site is typical of the Irish climate, which is temperate maritime. Over the summer months the influence of anti-cyclonic weather conditions on the western and north-western region results in dry continental air interspersed by the passage of Atlantic frontal systems. During much of the winter period the climate is characterised by the passage of Atlantic low-pressure weather systems and associated frontal rain belts. Occasionally the establishment of a high-pressure area or anticyclone over Ireland results in calm conditions and during the winter months these are characterised by clear skies and the formation of low-level temperature inversions with light wind conditions at night time.

By collecting weather information all around the country and by analysing these records over a long period of time, typically 30 years, average values for Ireland are calculated. The closest Met Éireann Synoptic Station is Kilkenny which is located approximately 28km to the south of the application site. The most recent climate average for this station is for the period of 1978 – 2007 which is tabulated in Table 8.1 below. Parameters recorded at the station include temperature, relative humidity, sunshine, rainfall, wind speed and direction.

Table 8.1: Monthly, Annual Mean and Extreme Values at Kilkenny Station

Kilkenny 1978–2007 averages													
Temperature	***Jan***	***Feb***	***Mar***	***Apr***	***Ma***	***Jun***	***Jul***	***Au***	***Sep***	***Oct***	***Nov***	***Dec***	***Year***
mean daily max	8.2	8.6	10.6	12.9	15.7	18.2	20.3	20.2	17.8	14.1	10.8	8.8	13.8
mean daily min	1.6	1.9	3.2	4.2	6.5	9.3	11.3	11	9.1	6.5	3.7	2.4	5.9
mean temperature	4.9	5.2	6.9	8.5	11.1	13.8	15.8	15.6	13.4	10.3	7.3	5.6	9.9
absolute max.	14.1	15.6	19.2	22.4	26	29.6	31.4	30.8	26.6	21.4	17.5	15.5	31.4
absolute min.	-14.1	-8.5	-7.9	-4	-3	1	3.6	2.2	-0.9	-4.8	-7	-8.8	-14.1
mean no. of days with air frost	10.9	9	5.4	3.2	0.7	0	0	0	0.2	2	6.6	8.9	46.9
mean no. of days with ground frost	20	16	15	14	9	2	0	1	4	9	15	18	123
Rainfall *(mm)*													
mean monthly total	78.3	66.1	67.9	56.4	60.4	61	54.6	77.8	69	95.3	80.2	90.4	857.4

greatest daily total	25.2	24.8	27.9	23.4	31.1	28.2	66.4	58.3	34.7	33.6	34.2	43.8	66.4
mean num. of days with >= 0.2mm	18	16	18	14	16	14	14	15	15	18	17	18	193
mean num. of days with >= 1.0mm	13	12	12	10	11	10	9	10	10	13	12	13	135
mean num. of days with >= 5.0mm	5	4	4	4	4	3	3	4	4	6	5	6	52
Wind *(knots)*													
mean monthly speed	7.9	8	8.1	7	6.6	6.2	5.9	5.7	6.2	6.8	6.9	7.3	6.9
max. gust	68	72	62	56	54	44	48	50	54	57	56	75	58
max. mean 10-minute speed	44	39	43	34	32	27	29	29	30	38	36	47	35.7
mean num. of days with gales	0.5	0.4	0.2	0	0	0	0	0	0	0.1	0.1	0.6	1.9
Weather *(mean no. of days with...)*													
snow or sleet	3.6	3.6	2.5	0.8	0.1	0	0	0	0	0	0.1	2	12.8
snow lying at 0900UTC	1.5	1.1	0.3	0.1	0	0	0	0	0	0	0	0.2	3.2
hail	0.7	1	2.1	2.5	1.2	0.3	0.2	0.1	0.1	0.3	0.2	0.2	8.9
thunder	0.1	0	0.1	0.4	0.7	0.9	0.7	0.8	0.2	0.2	0.1	0	4.2
fog	3.2	2.8	1.7	1.9	1.9	1.3	1.7	2.9	3.8	3.8	3.2	3.8	32.1

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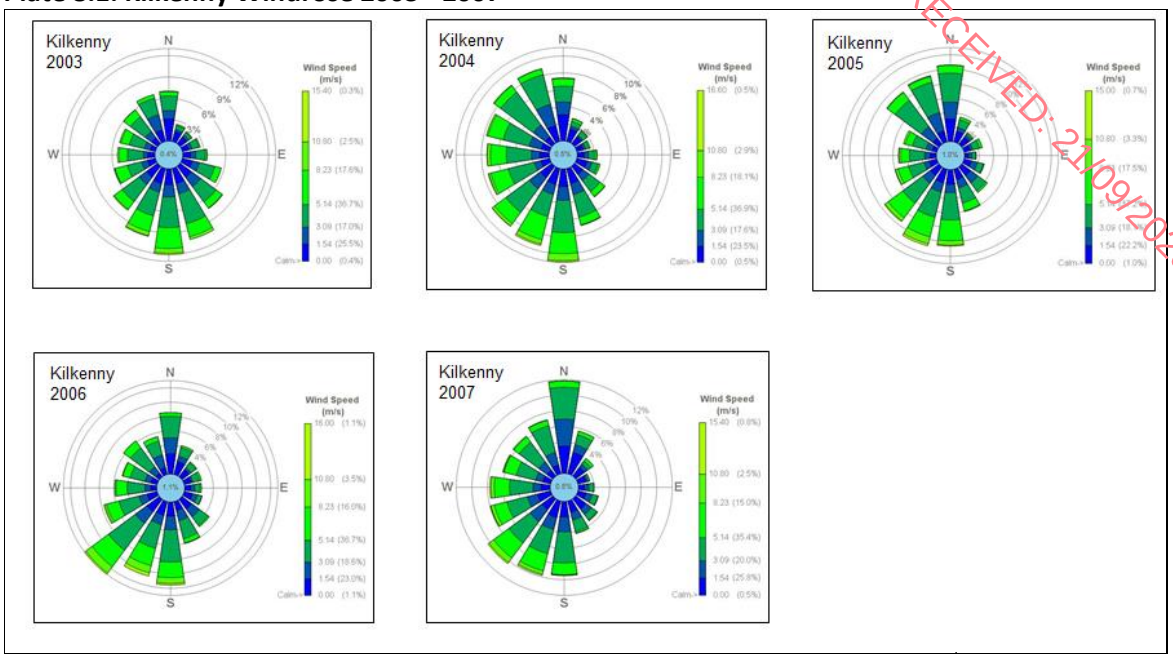
The average annual rainfall (AAR) for the 30 years period from 1978 – 2007 was 857.4mm/year. In relation to rainfall intensity, the mean number of days where there was ≥0.2mm of rainfall was 193, ≥1mm of rainfall 135 days and ≥5mm of rainfall 52 days. The windrose for Kilkenny weather station for the period of 2003 to 2007 is illustrated in Plate 8.1. The windrose shows that the majority of wind blows from a westerly and south westerly direction.

Plate 8.1: Kilkenny Windrose 2003 - 2007



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8.3.8 Land-Use

Land in the vicinity of the application site consists of agricultural land with livestock grazing being the predominant sector practiced where productive land exists. The application site is bounded to the north, south and east by agricultural land with a local road to the west which the application site gains access off. A number of residential dwellings are located along the local road. Further north (~200m) along the local road to the west, there are a number of housing estates on the outskirts of Abbeyleix.

There are a number of existing sand and gravel pits in the area, the closest one is a small disused pit located approximately 500m to the southeast of the site. This is currently used as a Defence Forces and An Garda Síochána Firing Range.

Abbeyleix Bog is situated to the southwest of the application site and consists of approximately 500 acres of diverse habitats including degraded (but recovering) raised bog, lagg, cutaway, wet carr woodland and meadows.

The existing Booth Precast Products Ltd sand and gravel pit and manufacturing facility is located 1.3km to the south of the site. The closest EPA licensed facility is located approximately 500m to the northwest of the application site. Stonearch previously manufactured Vitamin K3 for use as a supplement in animal feed until closure in the early 2000s. The facility is still licensed by the EPA (P0332).

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8.4 Characteristics of the Development

The application site consists of a greenfield area of 8.5 hectares comprising of several grazing fields with some woodland and scrub in the central area. The applicant proposes to remove the existing woodland, vegetation and overburden and extract the underlying sand and gravel material in line with an eight-phase extraction plan.

It is proposed to construct a berm along the western boundary using overburden and sand and gravel material removed from Phase 1. As extraction proceeds into various phases, overburden removed from the working phase will be used to restore the previous phase where material has been extracted. This will be undertaken on a rolling basis to minimise the uncovered area of the site.

All extracted sand and gravel material from the application site will be transported to the applicants manufacturing facility located approximately 1.3km to the south of the application site.

The proposed development will require the erection of minor infrastructure to include a wheel wash and refuelling area. These facilities will be located close to the entrance to the site. Plant and machinery which will operate at the application site will consist of excavators, road trucks and a water bowser.

The pit will operate between the hours of 0700 hours and 2000 hours Monday to Friday and 0800 to 1800 hours on Saturday and will not operate on Sundays or Public Holidays. The maximum rate of extraction will be in the region of 200,000 tonnes/annum; however, this will depend on the demand for material. Therefore, the applicant is seeking a 10-year permission in order to extract the available material taking into account years when the maximum extraction rate will not be achieved. The application site will be landscaped and restored in line with the proposed landscape and restoration plan.

8.5 Impact Assessment

The proposed development will consist of the removal of trees, vegetation and overburden material, construction of a screening berm and minor operational infrastructure and extraction of the available resource. Potential impacts associated with day-to-day activities are assessed under the following headings.

8.5.1 Plant & Vehicle Emissions

The operation of plant and vehicles associated with the removal of vegetation and overburden, extraction, processing and transport of material will generate exhaust emissions (e.g. $C0_2$ and N_20) which cannot be eliminated as in order for products to be produced, plant and vehicles need to operate. Emissions associated with this activity are assessed as having an imperceptible impact over a long-term period.

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The proposed development will result in an overall reduction of emissions associated vehicles transporting materials to and from the manufacturing facility as material will sourced closer to the facility rather than transporting over long distances from pits located at a greater distance away than the application site. Plate 8.2 details the quarries and pits where material is currently sourced from.

The estimated $C0_2$ produced by a HGV per mile travelled running at a consumption rate of 5 miles/gallon is 2.38kg $C0_2$. The total annual $C0_2$ produced associated with the transport of material to the manufacturing facility from various source site in 2019 was 307,554kg. It is estimated that if the proposed development is granted planning permission the total annual contribution would be in the region of 34,471kg which represents an annual reduction of 273,083 kg per year over 10 years a total reduction in carbon of 2,730,083 kg which would result in a positive impact.

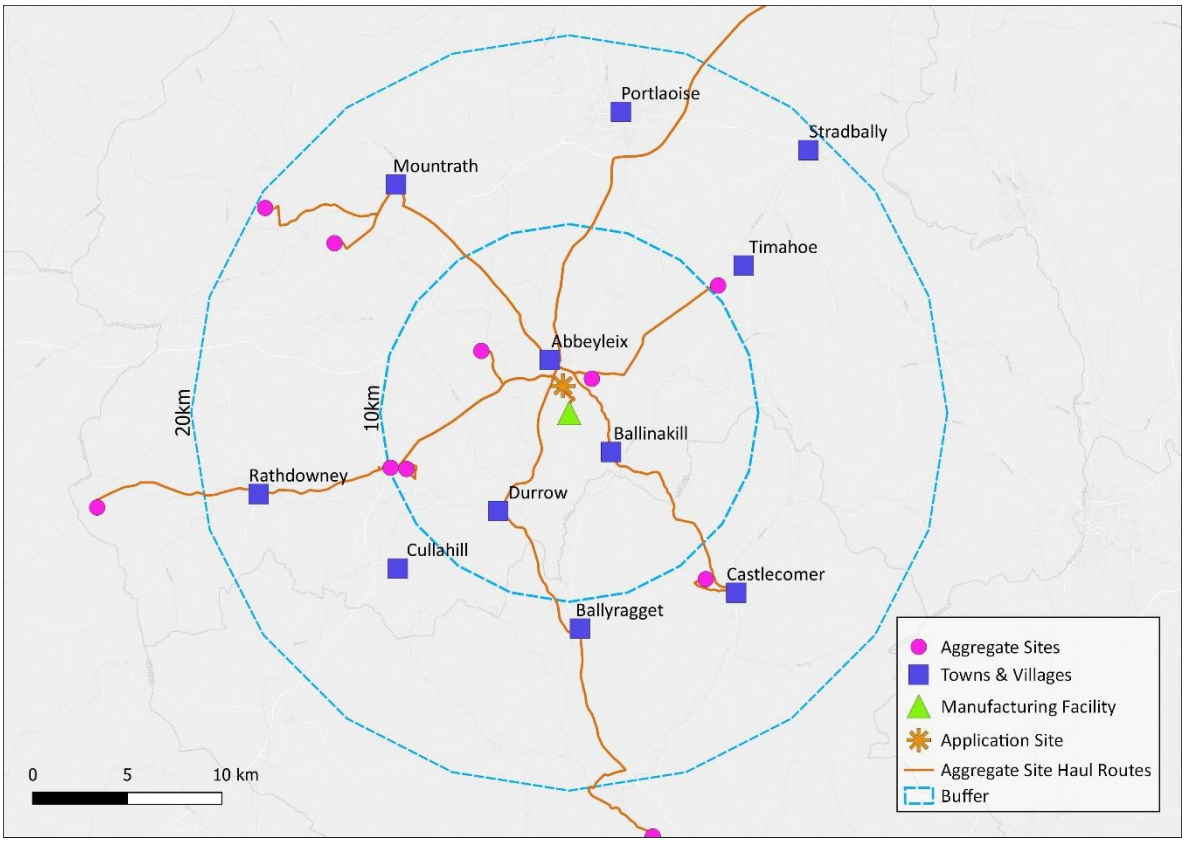

Plate 8.2: Sources Sites

8.5.2 Unplanned Events

The proposed development must also be assessed in relation to unplanned events in terms of vulnerability to the risks of major accidents and/or disasters which are relevant to the project. The unplanned events in relation to climate which the proposed development could potentially be vulnerable to include flooding, extreme temperatures, storms and high wind events.

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Flooding - Extreme rainfall events are becoming frequent and can potentially lead to flooding of low lying areas. It is unlikely that the proposed development will lead to a flood event due to the porous nature of the underlying material which water will percolate through to ground. The extraction of material will result in a reduction in the slope of the ground therefore reducing the potential for run-off. Therefore, the potential effect is assessed as neutral.
Storm Events - Extreme windy conditions could potentially lead to damage to buildings and infrastructure if not structurally sound. The infrastructure proposed will be limited and will be structurally safe with no loose items located on infrastructure or stored in areas around the pit that could be carried by winds. Therefore, the potential effect is assessed as neutral.

Extreme Temperatures – Extreme temperatures particularly freezing temperatures increase the potential for accidental collisions or slips by employees working at the proposed development. All weather warnings issued by the National Meteorological Service will be reviewed to assess driving conditions for vehicles transporting material to the manufacturing facility. The pit will not operate when 'red warning alerts' are issued. Therefore, the potential effect is assessed as neutral.

8.5.3 Cumulative Impact

Other contributors of CO_2 emissions within the study area which are listed in Table 3.2 of Chapter 3.0 Project Description were assessed in relation to Climate. The main potential cumulative impact would be associated with vehicles using the local road infrastructure, agricultural activity and the applicants manufacturing facility located to the south of the application site. Due to the low level of activity the potential cumulative impact is assessed as a medium imperceptible effect.

8.5.4 Do-Nothing Effect

If the proposed development is not granted planning permission, the site will continue to be used for agricultural use and material will continue to be sourced from pits and quarries located at a greater distance from the application site.

8.6 Mitigation Measures

The following mitigation measures will be practiced at the proposed development in order to limit the effects of the development on the local and regional climate:

- Strict adherence to 'good site/engineering practices' such as switching off all vehicles and plant when not in use.
- Plant will be serviced regularly to ensure efficient fuel consumption.
- Energy consumption and emission volumes will be considered when purchasing new plant and vehicles.

- It is proposed to implement energy audits in order to assess energy requirements and areas where energy usage can be reduced which will lead to a reduction in greenhouse gas emissions.

RECEIVED: 21/09/2023

8.7 Residual Impacts

No residual impacts are predicted.

8.8 Technical Difficulties

No technical difficulties were encountered.

8.9 References

RECEIVED: 21/09/2023

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RECEIVED: 21/09/2023

9.0 AIR QUALITY

9.1 Introduction

This chapter assesses the likely impact on air quality associated with the proposed development of a sand and gravel pit at Knocknamoe and Ballymullen townlands, Abbeyleix, Co. Laois.

The application site consists of a greenfield area of 8.5 hectares comprising of several grazing fields with some woodland and scrub in the central area. The applicant proposes to extract the available resource and transport off site to the applicant's manufacturing facility located approximately 1.3km to the south of the application site. The maximum rate of extraction will be in the region of 200,000 tonnes/annum; however this will depend on the demand for material. Therefore, the applicant is seeking a 10 year permission in order to allow for years when the anticipated extraction rate will not be achieved.

This chapter was completed by Dr. Avril Challoner who is a Senior Environmental Consultant in the Air Quality section of AWN Consulting. She holds a BEng (Hons) in Environmental Engineering from the National University of Ireland Galway, HDip in Statistics from Trinity College Dublin and has completed a PhD in Environmental Engineering (Air Quality) in Trinity College Dublin graduating in 2013. She is a Chartered Scientist (CSci), Member of the Institute of Air Quality Management and specialises in the fields of air quality, EIA and air dispersion modelling.

9.2 Methodology

The methodology used as part of this assessment involved undertaking a desk-based study to examine all relevant information relating to air quality conditions in the vicinity of the application site.

The air quality assessment has been carried out following procedures described in the publications by the EPA (EPA 2010, 2015, 2017, 2022) and using the methodology outlined in the guidance documents published by the USEPA (USEPA 2004, 2017, 2018). The air dispersion modelling input data consisted of information on the physical environment, design details from all emission sources on-site and five years of meteorological data.

Using this input data the model predicted ambient ground level concentrations and deposition rates beyond the land ownership boundary for each hour of the modelled meteorological years. The model post-processed the data to identify the location and maximum of the worst-case ground level concentration. This worst-case concentration and deposition rate was then added to the background concentration and deposition rate to give the worst-case predicted environmental concentration (PEC) and deposition flux. The PEC was then compared with the relevant ambient air quality standard to assess the significance of the releases from the site.

The assessment of the potential impacts of the proposed development on air quality was previously undertaken as part of the EIAR submitted for planning application P20/7 which

RECEIVED: 21/09/2023

was subsequently withdrawn. This proposal consisted of the extraction of the material and dry screening of the extracted material using over a 4 phase extraction plan with continuous restoration. The processed material would then be transported to existing manufacturing facility or directly to market.

The proposed development broadly consists of the same development as previously proposed as part of P20/7 with the following revisions:

- Material will be extracted over an eight-phase extraction plan with a four phase plan originally proposed. This will reduce the area of the pit which will be subject to quarrying activity at any one time.
- No material will be screened on-site.
- All material will be extracted and loaded directly onto trucks and transported directly to the manufacturing facility.

As the assessment models previously compiled were based on a worst-case scenario with extraction and processing activity being undertaken it is considered that the removal of the processing activity will reduce air emissions from the proposed development. Therefore, the models compiled as part of the EIAR for planning application P20/7 were used for this assessment.

9.2.1 Criteria for Rating of Impacts

The rating of potential environmental effects of the proposed project on air quality is based on the criteria presented in Table 9-1 below. These criteria consider the quality, significance, duration and types of effect characteristics identified and are based on Table 3.4 presented in the EPA (2022) document titled *"Guidelines on the Information to Be Contained in Environmental Impact Assessment Reports".*

Table 9.1: Criteria Used in the Assessment of Impacts on Air Quality (EPA, 2022)

Characteristic	Level	Description
Quality	Positive	A change which improves the quality of the environment.
	Neutral	No effects/effects which are imperceptible, within normal bounds of variation or within the margin of forecasting error.
	Negative	A change which reduces the quality of the environment.
Significance	Imperceptible	An effect capable of measurement but without significant consequences.
	Not significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
	Slight	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.

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Characteristic	Level	Description
	Moderate	An effect that alters the character of the environment in a manner consistent with existing and emerging baseline trends.
	Significant	An effect, which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
	Very significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.
	Profound	An effect which obliterates sensitive characteristics.
Magnitude	Extent	Describe the size of the area, number of sites and the proportion of a population affected by an effect.
	Context	Describe whether the extent, duration, or frequency will conform or contrast with established (baseline) conditions.
Probability	Likely	The effects that can reasonably be expected to occur because of the planned project if all mitigation measures are properly implemented.
	Unlikely	The effects that can reasonably be expected not to occur because of the planned project if all mitigation measures are properly implemented.
Duration and Frequency	Momentary	Effects lasting from seconds to minutes.
	Brief	Effects lasting less than a day.
	Temporary	Effects lasting less than a year.
	Short-term	Effects lasting one to seven years.
	Medium-term	Effects lasting seven to fifteen years.
	Long-term	Effects lasting fifteen to sixty years.
	Permanent	Effects lasting over sixty years.
	Reversible	Effects that can be undone, for example through remediation or restoration.
	Frequency	Describe how often the effect will occur. (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually).
Types of Effects	Indirect (Secondary)	Impacts on the environment, which are not a direct result of the project, often produced away from the project site or because of a complex pathway.
	Cumulative	The addition of many minor or significant effects, including effects of other projects, to create larger, more significant effects.
	'Do Nothing'	The environment as it would be in the future should the subject project not be carried out.
	'Worst Case'	The effects arising from a project in the case where mitigation measures substantially fail.
	Indeterminable	When the full consequences of a change in the environment cannot be described Irreversible When the character, distinctiveness, diversity, or reproductive capacity of an environment is permanently lost.

Characteristic	Level	Description
	Residual	Degree of environmental change that will occur after the proposed mitigation measures have taken effect
	Synergistic	Where the resultant effect is of greater significance than the sum of its constituents.

RECEIVED: 21/09/2023

9.2.2 Dispersion Modelling Methodology

In order to assess the dust deposition flux at the land ownership boundary, and the PM_{10} and $PM_{2.5}$ concentrations associated with the proposed activities at sensitive locations beyond the land ownership boundary, air dispersion modelling was undertaken. Modelling using the United States Environmental Protection Agency (USEPA) new generation dispersion model AERMOD (USEPA 2019) (version 19191) was used as recommended by the USEPA (USEPA 2017). The model is a steady-state Gaussian plume model used to assess pollutant concentrations associated with industrial sources. The model has been designated as the regulatory model by the USEPA for modelling emissions from industrial sources in both flat and rolling terrain (USEPA 2017). The AERMET PRO meteorological pre-processor (USEPA 2018) was used to generate hourly boundary layer parameters for use by AERMOD. Dust generation rates were calculated from factors derived from empirical assessment and detailed in the USEPA database entitled "Compilation of Air Pollution Emission Factors", Volume 2, AP-42 (1986, updated periodically) (USEPA 1986). The emission factors have been presented in Appendix 9.2.

9.2.3 Process Emissions

Quarrying activities typically emit dust. Dust is characterised as encompassing particulate matter with a particle size of between 1 and 75 microns (1-75µm). Deposition typically occurs in close proximity to the site and potential impacts generally occur within 500 metres of the dust generating activity as dust particles fall out of suspension in the air. Larger particles deposit closer to the generating source and deposition rates will decrease with distance from the source. Sensitivity to dust depends on the duration of the dust deposition, the dust generating activity, and the nature of the deposit. Therefore, a higher tolerance of dust deposition is likely to be shown if only short periods of dust deposition are expected and the dust generating activity is either expected to stop or move on.

The potential for dust to be emitted will depend on the type of activity being carried out in conjunction with environmental factors including levels of rainfall, wind speed, wind direction and dust prevention measures in place. This report identifies and quantifies the dust sources from the application site.

RECEIVED: 21/09/2023

9.2.4 Dust Generation Rates

Dust generation rates depend on the site activity, particle size, the moisture content of the material and weather conditions. Dust emissions are dramatically reduced where rainfall has occurred due to the cohesion created between dust particles and water and the removal of suspended dust from the air. It is typical to assume no dust is generated under "wet day" conditions where rainfall greater than 0.2mm has fallen.

Large particle sizes (greater than 75 microns) fall rapidly out of atmospheric suspension and are subsequently deposited in close proximity to the source. Particle sizes of less than 75 microns are of interest as they can remain airborne for greater distances and give rise to potential dust nuisance at the sensitive receptors. This size range would broadly be described as silt. Emission rates are normally predicted on a site-specific particle size distribution for each dust emission source. In the absence of such information, the particle size distribution outlined in AP-42 Appendix B.2.2 for Category 3 (mechanically generated aggregate) (USEPA 1986) has been used and is outlined in Table 9-2. The moisture content of glaciofluvial sands and gravels has been estimated at 1.5%.

Table 9:2: Category 3 Mechanically Generated Aggregate Taken From AP-42 (USEPA 1986)

Cumulative % ≤ Stated Size	Particle Size, µm	Minimum Value	Maximum Value	Standard Deviation
4	1.0	-	-	-
11	2.0	-	-	-
15	2.5	3	35	7
18	3.0	-	-	-
25	4.0	-	-	-
30	5.0	-	-	-
34	6.0	15	65	13
51	10.0	23	81	14

Dust deposition typically occurs in close proximity to the dust-generating source. The immediate vicinity of the application site is a greenfield and forested area. However, Abbeyleix Village is located in proximity to the proposed location. There are a number of sensitive locations present which can be affected by dust deposition. There are two small housing estates and a number of one-off houses within 500m of the site boundary. These residential properties are included as sensitive receptors within the model.

Generally, the potential for severe dust impacts is greatest within 100m of dust generating activities, though residual impacts can occur for distances beyond 100m.

A receptor grid was created at which concentrations would be modelled. The receptor grid was based on a Cartesian grid with the site at the centre. The inner grid extended to 1 km from the site with concentrations calculated at 25 m intervals. The outer grid extended to 5 km from the site with concentrations calculated at 250 m intervals. Boundary receptor locations were also placed along the land ownership boundary of the site, at 10 m intervals. In addition there were receptors for individual residential properties in the area. The

modelling has investigated the deposition and concentrations of dust, PM_{10} and $PM_{2.5}$ for the activities outlined in Section 9.5.

RECEIVED: 21/09/2023

9.3 Legislation

9.3.1 Air Quality

A number of international initiatives, protocols and Directives exist to limit and reduce emissions at a national level. The following criteria were considered in the assessment of impact on air quality:

- Air Quality Standards Regulations (S.I. No. 180 of 2011).
- Directive 2001/81/EC on National Emission Ceilings for certain pollutants (NECs) (S.I. No. 10 of 2004).
- There are no statutory limits for deposition of dusts and industry guidelines are typically employed to determine any impact. The TA Luft (German Government 'Technical Instructions on Air Quality') states a guideline of 350 mg/(m^2*day) for the deposition of non-hazardous dusts. This value was used to determine the impact of dust deposition as an environmental nuisance.
- The National Roads Authority (NRA) (now called Transport Infrastructure Ireland, TII) has published guidance for assessing dust impacts from road construction ('Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes'). This has been used to determine the potential impacts from the proposed construction site operations.

The relevant Irish ambient air standards have been adopted from the European Commission (EC) Directives 1996/62/EC, 1999/30/EC and 2000/69/EC and are cited as the Air Quality Standards Regulations, which came into force on 17th June 2002 (Irish Legislation S.I. No. 271 of 2002). In May 2008, these EC Directives on air quality were replaced with a new Directive on ambient air quality and cleaner air for Europe (2008/50/EC), which has been transposed into Irish Legislation through the revised Air Quality Standards Regulations (S.I. 180 of 2011). The new legislation specifies limit values in ambient air for sulphur dioxide (SO_2), lead (Pb), benzene (C_6H_6), particulate matter (PM_{10} and $PM_{2.5}$), carbon monoxide (CO), nitrogen dioxide (NO_2) and oxides of nitrogen (NO_x). These limits are set for the protection of human health and are largely based on review of epidemiological studies on the health impacts of these pollutants. The pollutants of concern for the EIAR are PM_{10} and $PM_{2.5}$, the limit values of which are presented in Table 9-3.

Table 9:3: Revised Air Quality Standard Regulations S.I. 180 of 2011 and TA-Luft

Pollutant Criteria Value	Criteria	Value
Particulate Matter (PM_{10})	24-hour limit for protection of human health - not to be exceeded more than 35 times/year	50 µg/m^3 PM_{10}
	Annual limit for protection of human health	40 µg/m^3 PM_{10}
Particulate Matter ($PM_{2.5}$)	Annual target value for the protection of human health	25 µg/m^3 $PM_{2.5}$
Dust deposition (non-hazardous dust)	Average daily dust deposition at the boundary of the site	350 mg/(m^2*day) Total Dust

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9.3.2 Dust Deposition

There are no statutory limits on dust deposition and the focus is on the prevention of nuisance and minimising air borne dust emissions where practicable. Although coarse dust is not regarded as a threat to health, it can create a nuisance by depositing on surfaces. No statutory or official air quality criterion for dust annoyance has been set in Ireland, UK, Europe or at World Health Organisation level.

The most commonly applied guideline is the German (TA Luft) (German VDI 2002) guideline of 350mg/m^2/day as measured using Bergerhoff type dust deposit gauges as per the German Standard Method for determination of dust deposition rate (VDI 2119). This is commonly applied to ensure that no nuisance effects will result from specified industrial activities. Below these thresholds dust problems are considered less likely. Dust Deposition is normally measured by gravimetrically determining the mass of particulates and dust deposited over a specified surface area over a period of one month (30 days +/- 2 days).

Recommendations outlined by the Department of the Environment, Heritage & Local Government (DOEHLG 2004), apply the Bergerhoff limit of 350 mg/(m^2*day) to the land ownership boundary of quarries.

9.4 Existing Environment

The application site consists of a greenfield area of 8.5 hectares comprising of several grazing fields with some woodland and scrub in the central area. The applicant proposes to extract the available resource and transport off site to the applicants manufacturing facility located approximately 1.3km to the south of the application site. The maximum rate of extraction will be in the region of 200,000 tonnes/annum; however this will depend on the demand for material. Therefore the applicant is seeking a 10 year permission in order to allow for years when the anticipated extraction rate will not be achieved.

Abbeyleix Town is located approximately 1km to the north of the application site. There are a number of sensitive locations present which can be affected by dust deposition. There are

two small housing estates and a number of one-off houses within 500m of the site boundary. These residential properties are included as sensitive receptors within the model.

RECEIVED: 21/09/2023

9.4.1 Meteorological Conditions

Meteorological conditions significantly affect the level of dust emissions and subsequent deposition downwind of the source. The most significant meteorological elements affecting dust deposition are rainfall and wind-speed. High levels of moisture either retained in soil or as a result of rainfall help suppress the generation of dust due to the cohesive nature of water between dust particles. Rain also assists in removing dust from the atmosphere through washout. Wind can lift particles up into the air and transport the dust downwind as well as drying out the surface. The worst dust deposition conditions typically occur, therefore, during dry conditions with strong winds.

The closest Met Éireann meteorological station to the site is at Oak Park, Carlow, which is approximately 30 km east of the application area.

The mean monthly rainfall from January 2014 to December 2018 recorded at Oak Park Head was 72 mm/month. The monthly total during the winter months (October-March) accounts for the majority of the annual total for these years.

There is no long-term (1981–2010) set for Oak Park as the site was only opened in 2003. However Kilkenny Met station, located roughly 30 km south of the proposed development has an average monthly rainfall recorded. Met Éireann records for this station show that the Average Annual Rainfall (AAR) for the period 1981 – 2007 (latest 30 year data set available, the station shut in 2007) shows 193 days with greater than 0.2 mm of rain.

Wind frequency is important as dust can only be dispersed by winds, and deposition of dust is a simple function of particle size, wind speed and distance. The closer the source of dust is to a receptor; the higher the potential risk of impact of dust blow. The prevailing winds in the area are westerly to southerly in direction, thereby predominantly dispersing any potential dust emissions to the east and north of the site (see Figure 9.1). The mean wind speed at Oak Park was approximately 3.8 m/s over the period 2014 - 2018. All meteorological data referenced within this report is provided by Met Éireann (source www.met.ie).

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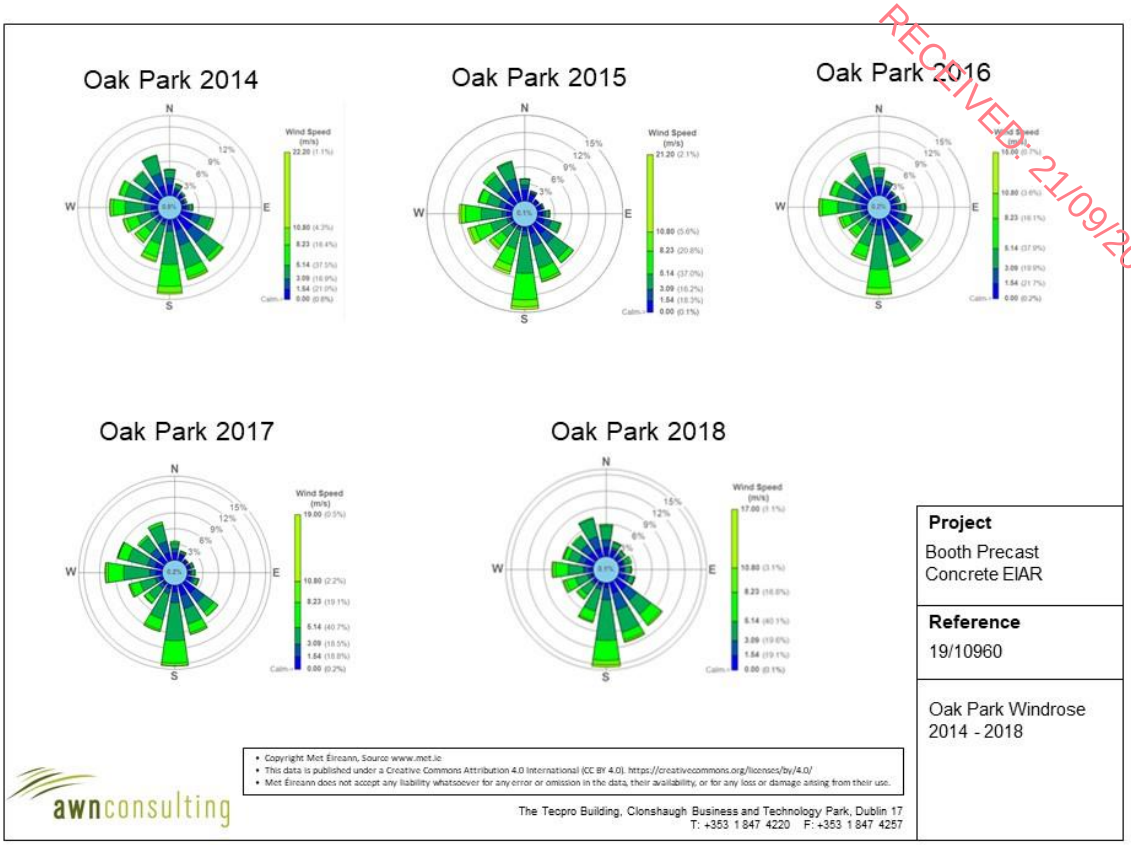

Figure 9.1 Oak Park Windrose 2014 - 2018

9.4.2 Background Sources of Dust

The sources of dust arising from the site contribute to background levels of dust. Dust is present naturally in the air from a number of sources including weathering of minerals, and pick-up across open land and dust generated from fires. Monitoring of dust deposition is not currently undertaken at the site and therefore background levels for the immediate vicinity of the site are not available.

However, a study by the UK ODPM (UK ODPM 1986) gives estimates of likely dust deposition levels in specific types of environments. In open country a level of 39 mg/(m^2*day) is typical, rising to 59 mg/(m^2*day) on the outskirts of town and peaking at 127 mg/(m^2*day) for a purely industrial area. A level of 39 mg/(m^2*day) can be estimated as the background dust deposition level for the region of the site in Ballymullen, Co. Laois.

9.4.3 Background Sources of PM_{10} and $PM_{2.5}$

Long-term PM_{10} monitoring was carried out at the rural Zone D location of Kilkitt and the urban locations of Claremorris and Castlebar over the period 2014 – 2018 (EPA 2019a, 2019b). The maximum 24-hour concentration (as a 90th%ile) at each of the Zone D locations

RECEIVED: 21/09/2023

is shown in Table 9-4 with the annual average concentrations shown in Table 9-5. The long-term average 90th%ile of 24-hour concentrations at the rural location of Kilkitt Claremorris ranges from 14 – 18 µg/m^3. The average annual mean concentrations in Kilkitt from 2014 to 2018 ranged from 8 – 9 µg/m^3, including urban locations. In order to be conservative, an upper average concentration of 12 µg/m^3 as an annual mean has been selected as shown in Table 9-5. Based on the above information an estimate of the background PM_{10} concentration in the region of the application site is 12 µg/m^3 whilst a value of 17 µg/m^3 has been selected for the 90th%ile of 24-hr means.

Table 9:4: 90th%ile of 24-Hour PM10 Concentrations In Zone D Locations (µg/m3)

Year	Claremorris	Kilkitt	Castlebar
2014	15	15	21
2015	17	18	13
2016	17	15	12
2017	17	14	19
2018	20	15	20
Average	**17**	**16**	**17**

Table 9:5: Annual Mean PM10 Concentrations In Zone D Locations (µg/m3)

Year	Claremorris	Killkitt	Castlebar
2014	10	9	12
2015	10	9	13
2016	10	8	12
2017	11	8	11.2
2018	12	9	11
Average	**11**	**9**	**12**

The results of $PM_{2.5}$ monitoring at Claremorris (Zone D) over the period 2014 – 2018 (EPA 2019a) indicated an average $PM_{2.5}/PM_{10}$ ratio ranging from 0.5 – 0.6. Based on this information, a conservative ratio of 0.6 was used to generate a rural background $PM_{2.5}$ concentration of 7.2 µg/m^3 for the region of the application site.

In relation to the annual averages, the ambient background concentration is added directly to the process concentration. However, in relation to the short-term peak concentration, concentrations due to emissions from elevated sources cannot be combined in the same way. Guidance from the UK DEFRA (UK DEFRA 2016) and the EPA (EPA 2010) advises that for PM_{10} an estimate of the maximum combined pollutant concentration can be obtained as shown below:

PM_{10} - The 90.4th%ile of total 24-hour mean PM_{10} is equal to the maximum of either A or B below:

a) 90.4th%ile of 24-hour mean background PM_{10} + annual mean process contribution PM_{10}

b) 90.4th%ile 24-hour mean process contribution PM_{10} + annual mean background PM_{10}.

RECEIVED: 21/09/2023

9.4.4 Dust Sensitive Receptors

Potentially dust sensitive activities, which can be categorised in relation to their dust sensitivity as potential increases in ambient dust levels, will have varying degrees of effects. This is dependent on the type and sensitivity of the receptor. Although this principle does not always apply, Table 9-6 categorises dust sensitive receptors and highlights their risk in relation to potential sources of dust.

Table 9:6: Levels of Sensitivity per Receptor Type

High Sensitivity	Medium Sensitivity	Low Sensitivity
Hospitals and clinics Retirement homes Hi-tech industries Painting and furnishing Food processing	Schools Residential areas Food retailers Greenhouses and nurseries Horticultural land Biodiversity	Farms Light and heavy industry Outdoor storage

The immediate vicinity of the application site is a greenfield and forested area. However, Abbeyleix town is located approximately 1km to the north of the application site. There are a number of sensitive locations present which can be affected by dust deposition. There are two small housing estates and a number of one off houses within 500m of the application site boundary. These residential properties are included as sensitive receptors within the model.

Vegetation, berms and the natural topography can act as breaks between the sources and the receptors. However, these are not included in the modelled scenarios as a worst-case. Tree lines can also act as an efficient dust filter and can be a useful dust control safeguard.

9.5 Characteristics of the Development

The development involves the assessment of the likely impact on air quality associated with the proposed development at the Booth Precast Products Ltd located at Ballymullen, Co. Laois.

The application site consists of a greenfield area of 8.5 hectares comprising of several grazing fields with some woodland and scrub in the central area. The applicant proposes to remove the existing woodland, vegetation and overburden and extract the underlying sand and gravel material in line with an eight-phase extraction plan.

All extracted sand and gravel material from the application site will be transported to the applicant's manufacturing facility located approximately 1.3km to the south of the application site.

The maximum rate of extraction will be in the region of 200,000 tonnes/annum; however, this will depend on the demand for material. Therefore, the applicant is seeking a 10 year permission in order to allow for years when the anticipated extraction rate will not be

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achieved. The assessment has assumed a single phase of the application site will be disturbed at any time with all other phases left untouched or restored. Full details of the proposed development are included in Chapter 3.0 of the EIAR. The phase modelled was chosen after a sensitivity study modelling the full site area and reviewing the area of worst case impact due to proximity of receptors and wind directions.

During the average year based on the modelled extraction rate of 200,000 tonnes/annum, it is proposed there will be a maximum of 29 external truck movements per day.

The hours of operation at the pit will be Monday to Friday 07:00 to 20:00 and Saturday 08:00 to 18:00. With no operations on Sundays or public holidays. These hours have been used for the purpose of the assessment. There will be no blasting on site. The following operations are the main dust generating sources or activities at the pit:

1) Movement of trucks along paved public roads
2) Movement of trucks along unpaved haul roads
3) Extraction of material
4) Loading of material
5) Wind erosion at material storage areas, stockpiles and exposed surfaces.

As stated previously the modelled scenarios were based on screening and stockpiling of material on site. These activities will not be undertaken as part of the revised proposal.

9.6 Predicted Impacts

9.6.1 Operational Phase

The main potential sources of emissions to air are associated with plant and machinery undertaking day to day activities such as extraction and transportation of material and dust blow generated during dry windy conditions. Potential impacts associated with day to day activities have been separated into dust deposition and vehicle and plant emissions.

9.6.1.1 Dust

Emissions from the site lead to a dust deposition level averaged over the full year of 6.2 mg/(m^2*day) at the boundary to the pit (see Table 9-7). Based on a worst case background dust deposition of 39 mg/(m^2*day) in the region of the site, the combined dust deposition level peaks at 45.2 mg/(m^2*day) which is 13% of the TA Luft Limit Value of 350 mg/(m^2*day), as shown in Figure 9-3. However, operational activities from the application site contribute a maximum of 2% of the TA-Luft Limit Value. The impact of dust deposition is considered localised, long-term and not significant.

Table 9:7: Dispersion Modelling Results for Dust Deposition at Boundary

Pollutant / Year	Worst Case Background Level (mg/(m²*day))	Process Contribution (mg/(m²*day))	Predicted Deposition (mg/(m²*day))	Limit Value (mg/(m²*day)) Note 1
Dust Deposition / 2014	39	6.2	45.2	350
Dust Deposition / 2015	39	5.3	44.3	350
Dust Deposition / 2016	39	5.8	44.8	350
Dust Deposition / 2017	39	5.2	44.2	350
Dust Deposition / 2018	39	5.7	44.7	350

Note 1 TA-Luft as interpreted by DOEHLG (2004)

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PM_{10}

Predicted PM_{10} concentrations are significantly lower than the ambient air quality standards at the worst-case residential receptor due to background concentrations and emissions from the application site (see Table 9-8). For emissions from the application site the predicted 24-hour and annual concentrations (excluding background) at the worst-case off site location peak at 11.2 µg/m³ and 4.1 µg/m³ respectively. Based on a background PM_{10} concentration of 12 µg/m³ in the region of the application site, the combined annual PM_{10} concentration including the site peaks at 16.1 µg/m³ (see Figure 94). This predicted level equates to at most 40% of the annual limit value of 40 µg/m³. The predicted 24-hour PM_{10} concentration (including background) peaks at 23.1 µg/m³ which is 46% of the 24-hour limit value of 50 µg/m³ (measured as a 90.4th%ile). Operational activities from the pit contribute a maximum of 10% of the PM_{10} annual mean limit value. The impact of PM_{10} is considered as a slight, negative, long-term effect.

Table 9:8: Dispersion Modelling Results for PM_{10}

Pollutant / Year	Annual Mean Background ($\mu g/m^3$)	Averaging Period	Process Contribution PM_{10} ($\mu g/m^3$)	Predicted Emission Concentration PM_{10} ($\mu g/m^3$) Note 2	Standard ($\mu g/m^3$) Note 1
PM_{10} / 2014	N/A	90.4th%ile of 24-hr means	11.2	23.2	50
	12	Annual Mean	4.0	16.0	40
PM_{10} / 2015	N/A	90.4th%ile of 24-hr means	9.9	21.9	50
	12	Annual Mean	3.3	15.3	40
PM_{10} / 2016	N/A	90.4th%ile of 24-hr means	10.4	22.4	50
	12	Annual Mean	3.8	15.8	40
PM_{10} / 2017	N/A	90.4th%ile of 24-hr means	10.2	22.2	50
	12	Annual Mean	3.7	15.7	40
PM_{10} / 2018	N/A	90.4th%ile of 24-hr means	11.1	23.1	50
	12	Annual Mean	4.1	16.1	40

Note 1 S.I. 180 of 2011 and EU Directive 2008/50/EC

Note 2 90.4th%ile of 24-Hr PM_{10} Concentration Calculated According To UK DEFRA Guidance and using background data from the rural Zone D EPA monitoring stations.

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$\underline{PM_{2.5}}$

Predicted $PM_{2.5}$ concentrations at the worst-case receptor are significantly lower than the limit value of 25 $\mu g/m^3$ (see Table 9-9).

The predicted annual concentration (excluding background) at the worst-case off-site location at 3.5$\mu g/m^3$. Based on a background $PM_{2.5}$ concentration of 7.2 $\mu g/m^3$ in the region of the site, the annual $PM_{2.5}$ concentration including the operations peaks at 10.7 $\mu g/m^3$. This peak level equates to 43% of the annual limit value for $PM_{2.5}$. The impact of $PM_{2.5}$ is considered is considered as a slight, negative, long-term effect.

Table 9:9: Dispersion Modelling Results for $PM_{2.5}$

Pollutant / Year	Annual Mean Background (µg/m³)	Averaging Period	Process Contribution $PM_{2.5}$ (µg/m³)	Predicted Emission Concentration $PM_{2.5}$ (µg/m³)	Standard (µg/m³) Note 1
$PM_{2.5}$ / 2014	7.20	Annual Mean	3.31	10.5	25
$PM_{2.5}$ / 2015	7.20	Annual Mean	2.81	10.0	25
$PM_{2.5}$ / 2016	7.20	Annual Mean	3.19	10.4	25
$PM_{2.5}$ / 2017	7.20	Annual Mean	3.07	10.3	25
$PM_{2.5}$ / 2018	7.20	Annual Mean	3.54	10.7	25

Note 1 S.I. 180 of 2011 and EU Directive 2008/50/EC

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9.6.1.2 Contour Plots

The geographical variations in pollutant concentrations for the worst-case scenario for each pollutant are illustrated as concentration contours in Figures 9-2 and 9-5. The contents of each figure are described below:

Figure 9.2 Annual Average Dust Deposition (g/m2/year)
Figure 9.3 90.4th Percentile of 24-Hour Average PM10 Concentrations (µg/m3)
Figure 9.4 Annual Average PM10 Concentrations (µg/m3)
Figure 9.5 Annual Average PM2.5 Concentrations (µg/m3)

The concentrations and deposition levels listed in Tables 9.7 – 9.9 are for the maximum concentrations / deposition levels predicted at the worst-case receptors. All other receptors are below these values. The concentration contours show where the maximum concentrations and deposition levels are predicted to occur and the reduction in concentration or deposition with distance away from the maximum.

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Figure 9.2: Annual Average Dust Deposition (g/m2/yr)

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Figure 9.3: 90.4th Percentile of 24-Hour Average PM10 Concentrations (µg/m3)

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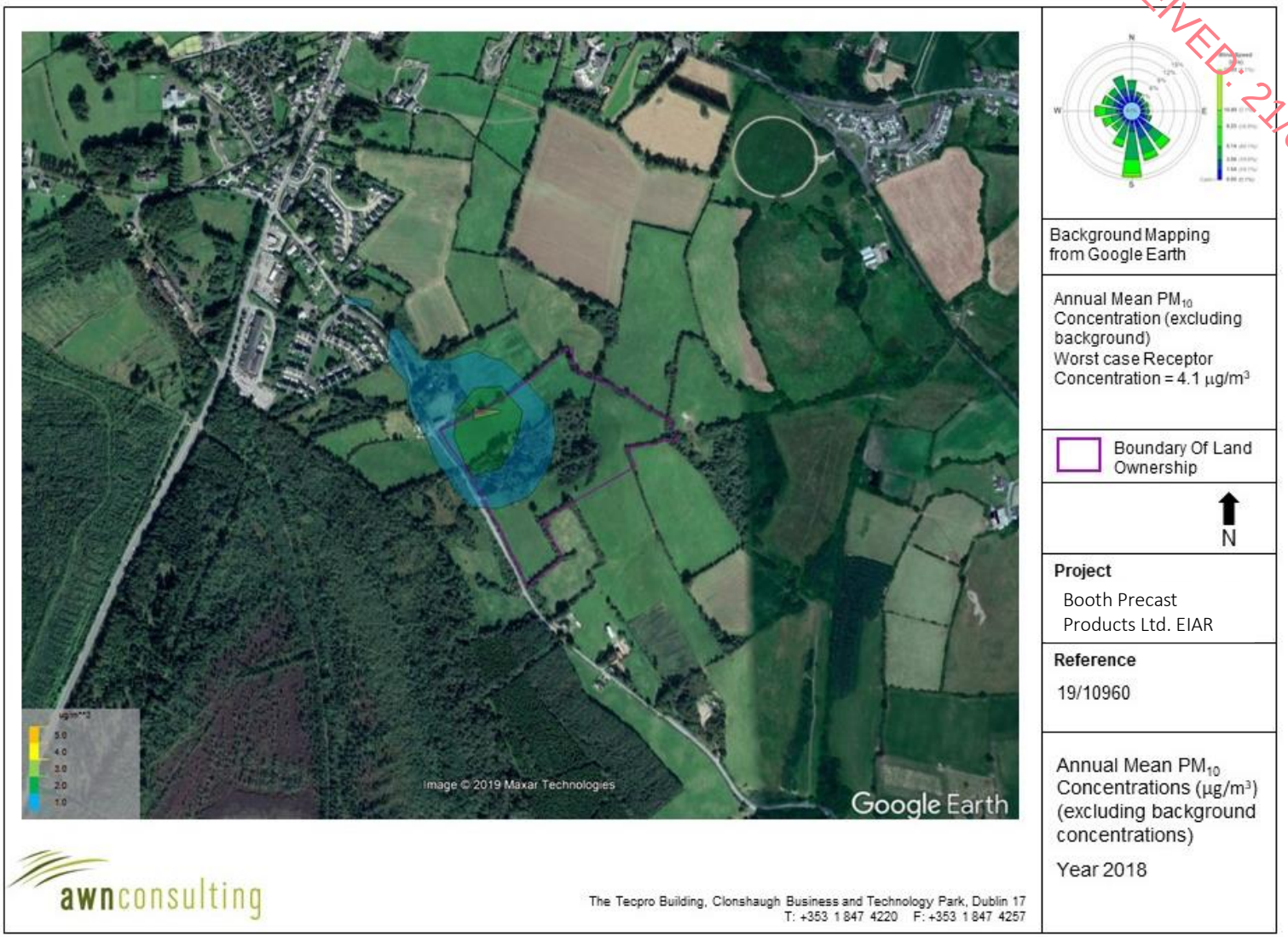

Figure 9.4: Annual Average PM10 Concentrations (µg/m3)

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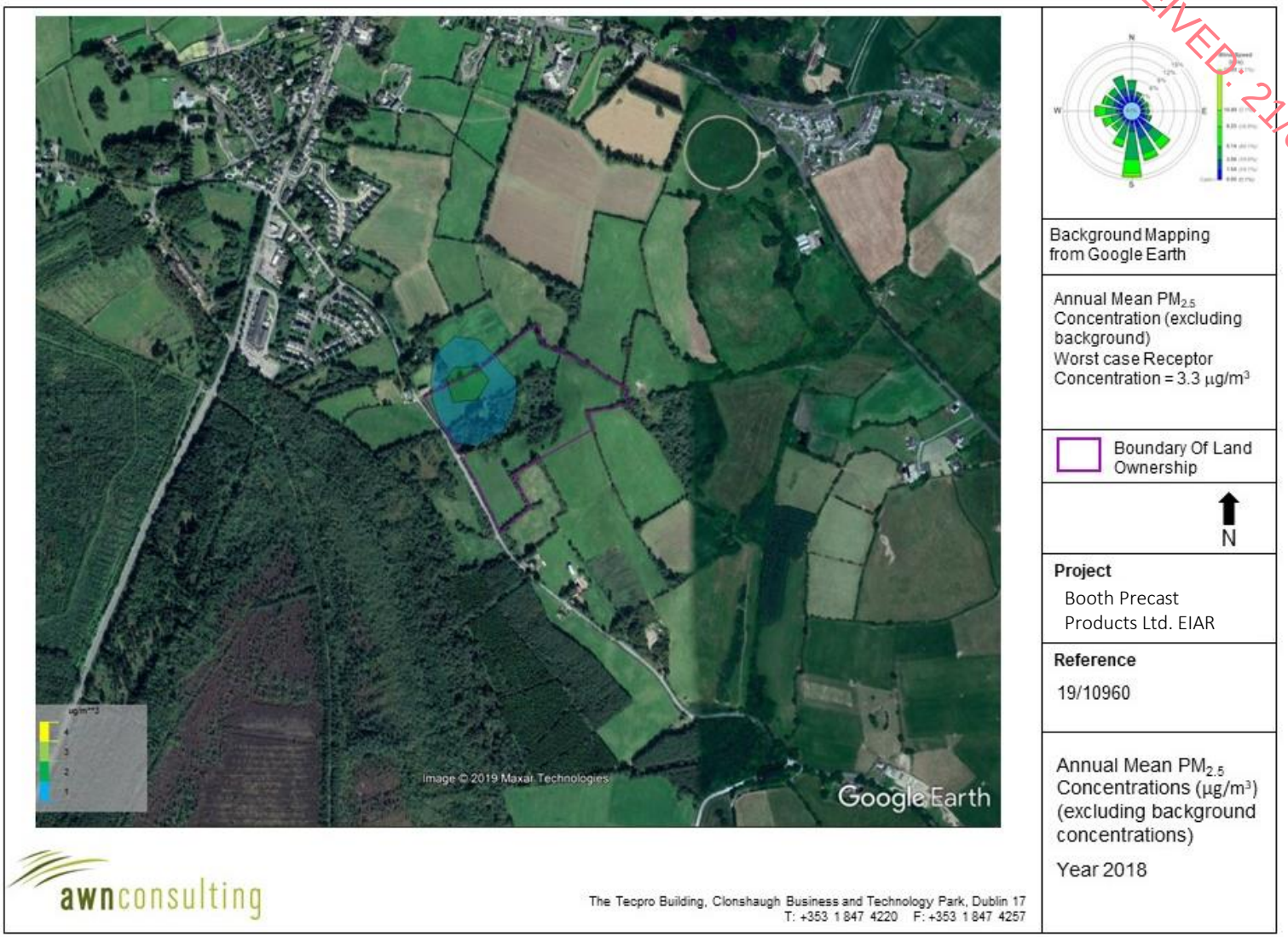

Figure 9.5: Annual Average PM2.5 Concentrations (µg/m3)

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9.6.1.3 Road Traffic

The UK Design Manual for Roads and Bridges guidance (UK Highways Agency 2007), on which TII guidance was based, states that road links meeting one or more of the following criteria can be defined as being 'affected' by a proposed project and should be included in the local air quality assessment:

- Road alignment change of 5m or more;
- Daily traffic flow changes by 1,000 annual average daily traffic movements (AADT) or more;
- HGVs flows change by 200 vehicles per day or more;
- Daily average speed changes by 10km/h or more; or
- Peak hour speed changes by 20km/h or more.

Concentrations of key pollutants are calculated at sensitive receptors which have the potential to be affected by the proposed development. For road links which are deemed to be affected by the proposed development and within 200m of the chosen sensitive receptors, inputs to the air dispersion model consist of: road layouts, receptor locations, AADT, percentage heavy goods vehicles, annual average traffic speeds and background concentrations. During the operational phase it is expected that no more than 58 HGV movements per day will occur which is significantly less than the criteria set out by the UK Highways Agency for being classified as an 'affected' road. Therefore, impacts on air quality due to the HGV's can be considered imperceptible, localised and long-term.

9.6.1.4 Climate

There is the potential for a number of greenhouse gas emissions to atmosphere during the operational phase. Construction vehicles, generators etc., may give rise to CO_2 and N_2O emissions. However, the impact on the climate with respect to Ireland's 2020 GHG emissions targets is considered to be imperceptible in the long-term.

There is the potential for future climate change to alter meteorological conditions, increasing wind speeds, longer dry periods and increased rainfall. While increased rainfall is likely to reduce the risk of dust nuisance, increased windspeeds and dry periods have the potential to cause adverse impacts beyond the site boundary. However, any increase in boundary dust deposition concentrations can be recorded through dust monitoring and additional dust minimisation efforts can be put in place in order to suppress and minimise dust nuisance.

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9.6.1.5 Human Health

The dispersion modelling results show that predicted levels of particulate matter (PM_{10} and $PM_{2.5}$) will be significantly below the EU ambient air quality limit values which are based on the protection of human health. Therefore, the impact to human health is predicted to be long-term and imperceptible.

9.6.2 Do Nothing Scenario

Under the Do Nothing Scenario the site would remain as per its current use as a greenfield site. Under this scenario levels of dust deposition, PM_{10} and $PM_{2.5}$ would remain at baseline levels. The impact to air quality and climate under this scenario are considered neutral.

9.6.3 Cumulative Impacts

Cumulative effects have been assessed for the application site. Background concentrations have been included in the modelling study for dust deposition and EPA data for PM_{10} and $PM_{2.5.}$ These background concentrations account for non-localised sources of the pollutants of concern.

There are no other significant sources of dust, PM_{10} or $PM_{2.5}$ within the area of impact from the pit and therefore no further prediction of cumulative impact is required.

9.7 Mitigation Measures

The following mitigation measures are implemented within the pit in order to limit the effects on air quality:

- Vehicles using site roads have their speed restricted to 40 kph on unsurfaced roads. Speed restrictions on hard surfaced roads are dictated by site management and are within the legal speed limit.
- A truck wheelwash is available at the site exit to prevent track out of materials onto the public road.
- Un-paved site roads are regularly watered using bowsers, especially during dry and windy periods when watering should be done twice per day.

9.8 Monitoring

To ensure that the existing development is not impacting on air quality, it is recommended that dust deposition monitoring be undertaken at the boundary of the site. Monitoring will ensure that the TA Luft guideline limit value of 350 mg/(m^2*day) is complied with at the site boundary. Monitoring can be carried out using the Bergerhoff method as recommended by the Department of Environment, Heritage and Local Government (DOHLEG, 2004). If

monitoring indicates a potential issue with dust deposition, additional mitigation measures shall be implemented to remediate.

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9.9 Residual Impacts

Modelled emissions from the site lead to ambient concentrations which are within the relevant ambient air quality standards for dust, PM_{10} and $PM_{2.5}$. Thus, the impact on air quality and climate as a result of the proposed development is considered as long term, negative and slight and thus no residual impact is anticipated.

9.10 Technical Difficulties

There were no significant difficulties encountered during the compilation of the chapter.

RECEIVED 21/09/2023

9.11 References

DOEHLG (2004) *Quarries and Ancillary Activities, Guidelines for Planning Authorities*

Environmental Protection Agency (2019a) *Air Quality Monitoring Report 2017* (& previous annual reports)

Environmental Protection Agency (2019b) www.epa.ie/whatwedo/monitoring/air/data

EPA (2010) *Air Dispersion Modelling from Industrial Installations Guidance Note* (AG4)

EPA (2015) *Advice Notes for Preparing Environmental Impact Statements (Draft) on the Information to be Contained in Environmental Impact Assessment Reports* (Draft)

EPA (2022) *Guidelines on the Information to be Contained in Environmental Impact Assessment Reports*.

German VDI (2002) *Technical Guidelines on Air Quality Control – TA Luft*

Met Eireann (2019) www.met.ie

UK DEFRA (2018) *Part IV of the Environment Act 1995: Local Air Quality Management, LAQM*. TG(16)

UK Highways Agency (2007) *Design Manual for Roads and Bridges, Volume 11, Section 3, Part 1 - HA207/07* (Document & Calculation Spreadsheet)

UK ODPM (2000) *Controlling Environmental Effects: Recycled and Secondary Aggregates Production*

USEPA (1986) *Compilation of Air Pollutant Emission Factors, AP-42*, Fifth Edition (periodically updated)

USEPA (2017) *Guidelines on Air Quality Models*, Appendix W to Part 51, 40 CFR Ch.1

USEPA (2018) *User's Guide to the AERMOD Meteorological Preprocessor* (AERMET)

USEPA (2019) *AERMOD Description of Model Formulation and Evaluation*

RECEIVED: 21/09/2023

APPENDIX 9.1: Ambient Air Quality Standards

National standards for ambient air pollutants in Ireland have generally ensued from Council Directives enacted in the EU (& previously the EC & EEC) (see Table 10.1). The initial interest in ambient air pollution legislation in the EU dates from the early 1980s and was in response to the most serious pollutant problems at that time. In response to the problem of acid rain, sulphur dioxide, and later nitrogen dioxide, were both the focus of EU legislation. Linked to the acid rain problem was urban smog associated with fuel burning for space heating purposes. Also apparent at this time were the problems caused by leaded petrol and EU legislation was introduced to deal with this problem in the early 1980s.

In recent years the EU has focused on defining a basis strategy across the EU in relation to ambient air quality. In 1996, a Framework Directive, Council Directive 96/62/EC, on ambient air quality assessment and management was enacted. The aims of the Directive are fourfold. Firstly, the Directive's aim is to establish objectives for ambient air quality designed to avoid harmful effects to health. Secondly, the Directive aims to assess ambient air quality on the basis of common methods and criteria throughout the EU. Additionally, it is aimed to make information on air quality available to the public via alert thresholds and fourthly, it aims to maintain air quality where it is good and improve it in other cases.

As part of these measures to improve air quality, the European Commission has adopted proposals for daughter legislation under Directive 96/62/EC. The first of these directives to be enacted, Council Directive 1999/30/EC, has been passed into Irish Law as S.I. No 271 of 2002 (Air Quality Standards Regulations 2002), and has set limit values which came into operation on 17th June 2002. Council Directive 1999/30/EC, as relating to limit values for sulphur dioxide, nitrogen dioxide, lead and particulate matter. The Air Quality Standards Regulations 2002 detail margins of tolerance, which are trigger levels for certain types of action in the period leading to the attainment date. The margin of tolerance varies from 60% for lead, to 30% for 24-hour limit value for PM10, 40% for the hourly and annual limit value for NO2 and 26% for hourly SO2 limit values. The margin of tolerance commenced from June 2002. It started to reduce from 1 January 2003, continuing every 12 months thereafter by equal annual percentages to reach 0% by the respective attainment date for each pollutant. A second daughter directive, EU Council Directive 2000/69/EC, limit values for both carbon monoxide and benzene in ambient air is also included in the Air Quality Standards Regulations 2002. This has also been passed into Irish Law under the Air Quality Standards Regulations 2002.

The most recent EU Council Directive on ambient air quality was published on the 11/06/08. Council Directive 2008/50/EC combines the previous Air Quality Framework Directive and its subsequent daughter directives. This has also been passed into Irish Law under the Air Quality Standards Regulations 2011 (S.I. 180 of 2011) (see Table 10.1). Provisions were also made for the inclusion of new ambient limit values relating to PM2.5. The margin of tolerance specific to each pollutant were also slightly adjusted from previous directives. In regards to existing ambient air quality standards, it is not proposed to modify the standards but to strengthen existing provisions to ensure that non-compliances are removed. In addition, new ambient standards for PM2.5 are included in Directive 2008/50/EC. The approach for PM2.5 is to establish a target value of 25 µg/m3, as an annual average (to be attained everywhere by 2010) and a limit value of 25 µg/m3, as an annual average (to be attained everywhere by 2012), coupled with a target to reduce human exposure generally to PM2.5

between 2010 and 2020. This exposure reduction target will range from 0% (for PM2.5 concentrations of less than 8.5 µg/m3 to 20% of the average exposure indicator (AEI) for concentrations of between 18 - 22 µg/m3. Where the AEI is currently greater than 22 µg/m3 all appropriate measures should be employed to reduce this level to 18 µg/m3 by 2020. The AEI is based on measurements taken in urban background locations averaged over a three year period from 2008-2010 and again from 2018-2020. Additionally, an exposure concentration obligation of 20 µg/m3 has been set which was to be complied with by 2012 again based on the AEI.

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Although the EU Air Quality Limit Values are the basis of legislation, other thresholds outlined by the EU Directives are used which are triggers for particular actions. The Alert Threshold is defined in Council Directive 96/62/EC as "a level beyond which there is a risk to human health from brief exposure and at which immediate steps shall be taken as laid down in Directive 96/62/EC". These steps include undertaking to ensure that the necessary steps are taken to inform the public (e.g. by means of radio, television and the press).

The Margin of Tolerance is defined in Council Directive 96/62/EC as a concentration which is higher than the limit value when legislation comes into force. It decreases to meet the limit value by the attainment date. The Upper Assessment Threshold is defined in Council Directive 96/62/EC as a concentration above which high quality measurement is mandatory. Data from measurement may be supplemented by information from other sources, including air quality modelling.

Under the terms of EU Framework Directive on Ambient Air Quality (96/62/EC), geographical areas within member states have been classified in terms of zones. The zones have been defined in order to meet the criteria for air quality monitoring, assessment and management as described in the Framework Directive and Daughter Directives. Zone A is defined as Dublin and its environs, Zone B is defined as Cork City, Zone C is defined as 23 urban areas with a population greater than 15,000 and Zone D is defined as the remainder of the country. The Zones were defined based on among other factors, population and existing ambient air quality.

EU Council Directive 96/62/EC on ambient air quality and assessment has been adopted into Irish Legislation (S.I. No. 33 of 1999). The act has designated the Environmental Protection Agency (EPA) as the competent authority responsible for the implementation of the Directive and for assessing ambient air quality in the State. Other commonly referenced ambient air quality standards include the World Health Organisation. The WHO guidelines differ from air quality standards in that they are primarily set to protect public health from the effects of air pollution. Air quality standards, however, are air quality guidelines recommended by governments, for which additional factors, such as socio-economic factors, may be considered.

RECEIVED: 21/09/2023

APPENDIX 9.2: Emission Factors

Emission Factors Used In Dust Emission Calculations (USEPA, 1986 & subsequent updates):

Road Haulage (Unpaved)

$E = [281.9 * k * (s/12)^{a} (W/3)^{b} ((365-P)/365)$ g/veh km

Where:
s = surface silt content (9.2%)
k = 4.9 (Total Dust), 1.8 (PM_{10}), 0.15 ($PM_{2.5}$)
W = mean vehicle weight (30 tonnes)
a = 0.9 ($PM_{10}/PM_{2.5}$), 0.7 (Total Dust)
b = 0.45
P = 192 wet days

Road Haulage (Paved)

$E = [k * (sL)^{0.91} * (W)^{1.02}](1-(P)/4N)$ g/veh km

Where:
sL = surface silt loading (9.2 g/m_2)
k = 24 (Total Dust), 4.6 (PM_{10}), 0.66 ($PM_{2.5}$)
W = mean vehicle weight (30 tonnes)
P = 192 wet days
N = 365 days

Material Loading

$E = k(0.0016) * (U/2.2)^{1.3} / (M/2)^{1.4} ((365-P)/365)$ kg/Mg

Where:
k = 0.74 (Total Dust), 0.35 (PM_{10}), 0.053 ($PM_{2.5}$)
M = moisture content (2.1%)
U = mean wind speed (3.3 m/s)
P = 192 wet days

Operation	Total Dust Emission Rate	PM_{10} Emission Rate	$PM_{2.5}$ Emission Rate
Conveyor Transfer ($g/s/m^2$)	5.18E-08	1.90E-08	4.84E-09
Screening ($g/s/m^2$)	8.08E-07	2.78E-07	1.81E-08
Stockpiling($g/s/m^2$)	2.82E-06	1.41E-06	5.65E-07
Primary, Secondary & Teritary Crushing (uncontrolled)	4.46E-07	1.98E-07	3.64E-08
Paved Roads (g/s) per source every 10 m	9.11E-04	1.75E-04	4.23E-05
Unpaved Roads (g/s) per source every 10 m	1.50E-02	4.36E-03	4.36E-04
Blasting ($g/s/m^2$)	N/A	N/A	N/A

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APPENDIX 9.3: Dust Minimisation Plan

A dust minimisation plan will be formulated as activities are likely to generate some dust emissions. The potential for dust to be emitted depends on the type of activity being carried out in conjunction with environmental factors including levels of rainfall, wind speeds and wind direction. The potential for impact from dust depends on the distance to potentially sensitive locations and whether the wind can carry the dust to these locations. The majority of any dust produced will be deposited close to the potential source. The objective of dust control at the site is to ensure that no significant nuisance occurs at nearby sensitive receptors. In order to develop a workable and transparent dust control strategy, the following management plan has been formulated by drawing on best practice guidance from Ireland, the UK (BRE 2003), (The Scottish Office 1996) (UK Office of Deputy Prime Minister 2002) and the USA (USEPA 1997), (USEPA 1986).

Communications

- Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the Local Authority. The level of detail will depend on the risk and should include as a minimum the highly recommended measures in this document. The desirable measures should be included as appropriate for the site. The DMP may include monitoring of dust deposition and/or visual inspections.

Site Management

- Regular inspections of the site and boundary should be carried out to monitor dust, records and notes on these inspections should be logged.
- Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.
- Make the complaints log available to the local authority when asked.
- Record any exceptional incidents that cause dust and/or air emissions, either on- or offsite, and the action taken to resolve the situation in the log book.

Monitoring

- Undertake daily on-site and off-site inspection, where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the local authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100 m of site boundary, with cleaning to be provided if necessary.
- Carry out regular site inspections to monitor compliance with the DMP, record inspection results, and make an inspection log available to the local authority when asked Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.
- Agree dust deposition, dust flux, or real-time PM10 continuous monitoring locations with the Local Authority.

Preparing and Maintaining the Site

- Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.

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- Erect solid screens or barriers around dusty activities or the site boundary that is at least as high as any stockpiles on site.
- Fully enclose specific operations where there is a high potential for dust production and the site is active for an extensive period.
- Avoid site runoff of water or mud.
- Keep site fencing, barriers and scaffolding clean using wet methods.
- Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below.
- Cover, seed or fence stockpiles to prevent wind whipping.
- A truck wash is available at the site exit to prevent trackout of materials onto the public road.
- Un-paved site roads are regularly watered using bowsers, especially during dry and windy periods when watering should be done twice per day.
- Stockpiling of materials is undertaken in sheltered areas of site where possible. Bowers should be used to increase the moisture value of stockpiles during dry or windy periods.

Operating Vehicles / Machinery and Sustainable Travel

- Ensure all vehicles switch off engines when stationary - no idling vehicles.
- Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable.
- Vehicles using site roads have their speed restricted to 40 kph on unsurfaced roads. Speed restrictions on hard surfaced roads are dictated by site management and are within the legal speed limit. Operations
- Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.
- Use enclosed chutes and conveyors and covered skips.
- Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.
- Ensure equipment is readily available on site to clean any dry spillages and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.

Waste Management

- No burning of waste materials.

Measures Specific to Earthworks

- Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.
- Where possible, only remove the cover in small areas during work and not all at once. Only one phase of the pit should be opened at any one time.
- During dry and windy periods, and when there is a likelihood of dust nuisance, a bowser will operate to ensure moisture content is high enough to increase the stability of the soil and thus suppress dust. Measures Specific to Trackout Site roads (particularly unpaved) can be a significant source of fugitive dust if control measures are not in place. The most effective means of suppressing dust emissions from unpaved roads is to apply speed restrictions. Studies show that these measures can have a control efficiency ranging from 25 to 80%.
- A speed restriction will be applied as an effective control measure for dust for on-site vehicles.

- Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.
- Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).
- Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits.
- Access gates to be located at least 10 m from receptors where possible.

RECEIVED: 21/09/2023

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10.0 Noise and Vibration

10.1 Introduction

This chapter of the EIAR was prepared by Noise and Vibration Consultants Ltd who were commissioned to assess the potential noise and vibration impacts associated with the development of a proposed sand and gravel pit at Knocknamoe and Ballymullen townlands, Abbeyleix, Co Laois.

10.2 The Existing Environment

The application site is approximately 8.5ha. in area and is situated in the townlands of Knocknamoe and Ballymullen which is located approximately 1km south of Abbeyleix town. The site is bordered by agricultural grassland to the east, north and south and by a local public road to the west which defines the western site boundary.

Landuse in the surrounding area is largely agricultural with scattered rural pattern of residential dwellings along the local roads to the west. The density of housing increases on approach to Abbeyleix town.

The site has an elevation range of between approximately 92mOD and 130mOD (Ordnance Datum) and is located on a hillside that steadily slopes in a westerly direction.

10.3 Description of Proposed Activity

The proposed development consists of the removal of the existing vegetation and soil material and extraction of sand and gravel from an 8.5 Ha. greenfield area and transporting the material to the applicants manufacturing facility located approximately 1.3km to the south of the application site. There will be no processing of material on the 8.5 Ha site. The material transported to the manufacturing facility will be processed into various grades of aggregate and sold to market or used to manufacture concrete products. The applicant is applying for planning permission to extract the available reserve of material and to restore the pit in phases on extraction of the available resource.

The existing and proposed layouts and sections through the application site are illustrated on figures attached to Section 3.0 of the EIAR.

10.4 Statement of Authority

This section of the EIAR has been prepared by Mr. Brendan O'Reilly of Noise and Vibration Consultants Ltd. Brendan has a master's degree in noise and vibration from Liverpool University and has over 35 years' experience in noise and vibration control (and many years' experience in preparation of noise impact statements) and has been a member of a number of professional organisations including a committee member of IMQS. Brendan was a co-author and project partner (as a senior noise consultant) in 'Environmental Quality Objectives Noise in Quiet Areas' administered by the Environmental Protection Agency (EPA).

Brendan has considerable experience in the assessment of noise impacts and has compiled EIA studies ranging from quarries, mines, tailing ponds, retail development, wastewater treatment plants, housing developments and wind farms.

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10.5 Methodology

In order to carry out a baseline noise survey at receptors surrounding the site and to assess the potential noise emissions from the proposed development, the following relevant guidance and legislation were consulted:

- Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) (Jan 2016).
- ISO 1996-1-2016: Acoustics: Description and Measurement of Environmental Noise-Basic Quantities and Assessment Procedures.
- Integrated Pollution Control Licensing – Guidance Note for Noise in Relation to Scheduled Activities, EPA 1995.
- ISO 9613-2, First Edition 1996-12-15. Acoustics-Attenuation of sound during propagation outdoors-Part 2: General method of calculations
- Draft Guidelines for the Treatment of Noise and Vibration in National Road Schemes
- BS5228, 2009 Code of Practice for Noise Control on Construction and Open Sites: Part 1: Noise.
- EPA, 2006, Environmental Management Guidelines-Environmental Management in Extractive Industry (Non-Scheduled Minerals).
- EPA, 2003, Environmental Quality Objectives-Noise in Quiet Areas
- HMSO, Welsh Office, 1988. Calculation of Road Traffic Noise

10.5.1 EPA Description of Effects

The significance of effects of the proposed development is described in accordance with the EPA guidance document *Guidelines on the information to be contained in the Environmental Impact Assessment Reports (EIAR), EPA May 2022*. The details of the methodology for describing the significance of effects are provided in Table 3.4: Section 3.7.3 of the aforementioned EPA 2022 document.

10.5.2 Baseline Noise Survey

A baseline noise survey was carried out at some of the nearest receptors to the proposed development. Two noise monitors were set up to run continuously between 11th and 13th November 2019 at locations NSL1 and NSL2 as shown on Plate 10.1.

10.5.3 Noise Monitoring Methodology

The following instruments were used:

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- Two Larson Davis LxT Sound Expert Precision Integrating Sound Level Analyser/Data logger.
- Wind Shields Type: Double Skinned Wind Screens.
- Calibration Type: Larson Davis Precision Acoustic Calibrator.

All instruments conform to BS EN 61672-1 and BS EN 60942, Class 1 and ISO Type 1.

10.5.3.1 Weather

The baseline noise survey was in a range of wind speeds between 2-7m/s. There was no precipitation during the day periods (08.00 to 18.00hrs). During the survey there was dry conditions with a west to north-west light wind.

10.5.3.2 Measurement Parameters

L_{Aeq} is the A-weighted equivalent continuous sound level measured during the sample period. It is an average of the fluctuating noise level over the sample period. It can also be described as a notional steady level that has the same sound energy as the real fluctuating noise over a specified time interval- it is a type of average represented by a single number over a specified time interval.

L_{AFMax} is the maximum A-weighted sound level during a stated time period (Fast Time weighting).

L_{A10} is the A-weighted sound level, which is exceeded for 10% of the sample period.

L_{A90} is the A-weighted sound level, which is exceeded for 90% of the sample period and is defined as the background noise level within BS 4142.

L_{A50} is the A-weighted sound level, which is exceeded for 50% of the sample period.

Sound Power Level (L_{WA} dB) is a measure of the acoustic energy emitted from a source of noise, expressed in decibels. The Sound Pressure Level is the pressure disturbance in the atmosphere measured using predefined conditions such as the location of the equipment, the environmental conditions, and the distance of the measurement from the measurement point. Sound power level refers to the source and sound pressure level is measured by a sound level meter at a distance from a source.

10.5.3.3 Measurement Procedure

Noise monitors were set up to run continuously with instruments set on 30 minute intervals with microphones at 1.2-1.5m above ground level. All the environmental noise analysers had data logging facilities set on real-time, the logged data was later downloaded via a personal computer using software. All noise monitors were calibrated before and after the survey and the maximum drift of calibration was 0.02dB. All monitors were within calibration certification times (photos of monitor in-situ in Appendix 10.1). Noise monitoring was undertaken at locations NSL1 and NSL2 as shown on Plate 10.1. NSL3 and NSL4 are used as additional locations for prediction.

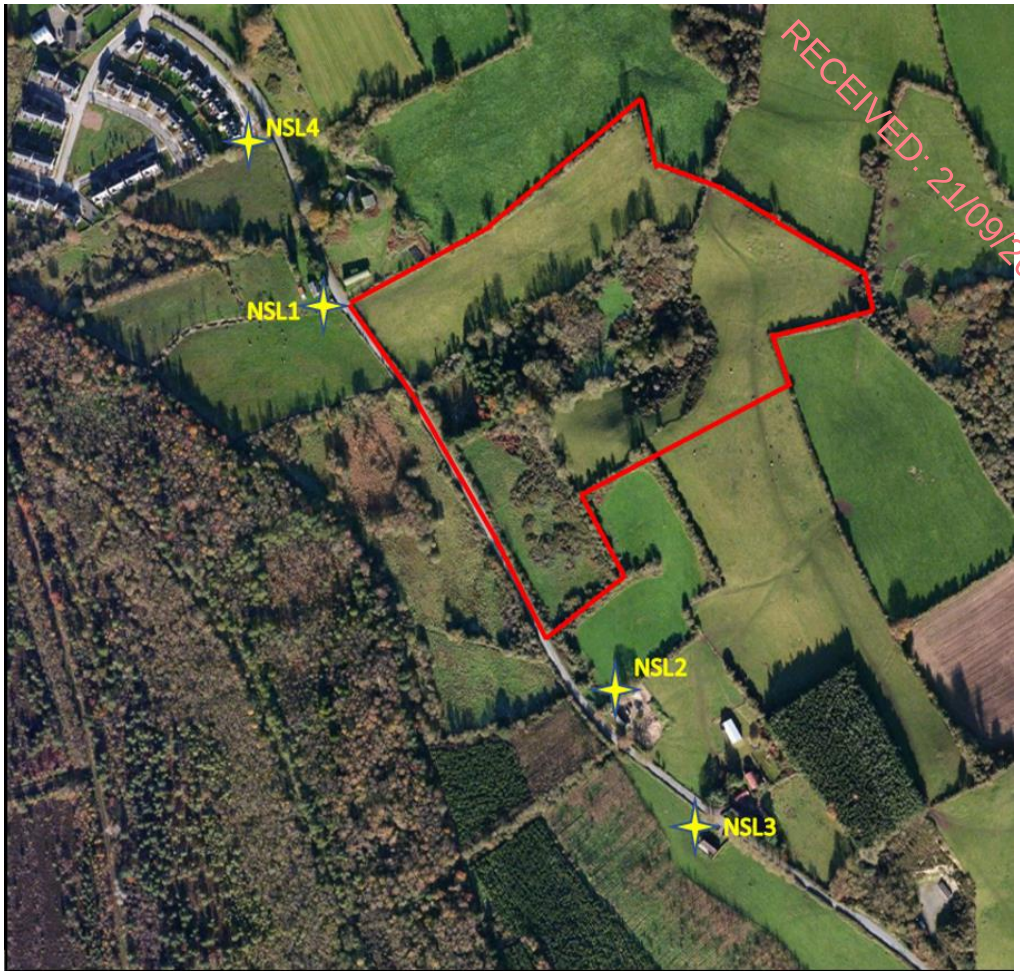

Plate 0.1: Noise monitoring and predictive locations.

10.5.4 Results of Baseline Noise Survey

A summary of the baseline mean noise levels is given in Table 10.1 (data in Appendix 10.2).

Table 0.1: Recorded mean noise levels taken at 30-minute intervals

ID	Date	Leq dBA	L10 dBA	L50 dBA	L90 dBA	Comments
NSL1	11th – 13th Nov'19	50.8	52.0	47.0	43.5	Road traffic flow from local road and N77, background from town and N77
NSL2	11th – 13th Nov'19	51.1	50.9	44.0	40.9	Road traffic flow from local road and N77, background from traffic flow on N77

10.6 Relevant Guidance and Legislation

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The EPA has produced Environmental Management Guidelines 2006[1]. This document references 'A Guidance Note for Noise in Relation to Scheduled Activities (EPA, 1996[2])'. It deals with the approach to be taken in the measurement and control of noise and provides advice in relation to the setting of emission limits values and compliance monitoring.

In relation to quarry developments and ancillary activities, it recommended that noise from the activities on site shall not exceed the following noise limits at the nearest noise-sensitive receptor:

Daytime	08.00-20.00 hrs	LAeq (1h) = 55dBA
Night-time	20.00-08.00 hrs	LAeq (1h) = 45dBA

95% of all noise levels shall comply with the specified limits values(s). No noise level shall exceed the limit value by more than 2dBA.

Recent night-time hours given by the EPA for licensed activities are 23.00hrs to 07.00hrs. There is no night-time activity proposed for the proposal.

The guidelines also recommend that where existing background noise levels are very low, lower noise level ELV's may be appropriate. It is also appropriate to permit higher ELV's for short term temporary activities such as construction of screening bunds etc. where such activities will result in considerable environmental benefit.

Very low background noise environment is well defined and referenced in the EPA's NG4 (January 2016). Quiet areas are referenced in NG4 and refer to in Environmental Quality Objectives - Noise in Quiet Areas. To qualify the first stage involves screening and a number of criteria needs to be satisfied, one which involves being more than 5km from a National Primary Route. The N77 is a National Primary Route and is within 0.9 km of the nearest receptors. The background noise survey demonstrates that the noise level at nearest receptors around the proposal are above that encountered at a low-level noise environment. Recent night-time hours given by the EPA for licensed activities are 23.00hrs to 07.00hrs. There is no night-time activity proposed for the proposal.

The noise limits proposed for this site is a daytime limit of LAeq (1h) of 55dBA with the limits being for noise emissions from sand and gravel extraction. The limits are for noise emissions from the sand and gravel operation.

10.6.1 Construction

Relevant Guidance

There is no published national guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. However National Roads Authority ("NRA") give limit values which are deemed acceptable ("the NRA Guidelines")[3]. Guidance to predict and control noise is also given in BS 5228:2009, *Code of Practice for Noise*

[1] Environmental Management in the Extractive Industry (Non-Scheduled Minerals),2006
[2] EPA's Guidance Note For Noise In Relation to Scheduled Activities, 1996
[3] National Roads Authority, *Guidelines for Noise and Vibration in National Road Schemes.*

and Vibration Control on Construction and Open Sites (two parts) where Part 1 deal with Noise. The NRA guidelines for construction noise which are considered typically acceptable are given in Table 10.2.

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Table 0.2: Construction noise levels that are typically acceptable based on the NRA guidelines

Day / Times	Guideline Limits
Monday to Friday 07:00 – 19:00hrs 19:00 – 22:00hrs Saturday 08:00 – 16:30hrs Sunday and Bank Holidays 08:00 – 16:00hrs	 70dB LAeq, (1h) and LAmax 80dB *60dB LAeq, (1h) and LAmax 65dB* 65dB LAeq,1h and LAmax75dB *60dB LAeq,1h and LAmax 65dB*

*Construction outside of these times, other than required by an emergency works, will normally require explicit permission from the relevant Local Authority

Part 1 of BS 5228 provides for control of noise effects from construction activities. The control methods include and are not limited to; the management of the site, supervision, maintenance and training, selection of equipment, working methods, hours of operation and screening barriers.

10.7 Development Proposal

The development includes removal of trees / vegetation, removal of topsoil, construction of acoustic berms followed by the extraction of the underlying sand and gravel. Material will be extracted by an excavator and transported by road trucks to the manufacturing facility located approximately 1.3km to the south of the application site. The development includes:

- Construction activity involves the removal of trees / vegetation, removal topsoil and construction of acoustic berms.
- Extraction of sand and gravel and restoration will be over an 8-phase extraction plan.
- The phased extraction is envisaged to extend over a period of 10 years. Revegetation will commence when an extraction phase is completed.

10.7.1 Hours for construction and operation

The proposed times of construction and operation are:

- Monday to Friday 07.00 hours and 20.00 hours
- Saturday 08.00 to 18.00 hours with no work Sunday, or Bank holidays

However, it is unlikely that the pit will operate to these maximum operating hours as the activities will be mainly confined to daylight hours. All activity on-site will be carried out within the aforementioned hours. The pit will provide employment for approximately 2 people. Plate 10.2 details the proposed phased extraction plan for the application site and the location of the proposed acoustic berms are detailed on Plate 10.3.

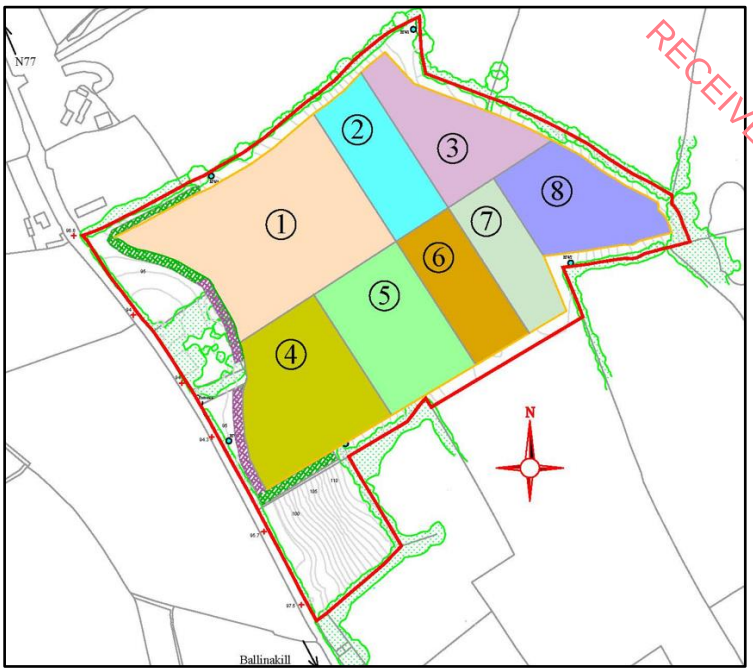

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Plate 0.2: Proposed Phases of Extraction

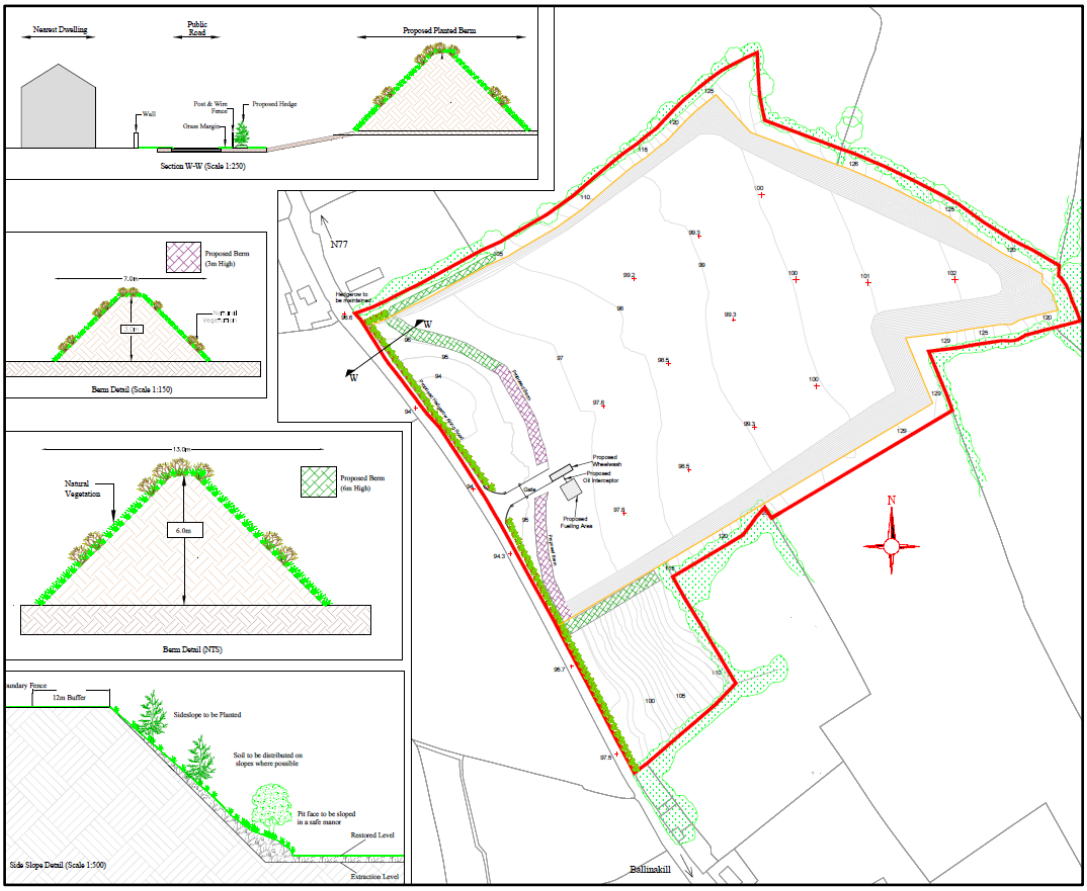

Plate 0.3: Location and Section through Proposed Berms

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10.7.2 Predicted Construction Noise Levels

The predicted noise levels are made for construction and operation phases of the development. The maximum levels will be during construction of the acoustic berms. All predictions are made at the boundary of the site when maximum levels are envisaged. This activity involves cutting of trees, removal of topsoil to construct of berms, removal of topsoil in a phased development and construction of wheel wash and concrete refuelling pad located close to the entrance/exit of the development.

10.7.2.1 Tree Cutting

The main noise source generated by this activity will be by a chain saw cutting trees. There will be no tree cutting on the boundary of the site. The nearest trees to the nearest receptor are as listed in Table 10.3. Recent research at the International Academic Research Congress, 2018[4] presented the results and analysis of noise level caused by a chainsaw during tree felling operations. Tree felling involves 4 stages (pre operation, undercut, back cut, post operation) with mean noise levels of 80.2 dBA. Assuming 2 chain-saws in operation the noise emission levels becomes 83.2 dBA. For the purpose of calculation a noise level of 83.2 dBA at 1m from a source which would equal a sound power level (L_{WA} of 94.2dB. The noise levels at a NSL's can be calculated by according to Equation 1.

Equation 1: Predicted Noise level = LW +D – (A_{geo} +A_{atm} +A_{gr} + A_{br} +A_{mis})

Where:

D is assumed as 2 when using hemi-spherical spreading which is taken into account in the equation for geometric spreading (by in effect adding 3dBA to the source).

A_{geo} –Geometric Spreading

Energy density doubles from a point source at ground level which results in hemi-spherical spreading resulting in attenuation over distance according to:

Lp = Lw – (20 log R + 8) which is equivalent to Lp = Lw – 20 log R - 8

Where:

Lp = sound pressure level

Lw = sound power level

R = distance from source to receptor

D = directivity is given as 2 with hemi-spherical spreading / radiation

and where

A_{atm} = Attenuation due to air absorption

A_{gr} = Attenuation due to ground absorption

A_{br} = Attenuation provided by a barrier- building

A_{mis} = Attenuation provided by miscellaneous other effects

Attenuation by Aatm, Agr and Amis is assumed to be 3dBA

The nearest group of trees to the nearest NSL (NSL1) is 112m. NSL2 is 213m from tree cutting. The maximum LAeq, 1hour noise levels generated by tree cutting at NSL1 gives 45.3 dBA. The maximum LAeq, 1hour noise levels generated by tree cutting at NSL2 gives 39.6dBA.

[4] Inac TAS, Abdulllah E, AKAY, 2018, Bursa Technical University, Bursa Turkey Analysis of Noise level caused by a chainsaw during tree felling operations, IARC

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10.7.7.2 Construction of Berm and Removal of Topsoil

The distance to the nearest location of construction and operation activity to the respective NSL's is given for each of the 8 phases of extraction in **Table 10.3.**

Table 0.3: Distance to receptors from construction noise sources (m)

Phases	Location id			
	NSL1	NSL2	NSL3	NSL4
Phase 1: Overburden removal on site boundary and construction of berm With berm constructed completed	48m 60m	286m	406m	172m
Phase 2: Overburden removal on site boundary	211m	337m	432m	245
Phase 3: Overburden removal on site boundary	256m	364m	449m	275m
Phase 4: Overburden removal on site boundary	164m	171m	302m	289m
Phase 5: Overburden removal on site boundary	200m	209m	309m	303m
Phase 6: Overburden removal on site boundary	255m	253m	332m	334m
Phase 7: Overburden removal on site boundary	293m	287m	354m	360m
Phase 8: Overburden removal on site boundary	328m	344m	410m	385m

Table 10.4 gives a list of plant and sound power levels (LWA dB) of the plant to be used on the site during operation of Development. All processing of material will be carried out off site.

Table 0.4: List of plant and LWA levels

Noise Source	Sound Power Level L_{WA}	Comments
Road lorry / truck	108	Operating at normal operation
Komatsu excavator	110	Operating filling truck / topsoil removal
Front end loader	109	Filling truck during operational phases
Tractor and bowser	107	Spraying water

Berm Construction

The maximum noise levels will be generated when constructing the berms as there will be no barrier attenuation. The berm construction activity in Phase 1 and Phase 4 (which requires topsoil material from Phase 1) will give the maximum noise levels. The activity will be short term and should be of duration of no more than 1 week equivalent (5 days), however the maximum levels at NSL1 and NSL2 will pertain for less than 1 day. During this activity no allowance is made for barrier attenuation, however attenuation by Aatm, Agr and Amis is assumed to be 3dBA. Construction of the berm will involve a dump truck and excavator

operating in tandem which equates to a level equivalent of (108 +110)L_{WA} equal to an L_{WA} = 112.1dB. The predicted noise levels are based on the nearest berm construction activity location in Phase 1 and Phase 4 to the respective NSL's when building the berm with assumption made that that the excavator and truck is working 100% of time. Table 10.5 gives the predicted maximum 1hr noise level from berm construction.

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Table 0.5: Predicted maximum noise levels from berm construction

Receptor ID	Distance to Receptor	Source LWA dB	Ground/Air absorption	Predicted Leq 1hr dBA
Phase 1				
NSL1	48	110.0	3	65.4+
NSL2	172	112.1	3	56.4
NSL3	211	112.1	3	54.6
NSL4	245	112.1	3	53.3
Phase 4				
NSL1	164	112.1	3	56.8
NSL2	171	110.0	3	54.4
NSL3	217	112.1	3	49.4
NSL4	289	112.1	3	51.9

+ Calculations based on an excavator constructing acoustic berm operating at 100% of time

10.7.2.3 Construction of Wheel Wash and Concrete Pad

This activity will be carried out close to the entrance at 170m from NSL1 and 265m from NSL2. These works of short duration with the main noise sources typically be an excavator and readymix truck emptying concrete. Levels expected from such activity given in Table 10.4 (110+108) giving an equivalent combined sound power level of 112.1 dBA. At NSL1 this will give a sound pressure level of 44.1ddBA and 40.5dBA at NSL2 without any berm/barrier effects. This activity is well within the noise limits as given in Table 10.2.

Vibration

Due to distance there are no ground vibration effects due to the onsite construction of the berms, removal of topsoil, cutting of trees or construction of wheel wash and concrete pad.

10.7.2.4 Decommissioning

Decommissioning of the phases commence when extraction is completed in each phase. Existing site plant will be used so there will be no increase in intensity of works. Decommissioning is expected to be of no more intensity and off shorter duration than construction so effects will be not significant.

10.7.3 Assessment

Tree cutting and berm construction noise levels are well within the construction guideline limits of 70dB LAeq, (1hr) as given in Table 10.2. The maximum level predicted are during the

construction of a barrier / berm on the north-east development which will persist for no more than one week equivalent (40 hrs).

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10.7.3.1 Description of Construction / Phase Decommissioning Effects

Construction effects include removal of topsoil to construct berms, cutting of trees and removal of topsoil in phases over the 10 year life of extraction. Even though the removal of topsoil will be carried out as part of the phased development the total accumulated time spent on this activity is expected to be no more than 6 months.

Using the EPA criteria for description of effects, the potential worst-case associated with construction and Phase Decommissioning effects at the nearest noise sensitive receptors are described below.

Table 0.6: Construction/ Phase Decommissioning Effects

Quality	Significance	Duration
Negative	Not significant	Temporary

It is not expected that there will be any cumulative impacts at NSL's during construction.

10.7.4 Operation of Development

With the 6m high berm completed attenuation is assumed as 18 dBA (calculated in excess of 18.4 dBA) and 13 dBA berm attenuation at distance of 150m (calculated at 13.4 dBA). The 6m high berm occupies an area north-west and south of the Development with a berm height of 3m along the road (see barrier effect calculations in Appendix 10.3). A berm/barrier is more effective when close to a source, or receptor.

The predicted noise levels are based on the nearest activity location to the respective NSL's during extraction with acoustic berm in place. The maximum predicted noise levels from extraction activity are given in Table 10.7. and is based on Equation 1 with no allowance made except for acoustic berm and hemi-spherical spreading.

The source noise level is taken as an L_{WA} of 112.1dB which means that a truck/lorry and excavator is working together and assumed to be working 100% in all one-hour periods with no down time which is highly unlikely (plant operating together for 50% in a one hour period would reduce the predicted noise levels by 3dBA).

Table 0.7: Predicted maximum noise levels from sand -pit extraction activity at NSL's

Phases	Location id- 1hour Leq dBA			
	NSL1	NSL2	NSL3	NSL4
Phase 1: Extraction nearest point	65.5-18 = **47.5** at 60m	55-13 = **42.0** at 286m	51.9-13 = **38.9** at 406m	59.4-13 = **46.4** at 172m
Phase 2: Extraction nearest point	57.6-13 = **44.6** at 212m	53.6-13 = **40.6** at 337m	51.4-13 = **38.4** at 432m	56.3-13 = **43.3** at 245m
Phase 3: Extraction nearest point	56.0-13 = **43.0** at 256m	52.9-13 = **39.9** at 364m	51.1-13 = **38.1** at 449m	55.3-13 = **42.3** at 275m
Phase 4: Extraction nearest point	59.8-13 = **46.8** at 164m	59.5-13 = **46.5** at 171m	57.4-13 = **44.4** at 217m	54.9-13 = **41.9** at 289m
Phase 5: Extraction nearest point	58.1-13 = **45.1** at 200m	57.7-13 = **44.7** at 209m	54.3-13 = **41.3** at 309m	54.9-13 = **41.5** at 303m
Phase 6: Extraction nearest point	56.0-13 = **43.0** at 255m	56.1-13 = **43.1** at 253m	53.7-13 = **40.7** at 332m	53.6-13 = **40.6** at 334m
Phase 7: Extraction nearest point	54.8-13 = **41.8** at 293m	55.0-13 = **42.0** at 287m	53.1-13 = **40.1** at 354m	53.0-13 = **40.0** at 360m
Phase 8: Extraction nearest point	53.8-13 = **40.8** at 328m	53.4-13 = **40.4** at 344m	51.9-13 = **38.9** at 410m	52.4-13 = **39.4** at 385m

NB: At the nearest locations NSL1 to the development berm attenuation of 18dBA will be obtained when the noise source is close to the berm.

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10.7.5 Assessment

The maximum predicted noise levels are well within the permitted daytime limit of 55dB LAeq (1h) given in the EPA's Environmental Management Guidelines 2006[2]. There is no plan to operate at night-time (where 45dB LAeq (1h) applies).

10.7.5.1 Noise assessment of sand and gravel operation proposal

Noise levels have been predicted at receptor locations at the nearest point in each of the eight phases of development. Mitigating measures have been recommended where deemed necessary. The predicted noise levels are maximum levels and include the cumulative on-site effects. The predicted noise levels are within the levels recommended by the EPA Environmental Management Guidelines for Quarries.

10.7.5.2 Description of Operational Effects

Using the EPA criteria for description of effects, the potential worst-case associated effects at the nearest noise sensitive receptors associated with the operation of the sand and gravel pit is described below. The description includes the ameliorative measures in Section 10.7.6 below.

[2] *Environmental Management Guidelines Environmental Management in the Extractive Industry (Non-Scheduled Minerals)*, EPA,2006

Table 0.8: Operational Effects

Quality	Significance	Duration
Negative	Not significant	Medium-term

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10.7.6 Ameliorative Measures Incorporated in Proposal

- Acoustic berms of minimum 6m height will be constructed as specified in Plate 10.3.
- There will be no processing of material on-site
- During extraction with acoustic berm constructed all plant will operate at local road elevation
- All plant on site will have well maintained silencers.
- Machinery will be throttled down or turned off when not in use.
- A noise buying standard will be put in place where any replacement of mobile plant will have noise characteristics considered.
- Construction activity will not be carried out during extraction activity.
- All mobile plant onsite will have white noise bleepers (broadband) for reversing to Health and Safety Standards

10.8 Cumulative Impacts

The application site was assessed in relation to the sites located within a 5km radius of the application site as tabulated in Table 3.2 and illustrated on Plate 3.3. None of the sites at a distances greater than 1.5km will have a noise impact due to distance on the nearest receptors to this development.

There are three facilities (O'Deas Quarry at 1.2km, Tullyroe Waste Water Treatment Plant at 1.2km and a licenced facility (EPA:P0710) not operating all located NW of the proposed site. Due to the significant hill between the aforementioned facilities and the nearest receptors a noise impact would have neutral effects.

Boots Concrete Products is located 1.3km south of the proposal and this facility was inaudible (less than 35dBA) at all both monitoring locations on my visits, accordingly a noise impact which would have neutral effects. Table 10.9 gives a description of the cumulative effects.

Table 0.9: Cumulative Effects

Quality	Significance	Duration
Neutral	Imperceptible	Medium-term

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10.9 Road Traffic Impacts

The road traffic flow is calculated as an average of 2 lorries per hour (4 movements) based on current demand / calculated based on tonnage. The development of the sand and gravel pit will not increase traffic flow but will lead to a decrease in the traffic flow noise on the north-west section of the local road (flow towards the town and through the town). Material currently being transported to the Booth Manufacturing Plant from Abbeyleix town direction will be significantly reduced which is a positive effect.

10.9.1 Description of Effects

There will be no increase in road traffic by the development and for a section of the local road traffic flow will be reduced. The effects of noise can be summarised as follows:

Table 0.9: Road Traffic Effects

Quality	Significance	Duration
Positive	Imperceptible	Medium-term

10.10 Ground Vibration

Road traffic vibration will not be increased due to the development with traffic flow reduced on the north-west section of the local road. The level of ground vibration at 5m from a loaded lorry will be below the human threshold at less than PPV of 0.2mm/sec[5]. There will be no activity on site that will generate ground vibration at any receptor.

10.11 Do-nothing Scenario

If the proposed development were not to proceed, then a higher level of road traffic would continue along the section of the local road towards the town and through the town.

10.12 Decommissioning Phases

Noise effects during decommissioning and restoration are likely to be of a similar nature to that during construction is Table 10.6. It is likely that the duration of decommissioning will be shorter than that during construction as decommissioning will be carried on a phased basis as part of the operation. When each phase is fully extracted then the revegetation process will commence with topsoil being placed over the phase area. Any legislation, guidance or best practice relevant at the time of decommissioning would be complied with.

10.13 Noise Monitoring

It is proposed to carry out noise monitoring at locations on the perimeter of the site on an annual basis close to the nearest two receptors NSL1 and NSL2.

[5] Wiss, J. F., and Parmelee, R. A.. (1974) Human Perception of Transient Vibrations, "*Journal of Structural Division*", ASCE, Vol 100, No. S74, PP. 773-787.

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10.14 Residual Effects

10.14.1 Construction / Decommissioning Phases

During construction there will be slight effects on the nearest NSL'S, however this activity is temporary with noise limits and defined working hours. There will be no ground vibration sources perceptible or measurable at any receptor. The effects as summarised based on maximum predicted noise levels based on specified ameliorative measures in Section 10.6.7 and are as follows:

Table 0.110: Construction / Decommissioning Phase Residual Effects

Quality	Significance	Duration
Negative	Not significant	Temporary

10.14.2 Operational Phases

At the nearest receptors there will be a slight change in noise levels for the nearest phases, however as the distance of activity increases from receptors the noise levels will decrease. The effects are as follows:

Table 0.111: Operational Residual Effects

Quality	Significance	Duration
Negative	Not Significant	Medium-term

10.15 Technical Difficulties

There were no technical difficulties encountered during the study / assessment.

10.16 Conclusion

Noise levels for the proposal have been predicted and include the cumulative effects of activity. Predictions have been made of maximum hourly noise levels with no allowance made for ground absorption or air attenuation. The predicted noise levels are given as maximum levels (worst-case scenario) and are well within the levels recommended by the EPA Environmental Management Guidelines-Environmental Management in Extractive Industry (Non Scheduled Minerals).

10.17 References

Department of Communities and Local Government (1993) *Minerals Planning Guidance 11 – The Control of Noise at Surface Mineral Workings* (MPG-11)

Department of the Environment, Heritage and Local Government (2004) *Quarries and Ancillary Activities: Guidelines for Planning Authorities*

DEFRA (2005) *Update of Noise Database for Prediction of Noise on Construction and Open Sites*

EPA (2006) *Environmental Management Guidelines Environmental Management in the Extractive Industry (Non-Scheduled Minerals)*

EPA (2012) *Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)*

EPA (2016) *Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)*

BS5228 (2009) *Code of Practice for Noise Control on Construction and Open Sites. Part 1: Noise*

Safety Health and Welfare at Work (Control of Noise at Work) Regulations 2006 (S.I. No. 371 of 2006)

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APPENDIX 10.1: Photos of Monitors in-situ.

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NSL1_Noise monitor in-situ

NSL2_Noise monitor in-situ

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APPENDIX 10.2: Baseline Noise Level Data.

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Table 1								Locn	NSL1	
Date	Time	Duration	LAeq	LAFmin	LAFmax	LAF5	LAF10	LAF33	LAF50	LAF90
2019-11-11	11:30:00	00:30:00.0	57.2	39.2	83.2	60.7	56.6	50.5	48.7	44.7
2019-11-11	12:00:00	00:30:00.0	52.2	39.2	70.9	56.8	53.5	49.6	48.1	44.1
2019-11-11	12:30:00	00:30:00.0	50.5	40	69	53.8	52.1	49.5	48.2	44.3
2019-11-11	13:00:00	00:30:00.0	51.2	39.3	71.2	54.3	52.6	49.8	48.6	44.2
2019-11-11	13:30:00	00:30:00.0	51.5	40.3	70.2	56.3	53.2	49	47.5	44.2
2019-11-11	14:00:00	00:30:00.0	51.7	39.2	72.5	55.1	52.7	49.5	48.1	44.5
2019-11-11	14:30:00	00:30:00.0	51.2	38.3	68.2	55.5	53.3	50.2	48.8	45.3
2019-11-11	15:00:00	00:30:00.0	53.3	39.8	76	57.7	54.8	51.1	49.7	45.7
2019-11-11	15:30:00	00:30:00.0	52.3	40	70.7	56.5	53.8	50.7	49.3	46.3
2019-11-11	16:00:00	00:30:00.0	52.1	38.8	72.5	55.8	53	49.7	48.5	45.1
2019-11-11	16:30:00	00:30:00.0	51.8	41	67.9	56.5	52.8	49	47.7	45.2
2019-11-11	17:00:00	00:30:00.0	50.2	39.6	64.4	55.2	52.1	48.8	47.8	44.7
2019-11-11	17:30:00	00:30:00.0	49.5	41.1	65.5	53.6	50.8	48.2	47.1	44.2
2019-11-11	18:00:00	00:30:00.0	47.7	39.6	65.5	50.5	48.7	46.6	45.7	43.2
2019-11-11	18:30:00	00:30:00.0	47.2	34.2	63.7	50	48.6	46	45.1	42.2
2019-11-11	19:00:00	00:30:00.0	46.2	36.7	63.3	49.2	47.8	45.7	44.6	41.2
2019-11-11	19:30:00	00:30:00.0	46.8	34.5	65.5	50	47.8	45.3	44.1	39.8
2019-11-11	20:00:00	00:30:00.0	46.8	35.5	62.5	51.2	48.7	45.8	44.7	40.8
2019-11-11	20:30:00	00:30:00.0	46.5	35.3	64.4	49.5	47.7	45.2	44	39.5
2019-11-11	21:00:00	00:30:00.0	45.8	35.2	63.7	49.8	48.2	45.1	43.3	38.6
2019-11-11	21:30:00	00:30:00.0	44.6	32.7	61.8	49	47.3	43.2	41.2	37.2
2019-11-11	22:00:00	00:30:00.0	42.6	31	57.1	47.3	46.2	43	40.6	34
2019-11-11	22:30:00	00:30:00.0	40.6	29.5	53.3	45.2	43.8	40.2	38.5	33.7
2019-11-11	23:00:00	00:30:00.0	43.2	31.8	60.7	47.2	45.5	42.2	40.7	36.7
2019-11-11	23:30:00	00:30:00.0	41.8	29.6	60.5	46.8	44.7	40.3	37.7	32.2
2019-11-12	00:00:00	00:30:00.0	38.7	26.3	59	44.5	42.2	37.1	34.3	28.6
2019-11-12	00:30:00	00:30:00.0	36.1	25.3	51.7	42.2	40.1	34.6	32.2	27.8
2019-11-12	01:00:00	00:30:00.0	38.2	26	61.1	44	42.1	36.6	34	28.8
2019-11-12	01:30:00	00:30:00.0	39.6	27.6	55.1	45.1	43.2	38.3	36.1	31.1
2019-11-12	02:00:00	00:30:00.0	40.6	26.3	58.2	46.8	44.3	37.7	34.8	29.6
2019-11-12	02:30:00	00:30:00.0	41.2	27.6	62.5	46.2	44.1	38.6	36.5	31
2019-11-12	03:00:00	00:30:00.0	40.6	28.1	54.5	46.8	44.1	38.7	36.2	32.2
2019-11-12	03:30:00	00:30:00.0	40.8	27.6	59.5	46.3	44.8	39.8	37.3	30.6
2019-11-12	04:00:00	00:30:00.0	43.1	32.2	59.5	48.7	46.8	41.3	39.2	35
2019-11-12	04:30:00	00:30:00.0	41	29.5	58.5	46.6	44.6	39.5	37.2	32.2
2019-11-12	05:00:00	00:30:00.0	43.7	32	57.6	48.7	47.1	43.2	41	35.7
2019-11-12	05:30:00	00:30:00.0	46.7	34.5	63.7	51.1	48.8	45.2	43.6	39.2
2019-11-12	06:00:00	00:30:00.0	47.3	34.7	66.2	51.3	49.2	46	44.5	39.2
2019-11-12	06:30:00	00:30:00.0	49.7	35.7	71.5	53.2	50.1	46.7	45.2	41.2
2019-11-12	07:00:00	00:30:00.0	51.6	37.2	69.5	55.5	52.6	49.2	47.8	44
2019-11-12	07:30:00	00:30:00.0	52.8	41.6	69.7	57.7	54.5	50.8	49.6	46
2019-11-12	08:00:00	00:30:00.0	52.8	43.1	69.5	56.7	54.2	51.2	50.1	46.6
2019-11-12	08:30:00	00:30:00.0	52.7	42.7	70.5	56.7	53.8	50.8	49.7	46.7
2019-11-12	09:00:00	00:30:00.0	51.7	42	69	56.2	53.2	50	48.8	45.7
2019-11-12	09:30:00	00:30:00.0	51.8	40.7	68	56.2	54.3	50.7	49.2	45.5
2019-11-12	10:00:00	00:30:00.0	51.7	41.3	71.9	55.8	52.7	49.2	48.2	44.7
2019-11-12	10:30:00	00:30:00.0	52	41.2	69.5	56.6	54.2	50.8	49.5	45.5
2019-11-12	11:00:00	00:30:00.0	52.5	43.5	68.2	56.8	54.8	51.7	50	46.5
2019-11-12	11:30:00	00:30:00.0	52.8	43.5	72	57	54.7	51.1	49.7	46.6

RECEIVED 21/09/2023

2019-11-12	12:00:00	00:30:00.0	53.1	43.3	69.5	57.8	55.7	51.5	50.1	46.5
2019-11-12	12:30:00	00:30:00.0	52.8	40.5	71.4	57.2	54.8	50.8	49.3	45.6
2019-11-12	13:00:00	00:30:00.0	51.1	38.7	69.4	55.8	53.1	49.6	47.8	43.2
2019-11-12	13:30:00	00:30:00.0	51.1	39.1	71.2	56.1	52.7	48.1	46.5	43
2019-11-12	14:00:00	00:30:00.0	50.2	36.3	68	54.8	52.1	47.8	46.2	41.8
2019-11-12	14:30:00	00:30:00.0	51.3	38.2	71	56.2	52.8	48.8	47.2	43.2
2019-11-12	15:00:00	00:30:00.0	51.2	37.2	75.4	56.2	52.2	47.5	46.2	42.2
2019-11-12	15:30:00	00:30:00.0	48.6	36.5	67.4	51.8	49	46	44.7	41.1
2019-11-12	16:00:00	00:30:00.0	50.8	38.6	71	55.5	51.7	47.2	45.7	42.1
2019-11-12	16:30:00	00:30:00.0	50.2	37.8	70.2	55.5	51.8	45.7	44.5	41.8
2019-11-12	17:00:00	00:30:00.0	50.3	40	69.2	55.2	51.5	47.7	46.6	43.6
2019-11-12	17:30:00	00:30:00.0	49.3	38.2	65	54.2	50.5	47.6	46.5	43.7
2019-11-12	18:00:00	00:30:00.0	48.7	38.6	65	53.7	49.8	47	45.8	43.2
2019-11-12	18:30:00	00:30:00.0	48.3	39	63.6	52.6	50	47.1	46	42.8
2019-11-12	19:00:00	00:30:00.0	46.7	37.3	61.7	49.8	48.3	45.7	44.7	41.6
2019-11-12	19:30:00	00:30:00.0	47.2	34.1	66.9	52	47.5	44.6	43.1	39.1
2019-11-12	20:00:00	00:30:00.0	45.2	33.2	66	47.3	46.1	43.6	42.3	38.6
2019-11-12	20:30:00	00:30:00.0	44.5	32.8	66.5	47.2	45.6	42.2	40.8	37.2
2019-11-12	21:00:00	00:30:00.0	44.2	33.3	61.8	48.7	46.3	42.6	40.8	36.7
2019-11-12	21:30:00	00:30:00.0	43.1	28.3	60.7	47.7	46.1	42.5	40.7	36
2019-11-12	22:00:00	00:30:00.0	40.7	27.6	51.2	44.8	43.7	41.2	39.8	33.3
2019-11-12	22:30:00	00:30:00.0	42.2	25.8	64.2	46.3	44.3	39.2	36.6	30.8
2019-11-12	23:00:00	00:30:00.0	39.2	24.5	57.2	43.7	42.3	38.8	36.2	29.8
2019-11-12	23:30:00	00:30:00.0	36.5	21.6	50.7	42.5	40.6	35.8	32.8	25.3
2019-11-13	00:00:00	00:30:00.0	36.7	21	51.2	43.1	41.2	35.2	31.5	24.1
2019-11-13	00:30:00	00:30:00.0	31.5	20.8	48.3	38.3	36.2	28.3	25.6	22.1
2019-11-13	01:00:00	00:30:00.0	38.2	20.1	64.7	39.3	36.8	26.8	23.8	21.1
2019-11-13	01:30:00	00:30:00.0	34.8	21.3	61.7	41.2	38.2	31.6	28.5	22.8
2019-11-13	02:00:00	00:30:00.0	37.7	22.1	55.2	43.6	41.6	36	33.1	24.5
2019-11-13	02:30:00	00:30:00.0	34.3	20.6	51.7	40.8	39	30.5	26.1	21.8
2019-11-13	03:00:00	00:30:00.0	35.6	20.6	51.1	42.5	39.8	32.7	25.6	21.6
2019-11-13	03:30:00	00:30:00.0	38.3	20.8	53.5	44.2	42.5	37.5	34.2	21.8
2019-11-13	04:00:00	00:30:00.0	37.2	21.1	56.2	43.7	41.2	33.6	30	23
2019-11-13	04:30:00	00:30:00.0	34.8	22.3	53.5	41.7	39.3	31.1	28	23.8
2019-11-13	05:00:00	00:30:00.0	38.5	23.3	57.7	43.3	41.8	38.1	35.2	26.3
2019-11-13	05:30:00	00:30:00.0	44.3	25.8	63.7	46.8	45.6	42.5	40.2	34.2
2019-11-13	06:00:00	00:30:00.0	45.1	30.6	66.9	47.1	44.8	42.1	40.7	36
2019-11-13	06:30:00	00:30:00.0	49	36.1	70.7	52.3	48.1	44.6	43.2	40
2019-11-13	07:00:00	00:30:00.0	51.2	36.7	70.2	55.6	51.3	45.8	44.6	41.2
2019-11-13	07:30:00	00:30:00.0	50.7	39.2	68.2	55.7	50.7	46.2	45.2	42.3
2019-11-13	08:00:00	00:30:00.0	51.7	39.8	71.2	57.2	51.8	47.3	46.3	43.3
2019-11-13	08:30:00	00:30:00.0	50.2	41	70.5	53.2	50.2	47.1	46.1	43.6
2019-11-13	09:00:00	00:30:00.0	50.6	38	70.2	54.7	50.1	45.8	44.7	42.1
2019-11-13	09:30:00	00:30:00.0	50.8	37.1	68	56.2	51.6	46.2	44.7	41.2
2019-11-13	10:00:00	00:30:00.0	50.5	34.3	70.9	55.2	51.1	44.7	43	39.5
2019-11-13	10:30:00	00:30:00.0	49.7	35	70.2	54	49.8	44.7	43.3	39.8
2019-11-13	11:00:00	00:30:00.0	51.1	33.1	70.7	54.8	50.7	46.8	45.2	40.1
2019-11-13	11:30:00	00:21:49.0	49.8	40.2	68.9	55	51.2	45.7	44.6	42.2

RECEIVED 21/09/2023

Table 2								Locn	NSL2	
Date	Time	Duration	LAeq	LAFmin	LAFmax	LAF5	LAF10	LAF33	LAF50	LAF90
2019-11-11	12:02:13	00:27:46.4	53.5	37.4	78.5	60.8	55.3	47.0	45.4	41.9
2019-11-11	12:30:00	00:30:00.0	49.7	37.1	68.5	53.8	49.3	45.5	44.4	40.7
2019-11-11	13:00:00	00:30:00.0	51.1	37.5	72.5	53.7	48.9	45.7	44.5	40.8
2019-11-11	13:30:00	00:30:00.0	52.9	36.7	74.3	59.2	52.9	45.8	44.2	40.6
2019-11-11	14:00:00	00:30:00.0	52.3	37.5	72.9	57.4	51.5	46.2	44.9	41.7
2019-11-11	14:30:00	00:30:00.0	51.0	38.4	69.3	54.9	50.9	46.9	45.6	42.7
2019-11-11	15:00:00	00:30:00.0	52.6	38.2	70.7	59.0	52.9	47.4	46.1	42.9
2019-11-11	15:30:00	00:30:00.0	52.1	38.9	70.6	56.8	51.7	47.2	46.0	43.2
2019-11-11	16:00:00	00:30:00.0	53.7	38.5	79.7	57.9	51.1	46.0	44.7	41.8
2019-11-11	16:30:00	00:30:00.0	52.7	38.1	70.0	59.6	52.7	45.8	44.6	41.9
2019-11-11	17:00:00	00:30:00.0	50.8	37.9	68.0	57.4	51.3	45.5	44.4	41.2
2019-11-11	17:30:00	00:30:00.0	49.3	38.4	69.0	53.9	48.3	44.5	43.4	41.2
2019-11-11	18:00:00	00:30:00.0	47.4	37.2	68.5	48.4	45.6	42.9	42.0	39.6
2019-11-11	18:30:00	00:30:00.0	46.5	31.7	68.0	47.7	45.4	42.7	41.7	39.1
2019-11-11	19:00:00	00:30:00.0	45.4	34.1	67.1	46.6	44.6	42.1	41.0	38.2
2019-11-11	19:30:00	00:30:00.0	46.5	32.0	68.3	46.8	44.8	41.5	40.3	37.0
2019-11-11	20:00:00	00:30:00.0	47.0	33.8	66.8	49.8	46.1	42.5	41.2	37.5
2019-11-11	20:30:00	00:30:00.0	46.4	33.1	67.9	47.5	45.2	41.6	40.1	36.7
2019-11-11	21:00:00	00:30:00.0	44.6	33.2	66.6	45.9	44.1	41.2	39.6	36.4
2019-11-11	21:30:00	00:30:00.0	43.9	31.1	67.4	45.5	43.6	40.3	38.7	35.0
2019-11-11	22:00:00	00:30:00.0	38.9	30.0	51.8	42.8	41.9	39.3	37.6	33.0
2019-11-11	22:30:00	00:30:00.0	37.5	27.1	54.0	42.2	40.6	37.0	35.8	31.6
2019-11-11	23:00:00	00:30:00.0	41.8	31.9	65.8	44.1	42.5	38.7	37.4	35.0
2019-11-11	23:30:00	00:30:00.0	39.4	29.5	62.8	41.6	40.2	37.2	35.6	32.2
2019-11-12	00:00:00	00:30:00.0	34.7	25.6	50.3	39.6	37.9	34.5	32.8	28.4
2019-11-12	00:30:00	00:30:00.0	32.6	25.1	47.2	37.5	36.1	32.0	30.3	26.9
2019-11-12	01:00:00	00:30:00.0	40.8	25.1	69.1	39.9	38.1	34.2	31.6	27.2
2019-11-12	01:30:00	00:30:00.0	36.4	26.3	55.0	40.8	39.3	36.3	34.4	30.2
2019-11-12	02:00:00	00:30:00.0	36.9	27.2	51.4	42.7	40.9	36.0	33.4	30.2
2019-11-12	02:30:00	00:30:00.0	39.9	27.1	67.5	42.3	40.0	36.1	34.0	30.0
2019-11-12	03:00:00	00:30:00.0	38.2	28.1	53.2	43.7	41.5	37.3	35.8	31.1
2019-11-12	03:30:00	00:30:00.0	37.3	25.2	51.2	42.3	40.9	37.1	34.9	28.6
2019-11-12	04:00:00	00:30:00.0	39.1	30.1	51.4	44.2	42.6	38.5	36.9	32.8
2019-11-12	04:30:00	00:30:00.0	38.2	28.1	50.8	43.1	42.0	37.9	36.2	31.2
2019-11-12	05:00:00	00:30:00.0	40.5	29.2	58.0	45.5	43.7	39.8	38.0	33.7
2019-11-12	05:30:00	00:30:00.0	45.6	34.2	69.6	47.6	45.7	41.8	40.5	37.4
2019-11-12	06:00:00	00:30:00.0	47.1	32.3	67.8	49.3	46.0	42.6	41.2	37.5
2019-11-12	06:30:00	00:30:00.0	50.3	34.4	69.9	53.4	47.5	43.5	42.3	38.6
2019-11-12	07:00:00	00:30:00.0	51.7	37.0	71.7	56.4	51.0	45.7	44.4	41.3
2019-11-12	07:30:00	00:30:00.0	54.1	39.4	72.1	61.6	55.6	48.2	46.8	43.6
2019-11-12	08:00:00	00:30:00.0	51.8	40.3	70.1	56.4	51.6	47.7	46.6	43.9
2019-11-12	08:30:00	00:30:00.0	53.1	40.7	71.0	59.8	53.1	47.7	46.6	43.9
2019-11-12	09:00:00	00:30:00.0	51.2	38.8	70.0	57.0	51.4	46.8	45.7	42.9
2019-11-12	09:30:00	00:30:00.0	51.7	40.4	70.0	56.9	52.7	48.0	46.4	43.4
2019-11-12	10:00:00	00:30:00.0	52.1	40.1	70.7	57.1	52.2	47.0	45.7	43.3
2019-11-12	10:30:00	00:30:00.0	51.9	41.2	70.0	56.3	52.9	48.9	47.5	44.6
2019-11-12	11:00:00	00:30:00.0	52.3	42.2	69.4	56.7	53.5	49.8	48.3	45.0
2019-11-12	11:30:00	00:30:00.0	53.1	41.4	73.3	58.2	53.8	49.2	47.7	44.5
2019-11-12	12:00:00	00:30:00.0	53.0	40.0	69.0	59.3	55.9	49.6	47.8	44.5
2019-11-12	12:30:00	00:30:00.0	52.4	40.3	70.6	57.2	53.0	48.2	46.6	43.5

RECEIVED: 21/09/2023

2019-11-12	13:00:00	00:30:00.0	51.0	37.9	69.2	56.2	51.9	46.5	45.0	41.3
2019-11-12	13:30:00	00:30:00.0	51.9	35.8	70.8	57.3	52.7	45.8	44.1	40.4
2019-11-12	14:00:00	00:30:00.0	51.4	36.3	70.4	56.4	51.5	45.1	43.3	39.8
2019-11-12	14:30:00	00:30:00.0	52.1	36.8	70.5	57.9	52.3	46.0	44.5	40.8
2019-11-12	15:00:00	00:30:00.0	51.7	34.9	70.6	57.0	51.6	44.6	42.7	39.3
2019-11-12	15:30:00	00:30:00.0	48.6	35.4	68.6	50.6	47.0	42.3	41.1	38.3
2019-11-12	16:00:00	00:30:00.0	51.2	35.4	69.2	56.0	49.7	43.6	42.3	39.2
2019-11-12	16:30:00	00:30:00.0	51.7	36.1	72.3	57.6	51.3	44.2	42.8	39.9
2019-11-12	17:00:00	00:30:00.0	50.7	36.6	68.4	56.5	50.3	44.1	43.0	40.4
2019-11-12	17:30:00	00:30:00.0	48.8	37.4	65.8	53.1	48.4	44.4	43.5	40.8
2019-11-12	18:00:00	00:30:00.0	49.1	36.9	67.9	53.4	47.8	43.8	42.7	40.0
2019-11-12	18:30:00	00:30:00.0	47.3	37.2	66.5	50.0	47.0	43.5	42.4	40.0
2019-11-12	19:00:00	00:30:00.0	46.1	34.5	66.4	47.9	45.6	42.6	41.4	38.6
2019-11-12	19:30:00	00:30:00.0	46.7	33.0	68.9	49.0	45.3	41.5	40.3	36.8
2019-11-12	20:00:00	00:30:00.0	46.4	32.9	69.7	46.1	43.5	40.5	39.2	36.4
2019-11-12	20:30:00	00:30:00.0	42.0	31.2	65.7	44.3	42.0	39.1	38.0	34.6
2019-11-12	21:00:00	00:30:00.0	42.5	30.1	66.4	44.6	42.6	39.5	37.9	34.1
2019-11-12	21:30:00	00:30:00.0	41.1	27.5	63.5	44.4	42.6	39.0	37.7	34.2
2019-11-12	22:00:00	00:30:00.0	38.7	26.6	61.0	41.4	40.2	37.9	36.8	31.9
2019-11-12	22:30:00	00:30:00.0	41.0	24.3	67.4	42.4	40.7	36.2	34.4	29.6
2019-11-12	23:00:00	00:30:00.0	36.8	22.6	58.0	40.7	39.3	35.8	33.5	28.3
2019-11-12	23:30:00	00:30:00.0	33.6	20.2	46.1	39.1	37.3	33.1	31.0	24.0
2019-11-13	00:00:00	00:30:00.0	32.9	19.0	48.1	38.2	36.8	32.4	29.6	22.9
2019-11-13	00:30:00	00:30:00.0	28.7	18.7	46.8	34.4	32.5	27.1	24.8	20.3
2019-11-13	01:00:00	00:30:00.0	38.4	17.8	67.4	37.4	34.2	26.2	23.3	19.5
2019-11-13	01:30:00	00:30:00.0	31.6	20.0	50.2	37.4	35.2	30.0	27.8	22.1
2019-11-13	02:00:00	00:30:00.0	35.2	20.7	51.7	40.6	39.0	34.8	31.7	23.8
2019-11-13	02:30:00	00:30:00.0	32.1	19.0	48.5	38.2	36.1	28.7	24.2	20.4
2019-11-13	03:00:00	00:30:00.0	32.2	18.9	47.2	38.6	36.6	30.2	24.6	20.2
2019-11-13	03:30:00	00:30:00.0	35.9	19.1	52.6	42.0	39.7	34.7	30.9	20.2
2019-11-13	04:00:00	00:30:00.0	35.4	19.4	54.2	42.0	38.2	30.9	27.4	21.4
2019-11-13	04:30:00	00:30:00.0	32.6	20.6	52.0	38.6	35.7	29.6	26.8	22.7
2019-11-13	05:00:00	00:30:00.0	37.3	21.8	63.3	40.7	38.8	34.6	32.1	25.3
2019-11-13	05:30:00	00:30:00.0	43.8	25.0	68.2	44.4	42.7	38.8	36.8	30.8
2019-11-13	06:00:00	00:30:00.0	46.1	29.4	68.9	45.9	43.6	40.7	39.5	33.7
2019-11-13	06:30:00	00:30:00.0	49.8	34.2	69.6	52.1	46.2	42.9	41.8	38.6
2019-11-13	07:00:00	00:30:00.0	52.4	35.3	71.6	57.9	49.5	43.4	42.2	39.0
2019-11-13	07:30:00	00:30:00.0	52.2	37.5	70.7	59.1	51.3	44.2	42.9	40.3
2019-11-13	08:00:00	00:30:00.0	54.1	37.1	78.8	60.4	52.9	44.9	43.4	40.6
2019-11-13	08:30:00	00:30:00.0	50.7	37.6	71.4	54.8	47.9	43.4	42.5	40.4
2019-11-13	09:00:00	00:30:00.0	51.2	36.3	70.6	55.3	48.9	42.8	41.8	39.5
2019-11-13	09:30:00	00:30:00.0	52.4	34.6	70.9	59.0	52.1	43.8	41.9	38.6
2019-11-13	10:00:00	00:30:00.0	52.3	34.3	73.0	58.5	51.4	42.6	40.7	37.8
2019-11-13	10:30:00	00:30:00.0	52.4	34.8	70.5	60.3	54.6	43.0	41.3	38.2
2019-11-13	11:00:00	00:30:00.0	54.4	34.3	70.5	62.1	58.3	46.4	44.6	38.9
2019-11-13	11:30:00	00:21:49.0	52.7	39.4	72.4	59.1	51.6	45.0	43.6	41.3

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APPENDIX 10.3: Barrier Effect Calculation.

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Appendix 10.3: Calculations of barrier effects

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Sketches not to scale

The source is taken as 2m height denoted by s. R is receptor and the barrier effect is calculated by by the *path difference*= a+b-c

Berm is 7m height and the nearest receptor NSL1 is approx. 2m below the level of extraction. The source is taken as 2m above pit base.

Path difference is 0.59 = 13.6dB when the barrier is from 50m receptor and 150m from source

Path difference is 2.52 = in excess of 18.4dB when the barrier is 50m from receptor and 5m from the source at boundary of excavation

Example given in Figure below *path difference* of 0.59

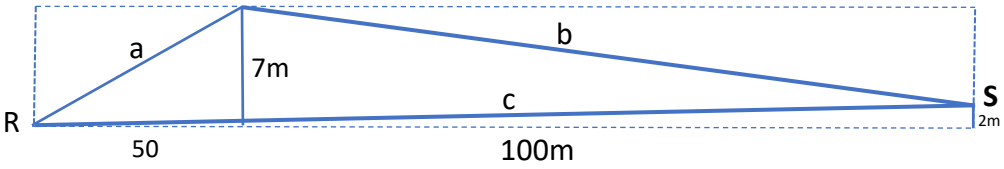

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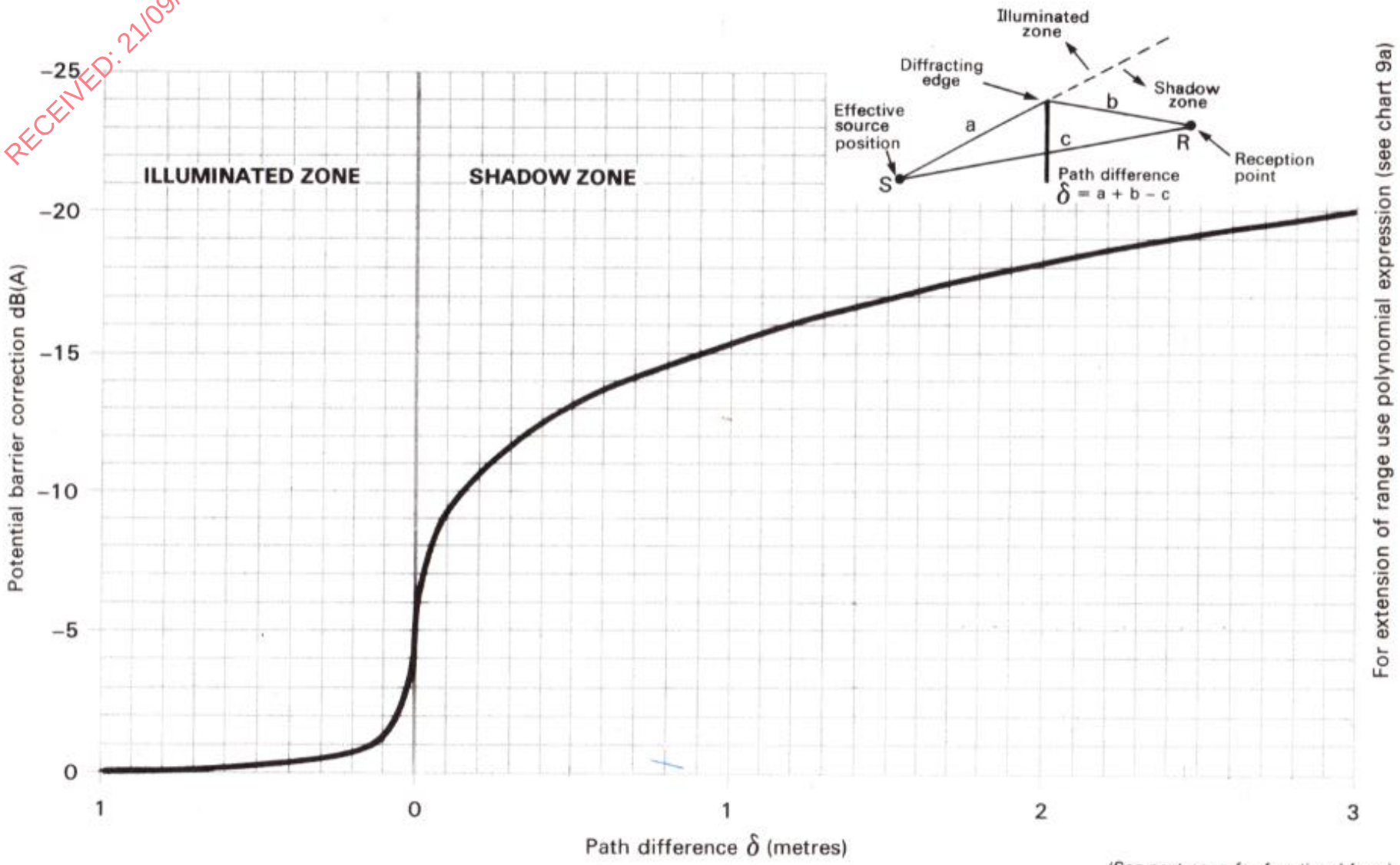
Chart 9 POTENTIAL BARRIER CORRECTION AS A FUNCTION OF PATH DIFFERENCE δ



(See next page for functional form)

Chart 9b Potential barrier correction A* dB(A) for path differences ($\delta = i + j$) calculated to the nearest 0.01 metres.**

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j	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
i	*SHADOW ZONE*									
0.0	5.0	6.4	7.1	7.6	7.9	8.2	8.5	8.7	9.0	9.2
0.1	9.3	9.5	9.7	9.8	10.0	10.1	10.3	10.4	10.5	10.6
0.2	10.8	10.9	11.0	11.1	11.2	11.3	11.4	11.5	11.6	11.7
0.3	11.7	11.8	11.9	12.0	12.1	12.1	12.2	12.3	12.4	12.4
0.4	12.5	12.6	12.6	12.7	12.8	12.8	12.9	13.0	13.0	13.1
0.5	13.1	13.2	13.3	13.3	13.4	13.4	13.5	13.5	13.6	13.6
0.6	13.7	13.7	13.8	13.8	13.9	13.9	14.0	14.0	14.1	14.1
0.7	14.2	14.2	14.3	14.3	14.4	14.4	14.5	14.5	14.5	14.6
0.8	14.6	14.7	14.7	14.7	14.8	14.8	14.9	14.9	14.9	15.0
0.9	15.0	15.1	15.1	15.1	15.2	15.2	15.3	15.3	15.3	15.4
1.0	15.4	15.4	15.5	15.5	15.5	15.6	15.6	15.6	15.7	15.7
1.1	15.7	15.8	15.8	15.8	15.9	15.9	15.9	16.0	16.0	16.0
1.2	16.1	16.1	16.1	16.2	16.2	16.2	16.3	16.3	16.3	16.3
1.3	16.4	16.4	16.4	16.5	16.5	16.5	16.6	16.6	16.6	16.6
1.4	16.7	16.7	16.7	16.8	16.8	16.8	16.8	16.9	16.9	16.9
1.5	16.9	17.0	17.0	17.0	17.1	17.1	17.1	17.1	17.2	17.2
1.6	17.2	17.2	17.3	17.3	17.3	17.3	17.4	17.4	17.4	17.4
1.7	17.5	17.5	17.5	17.5	17.6	17.6	17.6	17.6	17.7	17.7
1.8	17.7	17.7	17.8	17.8	17.8	17.8	17.8	17.9	17.9	17.9
1.9	17.9	18.0	18.0	18.0	18.0	18.1	18.1	18.1	18.1	18.1
2.0	18.2	18.2	18.2	18.2	18.3	18.3	18.3	18.3	18.3	18.4
	ILLUMINATED ZONE									
0.0	5.0	3.5	2.8	2.3	2.0	1.8	1.6	1.5	1.3	1.2
0.1	1.1	1.0	1.0	0.9	0.8	0.8	0.7	0.7	0.6	0.6
0.2	0.6	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.3
0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2
0.4	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1
0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.6	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0

* Values of A are negative

** e.g. where the reception point is in the shadow zone and $\delta = 1.45$ metres:
then $i = 1.4$ and $j = 0.05$
from the table the value of A is − 16.8 dB(A).

APPENDIX 10.4: Copy of Calibration Certificates.

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Appendix 10.4: Copy of Calibration certifaces

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MTS Calibration Ltd,
The Grange Business Centre,
Belasis Avenue,
Billingham TS23 1LG,
England
Telephone: 01624 876 410

CERTIFICATE OF CALIBRATION

Approved Signatory:

Tony Sherris

Issued by: MTS Calibration Ltd

Date of Issue: 24 January 2019 **Certificate Number:** 32818

Sound Level Meter

Sound Level Meter Periodic Tests to EN 61672-3: 2013 Class 1

Client: Environmental Measurements on behalf of Brendan O'Reilly
Unit 12, Tallaght Business Centre
Whitestown Business Park
Co.Dublin 24, Ireland

Instrument Make: Larson Davis
Instrument Model: LxT1L
Serial Number: 0004643

10

Associated Equipment	Make	Model	Serial number
Preamplifier	PCB	PRMLxT1L	042742
Microphone	PCB	377B02	173111
Calibrator	Larson Davis	CAL200	9175
Calibrator supplied by	by MTS for this calibration		

Test results summary, detailed results are shown on subsequent pages.

Periodic tests were performed in accordance with procedures from IEC 61672-3:2013 Class 1

Tests performed	Section	Results of test	Page	Comments
Calibration Certificate	22		1	
Additional information			2	
Indication with Calibrator Supplied	10	No Limit	3	
Self-Generated Noise	11	No Limit	3	
Frequency and Time-weightings at 1kHz	14	Complies	3	
Long term stability	15	Complies	3	
High stability	21	Complies	3	
Acoustic Tests	12	Complies	4	
Frequency Weighting A	13	Complies	5	
Frequency Weighting C	13	Complies	6	
Frequency Weighting Z	13	Complies	7	
Level Linearity	16	Complies	8	
Level Linearity Range Control	17		n/a	Only one range
Tone-burst Response	18	Complies	9	
Peak C sound level	19	Complies	10	
Overload indication	20	Complies	11	
Additional tests performed				
Microphone		32820		See additional certificate
Filter, third octave or octave		32818F		See additional certificate

The instrument was within the above specification as received - no modifications were made

The sound level meter submitted for testing has successfully completed the periodic tests of IEC 61672-3: 2013 for the environmental conditions under which the tests were performed. As evidence was publicly available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2: 2013, to demonstrate that the model of sound level meter fully conformed to the Class 1 specifications in IEC 61672-1: 2013, the sound level meter submitted for testing conforms to the Class 1 specifications of IEC 61672-1: 2013

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

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MTS Calibration Ltd,
The Grange Business Centre,
Belasis Avenue,
Billingham TS23 1LG,
England
Telephone: 01624 876 410

CERTIFICATE OF CALIBRATION

Approved Signatory:

Tony Sherris

Issued by: MTS Calibration Ltd

Date of Issue: 25 January 2019 **Certificate Number:** 32815

Sound Level Meter

Sound Level Meter Periodic Tests to EN 61672-3: 2013 Class 1

Client: Environmental Measurements on behalf of Brendan O'Reilly
Unit 12, Tallaght Business Centre
Whitestown Business Park
Co.Dublin 24, Ireland

Instrument Make: Larson Davis
Instrument Model: LxT1L
Serial Number: 0004647

9

Associated Equipment	Make	Model	Serial number
Preamplifier	PCB	PRMLxT1L	042725
Microphone	PCB	377B02	171552
Calibrator	Larson Davis	CAL200	9175
Calibrator supplied by	by MTS for this calibration		

Test results summary, detailed results are shown on subsequent pages.

Periodic tests were performed in accordance with procedures from IEC 61672-3:2013 Class 1

Tests performed	Section	Results of test	Page	Comments
Calibration Certificate	22		1	
Additional information			2	
Indication with Calibrator Supplied	10	No Limit	3	
Self-Generated Noise	11	No Limit	3	
Frequency and Time-weightings at 1kHz	14	Complies	3	
Long term stability	15	Complies	3	
High stability	21	Complies	3	
Acoustic Tests	12	Complies	4	
Frequency Weighting A	13	Complies	5	
Frequency Weighting C	13	Complies	6	
Frequency Weighting Z	13	Complies	7	
Level Linearity	16	Complies	8	
Level Linearity Range Control	17		n/a	Only one range
Tone-burst Response	18	Complies	9	
Peak C sound level	19	Complies	10	
Overload indication	20	Complies	11	
Additional tests performed				
Microphone		32817		See additional certificate
Filter, third octave or octave		32815F		See additional certificate

The instrument was within the above specification as received - no modifications were made

The sound level meter submitted for testing has successfully completed the periodic tests of IEC 61672-3: 2013 for the environmental conditions under which the tests were performed. As evidence was publicly available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2: 2013, to demonstrate that the model of sound level meter fully conformed to the Class 1 specifications in IEC 61672-1: 2013, the sound level meter submitted for testing conforms to the Class 1 specifications of IEC 61672-1: 2013

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