6. LAND, SOILS AND GEOLOGY

6.1 Introduction

6.1.1 Background and Objectives

Hydro-Environmental Services (HES) was engaged by McCarthy Keville O'Sullivan Ltd. (MKO) to carry out an Environmental Impact Assessment Report (EIAR) of the likely effects of the proposed infilling and restoration of a sand and gravel quarry (i.e. the site) at Portersize, Ballitore, Co. Kildare on the land, soils and geological environment.

The applicant (Lawler Ltd.) plans to operate the site as a soil recovery facility under an Environmental Protection Agency (EPA) waste licence which will grant permission to accept inert soil and stones (EWC 17 05 04) that will be used to infill and restore the site.

This EIAR provides a baseline assessment of the environmental setting of the site in terms of land, soils and geology and discusses the potential likely effects and cumulative effects that the proposed infilling and restoration will have. Where required, appropriate mitigation measures to limit any identified significant effects to land, soils and geology are recommended.

6.1.2 Statement of Authority

HES are a specialist geological, hydrological, hydrogeological, and environmental practice which delivers a range of geological, water and environmental management consultancy services to the private and public sectors throughout Ireland and Northern Ireland. HES was established in 2005, and their office is located in Dungarvan, County Waterford.

HES core areas of expertise includes soils, subsoils and geology. We routinely complete impact assessments for land, soils and geology, and hydrology and hydrogeology, for a large variety of project types.

This chapter of the EIAR was prepared by Michael Gill and David Broderick.

Michael Gill is an Environmental Engineer with over 18 years' environmental consultancy experience in Ireland. Michael has completed numerous geological, hydrological and hydrogeological impact assessments of sand and gravel pits and quarries across Ireland. He has also managed EIAR assessments for infrastructure projects and private residential and commercial developments, and also renewable energy projects. In addition, he has substantial experience in EIAR for soil recovery facilities, and waste licence facilities. Some recent examples include: Garryhesta, Co. Cork; Clashford Waste Recovery Facility, The Naul, Co. Meath; Clasheen Pit, Killarney, Co. Kerry; Brownwood, Enniscorthy, Co. Wexford; and Kildare Sand and Gravel Ltd, Boherkill, Rathangan, Co. Kildare.

David Broderick is a hydrogeologist with over 13 years' experience in both the public and private sectors. Having spent two years working in the Geological Survey of Ireland (GSI), mainly on groundwater and source protection studies, David moved into the private sector. David has a strong background in groundwater resource assessment and hydrogeological/hydrological investigations in relation to developments such as quarries and landfills. David has completed numerous geology and water sections for input into EIARs for a range of commercial developments.

6.1.3 Relevant Legislation

The following European Union (EU) Directives relate to Land, Soils and Geology at the site in this EIAR:

- Environmental Impact Assessment Directive (2011/92/EU);
- Environmental Impact Assessment Directive (2014/52/EU);
- The management of waste from extractive industries (2006/21/EC); and,
- Environmental Liability Directive (2004/35/EC).

The EU EIA Directive regulates the information impact assessment process and information in this EIAR. The management of waste Directive and the Environmental Liability Directive regulates the activities at the site.

The requirements of the following legislation are complied with:

- S.I. No. 349 of 1989: European Communities (Environmental Impact Assessment) Regulations, and subsequent Amendments (S.I. No. 84 of 1995, S.I. No. 352 of 1998, S.I. No. 93 of 1999, S.I. No. 450 of 2000 and S.I. No. 538 of 2001), S.I. No. 30 of 2000, the Planning and Development Act, and S.I. 600 of 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; and,
- S.I. No 296 of 2018: S.I. No. 296 of 2018: European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 which transposes the provisions of Directive 2014/52/EU into Irish law.

6.1.4 Relevant Guidance

This Land, Soils and Geology section of the EIAR has been prepared with regard to the following guidelines:

- Environmental Protection Agency (2017) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports. Draft dated May 2017. Environmental Protection Agency, Johnstown Castle Estate, Co. Wexford;
- Department of the Environment, Climate and Communications (DECC) (2010) Appropriate Assessment of Plans and Projects in Ireland - Guidance for Planning Authorities;
- (GSI), Irish Concrete Federation (2008) Geological Heritage Guidelines for the Extractive Industry;
- Institute of Geologists of Ireland (2002) Geology in Environmental Impact Statements, A Guide;
- Institute of Geologists of Ireland (2007) Recommended collection, presentation and interpretation of geological and hydrogeological information for quarry developments;
- Institute of Geologists of Ireland (2013) Guidelines for the preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements;
- National Roads Authority (NRA) (2008) Environmental Impact Assessment of National Road Schemes - A Practical Guide;
- NRA (2008) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;

- Guidelines for Planning Authorities and An Bord Pleanála (ABP) on carrying out Environmental Impact Assessment (Department of Housing, Local Government and Heritage (DoHLGH) 2018); and,
- Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended by 2014/52/EU), (European Union, 2017).

6.2 Schedule of Works

6.2.1 Desk Study

A desk study of the site and the surrounding area was completed in advance of undertaking the walkover survey and site investigations. This involved collecting all relevant geological data for the site and surrounding area. This included consultation of the following:

- Environmental Protection Agency (EPA) database (www.epa.ie);
- Geological Survey of Ireland (GSI) - Groundwater Database (www.gsi.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 16 (Kildare-Wicklow). GSI (GSI, 1995);
- GSI – 1:25,000 Field Mapping Sheets;
- General Soil Map of Ireland 2nd edition (www.epa.ie); and,
- Previous sites investigations undertaken by John Barnett and Associates (JBA) in 2005.

6.2.2 Baseline Monitoring and Site Investigations

A site walkover and geological baseline mapping was undertaken by HES in January 2020. Site investigations, topographic surveys and baseline monitoring was undertaken in June and July 2020.

In summary, surveys to address the Land, Soil and Geology section of the EIAR included the following:

- A detailed walkover survey to assess the ground conditions and layout of the proposed infilling/restoration site including surveys of current extraction areas and adjacent lands;
- Mapping of sand/gravel and overburden exposures on the sides of the quarry void; and,
- Drilling of 4 no. groundwater monitoring wells to investigate depth to bedrock and overburden type/lithology.

6.2.3 Scoping and Consultation

The scope for this chapter of the EIAR has also been informed by consultation with statutory consultees, bodies with environmental responsibility and other interested parties. This consultation process is outlined in Section 2.4 of this EIAR.

With respect to Land, Soils and Geology relevance, there was a response from the GSI which was informative in nature, regarding their available online geological mapping datasets (www.gsi.ie).

6.2.4 Impact Assessment Methodology

Using information from the desk study and data from the site investigation, an estimation of the importance of the land, soil and geological environment within the study area is assessed using the criteria set out in Table 6-1 (NRA, 2008).

Table 6-1: Estimation of Importance of Soil and Geology Criteria (NRA, 2008).

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

The guideline criteria (EPA, 2017) for the assessment of impacts require that likely impacts are described with respect to their extent, magnitude, complexity, probability, duration, frequency, reversibility and trans-frontier nature (if applicable). The descriptors used in this environmental impact assessment are those set out in EPA (2002) Glossary of Impacts, as detailed in Chapter 1 of this EIAR. In addition, the two impact characteristics, proximity and probability, are described for each impact and these are defined in

Table 6-2.

In order to provide an understanding of this descriptive system in terms of the geological/hydrological environment, elements of this system of description of impacts are related to examples of potential impacts on the hydrology and morphology of the existing environment, as listed in Table 6-3.

Table 6-2: Additional Impact characteristics

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

Table 6-3: Impact descriptors related to the receiving environment

Impact Characteristics		Potential Hydrological Impacts
Quality	Significance	
Negative only	Profound	Widespread permanent impact on: › The extent or morphology of a Special Area of Conservation (SAC). › Regionally important aquifers. › Extents of floodplains. Mitigation measures are unlikely to remove such impacts.
Positive or Negative	Significant	Local or widespread time dependent impacts on: › The extent or morphology of a SAC / ecologically important area. › A regionally important hydrogeological feature (or widespread effects to minor hydrogeological features). › Extent of floodplains. Widespread permanent impacts on the extent or morphology of a Natural Heritage Area (NHA) or ecologically important area. Mitigation measures (to design) will reduce but not completely remove the impact – residual impacts will occur.

Impact Characteristics		Potential Hydrological Impacts
Quality	Significance	
Positive or Negative	Moderate	Local time dependent impacts on: › The extent or morphology of a SAC / NHA / ecologically important area. › A minor hydrogeological feature. › Extent of floodplains. Mitigation measures can mitigate the impact or residual impacts occur, but these are consistent with existing or emerging trends.
Positive, Negative or Neutral	Slight	Local perceptible time dependent impacts not requiring mitigation.
Neutral	Imperceptible	No impacts, or impacts which are beneath levels of perception, within normal bounds of variation, or within the bounds of measurement or forecasting error.

6.2.5 Limitations/Difficulties Encountered

This EIAR has been prepared based on available desktop information, a recent topographic survey of the site and site visits undertaken between January and July 2020.

Ground investigation works have been carried out at the site to confirm the nature, extent and depth / thickness of the sand and gravel resource at the proposed infill areas. The assessment is also based on existing exposures in the pits.

No specific limitations or difficulties were encountered in the preparation of this EIAR.

6.3 Existing Environment

6.3.1 Site Description, Land and Topography

The proposed development site is located in the townland of Portersize, approximately 1.5 kilometres (km) southeast of Ballitore, County Kildare. The R448 Regional Road is located approximately 0.5 km to the west of the site and the R747 is located adjacent to the south of the site, where it forms a junction at the site entrance. The proposed site for infill and restoration is an active sand and gravel quarry which operates above the local groundwater table.

The planning application boundary area measures approximately 34.25 hectares (ha) which is contained within a landholding in the control of Lawler Ltd., which measures approximately 65.2 ha. The existing quarry void measures approximately 10.74 ha. The proposed development being applied for under this current planning application includes for the infilling and restoration of the existing and future quarry void, over an area of approximately 18.95 ha (extent of current permitted extraction boundary). The floor elevation of the quarry void varies between approximately 110mOD (Ordnance Datum – Malin Head) and 129mOD with the lowest area being on the north of the extraction area and the highest at the south.

The site is bordered by grassland to the east, west and south where the natural ground elevation varies between 130m and 135mOD. The northern site boundary is defined by the Crookstown Stream. The northern extent of the extraction area is set back at least 100m from the Crookstown Stream and much of the site in between is tree covered natural ground. A manmade earthen berm, which is approximately 6-7m high, runs along the bank of the Crookstown Stream, close to the northern boundary.

A reception cabin, a weigh bridge and maintenance/welfare facilities are located on the west of the site which is the access point to the extraction area. An aggregate processing area (wet and dry sorting) is located in the central area of the extraction pit along with a number of closed system/recycling washing lagoons and aggregate stockpiles.

Access to the site via a site entrance road is from the R747 which is located to the southwest of the site.

6.3.2 Soils and Subsoils

The published soils map (www.epa.ie) for the area shows that deep well drained mineral soils (AminDW) are mapped in the area site (much of the soils inside the site boundary have been removed as a result of ongoing aggregate extraction) with Alluvium mapped along the Crookstown Stream which flows along the northern boundary.

Based on the GSI subsoils map (www.gsi.ie), limestone sand and gravels are mapped in the central area of the site with sandstone and shale tills on the east and west of the site with limestone tills on the north-western section of the site. A GSI subsoil geology map is shown below as Figure 6-1.

The sand and gravels exposed on the sides of the current extraction area, which are glaciofluvial in nature, are typically poorly sorted with occasional bands of fine sorted SAND and SILT. Cobbles and boulders are numerous within the poorly sorted horizons.

Four groundwater monitoring wells were installed at the site between 15th and 17th June 2020 by Petersen Drilling Services Ltd., with oversight provided by HES. Boreholes were constructed using a truck mounted air rotary drilling rig with a 50mm internal diameter (id) standpipe used at each location.

The locations of the wells are shown on Figure 6-1 below and summary details are shown in Table 6-4 below. Detailed drilling logs are attached as Appendix 6-1.

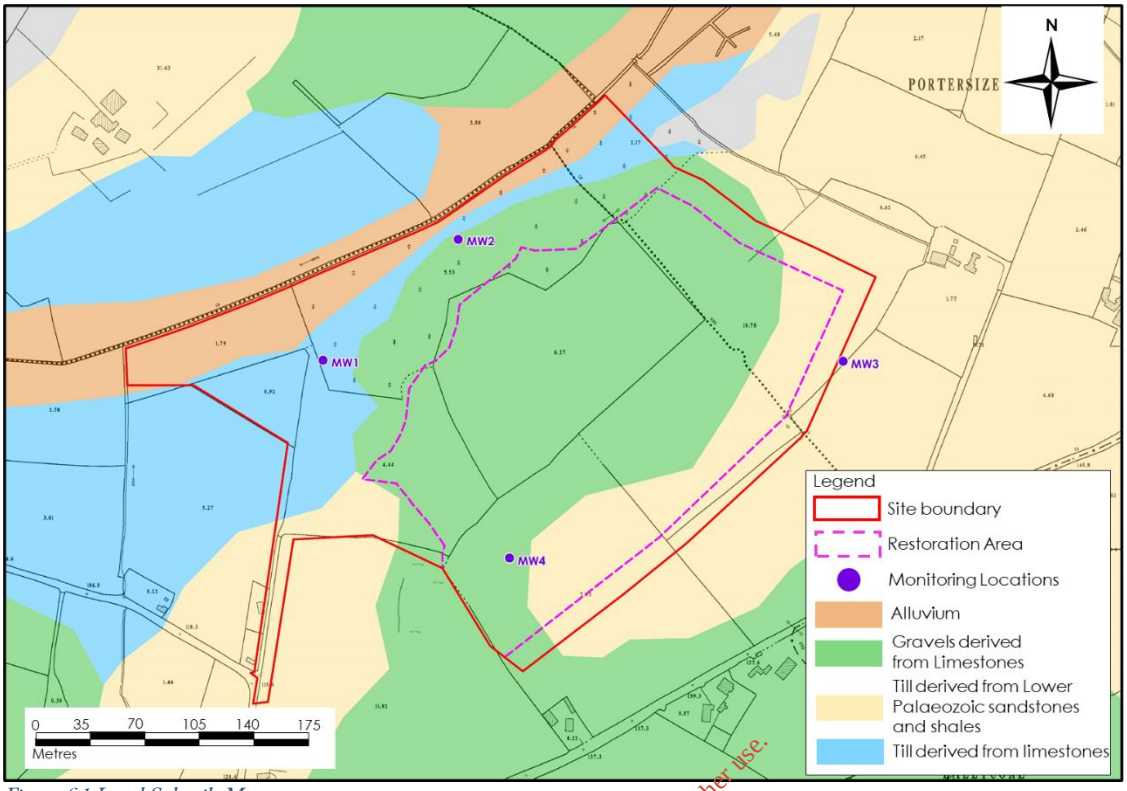

Figure 6-1 Local Subsoils Map

Table 6-4: Summary of Monitoring Well Drilling logs

Monitoring Well	Ground Elevation (mOD)	Total Hole Depth (m)	Depth to Bedrock in m & Bedrock Elevation (mOD)	Summary of Main Subsoil Lithology
MW1	106.031	24.5	9.1 (96.931)	Silty, SAND & GRAVEL
MW2	105.816	21.5	10.1 (95.716)	Silty, SAND & GRAVEL over gravelly SAND
MW3	132.560	30.0	4.1 (128.46)	Silty, gravelly SAND
MW4	134.662	39.5	13.2 (121.46)	Silty, gravelly SAND over silty SAND & GRAVEL and gravelly SILT

The subsoils encountered during the drilling investigation are similar to the overburden exposed on the quarry sides, i.e. poorly sorted SAND and GRAVEL with occasional horizons of SAND or SILT dominated layers.

The drilling investigation shows that the overburden depth decreases to the east/southeast which is consistent with topography (i.e. decreasing overburden depth with elevation).

The depth to bedrock surrounding the quarry void varied between 4.1 and 13.2m below ground level (mbgl), or between 96.931mOD and 128.46mOD.

Based on the trial pits undertaken by JBA in the 2005 site investigation, bedrock is close (0 -1m) to the lower quarry floor on the north of the extraction area, and within 3-4m on the upper floor level on the south of the extraction area.

6.3.3 Bedrock Geology

Based on the GSI bedrock map (www.gsi.ie), the majority of the site (which includes all of the proposed infill area) is underlain by Kipperkevin Formation which comprises greywacke and shale, while the northwestern corner of the site is mapped to be underlain by the Carrighill Formation which consists of calcareous greywacke, siltstone and shale. A bedrock geology map is shown below as Figure 6-2.

The drilling investigation undertaken at the site (i.e. 4 no. monitoring wells) encountered SHALE at all locations which was reported as very weak and weathered on the top 1-2m and increased in strength to medium strong with depth. The depth to bedrock surrounding the quarry void varied between 4.1 and 13.2mbgl, or between 96.931mOD and 128.46mOD.

Based on the drilling investigation the top of rock elevation increases to the east/southeast which is consistent with the local valley topography.

There are a series of northeast/southwest trending faults mapped in the area of the site and one of these mapped faults runs through the centre of the site. The presence of underlying faulting will not have any bearing on the proposed infilling operations.

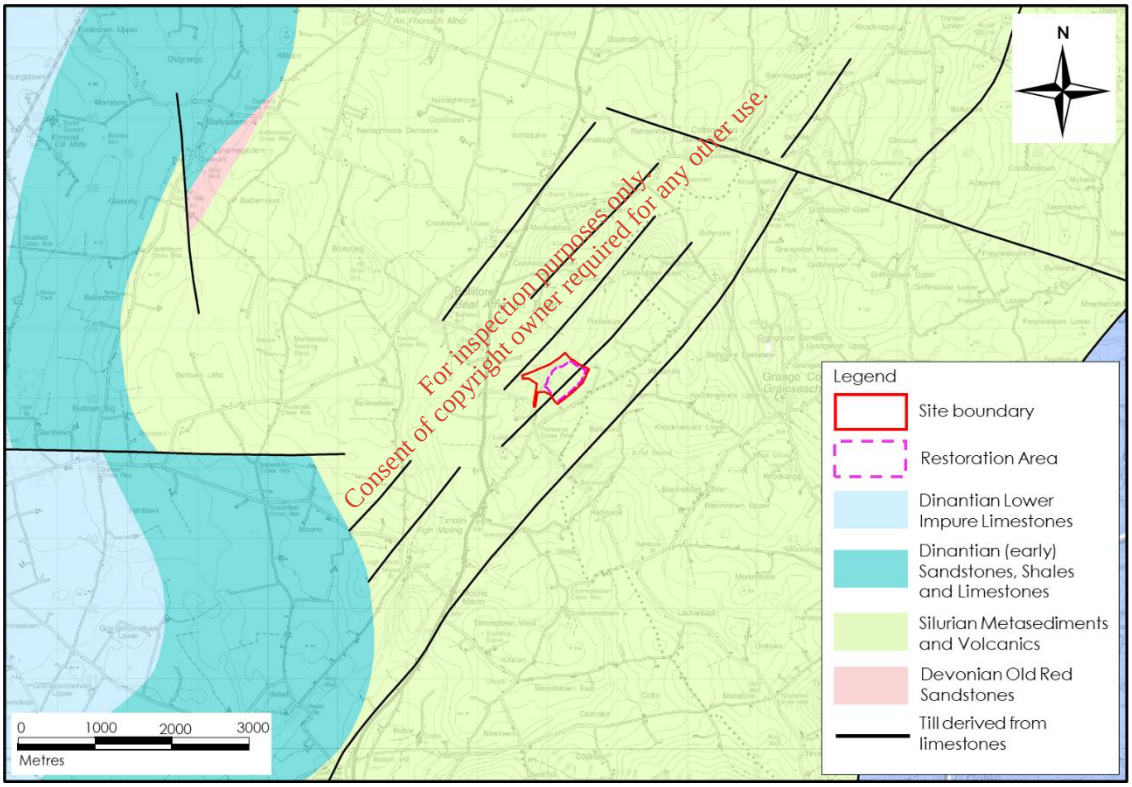

Figure 6-2 Local Bedrock Geology Map

6.3.4 Geological Resource Importance

Based on the GSI Aggregate Potential Mapping, the granular aggregate potential is mapped as Low (sands and gravels of glaciofluvial origin) with the crushed rock potential being classified as Very High.

However, the granular aggregate at the site has proven to be an economically extractable mineral resource and therefore is classified by HES as having "High" importance. Refer to Table 6-1 for criteria.

6.3.5 Geological Heritage and Designated Sites

The proposed development site is not located within or adjacent to any designated site (i.e. SAC, NHA etc). The closest designated site to the proposed development site is Ballycore Rath proposed Natural Heritage Area (pNHA) which is located approximately 1km to the south of the site.

Designated sites downstream of the site include the River Barrow and River Nore SAC. Downstream designated sites are dealt with in Chapter 5 Biodiversity, and Chapter 7 Hydrology and Hydrogeology of this EIAR.

The GSI Irish Geological Heritage (IGH) programme of audited sites was reviewed (www.gsi.ie) to establish if any geological heritage issues were present in the area of the proposed site. There are no mapped Geological Heritage sites within 7km of the proposed development.

6.3.6 Soil Contamination

Historic land uses in the vicinity of the current quarry site include agriculture (pasture and dairy farms), sand and gravel quarrying and residential.

There are no known areas of soil contamination on the site of the proposed development. During the site walkovers and intrusive investigation, no areas of contamination concern or contaminated soils were identified.

According to the EPA's online mapping tool (https://gis.epa.ie/EPAMaps/), there are no licensed or historic waste treatment facilities located within 5km of the site.

There is one EPA Industrial Emissions Licensing (IEL) facility located within 5km of the proposed development; Glanbia Foods Ltd, approximately 1.3km to the northwest in Ballitore. Glanbia Foods is an agricultural supplies business. This facility is also listed on the EPA Integrated Pollution Prevention Control (IPPC) registry. Due to the nature of the business and its distance from the proposed development it is not a potential source of contamination.

No further EPA registered facilities were identified within 5km of the development site.

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

6.4 Potential Significant Effects of the Proposed Development

6.4.1 Characteristics of the Proposed Development

It is proposed to import approximately 1,299,791m^3 (or 2,339,624 tonnes) of inert soil and stone material for the infilling of the quarry void in order to return the land to a beneficial use.

There will be a phased restoration of the pit quarry void working from the base of the void vertically building up soil and stone. The material will be spread in layers, each of approximately 1 to 2 m depth, up to the required ground contour level. If required, the layers will be compacted using the dozer which is spreading the material.

Following completion of the infilling works, topsoil will be placed (approximately 300 mm depth) and the soils will be rolled and reseeded with grasses to bring the site into agricultural use.

The proposed development also includes the following restoration measures:

- Infill, grading and restoration of two settlement ponds, totalling 1.065 ha (two settlement pond areas in NW of site approx. 0.788 and 0.277 ha).
- Restoration of three smaller ponds, totalling 0.44 ha, in order to provide an area of aquatic habitat (three ponds are approx. 0.321, 0.0835 and 0.0358 ha).
- Planting of a raised soil bund with native tree species, along northern site boundary (planting area approx. 0.48 ha).
- Grading of a pre-existing soil mound at the site entrance (approx. 1.11 ha).
- Development and management of an artificial sand martin nesting site, to replace the existing nesting location identified in the soil mound at site entrance.
- Construction of a soil quarantine shed (approx. 180m^2 in area, 15m height), inspection area and re-fuelling area (hardstanding) located north of the existing site office (approx. 400m^2 hardstanding area).
- Associated minor works to include site access road improvements (resurfacing), upgrade of drainage infrastructure including new fuel/oil interceptor and surface drains on hardstanding, refurbishment/repair of existing site office and weighbridge.

The proposed development will utilise the existing quarry infrastructure including internal roads, site office (portacabin), weighbridge, wheel-wash, welfare facilities and other ancillaries to complete the works. These facilities are currently located on the west of the site, adjacent to the main site entrance. The construction of a soil quarantine area comprising an inspection shed and concrete hardstand is proposed for the west of the site, to be situated northeast of the existing facilities.

A refuelling area will also be provided as part of the development. Drainage from the refuelling areas will be routed through a full hydrocarbon interceptor, a wetland, and then a soakaway for final discharge to ground.

6.4.2 Do Nothing Scenario

Under the Do-Nothing Scenario, the land areas will remain as excavated open quarry/pit voids. The land, soils and geology would remain largely unaltered from the current baseline as a result of the Do-Nothing Scenario.

6.4.3 Construction/Operational Stage - Likely Significant Effects and Mitigation Measures

6.4.3.1 Reinstatement of the Quarry Ground Profile and Landuse Change

Due to past extraction activities a significant manmade excavated void remains at the site. As stated above the existing quarry/pit void has an area of approximately 18.95 hectares (extent of current permitted extraction boundary). The importation of 1,299,791m^3 or 2,339,624 tonnes of soil and stone material will allow the restoration of the quarry/pit void profile back to a level close to the surrounding natural ground level.

Once restoration works are completed, the site will be reinstated to deliver high quality restoration and long-term agricultural benefits.

Mechanism: Importation/infilling

Receptor: Land, soils and geology, topography and landuse

Pre-Mitigation Potential Impact: Positive, irreversible, moderate, direct, likely, permanent effect on land, soils and geology, topography and landuse

Mitigation Measures:

The restoration of the quarry/pit void is seen as a positive effect with respect land, soils and geology. The mitigation will include the adoption of a suitable restoration plan which considers the natural local topography and landuse.

Residual Effect:

Restoration of pre-quarrying topography and land-use will occur, and this will result in a positive, moderate, direct, permanent effect on the land, soils and geology environment.

Significance of Effects: For the reasons outlined above, no significant effects on land, soils and geology will occur.

6.4.3.2 Contamination of Soils and Bedrock due to Oil and Fuel Spillages

Restoration works at the site will be completed using machinery. Such machinery/plant are 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.

Accidental spillage during refuelling of construction plant with petroleum hydrocarbons has the potential to be a pollution risk. The accumulation of small spills of fuels and lubricants during routine plant use can also be a potential pollution risk. Hydrocarbon has a high toxicity to humans, and all flora and fauna, including fish, and is persistent in the environment. Large spills or leaks have the potential to result in significant effects (i.e. contamination of soil, subsoils and pollution of the underlying aquifer) on the geological and water environment.

Receptor: Soil and bedrock

Pathway: Soil and bedrock pore space

Pre-Mitigation Potential Impact: Negative, reversible, slight, direct / indirect, unlikely, long term effect on soil and bedrock.

Mitigation Measures:

The following mitigation is proposed:

- Refuelling will be completed at a dedicated refuelling area;
- Drainage from the refuelling area will be routed through a full retention hydrocarbon interceptor, a wetland, and then a soakaway for final discharge to ground;
- All plant and machinery will be serviced at a dedicated area which will drain to an oil interceptor;
- Fuel containers will be stored within a secondary containment system, e.g. bunds for static tanks or a drip tray for mobile stores;
- Containers and bunding for storage of hydrocarbons and chemicals will have a holding capacity of 110% of the volume to be stored;
- Fuel and oil stores including tanks and drums will be regularly inspected for leaks and signs of damage;
- Drip-trays will be used for fixed or mobile plant such as pumps and generators in order to retain oil leaks and spills;
- Only designated trained operators will be authorised to refuel plant on site;

- Procedures and contingency plans will be set up to deal with emergency accidents or spills; and,
- An emergency spill kit with oil boom, absorbers etc. will be kept on-site for use in the event of an accidental spill.

Residual Effect:

The use and storage of hydrocarbons and small volumes of chemicals 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 is – Negative, imperceptible, direct, long term, unlikely effect on the land soils and geology environment.

Significance of Effects:

For the reasons outlined above, no significant effects on land, soils and geology will occur.

6.4.3.3 Contamination of Soils and Bedrock due to Unsuitable Imported Soil and Stone by-product Material

The proposed development comprises importing inert soil and stone material in order to restore the site. Infilling of the site with inert soil will pose a very low contamination risk as no harmful contaminants will not be present. In addition, inert soil and stone will not contain either organic matter or liquids that will form a source of organic contamination.

Receptor: Soil and bedrock

Pathway: Soil and bedrock pore space

Pre-Mitigation Potential Impact: Negative, imperceptible, direct / indirect, unlikely, long term effect on soil and bedrock.

Mitigation Measures:

The following mitigation is proposed:

- Sourcing material that is proven to be inert prior to transport to the site;
- Pre-agreed source sites for inert material ensuring; no pollutants, unauthorised material, invasive species;
- Regular checks of incoming loads to ensure suitability of imported material;
- The site will be operated under an Environmental Management System;
- All required pollution prevention measures will be implemented at the site;
- The operator will prepare and implement an Emergency response procedure;
- The operator will complete environmental monitoring, including local groundwater and surface water monitoring;
- A phased restoration of the site will be implemented, and end with the closure of site;
- The operator will have a documented waste recording procedure for all material entering the site; and,
- No unauthorised dumping of waste will be allowed at the site.

Residual Effect:

The importation of soil and subsoil is an integral part of the proposed development. Proven and effective control measures to mitigate the risk of contaminated soils being imported to the site are outlined above. Application of these controls will break the pathway between the potential source and

the receptor. The residual effect is - Neutral, imperceptible, direct / indirect, unlikely, long term effect on the land, soil and geology environment.

Significance of Effects:

For the reasons outlined above, no significant effects on land, soils, subsoils or bedrock will occur.

6.4.4 Final Restoration/Decommissioning and Aftercare - Likely Significant Effects and Mitigation Measures

The principal activity undertaken at the application site is for the restoration of lands within the existing sand and gravel quarry void. The void will be backfilled to original land contours and restored for agricultural use.

No significant effects on the soils and geology environment are envisaged during the decommissioning stage of the proposed development.

6.4.5 Human Health Effects

Potential health effects in relation to land, soils and geology mainly occur due to direct and indirect (dust) contact with contaminated soil. However, as stated above all imported material will be inert soil and stone by-product material and no contamination risk to human health is anticipated. There will be best practice controls in place to ensure all imported material is source checked and is suitable for the restoration works. Spot checks of incoming loads will be carried out on a daily basis.

Hydrocarbons, in the form of fuels and oils, will be used on-site during the restoration 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 effects associated with soil and geology contamination and subsequent health effects will be imperceptible.

6.4.6 Cumulative Land, Soil and Geological Effects

The other land use activities in the area are mainly agricultural related. Due to the restorative nature of the development and the lack of significant residual effects from the development that would affect the wider land, soil or geological environment, there will be no significant cumulative effects to land, soil and geology resulting from this project, and other local existing developments, projects and plans. All potential effects on land, soils and geology relating to the proposed project will be localised and within the development footprint.

6.5 Conclusion

The proposed development, which involves the restoration of a sand and gravel quarry site using imported soil and stone material, will have an overall positive effect on the local land, soils and geological environment. The inert nature of the proposed material for importation means no negative effects on land, soils, geology or human health will occur.

Once restoration works are completed, the site will be reinstated to deliver high quality restoration and long-term agricultural benefits.

APPENDIX 6-1

BOREHOLE LOGS

petersen drilling services ltd. on behalf of **Lawler** 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	sandy gravelly fill MADE GROUND		RO		0.00	24.50	0000		100	brown												Dry
0.70	Dense brown silty SAND & GRAVEL with occasional bands of silty sand																					
9.10	Very weak brown SHALE very weathered																					
9.80	Weak to Medium strong brown SHALE																					
23.00	Medium strong to Strong brown greenish SHALE																					

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
0940			
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1420	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	11.00							
RO	154.00	0.00	11.00				DTH	115	Air	No
RO	120.00	11.00	24.50				DTH		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)
1120	21.00	11.00	Medium	10.20	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

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 Broderick		
Lead Driller's signature			

Project Title

Lawlers Quarry

Weather	Variable	Project No	16/20
Date	15/06/2020	Day	Monday
Rig type	knebel hy79	Borehole Number	
Inclination		Orientation	MW 1
Sheet	1 of 1	Completed	Y

AGS

Produced by KeyLogbook

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

Depth of Stratum Top (m)	Driller's Stratum Description
0.00	Soft to firm brown sandy gravelly clayey fill MADE GROUND
6.10	Medium dense brown silty SAND & GRAVEL with occasional cobbles and boulders
8.20	Very loose brown very silty slightly gravelly SAND
10.10	Medium strong brown SHALE

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)
1520			
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1640	11.00	Dry	11.00

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)
1655	9.00	9.00	Very Slow	0.00	0.00	0.00	0.00	10.50

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 Broderick		
Lead Driller's signature			

Project Title

Lawlers Quarry

Weather	Variable	Project No	16/20
Date	15/06/2020	Day	Monday
Rig type	knebel hy79	Borehole Number	
Inclination		Orientation	MW 2
Sheet	1 of 2	Completed	Y

AGS

Produced by KeyLogbook

petersen drilling services ltd. on behalf of **Lawler** 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)
			RO		0.00	21.50	0000		100	brown												8.50

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
0810	11.00	8.50	11.00
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1125	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
RO	154.00	0.00	11.00				DTH	115	Air	No
C	140.00	0.00	11.00							
RO	120.00	11.00	21.50				DTH		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)
0810	9.50	9.50	Very Slow	0.00	0.00	0.00	0.00	11.00
1025	15.00	11.00	Medium	8.50	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 Broderick		
Lead Driller's signature			

Project Title

Lawlers Quarry

Weather	Variable	Project No	16/20
Date	16/06/2020	Day	Tuesday
Rig type	knebel hy79	Borehole Number	
Inclination		Orientation	MW 2
Sheet	2 of 2	Completed	Y

AGS

Produced by KeyLogbook

petersen drilling services ltd. on behalf of Lawler — 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 silty TOPSOIL		RO		0.00	30.00	0000		100	brown												8.00
0.20	Dense brown very silty gravelly SAND																					
4.10	Very weak brown orangish SHALE very weathered																					
6.50	Medium strong brown greenish SHALE partly very fractured																					

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
1125			
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1620	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	5.00							
RO	154.00	0.00	5.00				DTH	115	Air	No
RO	120.00	5.00	30.00				DTH		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)
1205	5.00	5.00	Very Slow	0.00	0.00	0.00	0.00	5.50
1205	12.00	5.00	Slow	0.00	0.00	0.00	0.00	
1320	17.00	5.00	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

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 Broderick		
Lead Driller's signature			

Project Title

Lawlers Quarry

Weather	Variable	Project No	16/20
Date	16/06/2020	Day	Tuesday
Rig type	knebel hy79	Borehole Number	
Inclination		Orientation	MW 3
Sheet	1 of 2	Completed	Y

AGS

Produced by KeyLogbook

petersen drilling services ltd. on behalf of Lawler — 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)

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
1125			
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1620	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)
1345	26.00	5.00	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

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 Broderick		
Lead Driller's signature			

Project Title

Lawlers Quarry

Weather	Variable	Project No	16/20
Date	16/06/2020	Day	Tuesday
Rig type	knebel hy79	Borehole Number	
Inclination		Orientation	MW 3
Sheet	2 of 2	Completed	Y

AGS

Produced by KeyLogbook

petersen drilling services ltd. on behalf of **Lawler** 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 to stiff silty sandy TOPSOIL		RO		0.00	39.50	0000		100	brown												20.00
0.20	Dense to very dense brown very silty slightly gravelly SAND																					
2.00	Dense to very dense brown silty SAND & GRAVEL with frequent cobbles and boulders																					
11.90	Stiff to very stiff brown sandy gravelly SILT																					
13.20	Weak brown SHALE weathered																					
28.00	Medium strong green greyish SHALE																					

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
0810			
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1745	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	14.00							
RO	154.00	0.00	14.00				DTH	115	Air	No
RO	120.00	14.00	39.50				DTH		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)
1145	24.00	14.00	Very Slow	0.00	0.00	0.00	0.00	N/S
1445	36.00	14.00	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
1545	0200	Dayworks: Airlift developing of all 4 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 Broderick		
Lead Driller's signature			

Project Title

Lawlers Quarry

Weather	Fine	Project No	16/20
Date	17/06/2020	Day	Wednesday
Rig type	knebel hy79	Borehole Number	
Inclination		Orientation	MW 4
Sheet	1 of 1	Completed	Y

AGS

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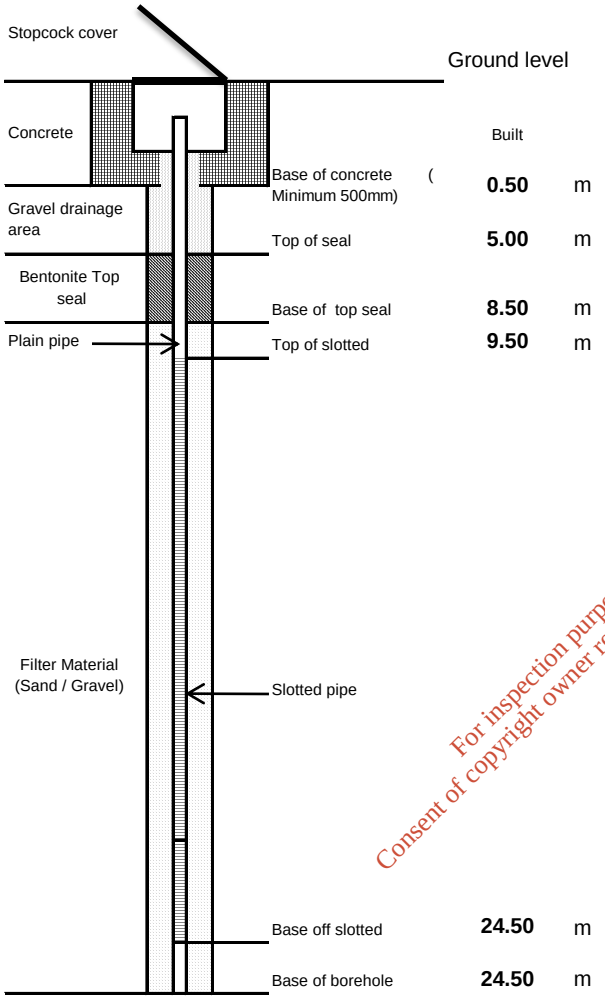
petersen drilling services ltd.

Summary of Standpipe Installation

Schematic Diagram (not to scale)



Installation Details

Standpipe diameter (id)	50	mm
Borehole diameter	120	mm
Slot size	1	mm
Geosock	No	
Gas tap	None	
Filter type	Gravel	
Type of cover	Upright	
Initial reading	10.20	m
Time of Initial reading	1320	hhmm

	Base (m)	Top (m)
Concrete	0.50	GL
Gravel drainage	5.00	0.50
Borehole seal top	8.50	5.00
Filter zone	24.50	8.50
Plain pipe	9.50	GL
Slotted zone	24.50	9.50
Base of borehole	24.50	

Remarks

Rig type	knebel hy79	**Project Title**			
Drilling Crew Details		Lawlers Quarry			
Support Operative	john whyte				
Lead Driller	stephan petersen	**Project No**		16/20	
Site category	Green	**Day**	Monday	**Date**	June 15, 2020
Engineer	D Broderick			**Borehole Number**	
Lead Driller's signature				**MW 1**	

AGS

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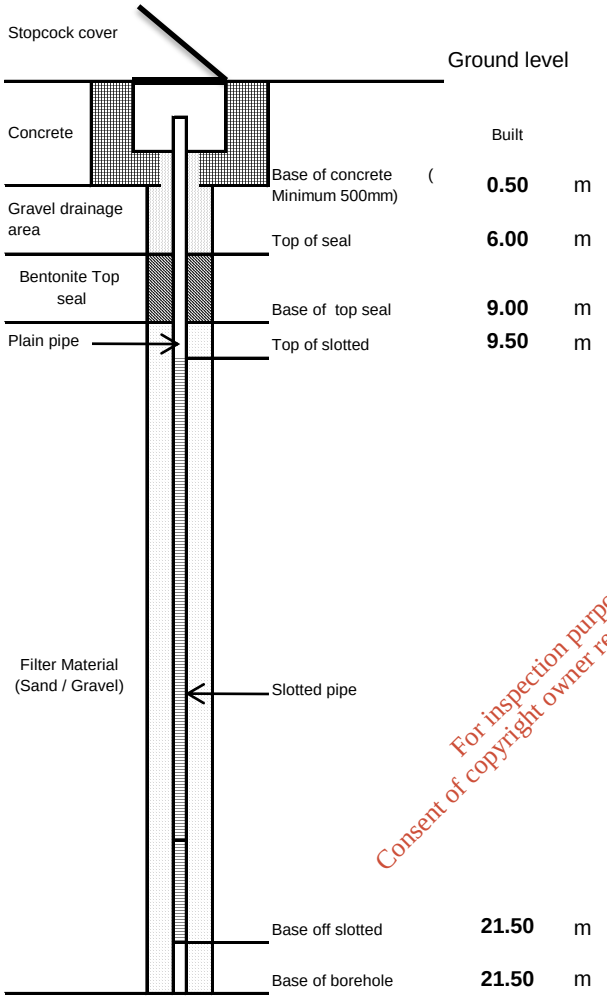
petersen drilling services ltd.

Summary of Standpipe Installation

Schematic Diagram (not to scale)



Installation Details

Standpipe diameter (id)	50	mm
Borehole diameter	120	mm
Slot size	1	mm
Geosock	Yes	
Gas tap	None	
Filter type	Gravel	
Type of cover	Upright	
Initial reading	8.50	m
Time of Initial reading	1120	hhmm

	Base (m)	Top (m)
Concrete	0.50	GL
Gravel drainage	6.00	0.50
Borehole seal top	9.00	6.00
Filter zone	21.50	9.00
Plain pipe	9.50	GL
Slotted zone	21.50	9.50
Base of borehole	21.50	

Remarks

Rig type	knebel hy79	**Project Title**			
Drilling Crew Details		Lawlers Quarry			
Support Operative	john whyte				
Lead Driller	stephan petersen	**Project No**		16/20	
Site category	Green	**Day**	Tuesday	**Date**	June 16, 2020
Engineer	D Broderick			**Borehole Number**	
Lead Driller's signature				**MW 2**	

AGS

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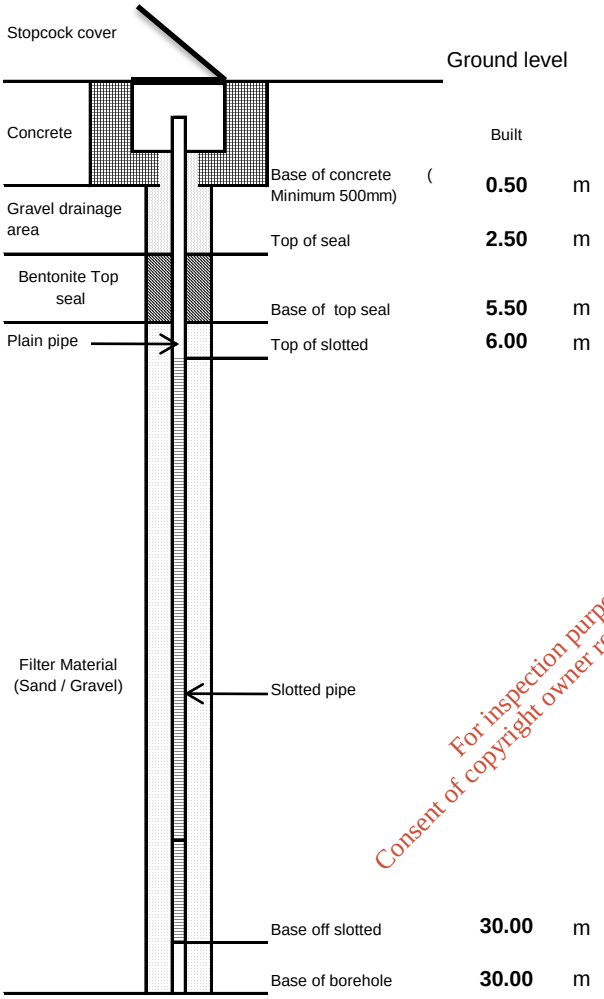
petersen drilling services ltd.

Summary of Standpipe Installation

Schematic Diagram (not to scale)



Installation Details

Standpipe diameter (id)	50	mm
Borehole diameter	120	mm
Slot size	1	mm
Geosock	No	
Gas tap	None	
Filter type	Gravel	
Type of cover	Upright	
Initial reading	5.30	m
Time of Initial reading	1720	hhmm

	Base (m)	Top (m)
Concrete	0.50	GL
Gravel drainage	2.50	0.50
Borehole seal top	5.50	2.50
Filter zone	30.00	5.50
Plain pipe	6.00	GL
Slotted zone	30.00	6.00
Base of borehole	30.00	

Remarks

Rig type	knebel hy79	**Project Title**			
Drilling Crew Details		Lawlers Quarry			
Support Operative	john whyte				
Lead Driller	stephan petersen	**Project No**		16/20	
Site category	Green	**Day**	Tuesday	**Date**	June 16, 2020
Engineer	D Broderick			**Borehole Number**	
Lead Driller's signature				**MW 3**	

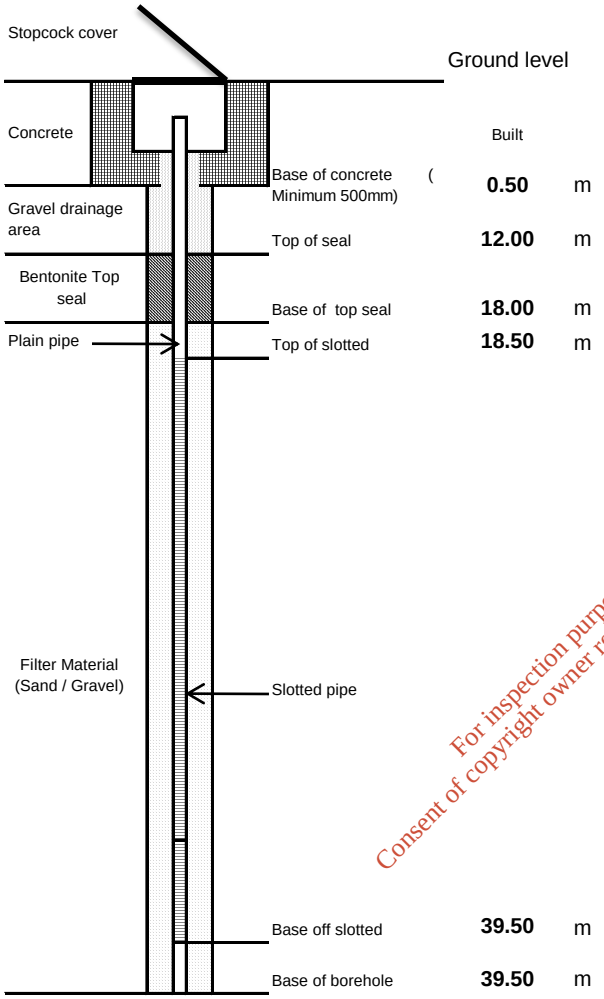
AGS

Produced by KeyLogbook

petersen drilling services ltd.

Summary of Standpipe Installation

Schematic Diagram (not to scale)



Installation Details

Standpipe diameter (id)	50	mm
Borehole diameter	120	mm
Slot size	1	mm
Geosock	No	
Gas tap	None	
Filter type	Gravel	
Type of cover	Upright	
Initial reading	20.00	m
Time of Initial reading	1355	hhmm

	Base (m)	Top (m)
Concrete	0.50	GL
Gravel drainage	12.00	0.50
Borehole seal top	18.00	12.00
Filter zone	39.50	18.00
Plain pipe	18.50	GL
Slotted zone	39.50	18.50
Base of borehole	39.50	

Remarks

Rig type	knebel hy79	**Project Title**			
Drilling Crew Details		Lawlers Quarry			
Support Operative	john whyte				
Lead Driller	stephan petersen	**Project No**		16/20	
Site category	Green	**Day**	Wednesday	**Date**	June 17, 2020
Engineer	D Broderick			**Borehole Number**	
Lead Driller's signature				**MW 4**	

AGS

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