Contents

Tables

Figures

Introduction

Background

7.1 This chapter of the EIAR provides a description of the surface water (hydrology) and groundwater (hydrogeology) conditions in the application area within the context of the regional setting, and assesses the potential impacts the proposed development will have on surface water and groundwater. Mitigation measures, if required, are proposed.

7.2 Available information on the surface water and groundwater of the Killough area and its surrounds was collated and evaluated.

Proposed Development

7.3 The proposed development is described in detail in Chapter 2: Project Description of this EIAR and only those elements which relate to water and water management are presented here for the purpose of this chapter. The proposed site layout is shown on EIAR **Figure 2-2**.

7.4 The overall planning application area (red line boundary) covers approximately 6.3 hectares (c. 15.6 acres) located within the southwest corner of the existing permitted Killough hard rock quarry.

7.5 The area is currently occupied by processed aggregate stockpiles which will be relocated elsewhere within the quarry site prior to any development works associated with the proposed bio-renewables facility being carried out.

Water Management

7.6 All waters will be managed on site, including clean rainwater, process water and foul waters. Process waters will be treated in the onsite treatment plant. All water will be reused on site where possible but some excess clean water will go to Killough Quarry for use there in concrete production and dust suppression, replacing the current abstraction requirements. There will be no discharge of waters off site.

7.7 The water streams at the site are as follows:

- Process waters;
- Roof water;
- Site surface water:
- Firewater; and
- Foul waters.

7.8 Water is stored in a number of tanks at the site for use in the process activities and also for emergency purposes.

7.9 There will be no discharge of water from the Killough Quarry site associated with the proposed development.

Scope of Work

7.10 The scope of this chapter includes:

- an assessment of the existing surface water and groundwater within approximately 5 km of the application area;

- an assessment of the potential impact of the proposed bio-renewables development on surface water and groundwater; and
- where necessary, recommendation(s) for mitigation measures to reduce or eliminate any potential impacts.

Project Team

7.11 This chapter of the EIAR was prepared by SLR Consulting Ireland. The project team consists of:

- Technical Director (Hydrogeology) Dominica Baird BSc (Earth Science), MSc (Hydrogeology), CGeol, EurGeol;
- Graduate Hydrogeologist Michelle Sherry BSc (Environmental Bio-Science); and
- Technical Director (Hydrology & Hydrogeology) Peter Glanville, PGeo. Eur.Geol.

Limitations / Difficulties Encountered

7.12 The evaluation of the hydrological and hydrogeological environment provided here relies on the detailed assessment, visual inspections conducted during site visits, a comprehensive dataset of monitoring records, publicly available information, and anecdotal evidence from local personnel.

7.13 No constraints or challenges were encountered during the compilation of this chapter in the Environmental Impact Assessment Report (EIAR).

Regulatory Background

Legislation

7.14 The key European Directives / European Union Legislation which apply to this Chapter of the EIAR and the hydrology and hydrogeology assessment presented herein are:

- Environmental Impact Assessment Directive (2011/92/EU); and
- Directive of the European Parliament and of the Council amending Directive 2011/92/EU on assessment of effects of certain public and private projects on the environment (2014/52/EU).

7.15 Other European Directives to which this EIAR makes reference, or has had regard, are listed in

7.16 **Appendix 7-**.

7.17 Irish Government Acts, National Legislation and Regulations which apply to this Chapter of the EIAR and the surface water and groundwater assessment presented herein are also listed in

7.18 **Appendix 7-**.

7.19 Most notably, under Regulation 4 of the Groundwater Regulations 2010, a duty is placed on public authorities to promote compliance with the requirements of the regulations and to take all reasonable steps including, where necessary, the implementation of programmes of measures, to:

7.20 *"(a) prevent or limit, as appropriate, the input of pollutants into groundwater and prevent the deterioration of the status of all bodies of groundwater;*

7.21 *`(b) protect, enhance and restore all bodies of groundwater and ensure a balance between abstraction and recharge of groundwater with the aim of achieving good groundwater quantitative status and good groundwater chemical status by 2015 or, at the latest, by 2027;*

7.22 *(c) reverse any significant and sustained upward trend in the concentration of any pollutant resulting from the impact of human activity in order to progressively reduce pollution of groundwater;*

7.23 *(d) achieve compliance with any standards and objectives established for a groundwater dependent protected area included in the register of protected areas established under Regulation 8 of the 2003 Regulations [S.I. No. 722 of 2003] by not later than 2015, unless otherwise specified in the Community legislation under which the individual protected areas have been established."*

Planning Policy and Development Control

7.24 The project site lies within the scope of the Tipperary County Development Plan 2022-2028.

7.25 Section 11.4.1 of the Tipperary County Development Plan, in relation to the Water Framework Directive states "*In considering applications for development, the Council will seek to ensure that surface and ground waters are protected and will seek measures, to improve the integrity of such water sources. 'Ground Water Protection Schemes' and 'Zones of Contribution' which contribute to public water supplies identify key aquifers and groundwater resources, and will be applied by the Council in assessing the impacts of new development on receiving waters. There are a number of sensitive fisheries in Tipperary, the Council will provide for the sustainable development of fisheries, where this is following the Habitats and Birds Directives and other ecological protection objectives*".

7.26 Section 3.4.6 of the Tipperary County Development Plan, in relation to a low-carbon society and climate action states that: *'The use of nature-based water management solutions, urban greening and Sustainable Urban Drainage Systems (SUDS) will be required by the Council, as a normal part of new development and as part of public realm and town centre enhancement in Tipperary, as addressed in Chapters 7 Town Centres and Place-making, and Chapter 11 Environmental and Natural Assets.'*

Guidelines and Technical Standards

7.27 The following key guidelines apply to this hydrology and hydrogeology assessment:

- Environmental Protection Agency (EPA), 2006. Environmental Management in the Extractive Industry: Non-Scheduled Minerals;
- Geological Survey of Ireland (GSI) - Irish Concrete Federation (ICF), 2008. Geological Heritage Guidelines for the Extractive Industry;
- Institute of Geologists of Ireland (IGI). Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements, April 2013;
- Environmental Protection Agency (2022) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports: Environmental Protection Agency;

7.28 Additional guidelines and technical standards which apply to this report and the hydrology and hydrogeology assessment presented herein are listed in **Appendix 7-A**.

Receiving Environment

Study Area

7.29 For the purposes of this assessment, the study area comprises the application site and the surrounding area c. 5 km from the site, reflecting the sensitivity of the geology with Limestone and karst identified; this is in line with the IGI Guidelines.

7.30 The IGI guidelines state that the minimum distance of 2 km should be reviewed in the context of the geological environment as well as the scale of development and increased to reflect the sensitivity of the subsurface with Limestone and karst geology present, and where present the distance should be increased to 5 km to reflect the more complex karst geology. The use of a wider 5 km radius for the study area is therefore considered to be a conservative approach.

7.31 The IGI guidelines also state that maps should be sourced to allow for the review of the geological and hydrogeological conditions that exist within a minimum of 5 km of the site boundary for geology with Limestone and karst identified (from the outer limit of the planning and/or licence area) and presented at a scale of 1:25,000.

Baseline Study Methodology

7.32 The investigation methodology adheres to the Environmental Protection Agency's (EPA) 2022 guidelines on environmental impact assessments and the IGI's recommendations on Geology in Environmental Impact Statements (2013).

7.33 Collation and evaluation of existing data regarding the geology, hydrogeology, and hydrological characteristics of the area and its surroundings were conducted. Assessment of monitoring data included rainfall data and groundwater data.

7.34 The methodology for assessing hydrology and hydrogeology in the Killough area and the development vicinity is outlined as follows:

- A desk study, in which existing data and relevant regional data sources for the area were examined;
- A review of the Proposed Development design details provided by the applicant;
- Review of all available water monitoring data (see para. 7.36 below);
- Assess the potential impacts that the Proposed Development may have on the receiving water environment; and
- Summarise the information gathered.

Sources of Information

7.35 The desk study involved the examination of available datasets to determine the geological and hydrogeological setting of the area (IGI, Required Information), together with all available studies and technical reports in time of preparation of this report, as detailed in **Table 7-1**.

Table 7-1: Required Information – Data Sources

Data	Dataset Source
Topography and aerial photography	Tailte Éireann GeoHive map viewer

Designated Sites	Environmental Protection Agency; Geological Heritage Sites and County Geological Sites; and Natura 2000 Sites (National Parks and Wildlife Service
Bedrock Geology	GSI Groundwater Data Viewer - Bedrock Geology
Subsoil Geology	Subsoil mapping (GSI)
Soils	Irish Soils Information System (Teagasc)
Groundwater	GSI Groundwater Data Viewer - bedrock and gravel aquifers, vulnerability, water supplies; GSI Groundwater body description documents and Environmental Protection Agency water maps.
Surface Water	Watercourses and water quality (EPA); Water Framework Directive (EPA); and Flooding (OPW CFRAM).
Abstractions	Surface water and groundwater (EPA abstractions register)
Permitted Sites	EPA licence register
Rainfall/Climate data	Met Éireann
Environmental Pressures	Water Framework Directive (EPA)

Detailed Site Investigations

7.36 In addition to the above desk study of publicly available data, extensive data gathering has been undertaken at the site. The works carried out for assessing hydrology and hydrogeology in the Killough area is outlined as follows with the BH locations shown on **Figure 7-5**:

- Drilling of three groundwater monitoring boreholes (GW1 – GW3) was undertaken in August 2020 and all three boreholes were drilled to 101m depth.
- A borehole survey was undertaken in November 2020 to determine which of the existing boreholes could be used for groundwater level monitoring. PW06 was identified as a borehole where groundwater level monitoring could be undertaken. PW05 was monitored until Q2 2022. Pumps are installed in PW01 – PW03, and so the groundwater levels (GWLS) are not monitored at these locations.
- Installation of groundwater level data loggers in November 2022 at groundwater monitoring boreholes GW01 – GW03 and PW06 to facilitate continuous groundwater level monitoring;
- Quarterly manual dipping of groundwater wells and groundwater level logger downloads since November 2020;
- Annual groundwater quality monitoring results at GW01 – GW03 from 2022 to 2024.

Site Setting

7.37 The proposed application (red line) area (c. 6.3 hectares) lies in County Tipperary and is located c. 6.5km south of Thurles, 4km west of Horse and Jockey and c. 10km north of Cashel. The proposed site is located c. 2.5km west of the Dublin to Cork Motorway (M8) and is accessible from the M8 via the R639. This proposed development site is set to be located within the Roadstone Killough Quarry (area c. 108.3 hectares) which is located within the

townlands of Gaile, Aughnagormaun and Sallsquarter. The proposed site is set to be located in the southeast of the quarry.

7.38 The proposed application area is located within Killough Hill which is a limestone escarpment. The land immediately surrounding Killough Hill lies at levels of between 110 and 120m AOD. The land gently slopes down towards the River Suir (c. 3.5km west of Killough Hill) to just under 80m AOD. Killough Hill is the only noticeable high point in the local area at a maximum heigh of c. 215m.

7.39 To the immediate northwest of the Quarry landholding , the land slopes steeply towards the surrounding plainlands, resulting in a height difference of between 50-80m over a distance of roughly 200m. These steep slopes are covered by conifer and mixed woodland. To the southeast of the Quarry landholding, the land slopes less steeply and is made up from agricultural land and some woodland scrub areas. To the southwest of the site, the quarry processing facilities are located at levels between 140m AOD and 170m AOD.

7.40 The ground levels rise from c. 160m AOD at the northwest region of the quarry and from c.186m AOD at the northeast end of the quarry. At the southeast region of the quarry, the ground levels rise from c. 169m AOD.

7.41 The lands surrounding the quarry consist of existing agricultural lands both for grazing and arable purpose. There are several private residential properties and farmyards located within the surrounding rural landscape of the quarry. There are approximately 12 residences located within 500m of the red line application boundary and 22 residences (including the 12 within 500m) located within 1km of the application site. Gaile national school is located c. 1.4km west of the site.

7.42 Surface water features at the proposed development area include two small streams located close to the boundary of the site, as shown on **Figure 7-1**. The first stream, SUIR_080 is located along the northwestern border and the second stream, LISNAGONOGE_010 is located along northern boundary and flows into the north of the quarry.

7.43 The SUIR_080 stream, located northwest of the proposed development site, flows into the Lower River Suir SAC which is located c. 3.5km north of the proposed development site. The Lower River Suir SAC is also located c. 4km west of the proposed site.

Site Walkover

7.44 The existing quarry site has been in operation since the 1950s and material extracted from the quarry area is processed within the quarry void using mobile processing plant. The materials are then stockpiled, pending further use in the value-added activities on site or transported off-site to market.

7.45 The proposed bio-renewables production facility compound will cover an area of c. 4 hectares within the southwest corner of the existing quarry adjacent to the existing asphalt and concrete batching plants in an area currently used for aggregate stockpiling. The proposed facility will utilise the existing quarry entrance and access road, and along with some peripheral buffer areas and the compound site itself, the overall application area for the proposed development is 6.3 hectares.

7.46 SLR visited the proposed facility location on the 29th of May 2024, as well as on a quarterly basis for groundwater monitoring. The overall planning application area is currently occupied by processed aggregate stockpiles which will be relocated elsewhere within the quarry site prior to any development works associated with the proposed bio-renewables facility being carried out. See **Plate 7-1**.

7.47 An existing store building (c. 158m²) lies partially within the red line boundary area as shown on **Figure 2-2**. It is proposed to demolish the store building to facilitate the proposed development, should planning permission be granted. See **Plate 7-2**.

7.48 There are ten groundwater well locations on the overall Quarry landholding, 6 of which are located within the planning application boundary: PW01, PW02, PW03, PW05, PW06 and PW07. PW01, PW02 and PW03 have pumps installed and groundwater is regularly abstracted from them. PW05 and PW06 are located just on the border of the proposed boundary. PW07 has been capped. Groundwater levels in PW06 have been monitored since November 2020.

7.49 SLR also monitor three other boreholes on the overall Quarry landholding GW01, GW02 and GW03, located over 500m from the planning application area. These wells were installed in February 2020 by Peterson Drilling Services Ltd. GW01 is located in the northwest of the Quarry in an area that is used for aggregate stockpiles. GW02 is located in the northeast of the Quarry landholding. GW03 is located in the southeast corner of the Quarry landholding. The locations are shown in **Figure 7-5**.

7.50 The proposed bio-renewables production facility (incorporating anaerobic digestion) compound will cover an area of c. 4 hectares with c. 16,821.5m² of new buildings consisting of an administration building; a dry matter reception building; a workshop; a bio-conversion building; a pre-treatment, equalisation and gas upgrading building; a digestate handling building; a warehouse storage building; a bio-filling station building; an odour abatement and pumping station building; a linear generator building; and an ESB sub-station building.

Plate 7-1 – Aggregate piles within proposed planning application

Plate 7-2 – Store building within proposed application area

Rainfall and Climate

7.51 The nearest Met Éireann rainfall gauging station to the proposed application site is Clonoulty (Clogher) which is c. 4km southwest of the site and the second closest rainfall station is Littleton which is approximately 5km northeast of the site. The monthly precipitation amount (mm) for 2024 is only available until June 2024. The average monthly rainfall for 2024 is tabulated down below in **Table 7-2.**

Table 7-2: Average Monthly Rainfall (mm) 2024 for Clonoulty (Clogher)

Jan	Febr	Mar	Apr	May	Jun
62.1	155	93.9	74.9	50.9	42.8

7.52 There is no Long-Term Average (LTA) annual rainfall data available for Clonoulty (Clogher) so the nearest Met Eireann station with LTA available was chosen instead. Gurteen, which is c. 47km northwest of the site is the closest station with this data. The most recent period published is 1981-2010. The LTA annual rainfall for Gurteen is 948.2 mm/yr for the period 1981-2010 (Met Eireann, 2021). The LTA monthly rainfall for the period 1981-2010 are shown in **Table 7-3** below.

Table 7-3: Long Term Average Annual Rainfall (1981-2010), Gurteen

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
96.4	66.2	74.5	59.8	68	71.8	66.7	84.9	74.8	103.8	89.8	91.5

7.53 According to Met Éireann's Past Weather Statement for Summer 2024 (June - August), Summer 2024 was defined as being cool and relatively dry overall. The highest daily rainfall total was 34.6 mm at Newport, Co. Mayo on Sunday 4th August. According to the report, the majority of seasonal rainfall totals from across Ireland were below their LTA.

Soils and Geology

7.54 Soils and Geology are discussed in detail in Chapter 6 of this EIAR. A summary is provided below. The soils are shown in **Figure 6-2**, subsoils are presented in **Figure 6-3** and Bedrock Geology is presented in **Figure 6-4**.

Soils and Subsoils

7.55 The Irish Soil Information System project has developed a national association soil map for Ireland, the project is co-funded by Teagasc and the Environmental Protection Agency (EPA). The soils are discussed in detail in Chapter 6 of this EIAR.

7.56 The soils surrounding the overall Quarry landholding are fine loamy drift with limestone stones known as the Elton (1000ET) Soil Association, see **Figure 6-2**.

7.57 The EPA website publishes subsoil maps created by the Spatial Analysis Unit and Teagasc in collaboration with the Geological Survey Ireland (GSI). The subsoils are discussed in detail in Chapter 6 of this EIAR.

7.58 The subsoils at the site are bedrock exposed to the surface which gives rise to shallow soils derived from calcareous rocks or gravels with or without peaty surface horizon. The permeability of these subsoils is not mapped. These soils are described as shallow, rocky, peaty/ non-peaty mineral complexes (BminSRPT).

7.59 Other subsoils at the site are glacial tills chiefly derived from Limestone, see **Figure 6-3**. These subsoils are moderately permeable (glacial tills) and described as a deep well drained mineral (BminDW) (GSI online map viewer).

Local Bedrock Geology

7.60 The GSI online map viewer (1:100,000 geology map) shows the site is underlain by crinoidal wackestone/packstone limestone of the Ballyadams Formation. The local bedrock geology is shown in **Figure 6-4**.

7.61 The formation consists predominantly of fossiliferous pure, pale grey limestone which were formed in shallow marine carbonate facies during the Caboniferous period.

7.62 The GSI online map also shows that a small section in the middle of the site is underlain by cherty, muddy, coarse grained, calcarentic limestone of the Clogrenan Formation. There is also another section of the Clogrenan Formation c. 1.5km south of the site.

Karst

7.63 Due to the exposure of bedrock at the surface, an epikarst layer has formed. This has led to the creation of a limestone pavement similar to that found in the Burren, Co. Clare. The underlying fossiliferous limestone has also led to the blossoming of calcareous grassland on

the flanks of Killough Hill. As a result of these features, parts of the Quarry landholding has been designated as a pNHA (000959).

7.64 The closest karst features are two swallow holes located just over 2km northwest of the proposed development, see **Figure 7-2**. The historic GSI Karst Feature IDs are 2015SWK008 and 2015SWK007, and the data source is listed as M. Keegan " Groundwater protection scheme - Tipperary S.R.", with the location on Durrow farm. The two karst features are located within the adjacent Durrow Formation shaly fossiliferous & oolitic limestone formation.

Groundwater – Hydrogeology

Aquifer Characteristics

7.65 The GSI online map viewer shows the site is underlain by a regionally important karstic aquifer (Rkd). This aquifer is defined as being a good aquifer capable of supplying regionally important supplies e.g. large public water supplies., see **Figure 7-2**. The aquifer has an area of 80 km^2.

Groundwater Vulnerability

7.66 The GSI has developed a groundwater vulnerability classification for Ireland, refer to **Table 7-4** below. The groundwater vulnerability at a particular point is controlled by the natural geological and hydrogeological characteristics at that point. The vulnerability depends on the nature of the subsoils (i.e. their permeability characteristics), the type of recharge (point or diffuse) and the thickness of the unsaturated zone (depth to groundwater).

7.67 The groundwater vulnerability at the site is classed as Extreme and as X (Rock at or Near Surface), see **Figure 7-3**.

Table 7-4: GSI Groundwater Vulnerability Rating

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

7.68 According to the GSI online database, the hydrogeological setting of the proposed development is described as having moderate permeability subsoil. The effective rainfall (rainfall after evaporation) is 510.40 mm/yr. The groundwater recharge at the site is between 433.84 mm/yr and no recharge cap applies to this site.

Groundwater Bodies

7.69 The proposed development is located within the Tipperary Groundwater Body (GWB). A description of the GWB is published by the GSI and is summarised below and refers to the karst limestone bedrock underlying the limestone till deposits at the site. Groundwater bodies are shown in **Figure 7-4**.

Tipperary GWB

7.70 This groundwater body is bordered by the Templemore GWB, Clonmel GWB and the North Kilmallock GWB. All of these GWBs, including Tipperary GWB, received a Good WFD status during the 2016-2021 period. The Tipperary GWB is considered to be Not At Risk. However, the surrounding GWBs are considered At Risk of deteriorating in quality. This GWB is located on the eastern border of the Suir catchment.

7.71 The groundwater predominantly recharges where rainwater can percolate down past the epikarst layer to the water table. There could also be indirect recharge from nearby poor aquifers via bedrock fractures. Indirect recharge can also result from overland flow that seeps into the ground at areas where the limestone is more permeable. The groundwater flow in this aquifer is expected to be close to the surface through karstic conduits and enlarged fissures, mainly along fault zones. In Karstic aquifers, surface water and groundwater are observed to interact with each other. In Karstic features such as springs, swallow holes and turloughs, surface water charges into groundwater.

7.72 Limestone aquifers tend to be unconfined due to the water table being less than 10m from the surface. The annual water table fluctuation is likely to be less than 5m according to GSI; the middle part of the Ballyadams Formation, where the proposed development site is based, will have restricted groundwater circulation and vertical permeability due to the presence of clay wayboards limiting the amount of surface exposure area. These clay wayboards have also caused secondary permeability to develop horizontally, extending between 10m and 30m.

7.73 The groundwater body bedrock is Calcareous therefore, the water is presumed to be hard and of high conductivity.

Groundwater Supply Wells

7.74 The Geological Survey Ireland (GSI) has an online database of wells and springs in Ireland. According to the GSI well database there are a number of wells within a 2 km radius of the site, these are shown on **Figure 7-7**. The wells abstract from the regionally important Rkd karstified bedrock aquifer and the locally important Ll bedrock aquifer. The distances below are taken from the centre of the locational accuracy radius.

7.75 The closest GSI recorded well is an industrial well located at the entrance of the quarry (GSI name 2015SWW137). This well reports a depth of 96m with no info on the depth to rock. The yield class is noted as excellent (491 m^3/day).

7.76 The next closest set of wells are located west of the site. There are three wells, one domestic (GSI name 2015SWW005) and two of which the use for are unknown (GSI name 2015SWW135 and GSI name 2015SWW136). The domestic well has a depth of 96m with no info on the depth to rock. The yield class is noted as excellent (490 m^3/day). Well 2015SWW135 has a depth of 40.8m and a depth of bedrock of 1.8m. It is classified as a failure with a yield of only 1.6 m^3/day. Well 2015SWW136 has a depth of 34.7m and a depth to bedrock of 0.9m. The well is classified as poor with a yield of 6.5 m^3/day.

7.77 There are several other wells within 2km of the site which are of domestic use or of unknown use that range from having a yield class of poor to moderate.

7.78 There is the Ash Hill Group Scheme Source Protection Area located c. 2.5km east of the site. The closest Group Water Scheme (GWS) is located c. 2km northeast of the site, the Graigue-Moycarkey GWS. The Graigue-Moycarkey GWS well has a depth of 76.2m with no info on the depth of rock. The yield class is noted as good (327.30 m³/day) and has a productivity class of III. There is no public supply source protection area within the vicinity of the proposed site, the closest is Tobernaloo Public Water Supply (PWS) c. 7km north of the site.

Groundwater Protection Scheme

7.79 The North Tipperary Groundwater Protection Scheme (GWPS) published in 2002, following The Geological Survey of Ireland (GSI), the Department of Environment and Local Government (DoELG) and the Environmental Protection Agency (EPA) methodology for the preparation of groundwater protection schemes (DoELG/EPA/GSI, 1999). The following is noted from the GWPS report.

7.80 At the time of writing 26 public water schemes were identified in North Tipperary that were supplied by groundwater, abstracting up to 11,000 m^3/d, contributing between 35% and 40% of the total public water supply for the area. This does not account for private or group water schemes so the true proportion of water supply from groundwater may be much higher.

7.81 Of these 26 supplies, the water-type has been classified as excessively hard (>350 mg/l) for 59%, hard (251 mg/l – 350 mg/l) for 21%, moderately hard (151 mg/l – 250 mg/l) for 10% and slightly hard (101 mg/l – 150 mg/l) for 10%.

7.82 Groundwater quality within North Tipperary has recorded human-caused issues with high nitrate, high iron and manganese and, bacteriological pollution (faecal coliforms). 38.5% of the 26 groundwater PWS were reported as having been contaminated with faecal coliforms at least once in the 12 years prior to the GWPS. Other groundwater quality issues are believed to be due to natural causes, i.e., dissolution and remobilisation of fluoride, barium and strontium.

Quarry Landholding Groundwater Monitoring Boreholes

7.83 There are ten groundwater monitoring well locations within the Quarry landholding, see **Figure 7-5**, however SLR staff only monitor four of these wells for groundwater levels and for data loggers (PW06, GW01, GW02 and GW03) and three of the wells for groundwater quality (GW01, GW02 and GW03). PW06 is not being monitored for groundwater quality due to the fact of its close proximity to wells PW01, PW02 and PW03. Each of these wells have pumps installed and groundwater is regularly abstracted from them. The pumping of these wells has appeared to affect PW06, causing large fluctuations in groundwater levels. PW06 is located in the vicinity of the proposed development, while GW01–GW03 are located around the periphery of the quarry excavation.

7.84 GW01-GW03 were installed in February 2020 by Peterson Drilling Services Ltd and supervised by Hydro Environmental Services. Each borehole was drilled to a depth of 101m. The boreholes each had a gravel pack installed in the annular space between the slotted casing and the borehole. A bentonite seal was installed above the gravel pack to prevent the entry of surface water runoff from surrounding areas flowing directly into the boreholes. They were fitted with a stand-up cover with a concrete surround. Borehole logs are presented in **Appendix 7-B**.

7.85 The date of when boreholes PW05-PW07 were drilled is unknown as well as their true depth. A depth measurement of PW05 and PW06 taken in 2020 revealed the depth to be c. 101m toc. A depth reading of PW07 could not be taken as it has been capped. Both PW01 and PW02 were drilled in 2008 while PW03 was drilled in 2007. All three of these boreholes have pumps installed and groundwater is actively abstracted from them, hence, no groundwater

investigation takes place from these boreholes. PW04 was drilled in 1988 and has since been capped and sealed and not in use anymore.

7.86 During drilling, the main lithology encountered was strong medium-grey limestone with minor weak weathered clayey sections.

7.87 Details of groundwater monitoring boreholes installed on the Quarry landholding are presented in **Table 7-5**. Groundwater monitoring borehole locations are presented in **Figure 7-5**.

Table 7-5: Details of groundwater monitoring boreholes on-site (GW1 – GW3)

	GW1	GW2	GW3
Easting, northing	610835.4, 651124	611330, 651040	611322, 650323
Ground Level Elevation (m AOD)	160.98	186.14	169.33
Reference Level* Elevation (m AOD)	161.51	186.45	169.81
Depth (m bgl)	101	101	101
Elevation of base of borehole (m AOD)	59.98	85.14	68.33
Fractures (m bgl)	Very little	Very little	No mention in logs
Water strikes (m bgl)	None**	None**	No defined strikes**
Standpipe installation (m bgl)	Plain 0 – 41, Slotted 41 – 101	Plain 0 – 41, Slotted 41 – 101	Plain 0 – 41, Slotted 41 – 101
Gravel pack installation (m bgl)	Backfill 0 – 19, Bentonite 19 – 20, Gravel 20 – 101	Backfill 0 – 29, Bentonite 29 – 30, Gravel 30 – 101	Backfill 0 – 34, Bentonite 34 – 35, Gravel 35 – 101

* Top of uPVC standpipe

** Water seeped in over few days after drilling

Table 7-6: Details of historical groundwater monitoring boreholes on-site (PW01 – PW07)

BH Ref.	Ground Level Elevation (m AOD)	TOC Level Elevation (m AOD)	Depth (m bgl)	Year Drilled	Easting Northing	Nov 2020 survey
PW01	140.42	140.79	110	2008	210526.5, 150636.9	Pump installed
PW02	138.98	139.29	146	2008	210590.7, 250514.6	Pump installed
PW03	139.03	139.23	244	2007	210710, 150500.9	Pump installed
PW04	157.56	157.61	96	1988	210834.4, 150616.2	Not operational
PW05	142.81	143.1	>101.75	-	210699.6, 150619.7	Operational
PW06	142.42	143.17	>101.75	-	210705.9, 150595.5	Operational
PW07	141.15	141.47	-	-	210729, 150534.4	Capped **

PW05 – PW07 year of drilling unknown.
PW05 – PW07 depth unknown.
PW05 and PW06 depth measured during November 2020 survey with a 101.75m dip metre

Groundwater Levels

7.88 After the drilling of GW01, GW02 and GW03 in August 2020, SLR personnel and Roadstone Ltd. undertook a borehole survey in November 2020 to determine which of these boreholes could be used for groundwater level monitoring.

7.89 It was decided to monitor four of these wells for groundwater levels and for data loggers (PW06, GW01, GW02 and GW03) and three of the wells for groundwater quality (GW01, GW02 and GW03), see **Figure 7-5**. PW06 is not being monitored for groundwater quality due to the fact it is in close proximity of supply wells PW01, PW02 and PW03. Each of these wells have pumps installed and groundwater is regularly abstracted from them. The pumping of these wells has also seemed to have affected PW06, causing large fluctuations in groundwater levels. PW06 is located in the vicinity of the proposed development, while GW01 – GW03 are located around the periphery of the quarry excavation, >500m from the planning application area.

7.90 Manual groundwater levels have been taken from GW01, GW02, GW03 and PW06 approximately every three months from since May 2021 by SLR personnel. These manual readings were used to calibrate, verify and adjust the logger groundwater level data. Manual readings coupled with barometric data were used to correct the logger groundwater data for the site conditions.

7.91 Four water level loggers were placed in GW01, GW02, GW03 and PW06 on the 5th November 2020 and set to record a groundwater level every hour. Groundwater level data from November 2021 to October 2024 is shown in **Figure 7-6**.

7.92 A barometer was installed in borehole GW03 and set to take readings every hour. The barometer records variations in atmospheric pressure. One barometer is sufficient for a 25 km^2 area, therefore only one is needed for this site.

7.93 No rainfall gauge station was established on the site. Therefore, rainfall data was taken from CLONOULTY_Clogher which is the closest rainfall gauging station c.4km.

7.94 Rainfall data is available from August 2020 to June 2024 and is graphed against groundwater levels in **Figure 7-6**. A summary of the groundwater levels recorded by the data loggers can be seen in **Table 7-7** below. The groundwater levels manually recorded are summarised in **Table 7-8** and a combination of the groundwater levels is summarised in **Plate 7-1**. As previously mentioned, summer 2024 was considered to be cool and dry and nearly all rainfall totals were below their LTA 1981-2020.

7.95 A review of groundwater level data (maximum, average, minimum) in relation to the reference datum (mAOD) allows the hydraulic head at each location to be estimated. The groundwater flow can also be estimated. Groundwater levels are generally highest at GW3, which is located in the south-east of the Quarry landholding and lower in GW1 and GW2. This indicates a general groundwater flow direction of south-east to north/north-west, towards the Lisnagonoge stream.

7.96 Between 2020 and 2024, large variations have been observed in all four monitoring wells. Since monitoring began, PW06 has shown a range of 48.35m, a maximum groundwater level of 113.25m AOD and a minimum groundwater level of 64.89m AOD. The smallest variation was seen in GW02 with a range of 9.62m, a maximum groundwater level of 122.45m AOD and a minimum level of 112.85m AOD. In borehole GW01, a range of 28.04m was observed and in GW03, a range of 28.58m was observed.

7.97 There are a number of sharp and rapid fluctuations that can be seen in PW06 throughout the December 2022 – October 2024 monitoring period. The most significant can be seen on the

8th of July, when groundwater levels were measured at 70mAOD and had increased to 100mAOD by the 20th of July, as shown in **Plate 7-1**.

7.98 It is likely that nearby groundwater pumping is the main cause of these large-scale fluctuations in groundwater levels. It is known from discussions with Roadstone Limited that boreholes PW01, PW02, and PW03 have pumps installed and groundwater is actively abstracted from the boreholes. These boreholes are in close proximity to borehole PW06. The graphed data shows evidence of pumping, particularly the significant fluctuations at mid-February 2024 and the start of July 2023 when water decreased ~20m despite rainfall in subsequent days. The frequent and rapid changes in groundwater levels can indicate the turning on and off of a pump. During a previous site visit and logger download (November 2021) the groundwater level was decreasing rapidly when measured manually. In half an hour, the groundwater level decreased 0.66m.

7.99 Due to the large range in groundwater levels, the groundwater level decreased below the level of the loggers in borehole PW06 during the 2021 and 2022 monitoring period, which was illustrated by a straight horizontal line at the minimum of the recorded groundwater levels. On the 20th of December 2022 the groundwater level logger was lowered a further 10m into PW06 in an attempt to prevent the loss of data in the event of groundwater levels falling below the installation depth of the logger. It appears that throughout the 2023 and 2024 monitoring period groundwater levels, while still variable, have remained above the level of the logger, allowing the full range of groundwater levels to be observed.

7.100 Groundwater levels at PW06 are generally the lowest and display the highest variability, likely due to the influence of nearby groundwater pumping on-site.

7.101 The groundwater levels in GW1 have shown significant variability, with a total variation of 28.04m, an annual maximum of 135.07m AOD and an annual minimum of 107.03m AOD. The groundwater level logger was lowered a further 10m into GW1 on the 20/12/2022 to prevent water levels dropping below the logger. The groundwater levels in GW1 appear to correlate strongly with rainfall events. The response of groundwater levels in relation to recharge in GW1 appear to be “flashy” and there are rapid spikes in groundwater levels following rainfall which quickly return to previous levels when the rainfall subsides. This can be seen particularly in July 2023, when stable and relatively low groundwater levels during May and June begin rise rapidly after a >30mm rainfall event. The rapid fluctuations in groundwater levels appeared more frequently during the 2023 monitoring period due to a higher rainfall throughout the year in comparison to previous years. Groundwater levels remain stable from May 2024 to September 2024 due to the decrease in rainfall recorded during these months.

7.102 The groundwater level in borehole GW2 is less affected by rainfall than the other on-site monitored boreholes. Although there appears to be potential evidence of groundwater levels corresponding with rainfall events greater than 25mm in January 2023 and July 2022, rainfall events seem to have less of an effect than at GW1. The groundwater levels also have a stronger response after periods of little rainfall. This is visible from May 2024 to October 2024 where a clear decline in groundwater levels is seen due to a period of low rainfall. Water levels dropped to their lowest recorded since monitoring began in 2020. It is possible that there are clayey fractures in the bedrock at this location, and this may be inhibiting groundwater inflow into the borehole. Throughout the 2020 to 2024 monitoring period, groundwater levels captured by the level loggers at GW2 saw a total variation of 9.6m, with an annual maximum of 122.47m AOD to annual minimum of 112.85m AOD. Although fluctuations have been observed, the groundwater levels in GW2 have not been particularly variable throughout the monitoring period.

7.103 The groundwater levels in GW3 throughout the 2020 to 2024 monitoring period have been observed to be variable with a total variation of 28.58m, with an annual maximum of 155.03m

AOD and an annual minimum of 126.45m AOD. The groundwater levels in GW3 appear to correlate with rainfall events, particularly in where levels rise in conjunction with significant rainfall in January March and July 2023. The groundwater levels in GW3 display similar trends and fluctuations to PW06, although responses appear to be more gradual and less flashy in comparison and there is less variation between fluctuations seen at this well.

7.104 Due to the large range in groundwater levels, the groundwater level decreased below the level of the loggers in borehole GW3 during the 2021 monitoring period. On the 20th of December 2022 the groundwater level logger was lowered a further 10m into GW3 in attempt to prevent the loss of data in the event of groundwater levels falling below the installation depth of the logger. It appears that throughout the 2023 and 2024 monitoring period groundwater levels, while still variable, have remained above the level of the logger, allowing the full range of groundwater levels to be observed.

7.105 Groundwater levels at all the monitoring boreholes have naturally large ranges due to high transmissivity and low storativity typical of limestone aquifers.

7.106 The effect of groundwater pumping that occurs in close proximity to borehole PW06 is likely to have negligible impact on Boreholes GW1, GW2, and GW3 due to distance (>500m), difference in elevation (boreholes GW1, GW2, and GW3 are >19m higher than borehole PW06), and difference in borehole depths (borehole PW06 is >19m deeper than boreholes GW1, GW2, and GW3 when compared in m AOD).

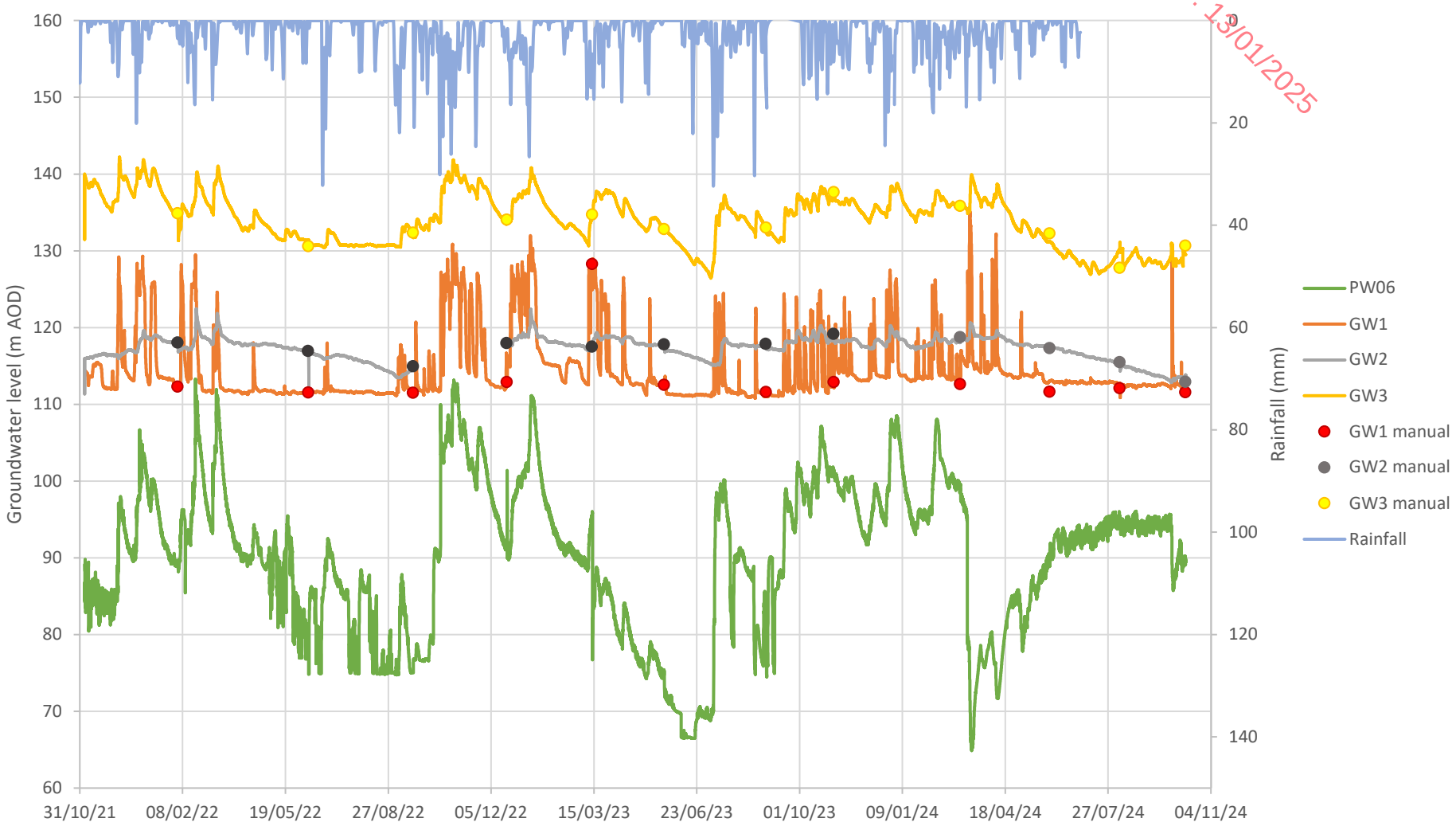
Table 7-7: Summary of groundwater level logger data (April 2024 – July 2024)

		PW0 6	GW1	GW2	GW3
Strata			Limestone	Limestone	Limestone
mAOD	**Minimum**	64.89	107.03	112.85	126.44
	Average	90.07	115.33	117.39	136.46
	Maximum	113.25	135.07	122.47	155.03
m	**Range**	48.35	28.04	9.62	28.58

Table 7-8 Summary of manual groundwater levels (November 2020 – October 2024)

	Units	GW01	GW02	GW03	PW06
Min	**m AOD**	128.33	127.37	149.39	101.74
Max	**m AOD**	111.56	112.97	127.81	75.02
Range	**m**	16.77	14.4	21.58	26.72

Plate 7-1: Groundwater levels at on-site boreholes and on-site rainfall



Groundwater Quality

Groundwater Quality Methodology

7.107 Groundwater quality monitoring was carried out on 7th August 2024, 22nd May 2023 and 3rd February 2022. The samples were collected by SLR personnel. A Waterra pump and tubing were used to pump water from depth in the borehole and ensure that recent surface water inflow was not collected. Each borehole was purged of three well volumes prior to taking the groundwater sample. Where the groundwater level was too deep to use the pump, the well was sampled using a bailer.

7.108 The samples were collected in the appropriate sample containers, which are supplied by the laboratory for the required analysis. Sample containers were filled so that there was minimum free air space. The containers were securely sealed so that there was no loss of volatile components such as moisture and no separation of components. All sample containers were clearly and uniquely labelled with details including ID and sampling date.

7.109 All samples were placed into a cooler box with ice packs to maintain a temperature at 5°C ± 3°C. The analysis required for each sample was listed on the Chain of Custody Record which accompanied samples. The samples were analysed at the ALS laboratories.

7.110 The following parameters were tested for on each water sample:

- Inorganics: Ammoniacal Nitrogen as N Low Level, Ammoniacal Nitrogen as NH3 Low Level, Ammoniacal Nitrogen as NH4 Low Level, Cyanide Free Low Level, Cyanide Total Low Level, Conductivity, Chloride, Fluoride, Nitrate as NO3, Nitrite as NO2, pH, Phosphate (Orthophosphate as P), Sodium, Sulphate, Sulphide, Total Oxidised Nitrogen as N;
- Filtered (Dissolved) Metals: Aluminium, Arsenic, Barium, Boron, Cadmium, Calcium, Chromium, Copper, Iron, Lead, Mercury, Nickel, Phosphorus, Potassium, Selenium, Sodium, Vanadium and Zinc;
- Unfiltered Metals: Aluminium, Magnesium and Manganese;
- Volatile Organic Compounds (VOCs), Total petroleum hydrocarbons (TPHs) and Extractable Petroleum Hydrocarbons (EPHs).

Groundwater Quality Results

7.111 The results were compared against several criteria: SI No 366 of 2016 (GW Regs), SI No 122 of 2014 (DW Regs), and EPA IGVs, in that order. The field record sheets are included in **Appendix 7-C.**

7.112 The results compared against assessment criteria are presented in **Table 7-9** through **Table 7-11**. TPHs, EPHs and VOCs are only reported if detected or exceedances occur. Across the three monitoring rounds, no exceedances were reported for TPHs, VOCs or EPHs. The laboratory results for the three monitoring rounds are presented in **Appendix 7-D**.

7.113 There was no visual or olfactory evidence of contamination during monitoring. TPHs, EPHs and VOCs were not detected at any of the monitoring locations during any of the monitoring rounds. The following localised exceedances were noted in concentrations of analysed parameters from samples obtained from GW1, GW2 and GW3 from the annual sampling for 2022-2024.

7.114 Conductivity, fluoride and nitrate occasionally marginally exceeded the assessment criteria.

7.115 Sulphate exceeded the GW Regs assessment criteria in GW2 for all rounds. Borehole GW2 is located in the northeast of the quarry and is located away from the working areas of the quarry. Additionally, it should be noted that the borehole is not downgradient of the quarry.

7.116 Calcium marginally exceeded the assessment criteria at GW2. Nickel also exceeded the assessment criteria at GW2, and at GW3 in 2023 only. Selenium was marginally exceeded at GW3 in 2024 only.

Table 7-9 Groundwater Quality (7th August 2024)

Parameter	Units	GW01	GW02	GW03
Inorganics				
Ammoniacal Nitrogen as N (low level)	mg/l	0.014	0.015	0.012
Ammoniacal Nitrogen as NH_3	mg/l	0.017	0.0182	0.0146
Ammoniacal Nitrogen as NH_4	mg/l	0.018	0.0193	0.0154
Chloride	mg/l	13.1	45	7.9
Conductivity	mS/cm	0.57	1.03	0.297
Cyanide, Free (low level)	µg/l	<2.5	<2.5	<2.5
Cyanide, Total (low level)	µg/l	<5	<5	<5
Fluoride	mg/l	<0.5	0.817	1.2
Nitrate as NO_3	mg/l	28.9	<0.3	4.93
Nitrite as NO_2	Mg/l	<0.05	<0.05	<0.05
pH	pH Units	7.62	7.26	7.92
Phosphate (Ortho as PO_4)	mg/l	<0.02	<0.02	<0.02
Sulphate	mg/l	47.3	345	31.3
Sulphide	mg/l	<0.01	<0.01	<0.01
Total Oxidised Nitrogen as N	mg/l	6.52	<0.1	1.11
Filtered (Dissolved) Metals				
Aluminium (diss.filt)	µg/l	<10	<10	<10
Arsenic (diss.filt)	µg/l	<0.5	2.68	<0.5
Barium (diss.filt)	µg/l	16.5	26.2	10.2
Boron (diss.filt)	µg/l	15.2	60.4	43.5

Cadmium (diss.filt)	µg/l	<0.08	<0.08	<0.08
Calcium (Dis.Filt)	mg/l	116	206	52
Chromium (diss.filt)	µg/l	<1	<1	<1
Copper (diss.filt)	µg/l	1.48	<0.3	1.89
Iron (Dis.Filt)	mg/l	<0.019	2.25	<0.019
Lead (diss.filt)	µg/l	0.345	<0.2	0.28
Mercury (diss.filt)	µg/l	0.0101	<0.01	<0.01
Nickel (diss.filt)	µg/l	9.98	23.6	2.58
Phosphorus (diss.filt)	µg/l	<10	<10	19.6
Potassium (Dis.Filt)	mg/l	0.648	2.82	0.743
Selenium (diss.filt)	µg/l	<1	<1	13.4
Sodium (Dis.Filt)	mg/l	7.55	21.8	5.04
Vanadium (diss.filt)	µg/l	<1	<1	<1
Zinc (diss.filt)	µg/l	20.6	14.2	18.4
Unfiltered (Total) Metals				
Aluminium (tot.unfilt)	µg/l	15200	2740	8150
Magnesium (Tot. Unfilt.)	mg/l	18.8	26.8	13.8
Manganese (tot.unfilt)	µg/l	2380	853	1430

Highlighted values; exceedances assessment criteria; SI No 366 of 2016 (GW Regs), SI No 122 of 2014 (EC Drinking Water Regs), EPA IGVs (in that order)

Bold values: Exceeds laboratory limit of detection for organics where no assessment criteria exists

Table 7-10 Groundwater Quality (22nd May 2023)

Parameter	Units	GW01	GW02	GW03
Inorganics				
Ammoniacal Nitrogen as N (low level)	mg/l	0.062	0.0245	0.0261
Ammoniacal Nitrogen as NH_3	mg/l	0.0752	0.0297	0.0317
Ammoniacal Nitrogen as NH_4	mg/l	0.0797	0.0315	0.0336
Chloride	mg/l	15.7	40.6	8.6
Conductivity	mS/cm	0.596	1.03	0.279
Cyanide, Free (low level)	µg/l	<2.5	<2.5	<2.5
Cyanide, Total (low level)	µg/l	<5	<5	<5
Fluoride	mg/l	<0.5	0.52	0.979
Nitrate as NO_3	mg/l	25.1	2.9	5.59
pH	pH Units	<0.05	<0.05	<0.05
Phosphate (Ortho as PO_4)	mg/l	7.67	7.52	8.09
Sulphate	mg/l	<0.02	<0.02	<0.02
Sulphide	mg/l	32.3	359	26.3
Total Oxidised Nitrogen as N	mg/l	<0.01	<0.01	0.0221
Filtered (Dissolved) Metals				
Aluminium (diss.filt)	µg/l	<10	<10	<10
Arsenic (diss.filt)	µg/l	<0.5	<0.5	<0.5
Barium (diss.filt)	µg/l	21.6	30.1	8.79
Boron (diss.filt)	µg/l	20.9	53.7	<10
Cadmium (diss.filt)	µg/l	<0.08	<0.08	<0.08
Calcium (Dis.Filt)	mg/l	138	219	48.7

Chromium (diss.filt)	µg/l	<1	<1	<1
Copper (diss.filt)	µg/l	0.803	0.618	<0.3
Iron (Dis.Filt)	mg/l	<0.019	<0.019	<0.019
Lead (diss.filt)	µg/l	0.502	<0.2	<0.2
Mercury (diss.filt)	µg/l	<0.01	<0.01	<0.01
Nickel (diss.filt)	µg/l	36	35.6	1.33
Phosphorus (diss.filt)	µg/l	<10	<10	<10
Potassium (Dis.Filt)	mg/l	0.794	2.66	0.578
Selenium (diss.filt)	µg/l	<1	1.32	9.48
Sodium (Dis.Filt)	mg/l	9.41	25.4	5.62
Vanadium (diss.filt)	µg/l	<1	<1	<1
Zinc (diss.filt)	µg/l	19.1	23.7	19.8
Unfiltered (Total) Metals				
Aluminium (tot.unfilt)	µg/l	5070	1610	286
Magnesium (tot. unfilt.)	mg/l	10.6	15.9	3.42
Manganese (tot.unfilt)	µg/l	745	515	36.1

Highlighted values; exceedances assessment criteria; SI No 366 of 2016 (GW Regs), SI No 122 of 2014 (EC Drinking Water Regs), EPA IGVs (in that order)

Bold values: Exceeds laboratory limit of detection for organics where no assessment criteria exists

Table 7-11 Groundwater Quality (3rd February 2022)

Parameter	Units	GW01	GW02	GW03
Inorganics				
Ammoniacal Nitrogen as N (low level)	mg/l	0.023	0.029	0.025
Ammoniacal Nitrogen as NH_3	mg/l	0.0279	0.0352	0.0304
Ammoniacal Nitrogen as NH_4	mg/l	0.0296	0.0373	0.0321
Chloride	mg/l	15.3	53.5	8.5
Conductivity	mS/cm	0.601	1.02	0.309
Cyanide, Free (low level)	µg/l	<2.5	<2.5	<2.5
Cyanide, Total (low level)	µg/l	<5	<5	<5
Fluoride	mg/l	<0.5	0.668	1.21
Nitrate as NO_3	mg/l	17.2	<0.3	5.08
Nitrite as NO_2	Mg/l	<0.05	<0.05	<0.05
pH	pH Units	7.44	7.39	8.06
Phosphate (Ortho as PO_4)	mg/l	<0.02	<0.02	<0.02
Sulphate	mg/l	30.4	319	42.5
Sulphide	mg/l	<0.05	0.0135	0.0261
Total Oxidised Nitrogen as N	mg/l	3.9	<0.1	1.15
Filtered (Dissolved) Metals				
Aluminium (diss.filt)	µg/l	<10	<10	<10
Arsenic (diss.filt)	µg/l	<0.5	<0.5	<0.5
Barium (diss.filt)	µg/l	16.6	26.4	10.1
Boron (diss.filt)	µg/l	<10	79.6	<10
Cadmium (diss.filt)	µg/l	<0.08	<0.08	<0.08

Calcium (Dis.Filt)	mg/l	131	210	55.3
Chromium (diss.filt)	µg/l	<1	<1	<1
Copper (diss.filt)	µg/l	1.01	0.519	0.355
Iron (Dis.Filt)	mg/l	<0.019	<0.019	<0.019
Lead (diss.filt)	µg/l	<0.2	0.21	<0.2
Mercury (diss.filt)	µg/l	<0.01	<0.01	<0.01
Nickel (diss.filt)	µg/l	7.92	39.1	2.11
Phosphorus (diss.filt)	µg/l	<10	10.6	<10
Potassium (Dis.Filt)	mg/l	0.466	2.78	0.658
Selenium (diss.filt)	µg/l	<1	<1	12.8
Sodium (Dis.Filt)	mg/l	8.07	21.6	5.89
Vanadium (diss.filt)	µg/l	<1	<1	<1
Zinc (diss.filt)	µg/l	5.87	49.6	18.1
Unfiltered (Total) Metals				
Aluminium (tot.unfilt)	µg/l	11700	4720	2370
Magnesium (Tot. Unfilt.)	mg/l	16.3	24.4	6.04
Manganese (tot.unfilt)	µg/l	1310	898	107

Highlighted values; exceedances assessment criteria; SI No 366 of 2016 (GW Regs), SI No 122 of 2014 (EC Drinking Water Regs), EPA IGVs (in that order)

Bold values: Exceeds laboratory limit of detection for organics where no assessment criteria exists

Surface Water - Hydrology

Surface Water Bodies

7.117 Surface water bodies in the area are shown in **Figure 7-1**.

7.118 The LISNAGONOGE_010 stream is located on the northern border of the quarry, north of the proposed development site. This river flows from c. 6.9km east of the site to directly northwest of the site where it joins with the SUIR_080 river.

7.119 The SUIR_080 river flows north to the SUIR_070 and back down south where it joins the SUIR_090 which is located c. 3.8km west of the proposed development site. The SUIR_090 continues to flow in a southerly direction into the SUIR_100.

7.120 The river ARGLO_010 is located c. 3.6km southeast of the proposed site which flows in a south-westerly direction to join the River ARGLO_020.

7.121 According to the EPA maps, there is an unnamed lake located southeast of the quarry and the proposed site with the segment code 16_118.

Catchment

7.122 The site is located in the mid-north region of the Suir Catchment (ID 16) which has an area of 3,542km².

7.123 The catchment encompasses the region drained by the River Suir and all tributary streams eventually flow into tidal waters between Drumdowney and Cheekpoint, County Waterford.

7.124 In terms of local catchments under the WFD, the quarry is situated in the Suir_SC_050 Sub Catchment (ID 16_10) and is split between three River Sub-Basin catchments, LISNAGONOGE_010, SUIR_090 and SUIR_080. The proposed development site is split between the SUIR_080 and SUIR_090 River Sub-Basin catchments, see **Figure 7-1**.

Flooding

7.125 The Office of Public Works (OPW) is the government agency with statutory responsibility for flooding in Ireland. The existing CFRAM and NIFM flood maps show that the site is at low risk of fluvial flooding. The available GSI data does not indicate that the site is vulnerable to groundwater flooding. Due to the location of the proposed development site, the risk of coastal flooding is also low. There are no records of historic flooding in the OPW database within 2 km of the site. A flood report was composed on an area located along the River Suir located c. 3.8km northwest of the proposed site in December 2005. The flood event report describes repeated flooding of lands within 2.5km of this chosen area as a result of the River Suir.

Surface Water Biological Quality in the River Suir : Q Values

7.126 The surface water quality data of surface water bodies within the study area, was obtained from EPA web map. The EPA has a registered surface water monitoring stations through Ireland, which are continuously recording near real time river ecology monitoring results. The results are presented through “Q” values, that are reflecting average water quality at any location. These values are based primarily on the relative proportions of pollution sensitive to tolerant macroinvertebrates (the young stages of insects primarily but also snails, worms, shrimps etc.) resident at a river site. Results scores are in range from 1 to 5, from the lowest (1) to the highest (5) water quality rating.

7.127 The closest monitoring station to the proposed site is Holycross Bridge located c. 3.8km northwest of the application site on the River Suir. The monitoring station is located downstream of SUIR_080 which is located c. 1km north of the site.

7.128 The latest water quality reports a 3 Q value, meaning that the river is poor and in unsatisfactory condition. This is a decline in status since the last monitoring round in 2020 when the river received a Q value of 3-4. **Table 7-12** summarises the monitoring station data.

Table 7-12: EPA Biological Water Quality Ratings

Station ID	RS16S021100
Station Name	Holycross Br.
Watercourse	SUIR_080
Distance	c. 3.8km northwest of site
Date	**Year**
1988	3
1992	3-4
1996	3
1999	3-4
2002	3-4
2005	3
2008	3
2011	3-4
2014	4
2017	3-4
2020	3-4
2023	3

Site Water Management

7.129 Site water management will involve a number of elements including the following elements:

i. **Process waters:** Treated and reused in the site processes;

ii. **Roof water:** Clean rainwater runoff from building roofs will go to the Clean Water Pond at the site where it will be reused or sent to the quarry (replacing the requirement to abstract water from PW01, PW02 and PW03);

iii. **Surface water:** Surface water runoff from trafficked and yard areas will go to the main pond after passing through an interceptor which is used for the attenuation of storm water runoff and also for Firewater retention. Following testing, water will be pumped to the Clean Water Pond and then to the tanks that will supply the concrete plant or dust suppression;

iv. **Firewater:** A firewater pond is provided at the site and sufficient capacity will be maintained in the pond to retain any waters used in the event of a fire at the site. Any firewater will be tested and then disposed of at a suitable facility; and

v. **Foul water:** A foul wastewater holding tank will be provided at the site. The tank will be emptied as required by a licenced contractor as and when required.

7.130 The water management at the site is shown in WEW Planning Drawing **1905-DG-0014**.

7.131 The water treatment plant at the site for process water will be located in the pretreatment building and will include standard water treatment technology including Coagulation, flocculation, Separation, Ultrafiltration and reverse osmosis.

7.132 The water details and volumes for the site are set out in **Table 7-13** below.

Table 7-13: Site Water Details and Volumes

Water Element	Management Details and Estimated Volumes
Process Water	• Water on imported material / stock is estimated to be c. 83,300 m^3/yr. • Water treatment capacity for c. 1,129 m^3/day based on a working day (includes water on imported material and soiled rainwater from site areas). The treatment capacity includes for a 10% uplift to provide a factor of safety.
Roof Water	• Clean rainwater generated at the site is estimated to be c. 46,720 m^3/yr.
Surface Water	• Soiled rainwater generated at the site is estimated to be c. 4,438 m^3/yr. • Storm rainfall runoff from site designed for 24 hr. 120 yr. return period which is equal to 4,564 m^3/day
Firewater	• Firewater attenuation capacity is 9,702 m^3 in the firewater pond which includes 10% capacity for a factor of safety.
Foul Water	• Foul water from site offices is directed to a sealed holding tank where it will be emptied on an as need basis.

7.133 Water treatment at the site includes the process water treatment infrastructure outlined above, as well as two hydrocarbon separators to treat potentially soiled water runoff to the fire water pond, see WEW Planning Drawing **1905-DG-0014** with site water management and treatment details.

Protected Areas

7.134 There is one Natura 2000 sites (SAC or SPA) within 5km of the site.

- Lower River Suir SAC (002137), located 3.3km west of the proposed development.

7.135 There are two pNHA sites within 5km of the site.

- Killough Hill pNHA (000959), located 5m from the proposed development boundary. The pNHA covers part of the existing quarry site. Killough Hill is designed for limestone pavement, semi-natural grassland and semi-natural woodland.
- Cabragh Wetlands pNHA (001934), located 3.6km north of the proposed development boundary.

Water Environment Receptors

7.136 From the baseline study undertaken here, the following water environment sensitive receptors have been identified in the receiving environment:

- Local rivers and streams (moderate WFD status, at risk);

- Downstream Lower River Suir SAC (002137), located 3.3km west, confluence with local stream (Lisnagonoge) located c. 3.7km;
- Regionally important karstic aquifer, within Tipperary Groundwater Body (good WFD status, not at risk);
- Private and Group Scheme groundwater supply wells; and
- Killough Hill pNHA (limestone pavement, semi-natural grassland and semi-natural woodland designation);

7.137 For each identified receptor, the significance and sensitivity of the receptor is assessed in **Table 7-14** below and a rating (High / Medium / Low / Negligible) applied, based on the methodology outlined in existing guidance and reproduced in **Appendix 7-E**.

Table 7-14: Existing Environment - Significance and Sensitivity / Importance

No.	Existing Environment	Significance	Sensitivity	Existing Environment Significance / Sensitivity Rating (H / M / L / N)
1	Local Rivers and Streams	Surface watercourse (Lisnagonoge Stream) located to the north of the quarry site. Site is within Suir Catchment (ID 16)	Local Rivers and Streams have moderate WFD status and are at risk. Groundwater level in bedrock aquifer is at depth so not in direct continuity	Medium – Attribute has a medium quality or value on a local scale
2	Lower River Suir SAC (002137)	Downstream surface watercourse, confluence c.3.7km from site.	The River Suir has an at risk WFD status.	High - Attribute has a high quality or value on an international scale (SAC status)
3	Regionally important karstic aquifer	Located within the Tipperary Groundwater Body (GWB)	Not at risk but bordering GWBs are at risk. All GWBs received 'Good Status' 2016-2021.	High - Attribute has a high quality or value on a local scale (Regionally Important Aquifer)
4	Private and Group Groundwater Supplies	All local residents are assumed to have a private water supply. Group water supply identified by GSI	The private wells will supply <50 homes and may be sensitive to changes at the local scale.	Low - Attribute has a low quality or value on a local scale (potable water source supplying <50 homes)
5	Killough Hill pNHA (000959)	Info about pNHA Located adjacent to proposed development and within existing quarry.	Limestone pavement, semi-natural grassland and semi-natural woodland	High - Attribute has a high quality or value on a regional or national scale (pNHA status)

Receiving Environment - Baseline Summary

7.138 The site is underlain by crinoidal wackestone/packstone limestone of the Ballyadams Formation and that a small section in the middle of the site is underlain by cherty, muddy, coarse grained, calcarentic limestone of the Clogrenan Formation. The soils surrounding the quarry site are fine loamy drift with limestone stones known as the Elton (1000ET) Soil Association.

7.139 The GSI online map viewer shows the site is underlain by a regionally important karstic aquifer (Rkd). This aquifer is defined as being a good aquifer capable of supplying regionally important supplies e.g. large public water supplies, see **Figure 7-2**. The aquifer has an area of 80 km2.

7.140 The site is within the Water Framework Directive (WFD) Suir_SC_050 Sub Catchment (ID 16_10) and is split between three River Sub-Basin catchments, LISNAGONOGE_010, SUIR_090 and SUIR_080. The proposed development site is split between the SUIR_080 and SUIR_090 River Sub-Basin catchments.

7.141 The closest surface water body to the site is the Lisnagonoge stream located to the north of the site.

7.142 Under the WFD classification, the River Suir is 'At Risk' status and the Lisnagonoge stream is classified as being of 'Moderate' status.

7.143 There are no recorded flood events at or near the site, nor is there any risk of potential flooding.

7.144 The proposed development is located within the Tipperary Groundwater Body (GWB). The groundwater flow in this aquifer is expected to be close to the surface through karstic conduits and enlarged fissures, mainly along fault zones. This GWBs is classified as being not at risk status under the WFD classification. This groundwater body is bordered by the Templemore GWB, Clonmel GWB and the North Kilmallock GWB. All of these GWBs, including Tipperary GWB, received a Good WFD status during the 2016-2021 period. However, these same GWBs, are considered At Risk of deteriorating in quality.

7.145 The groundwater vulnerability at the site is classed as Extreme and as X (Rock at or Near Surface)

7.146 There is the Ash Hill Group Scheme Source Protection Area located c. 2.5km east of the site. The closest Group Water Scheme (GWS) is located c. 2km northeast of the site, the Graigue-Moycarkey GWS. The Graigue-Moycarkey GWS well has a depth of 76.2m with no info on the depth of rock. The yield class is noted as good (327.30 m^3/day) and has a productivity class of III. There is no public supply source protection area within the vicinity of the proposed site, the closest is Tobernaloo Public Water Supply (PWS) c. 7km north of the site.

7.147 There are ten groundwater monitoring well locations on site, see **Figure 7-5**, SLR monitor four of these wells for groundwater levels and for data loggers (PW06, GW01, GW02 and GW03) and three of the wells for groundwater quality (GW01, GW02 and GW03). PW06 is not being monitored for groundwater quality due to its close proximity to wells PW01, PW02 and PW03. Each of these wells have pumps installed and groundwater is regularly abstracted from them.

7.148 Between 2020 and 2024, large variations have been observed in all four monitoring wells. Since monitoring began, PW06 has shown a range of 48.35m, a maximum groundwater level of 113.25m AOD and a minimum groundwater level of 64.89m AOD. The smallest variation was seen in GW02 with a range of 9.62m, a maximum groundwater level of 122.45m AOD and a minimum level of 112.85m AOD.

7.149 Groundwater levels are generally highest at GW3, which is located in the south-east of the quarry and lower in GW1 and GW2. This indicates a general groundwater flow direction of south-east to north/north-west, towards the Lisnagonoge stream.

7.150 Groundwater quality monitoring was carried out on 7th August 2024, 22nd May 2023 and 3rd February 2022. The results were compared against several criteria: SI No 366 of 2016 (GW Regs), SI No 122 of 2014 (DW Regs), and EPA IGVs, in that order. Across the three monitoring rounds, no exceedances were reported for TPHs, VOCs or EPHs.

Impact Assessment

Evaluation Methodology

7.151 The potential direct and indirect impacts to surface water and groundwater associated with the proposed bio-renewables facility at Killough Quarry are initially assessed in this chapter without any mitigation measures in place.

7.152 The methodology applied here is a qualitative risk assessment methodology in which the nature of the potential impacts are described in terms of the character, magnitude, duration, probability and consequence of the impact are considered. The terms used to describe the potential hydrological and hydrogeological impact or effects are explained in tables reproduced in **Appendix 7-E**. The cumulative impact of any potential impacts is also assessed.

7.153 The description of the potential impact is then screened against the significance and sensitivity of the receiving environment to establish the overall significance of the potential impact (without mitigation). The classification of the impact significance is determined using the matrix from the EPA Guidelines (2022) which is reproduced in **Appendix 7-F**.

7.154 This approach provides a mechanism for identifying the key areas where mitigation measures are required, and for identifying mitigation measures appropriate to the risk presented by the proposed development. Following consideration of mitigation measures (existing and proposed) an assessment of the residual impacts arising from the proposed development is provided.

7.155 The following sections identify the potential impacts of the proposed development on the hydrogeological and hydrological environments. It also assesses the likelihood of occurrence of each identified impact. As previously noted, the impacts are initially assessed with no mitigation or design measures incorporated to reduce the risk.

7.156 The potential direct and indirect impacts to surface waters and groundwater during the Construction Stage, the Operation Stage and Post Operational Stage (site restoration) are discussed below.

Construction Stage (No Mitigation)

7.157 The potential direct and indirect construction stage impacts to surface waters and groundwater are discussed below. In the context of the proposed bio-renewables facility, the construction stage is taken to comprise the construction of the proposed bio-renewables production facility compound and ancillary site facilities including surface water and fire water storage ponds and storage tanks for water. Topsoil has already been stripped from the site. Localised excavations will be undertaken to a depth of approximately 7m for the installation of water tanks with construction of the tanks being maintained above the underlying groundwater in the area.

Direct Impacts

Surface Water

7.158 There is no discharge from the proposed bio-renewables facility to the stream and therefore there are no direct impacts on surface water quality or quantity during this stage. Water, process and precipitate, will be reused, not discharged to outfall. All waters will be captured, pumped to storage with in-line quality monitoring and then pumped off site for reuse by the Killough Quarry.

Groundwater

7.159 The accidental leaking or spillage of fuel and/or other petroleum-based products could also impact on groundwater in the bedrock aquifer. The accidental leakage or spillage of concrete during the construction of the tanks.

Indirect Impacts

Surface Water

7.160 The accidental leaking or spillage of fuel and/or other petroleum-based products could also indirectly impact on nearby rivers and streams

7.161 Any indirect impact on the local rivers and streams could impact the downstream surface water bodies, i.e. the Lower River Suir SAC, at distance from the site.

Groundwater

7.162 The accidental leaking or spillage of fuel and/or other petroleum-based products could also indirectly impact on local water supplies.

7.163

Protected Areas

7.164 The Lower River Suir SAC is located 3.3km west.

Operational Stage Impacts

7.165 There is the potential for direct impacts on groundwater and indirect impacts on surface water and groundwater arising from the proposed bio-renewables facility during the operational stage. Potential impacts on surface water and groundwater have been identified and are outlined below.

Direct Impacts

Surface Water

7.166 There will be no discharge from the proposed bio-renewables facility to local streams and rivers and there will therefore be no direct impacts on surface water quality or quantity during the construction stage.

Groundwater

7.167 There is a potential impact on groundwater quality from accidental leaking or spillage of fuel and/or other petroleum-based products during the operational stage. This could result in fuel and/or other petroleum-based products being carried in recharge to groundwater in the underlying bedrock aquifer and this in turn could indirectly impact the local water supplies in the area.

7.168 Other contaminants that could potentially impact on the bedrock aquifer quality are leachate from bio-fuel storage, silage feed leachate, cattle manure / slurry spillage, chicken litter leachate, pot ale and spent grain material leachate and chemical spillages.

7.169 During the operational stage, the water supply wells will be decommissioned. The groundwater level in the monitoring boreholes has been measured at depths of >20m bgl. The groundwater level in the regionally important bedrock aquifer beneath the facility will rise following the decommissioning of the water supply wells.

Indirect Impacts

Surface Water

7.170 Accidental leaking or spillage of fuel and/or other petroleum-based products could result in contaminants being carried in recharge impacting the underlying groundwater in the regionally important bedrock aquifer which, in turn, could potentially impact the nearby rivers and streams. However, the groundwater levels in the bedrock aquifer will rise following decommissioning of the water supply wells, which may result in some hydraulic connectivity with local rivers and streams.

7.171 Other contaminants that could impact on the bedrock aquifer quality which, in turn, could potentially impact the nearby rivers and streams are leachate from bio-fuel storage, silage feed leachate, cattle manure / slurry spillage, chicken litter leachate, pot ale and spent grain material leachate and chemical spillages.

7.172 Any indirect impact on the local rivers and streams could impact the downstream surface water bodies, i.e. the Lower River Suir SAC, at distance from the site.

Groundwater

7.173 Any impact from accidental leaking or spillage of fuel and/or other petroleum-based products during the operational stage which could migrate into the underlying bedrock aquifer and this in turn could indirectly impact the local water supplies in the area.

7.174 Other contaminants that could impact on the bedrock aquifer quality which, in turn, could potentially impact the local water supplies in the area are leachate from bio-fuel storage, silage feed leachate, cattle manure / slurry spillage, chicken litter leachate, pot ale and spent grain material leachate and chemical spillages.

Protected Areas

7.175 The Lower River Suir SAC is located 3.3km west. Any indirect impact on local streams and rivers could impact on the Lower River Suir SAC, located at distance downstream.

‘Do-nothing Scenario’

7.176 If the proposed development is not permitted, this sustainability project, which is the first of a number of such sustainability projects to be initiated by Roadstone to reduce Carbon Footprint (CF) and greenhouse gas (GHG) emissions while also addressing the changeover to regenerative agriculture utilising organic fertilisers to increase carbon sequestration, will not proceed.

Rating of Identified Potential Impacts

7.177 The potential impacts outlined above during the construction and operational stages have been described in terms of the character, magnitude, duration, probability and consequence, and each impact is rated in terms of High (H), Medium (M), Low (L) and Negligible (N) based on the magnitude, extent, duration and consequence of the identified effects.

Significance of Impacts

7.178 The significance of impacts is based on the significance and sensitivity of the existing environment (**Table 7-14** above), and the description of identified potential impacts with likely significant effects outlined in **Table 7-15**. The significance of Impact is determined from the Classification of the Significance of Impacts in **Appendix 7-E**.

Table 7-15: Classification of Significance of Impacts (No Mitigation)

No.	Potential Impacts	Impact Rating (No Mitigation)	Significance of Impact (No Mitigation)
Construction Stage – Direct – Surface Water			
1	No discharge to local surface waters and therefore there are no direct impacts on surface water quality or quantity.	**Negligible.** No direct impacts on surface water quality or quantity. All waters (process and precipitate) will be captured, pumped to storage with in-line quality monitoring and then pumped off site for reuse by the Killough Quarry.	**Neutral**
Construction Stage – Direct - Groundwater			
2	Reduction in groundwater quality in regionally important bedrock aquifer from sediment run-off.	**Low.** Potential to affect groundwater quality in bedrock underlying facility through vertical migration of sediment in run-off. Any impact to groundwater will be limited due to short term nature of works.	**Slight**
3	Reduction in groundwater quality in regionally important bedrock aquifer from accidental fuel leakage/ spillage, which could migrate into the underlying bedrock aquifer	**Medium - Low.** Potential to affect groundwater quality in bedrock underlying bedrock aquifer through vertical migration. Any impact to groundwater will be limited due to short term nature of works. Any leakage / spillage would be accidental only and of limited volume.	**Moderate - Slight**
Construction Stage – Indirect – Surface Water			
4	Impact on surface water quality in nearby rivers and streams, and Lower Suir SAC which is at distance from the facility	**Low** to **Negligible.** Potential to affect surface water quality (fuel / suspended solids) in local rivers and streams, through groundwater baseflow to the watercourse. Groundwater is at depth at the facility and may not be in hydraulic continuity with watercourses. Impact is also unlikely due to short term nature of works. Any leakage / spillage would be accidental only and of limited volume.	**Slight - Not Significant**
Construction Stage – Indirect – Groundwater			
5	Impact on groundwater quality in bedrock aquifer could indirectly impact the local water supplies in the area.	**Low.** Potential to affect groundwater quality in bedrock aquifer (fuel / suspended solids) which could migrate to local water supplies. Any impact on groundwater in the bedrock aquifer will be limited due to short term nature of works. Any leakage / spillage would be accidental only and of limited volume.	**Slight**

Operational Stage *– Direct – Surface Water*			
6	No discharge to local surface waters and therefore there are no direct impacts on surface water quality or quantity.	**Negligible.** There will be no discharge from the proposed bio-renewables facility to local streams and rivers and there will therefore be no direct impacts on surface water quality or quantity during the construction stage.	**Not Significant**
Operational Stage *– Direct – Groundwater*			
7	Reduction in groundwater quality in bedrock aquifer from accidental fuel leakage/ spillage, leachate from bio-fuel storage and chemical spillages, which could migrate into the underlying bedrock aquifer	**Medium - Low.** Potential to affect groundwater quality in bedrock underlying groundwater through vertical migration. Any leakage / spillage would be accidental only and of limited volume. Groundwater level in the regionally important bedrock aquifer beneath the facility will rise following the decommissioning of the water supply wells.	**Moderate - Slight**
Operational Stage *– Indirect – Surface Water*			
8	Impact on surface water quality in nearby rivers and streams, and Lower Suir SAC which is at distance from the facility	**Low** to **Negligible.** Potential to affect surface water quality (fuel / suspended solids) in local rivers and streams, through groundwater baseflow to the watercourse. Groundwater level in the regionally important bedrock aquifer beneath the facility will rise following the decommissioning of the water supply wells. Any indirect impact on the local rivers and streams could impact the downstream surface water bodies, i.e. the Lower River Suir SAC, at distance from the site.	**Slight – Not Significant**
Operational Stage *– Indirect - Groundwater*			
9	Impact on groundwater quality in bedrock aquifer could indirectly impact the local water supplies in the area.	**Low** to **Negligible.** Potential to affect groundwater quality in bedrock aquifer (fuel / suspended solids) which could migrate to local water supplies. Any leakage / spillage would be accidental only and of limited volume. Groundwater level in the regionally important bedrock aquifer beneath the facility will rise following the decommissioning of the water supply wells.	**Slight - Not Significant**

Water Framework Directive

7.179 The Water Framework Directive (WFD) assessment is based on the information outlined in this EIAR including baseline data, groundwater monitoring data for the site and the identification of sensitive receptors under the WFD and the mitigation measures outlined above. An Appropriate Assessment Screening and Natura Impact Assessment Report has also been prepared for the proposed development which identifies ecological sensitive receptors.

7.180 A potential zone of influence was taken to be a 15 km radius from the site boundary. The assessment identified six potential receptors; they are:

- Killough Hill pNHA;
- the Lisnagonoge stream;
- the Lower River Suir SAC,
- the Cabragh Wetlands pNHA;
- Regionally important karstic aquifer;
- the Tipperary Groundwater body; and
- the River Suir Nutrient Sensitive Area.

7.181 Mitigation measures, outlined above in relation to water, will be embedded within the proposed development to protect surface water and groundwater and the identified WFD receptors. The measures for the proposed development will be secured via any future planning permission and associated conditions relating to an approval.

7.182 It is considered here, that based on the nature of the proposed development and with the designed embedded mitigation measures in place, that the proposed development will not result in a deterioration in the status of the identified WFD receptors or prevent them from achieving their status objectives.

Mitigation Measures

Construction & Operational Stages

7.183 An Environmental Management System (EMS) will be put in place for the facility, as will be required by the IE Licence. The operator shall develop the EMS in accordance with ISO14001:2015, applying for accreditation when operational. This EMS will include but not be limited to the following:

- Measures to comply with the IE licence and other relevant environmental legislation;
- Waste Acceptance Procedures;
- Standard Operating Procedures;
- Measures to comply with the corporate sustainability goals (e.g., reducing water and energy consumption); and
- Accident prevention and emergency response procedures.

7.184 As previously noted, process water and rainfall, will be reused and not discharged. On site water will be captured, pumped to storage with in-line quality monitoring and then pumped to the adjacent quarry site for re-use. Drainage networks are shown on planning drawing WEW 1905-DG -0014.

7.185 The application site drainage will comprise of:

- run-off from the building roofs in the facility will be collected in a sealed pipe network for onsite storage in the surface water pond and reused in the adjacent quarry site as required;
- drainage of hard standing / trafficked areas will be collected in a separate sealed pipe network for onsite storage in the surface water pond and reused in the adjacent quarry site as required;

7.186 In order to mitigate against the risk of pollution to groundwater and surface water occurring at the site the following management measures will be implemented.

- There will be no off-site discharge from the proposed development to any surface watercourse in the locality;
- Fuel and oils will be stored in existing covered bunded fuel tanks. There is no refuelling onsite and smaller items will use a bunded tray.
- Several storage tanks and silos located throughout the site including a water storage tanks, silage feed soil / mixing tanks, fire water supply tanks, treated water storage tanks, bio-rest tanks, cattle manure / slurry silo, pot ale and spent grain material tank / silo, maize silo and a chicken litter silo.
- A number of spill kits will be available on-site to stop the migration of any minor accidental leakages or spillages should they arise;
- All HGVs exiting the site will be routed through the proposed wheelwash. This will minimise the transport of fines by HGVs over the access / egress road and the public road network;
- All roads will be paved.
- Periodic sweeping of the internal paved site access road and surrounding public roads will be carried out as required by a mechanical road sweeper; and
- Environmental audits at the site will be undertaken to ensure that compliance with all planning consents, licences and site environmental management system, which is accredited to ISO 14 001 standard, is both maintained and enhanced.

7.187 Implementation of these measures at the application site will further reduce the potential impacts identified above to neutral.

Assessment of Impacts with Mitigation Measures in Place

7.188 With the above mitigation measures in place at the application site, it is projected that the following reduction in the assessed significance of impacts will result:

- Reduction of the potential impact on groundwater quality in the bedrock aquifer from suspended solids during the construction stage from “slight” to “slight – not significant” (No. 2).
- Reduction of the potential impact on groundwater quality in the bedrock aquifer from accidental fuel leakage/ spillage during the construction stage from “moderate - slight” to “slight” (No. 3).
- Reduction of the potential impact on surface water quality in nearby rivers and streams, and Lower Suir SAC from accidental fuel leakage/ spillage during the construction stage from “slight” to “slight – not significant” (No. 4).

- Reduction of the potential impact on groundwater quality in the bedrock aquifer from accidental fuel leakage/ spillage and leachate from bio-fuel storage, feed and litter etc during the operational stage from “moderate - slight” to “slight” (No. 7).
- Reduction of the potential impact on surface water quality in nearby rivers and streams, and Lower Suir SAC from accidental fuel leakage/ spillage during the operational stage from “slight” to “slight – not significant” (No. 8).
- The significance of all other potential impacts during the construction and operational stage will be “**slight - negligible**” or lower to the water environment receptors.

Residual Impact Assessment

7.189 Examination of the identified potential impacts on the receiving environment show that with the mitigation measures in place, there are no significant residual impacts with respect to groundwater and surface water during the construction / operational / post operational stages of the proposed bio-renewables facility development.

7.190 Following mitigation, the significance of all potential impacts identified will be reduced to “**slight**” or lower.

Monitoring

7.191 The following monitoring activities will be carried out to demonstrate that the development is not having an adverse impact on the surrounding environment and will document any improvements in water quality.

- groundwater levels in boreholes GW01, GW02 and GW03 will be monitored on a quarterly basis;
- groundwater loggers installed in the three boreholes will continue to provide for continuous groundwater level monitoring and logger downloads will be undertaken on a quarterly basis;
- groundwater quality monitoring to be undertaken on an annual basis; and
- all existing quarry supply wells (PW wells) to be capped and supply use discontinued as all quarry water requirements will come from the AD process recycled water. The quarry supply wells will be decommissioned at the operational stage.
- surface water quality testing will be carried out. Surface water runoff from trafficked and yard areas will go to the main pond after passing through an interceptor and after testing will be pumped to the Clean Water Pond and then to the tanks that will supply the concrete plant or dust suppression.

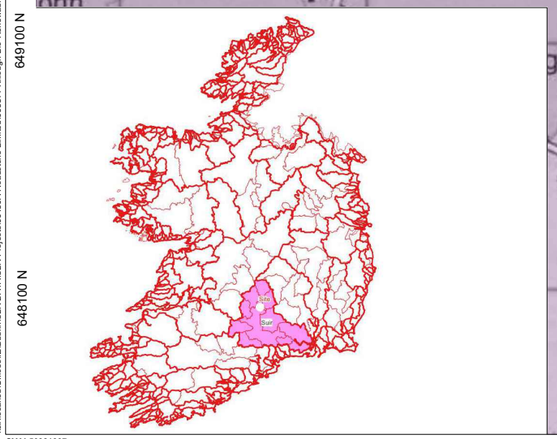
Figures

607000 E | 608000 E | 609000 E | 610000 E | 611000 E | 612000 E | 613000 E | 614000 E

654100 N | 653100 N | 652100 N | 651100 N | 650100 N | 649100 N | 648100 N

Holycross | Mainistir na Croiche | Whitefort | Bohernacrusha | Killeenyarda | Graiguenoe | Newtown | Twoford Bridges | Glenbane Lower | Glenbane Upper | Bohernaspie | Galbertstown Lower | Curtachaun | Clohoge | Galbertstown Upper | Killough | Caraun | Gaile | Peake | Ballinree | Cloghmartin | Graigue | Moycarky Bridge | Butlersfarm | Moycarky | Forgestown | Sallsquarter | Kilmelan | Knockstowry | Coolkip | Aughnagomaun | Ashhill | Knocknanuss | Ballytarsna | Toberadora | Toberadora Stream | Dismantled Railway | R661 | R660 | R639

Suir Upper | **Suir Main** | SUIR_080 | SUIR_090 | LISNAGONOGE_010 | BREAGAGH (TIPPERARY)_020 | SUIR_090



0 500 1000 1500 2000 2500m

Scale 1:25,000

N

Notes:

1. Extract from Ordnance Survey Discovery Series Map No. 66
2. Extract from WFD Catchments © EPA

Legend:

- Applicants Land Interest Area (c.108.3 hectares)
- Planning Application Area (c. 6.3 hectares)

EPA DATA:

- Subcatchment Boundary
- River Basin Boundary
- River Flow

Catchments (WFD River Basins):

- Suir_090
- Suir_080
- Lisnagonoge_010
- Breagagh (Tipperary)_020
- Clodiagh (Tipperary)_040
- Arglo_020
- Arglo_020

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roadstone A CRH COMPANY

Rev	Amendments	Date	By	Chk	Auth

SLR

www.slrconsulting.com

Client: Roadstone Ltd.

Project: Bio-Renewables Production Facility at Killough Quarry, Holycross, Co. Tipperary

Figure Title: Surface Water Features

Scale	SLR Project No.
1:25,000 @ A3	501.065577.00001

Designed	Drawn	Checked	Authorised
NB	NB	smcd	smcd
Date 10/24	Date 10/24	Date 12/24	Date 12/24

Figure Number: **Figure 7-1** | Rev. **R0**

03/12/2024

\\dir.local\eu\Offices\IE\Dublin\SLR DATA\SLR Projects\00180A Roadstone Limited\065577 Killough Bio-Renewables Plant PA EIAR\3 EIAR\07 Water\Dwgs\CAD\Wking\00180.065577 Killough Fig 7-1 SW Features.dwg

CYAL50381397

603000 E | 604000 E | 605000 E | 606000 E | 607000 E | 608000 E | 609000 E | 610000 E | 611000 E | 612000 E | 613000 E | 614000 E | 615000 E | 616000 E | 617000 E | 618000 E | 619000 E

657100 N | 656100 N | 655100 N | 654100 N | 653100 N | 652100 N | 651100 N | 650100 N | 649100 N | 648100 N | 647100 N | 646100 N | 645100 N

N

Lm - Locally Important Aquifer - Bedrock which is Generally Moderately Productive

Rkd - Regionally Important Aquifer - Karstified (diffuse)

Ll - Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones

SPRING

SPRING

ENCLOSED DEPRESSION

SWALLOW HOLE

SWALLOW HOLE

CAVE

CAVE

SWALLOW HOLE

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0 1,000 2,000 3,000 4,000 5,000m

Scale 1:50,000

Notes:

1. Extract from Ordnance Survey Discovery Series Map No. 66
2. Extract from GSI Bedrock Aquifer © GSI

Legend:

Applicants Land Interest Area (c.108.3 hectares)

Planning Application Area (c. 6.3 hectares)

5 km zone

GSI Bedrock Aquifer Classification:

Rkd - Regionally Important Aquifer - Karstified (diffuse)

Ll - Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones

Lm - Locally Important Aquifer - Bedrock which is Generally Moderately Productive

GSI Karst data:

Karst feature

roadstone
A CRH COMPANY

Rev	Amendments	Date	By	Chk	Auth

SLR

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Client
Roadstone Ltd.

Project
Bio-Renewables Production Facility at Killough Quarry, Holycross, Co. Tipperary

Figure Title
Bedrock Aquifer Map

Scale		SLR Project No.
1:50,000	@ A3	501.065577.00001

Designed	Drawn	Checked	Authorised
NB	NB	smcd	smcd
Date	Date	Date	Date
10/24	10/24	12/24	12/24

Figure Number
Figure 7-2

Rev.
R0

03/12/2024

\\dr.local\ie\Office\IE\Dublin\SLR DATA\SLR Projects\001180A Roadstone Limited\065577 Killough Bio-Renewables Plant PA EIAR\3 EIAR\07 Water\Dwgs\CAD\Wking\001180.065577 Killough Fig 7-2 Bedrock Aquifer Map.dwg

CYAL50381397

607000 E | 608000 E | 609000 E | 610000 E | 611000 E | 612000 E | 613000 E | 614000 E

654100 N | 653100 N | 652100 N | 651100 N | 650100 N | 649100 N | 648100 N

N

Holycross | Mainistir na Croiche | Whitefort | Bohernacrusha | Killeenyarda | Graiguenoe | Newtown | Twoford Bridges | Glenbane Lower | Glenbane Upper | Bohernaspie | Galbertstown Lower | Galbertstown Upper | Currachaun | Clohoge | Burrows | Killough | Killough Hill 235△ | Caraun | Gaile | Regaile | Peake | Toberadora | Nodstown South | Ballinree | Cloghmartin | Ballyhudda | Knockroe | Shanballa | Graigue | Smithsfarm | Moycarky Bridge | Butlersfarm | Moycarky | Forgestown | Kilmelan | Knockstowry | Coolkip | Aughnagomaun | Ashhill | Knocknanuss | Ballytarsna | Arglach

Castle | Church | Moated Site | Standing Stone | Burial Ground | Fortified House | Dismantled Railway | Sch | PO

R661 | R660 | R639

River Suir | An tSiúire

0 500 1000 1500 2000 2500m

Scale 1:25,000

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Notes:

1. Extract from Ordnance Survey Discovery Series Map No. 66
2. Extract from GSI Groundwater Vulnerability © GSI

Legend:

- Applicants Land Interest Area (c.108.3 hectares)
- Planning Application Area (c. 6.3 hectares)

GSI Groundwater Vulnerability Classification:

- X - Rock at or near Surface or Karst
- E - Extreme
- H - High
- M - Moderate
- L - Low

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Rev	Amendments	Date	By	Chk	Auth

SLR

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Client: Roadstone Ltd.

Project: Bio-Renewables Production Facility at Killough Quarry, Holycross, Co. Tipperary

Figure Title: Groundwater Vulnerability Map

Scale	SLR Project No.
1:25,000 @ A3	501.065577.00001

Designed	Drawn	Checked	Authorised
NB	NB	smcd	smcd
Date: 10/24	Date: 10/24	Date: 12/24	Date: 12/24

Figure Number: **Figure 7-3** | Rev.: **R0**

03/12/2024

\\slr.local\ie\Offices\IE\Dublin\SLR DATA\SLR Projects\00180A Roadstone Limited\065577 Killough Bio-Renewables Plant PA EIAR3 EIAR\07 Water\Dwgs\CAD\Working\001180.065577 Killough Fig 7-3 GW Vulnerability Map.dwg

CYAL50381397

603000 E 604000 E 605000 E 606000 E 607000 E 608000 E 609000 E 610000 E 611000 E 612000 E 613000 E 614000 E 615000 E 616000 E 617000 E 618000 E

657100 N 656100 N 655100 N 654100 N 653100 N 652100 N 651100 N 650100 N 649100 N 648100 N 647100 N 646100 N 645100 N 644100 N

Thurles

Templemore

Tipperary

Templemore

Clonmel

Killenaule

Holycross
Mainistir na Croiche

Horse & Jockey
An Marcach

Littleton
An Baile Beag

Boherlahan
An Bóthar Leathan

Clonoulty
Cluain Abhla

N

0 1,000 2,000 3,000 4,000 5,000m

Scale 1:50,000

RECEIVED: 13/01/2025

Notes:

1. Extract from Ordnance Survey Discovery Series Map No. 66
2. Extract from GSI Groundwater Body © GSI

Legend:

Applicants Land Interest Area (c.108.3 hectares)

Planning Application Area (c. 6.3 hectares)

GSI Groundwater Body Classification:

Tipperary

Templemore

Thurles

Killenaule

Clonmel

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Client
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Project
Bio-Renewables Production Facility at Killough Quarry, Holycross, Co. Tipperary

Figure Title
Groundwater Body Map

Scale		SLR Project No.
1:50,000	@ A3	501.065577.00001

Designed	Drawn	Checked	Authorised
NB	NB	smcd	smcd
Date 10/24	Date 10/24	Date 12/24	Date 12/24

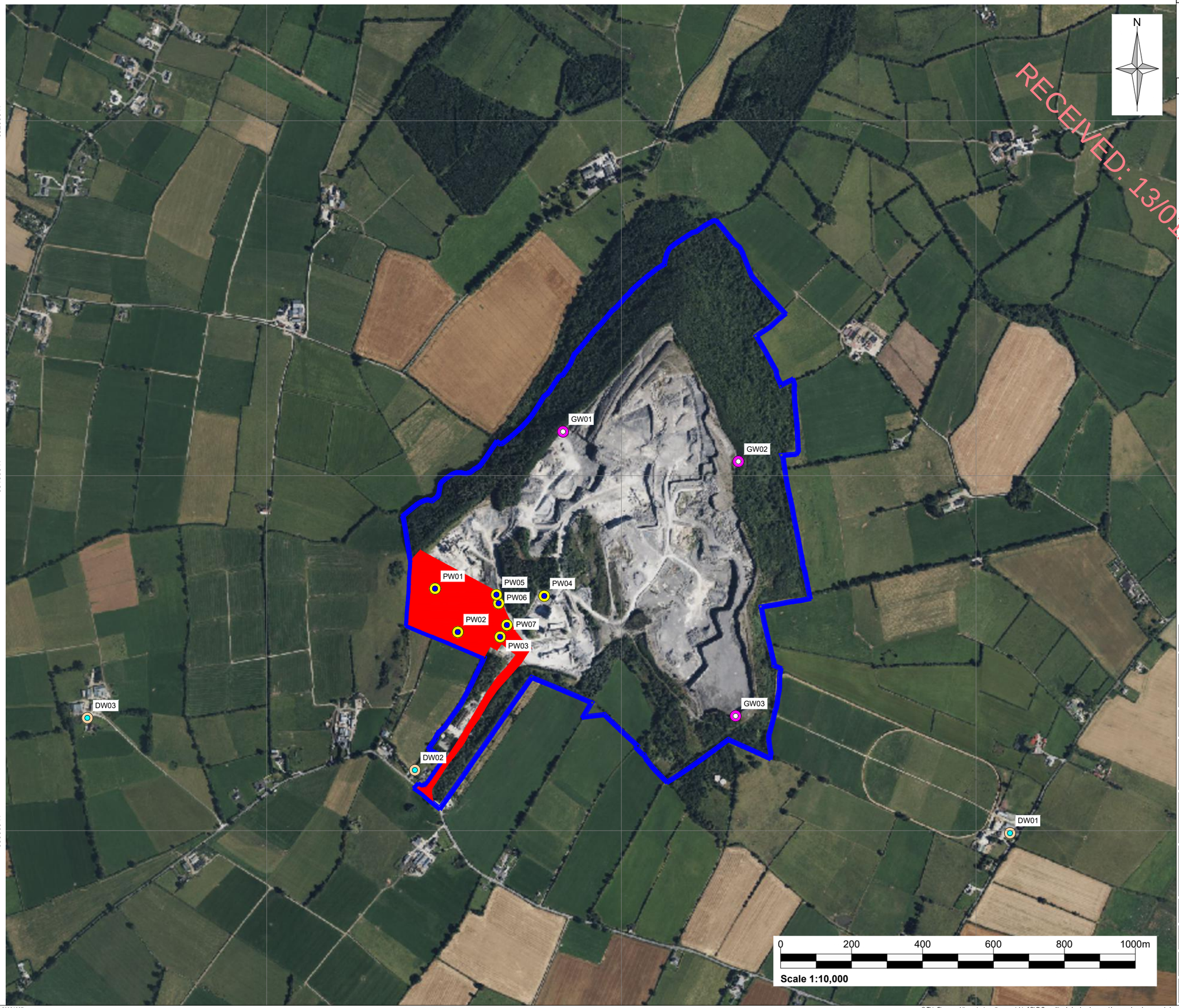
Figure Number **Figure 7-4** Rev. **R0**

\\slr.local\ie\Offices\IE\Dublin\SLR DATA\SLR Projects\00180A Roadstone Limited\065577 Killough Bio-Renewables Plant PA EIAR3 EIAR\07 Water\Dwgs\CAD\Wking\00180.065577 Killough Fig 7-4 GW Body Map.dwg

03/12/2024

CYAL50381397

610000 E
611000 E
612000 E
652000 N
651000 N
650000 N



Notes:

1. Extract from Ordnance Survey Discovery Series Map No. 66
2. Client Data Base

Legend:

Applicants Land Interest Area (c.108.3 hectares)

Planning Application Area (c. 6.3 hectares)

Groundwater Boreholes:

Domestic Wells (DW)

Groundwater Monitoring Wells (GW)

Pumping Wells (PW)

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Rev	Amendments	Date	By	Chk	Auth

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Client
Roadstone Ltd.

Project
Bio-Renewables Production Facility at Killough Quarry, Holycross, Co. Tipperary

Figure Title
Boreholes Locations Map

Scale	SLR Project No.
1:10,000 @ A3	501.065577.00001

Designed	Drawn	Checked	Authorised
NB	NB	smcd	scmd
Date 10/24	Date 10/24	Date 12/24	Date 12/24

Figure Number **Figure 7-5** Rev. **R0**

03/12/2024

\\slr.local\ie\Offices\IE\Dublin\SLR DATA\SLR Projects\001180A Roadstone Limited\065577 Killough Bio-Renewables Plant PA EIAR3 EIAR\07 WaterDwgs\CAD\Wking\001180.065577 Killough Fig 7-5 BH Location Map.dwg

CYAL50381397

603000 E | 604000 E | 605000 E | 606000 E | 607000 E | 608000 E | 609000 E | 610000 E | 611000 E | 612000 E | 613000 E | 614000 E | 615000 E | 616000 E | 617000 E | 618000 E | 619000 E

657100 N | 656100 N | 655100 N | 654100 N | 653100 N | 652100 N | 651100 N | 650100 N | 649100 N | 648100 N | 647100 N | 646100 N | 645100 N

Urban Council
Thurles Urban Council
Public supply (Co Co)
Tipperary Sr County Council
Dug well
Group Scheme
Group Scheme
Borehole
Spring
Spring
Littleton Wss

2015SWW182 2015SWW179 2015SWW114 2015SWW108 2015SWW107 2015SWW109 2015SWW110 2015SWW008 2015SWW146 2015SWW118 2015SWW119 2015SWW144 2015SWW143 2015SWW116 2015SWW006 2015SWW002 2015SWW224 2015SWW121 2015SWW120 2015SWW123 2015SWW148 2015SWW149 2015SWW004 2015SWW132 2015SWW128 2015SWW138 2015SWW140 2015SWW141 2015SWW142 2015SWW135 2015SWW136 2015SWW007 2015SWW003 2015SWW005 2015SWW151 2015SWW150 2015SWW153 2015SWW137 2013NWW129 2013NWW019 2013NWW014 2013NWW103 2013NWW127 2013NWW128 2013NWW009 2013NWW010 2013NWW041 2013NWW111 2013NWW015 2013NWW112 2013NWW125 2013NWW124 2013NWW122 2013NWW104 2013NWW123 2013NWW026 2013NWW105 2013NWW016 2013NWW144 2013NWW032 2013NWW030 2013NWW007 2013NWW150 2013NWW006 2013NWW151 2013NWW108 2013NWW154 2013NWW155 2013NWW012 2013NWW013 2013NEW101 2013NWW134 2015SEW006 2015SEW106 2015SEW107 2015SEW108 2015SEW109 2015SEW110 2015SEW112 2015SEW154 2015SEW111 2015SEW115 2015SEW163 2015SEW158 2015SEW156 2015SEW157 2015SEW161 2015SEW143 2015SEW144 2015SEW155 2015SEW172 2015SEW002 2015SEW001 2015SEW147 2015SEW146 2015SEW145 2015SEW148 2015SEW149 2015SEW003 2015SWW139 2015SWW122 2015SWW123

N

RECEIVED 13/04/2025

0 1,000 2,000 3,000 4,000 5,000m
Scale 1:50,000

Notes:

1. Extract from Ordnance Survey Discovery Series Map No. 66
2. Extract from GSI Groundwater Wells © GSI

Legend:

- Applicants Land Interest Area (c.108.3 hectares)
- Planning Application Area (c. 6.3 hectares)
- 5 km zone

GSI WELLS:

- WELLS FOR DOMESTIC USE ONLY
- WEELS FOR AGRICULTURAL & DOMESTIC USE
- Unspecified Use in GSI Database
- Industrial Use
- Group Scheme
- Public Supply (Co Co)

GSI BEDROCK AQUIFERS:

- LI - Locally Important Aquifer
- Regionally Important Aquifer - Karstified (diffuse)

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Rev	Amendments	Date	By	Chk	Auth

SLR
www.slrconsulting.com

Client: Roadstone Ltd.

Project: Bio-Renewables Production Facility at Killough Quarry, Holycross, Co. Tipperary

Figure Title: GSI Groundwater Supply Wells

Scale	SLR Project No.
1:50,000 @ A3	501.065577.00001

Designed	Drawn	Checked	Authorised
NB	NB	smcd	smcd
Date 10/24	Date 10/24	Date 12/24	Date 12/24

Figure Number: **Figure 7-7** Rev.: **R0**

03/12/2024

\\dir.local\ew\Offices\IE\Dublin\SLR DATA\SLR Projects\00180A Roadstone Limited\065577 Killough Bio-Renewables Plant PA EIAR\3 EIAR\07 Water\Dwgs\CAD\Working\00180.065577 Killough Fig 7-7 GSI GW supply Wells.dwg

CYAL50381397

Appendices

Appendix 7-A
EU Directives / National Legislation and Regulations / Guidelines / Technical Standards

Appendix 7-B
Borehole Logs

Appendix 7-C
Field Record Sheets

Appendix 7-D
Laboratory Results

Appendix 7-E
Rating of Existing Environment Significance / Sensitivity

Appendix 7-F
Descriptions of Effects (EPA, 2022)

Appendix 7-G
Classification of the Significance of Impacts

Appendix 7-A

EU Directives / National Legislation and Regulations / Guidelines / Technical Standards

European Directives

- Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment;
- Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment;
- Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy;
- Directive 2006/118/EC of the European Parliament and of the Council of 12 December 2006 on the protection of groundwater against pollution and deterioration;
- Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks;
- Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) (recast); and
- Directive 2006/21/EC of the European Parliament and of the Council of 15 March 2006 on the management of waste from extractive industries and amending Directive 2004/35/EC.

Irish Government Acts, National Legislation and Regulations

- S.I. No. 349/1989, European Communities (Environmental Impact Assessment) Regulations, as amended;
- Planning and Development Act 2000, as amended;
- S.I. No. 600/2001 - Planning and Development Regulations, 2001, as amended.
- S.I. No. 9/2010 - European Communities Environmental Objectives (Groundwater) Regulations 2010, as amended;
- S.I. No. 272/2009 European Communities Environmental Objectives (Surface Waters) Regulations 2009, as amended;
- S.I. No. 684/2007 Waste Water Discharge (Authorisation) Regulations, 2007, as amended;
- S.I. No. 122/2010 European Communities (Assessment and Management of Flood Risks) Regulations 2010, as amended;
- S.I. No. 457/2008 European Communities (Environmental Liability) Regulations 2008, as amended;
- S.I. No. 404/2018 - European Union (Planning and Development) (Environmental Impact Assessment) (No. 2) Regulations 2018;
- Local Government (Water Pollution) Acts 1977, as amended;
- S.I. No. 293/1988 - European Communities (Quality of Salmonid Waters) Regulations, 1988;
- S.I. No. 268/2006 - European Communities (Quality of Shellfish Waters) Regulations 2006, as amended;
- S.I. No. 79/2008 - Bathing Water Quality Regulations 2008, as amended; and
- S.I. No. 99/2023 - European Union (Drinking Water) Regulations 2023, as amended.
- Water Environment (Abstractions and Associated Impoundments) Act 2022.
- S.I. No. 418/2024 - Water Environment (Abstractions and Associated Impoundments) Licencing Fees Regulations 2024
- S.I. No. 419/2024 - Water Environment (Abstractions and Associated Impoundments) Regulations 2024

Guidelines

- European Commission (2007). Common Implementation Strategy (CIS) for the Water Framework Directive (2000/60/EC) Guidance on preventing or limiting direct and indirect inputs in the context of the Groundwater Directive 2006/118/EC. Guidance Document No. 17.
- European Commission (2010). Common Implementation Strategy (CIS) for the Water Framework Directive (2000/60/EC). Guidance on risk assessment and the use of conceptual models for groundwater. Guidance document No. 26.
- DEHLG (2004). National Urban Waste Water Study. National Report.
- DEHLG (2009). Appropriate Assessment of Plans and Projects in Ireland. Guidance for Planning Authorities.
- DELG/EPA/GSI (1999). Groundwater Protection Schemes. Document prepared jointly by the Geological Survey of Ireland (GSI), the Environmental Protection Agency, and the Department of Environment, Heritage and Local Government.
- EPA (2022) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports.
- EPA (2010). Methodology for Establishing Groundwater Threshold Values and the Assessment of Chemical and Quantitative Status of Groundwater, Including and Assessment of Pollution Trends and Trend Reversal.
- EPA (2011). Guidance on the Authorisation of Direct Discharges to Groundwater.
- EPA (2003). Towards Setting Guideline Values for the Protection of Groundwater in Ireland. Interim Report.
- EPA (2006). Ireland Water Framework Directive Monitoring Programme.
- Fitzsimons, V., Daly, D. and Deakin, J. (2003). Draft GSI guidelines for assessment and mapping of groundwater vulnerability to contamination. Groundwater Chapter, Geological Survey of Ireland.
- GSI (2006). Criteria used in aquifer classification. Available from http://www.gsi.ie/Programmes/Groundwater/Aquifer+Classification.htm
- IGI (2007). Guidelines on Water Well Construction. Available from http://www.igi.ie/assets/files/Water%20Well%20Guidelines/Guidelines.pdf
- Kilroy, G., Dunne, F., Ryan, J., O'Connor, A., Daly, D., Craig, M., Coxon, C., Johnston, P. and Moe, H. (2008). A Framework for the Assessment of Groundwater – Dependent Terrestrial Ecosystems under the Water Framework Directive. Environmental Research Centre Report Series No. 12.
- Institute of Geologists of Ireland (2007). Recommended collection, presentation and interpretation of geological and hydrogeological information for quarry developments.

Technical Standards

- British Standards Institute (2015). Code of Practice for Ground Investigations BS 5930:2015+A1:2020.

Appendix 7-B

Borehole Logs

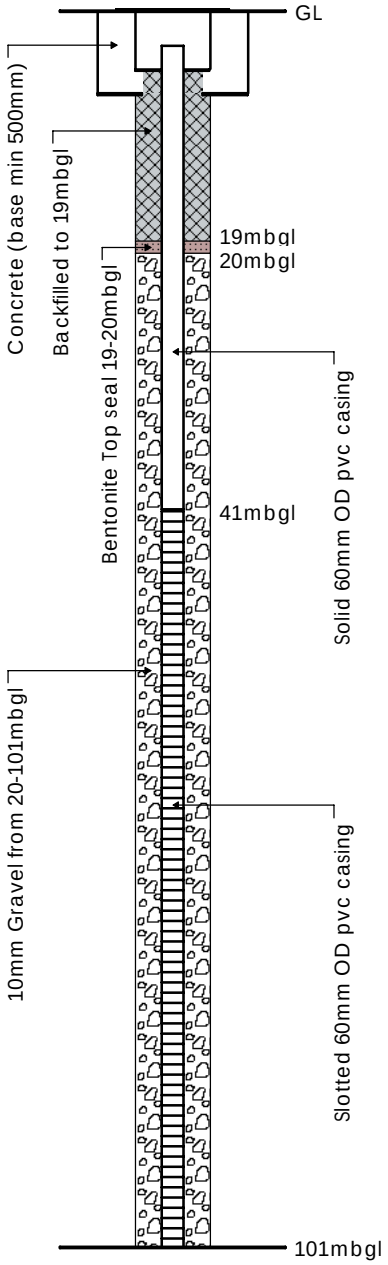
MONITORING WELL LOG

WELL NUMBER: GW1

PROJECT NUMBER: P1122-1
SITE: Kilough Quarry, Co. Tipperary
CLIENT: Roadstone Ltd
DRILLING CONTRACTOR: Petersen Drilling Ltd

DATE STARTED: 11/08/2020
DATE FINISHED: 13/08/2020
LOGGED BY: A. Keegan
DRILLING TYPE:

EASTING: 610835.4
NORTHING: 651124.0
ELEVATION: 160.98mOD



Comments	Water Strikes	Elevation	Meters Below Ground Surface	Lithology	Formation Description
		160.98	0		Ground Surface
					Limestone fill
Very little fractures, no water strikes			5		Hard, medium grey Limestone
		147.48	10		
			15		Soft brownish grey clay infill
			20		Hard, medium grey Limestone
			25		
			30		
			35		
			40		
			45		
			50		
			55		
			60		
Very little fractures, no water strikes, water seeped in over next few days			65		
			70		
			75		
			80		
			85		
			90		
			95		
		59.98	100		Total Depth of Borehole
			105		

REMARKS
Dip reference elevation(top uPVC) = 161.51mOD
Ground elevation and casing elevation surveyed on 14/08/2020.
Using dGPS accurate to 1cm XYZ.

PAGE 1 of 1

SCALE

HYDRO-ENVIRONMENTAL SERVICES 22 Lower Main Street Dungarvan Co. Waterford Tel: 058-44122 Fax: 058-44244 Email: info@hydroenvironmental.ie

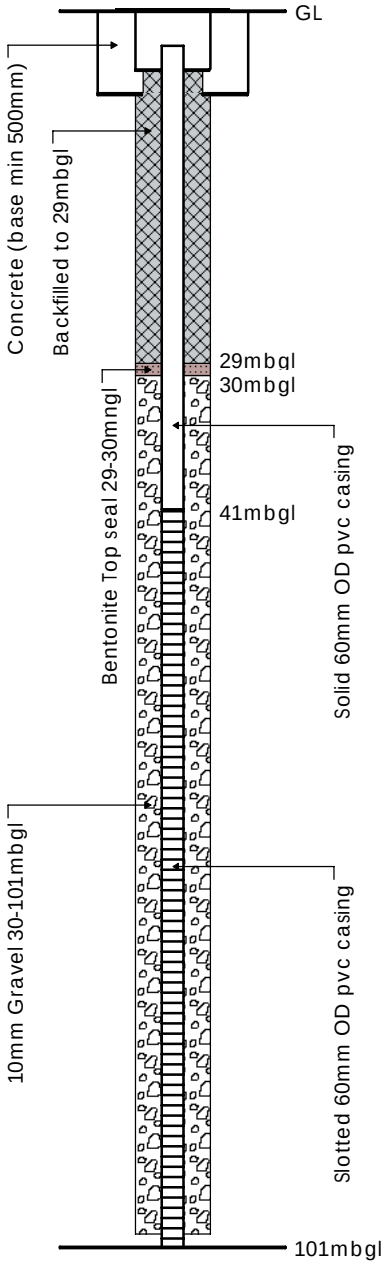
MONITORING WELL LOG

WELL NUMBER: GW2

PROJECT NUMBER: P1122-1
SITE: Kilough Quarry, Co. Tipperary
CLIENT: Roadstone Ltd
DRILLING CONTRACTOR: Petersen Drilling Ltd

DATE STARTED: 13/08/2020
DATE FINISHED: 18/08/2020
LOGGED BY: A. Keegan
DRILLING TYPE:

EASTING: 611330
NORTHING: 651040
ELEVATION: 186.14mOD



Well Completion Description	Comments	Water Strikes	Elevation	Meters Below Ground Surface	Lithology	Formation Description
	Very little fractures, no water strikes, no dip after drilling - water slowly seeped in over ~48 hours		186.14 169.64 85.14	0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105		Ground Surface Silty sandy rock fill MADE GROUND Soft medium grey Limestone with clay infill Strong, medium grey Limestone Weak fracture grey Limestone with clay infill Strong, medium grey Limestone Total Depth of Borehole

REMARKS

Ground elevation surveyed on 14/08/2020.
Using dGPS accurate to 1cm XYZ.

PAGE 1 of 1

SCALE

HYDRO-ENVIRONMENTAL SERVICES 22 Lower Main Street Dungarvan Co. Waterford Tel: 058-44122 Fax: 058-44244 Email: info@hydroenvironmental.ie

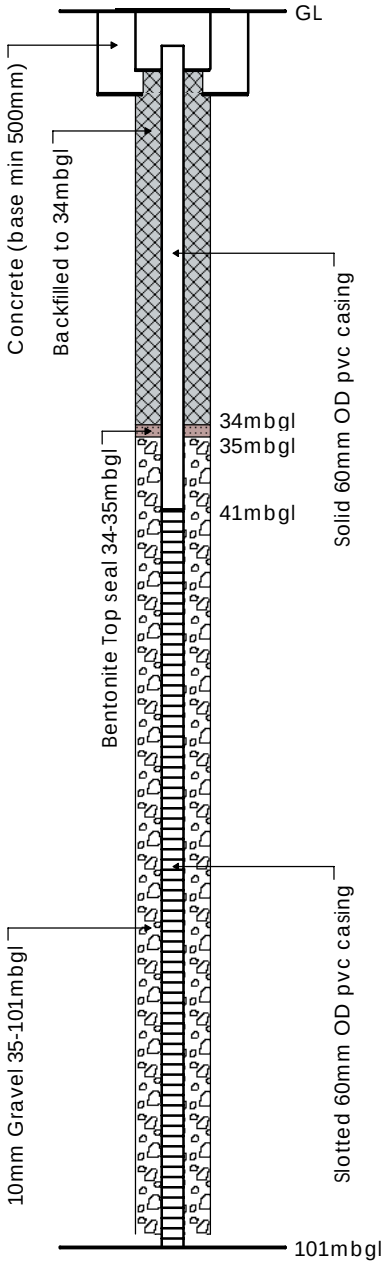
MONITORING WELL LOG

WELL NUMBER: GW3

PROJECT NUMBER: P1122-1
SITE: Kilough Quarry, Co. Tipperary
CLIENT: Roadstone Ltd
DRILLING CONTRACTOR: Petersen Drilling Ltd

DATE STARTED: 19/08/2020
DATE FINISHED: 21/08/2020
LOGGED BY: A. Keegan
DRILLING TYPE:

EASTING: 611322
NORTHING: 650323
ELEVATION: 169.33mOD

Well Completion Description	Comments	Water Strikes	Elevation	Meters Below Ground Surface	Lithology	Formation Description
	No defined water strikes, water seeped in over next few days		169.33 68.33	0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105		Ground Surface Coarse Limestone fill material Coarse Limestone fill material Total Depth of Borehole

REMARKS

Ground elevation surveyed on 14/08/2020.
Using dGPS accurate to 1cm XYZ.

PAGE 1 of 1

SCALE

HYDRO-ENVIRONMENTAL SERVICES 22 Lower Main Street Dungarvan Co. Waterford Tel: 058-44122 Fax: 058-44244 Email: info@hydroenvironmental.ie

Appendix 7-C

Field Record Sheets

GROUNDWATER SAMPLING FIELD RECORD SHEET

Site location: Killough, Tipperary
SLR job number: 501.00180A.00356 **Date:** 03/02/2022
Time: 09:30 – 15:30 on site
Staff: Jake Shiel, Cathal Faherty
Equipment: Waterra, Bailers, YSI

	GW1	GW2	GW3
Groundwater level (mpvc)	49.18	68.42	34.87
Total depth (m)	101	101	101
Volume of water in borehole (litres)	285	179	367
Waterra/bailer	Bailer	Bailer	Waterra

Temperature (°C)	10.1	11.1	10.5
Dissolved oxygen (%)	31.3	17.5	37.8
Dissolved oxygen (mg/l)	3.53	1.93	4.22
Specific conductivity (µS/cm)	629.0	1102	309.2
Conductivity (µS/cm)	450.4	809	223.5
pH	6.92	6.99	7.62
pHmv	-39.1	-42.7	-77.5

	GW1	GW2	GW3
Odour	No	No	No
Sheen	No	No	No
Silt	High	Medium	Medium
Colour	Milky Cloudy	Cloudy Grey	Cloudy Grey
Free product	No	No	No

Well purged dry	No	No	No*

Any other field observations:

GW1: Grab sample with the bailer. Logger downloaded at 10:30.

GW2: Grab sample with the bailer. Logger downloaded at 12:37.

GW3: Pump filled with petrol over 100m from BH, gloves changed. *Borehole pumped with waterra until the water level dropped below the tubing after 1.5 buckets. Waited 20 minutes for recharge and filled bottles. Logger downloaded at 13:55.

ONE WELL VOLUME (50mm diameter casing)	BS 10175
Terrier Borehole with 50mm Pipe	4l/m
6" Borehole with 50mm Pipe	5.5l/m
6" Borehole with 100mm Pipe	11.5l/m
8" Borehole with 50mm Pipe	8.25l/m
8" Borehole with 100mm Pipe	14.25l/m
Note : *Purging should continue until Removal of at least three well volumes, or pH, conductivity and temperature readings have stabilised (any two successive reading are within 10% of eachother). If well is not recovering and it is not possible to meet these criteria then a grab sample should be obtained.*	

GROUNDWATER SAMPLING FIELD RECORD SHEET

Site location: Roadstone - Killough Quarry
SLR job number: 501.064999.00001
Date: 22/05/2023
Time: 09:00 – 17:00
Staff: Orlaith Tyrrell
Equipment: Aquatroll, dip meter, Waterra pump, bailers

	GW01	GW02	GW03
Groundwater level (m btoc)	48.93	68.64	36.95
Groundwater level (m bgl)	48.49	68.27	36.43
Total depth approx (m)	101	101	101
Volume of water in borehole (litres)	288.8	180.0	355.1
Waterra/bailer	Bailer	Bailer	Bailer

Temperature (°C)	-	12.6	11.1
Dissolved oxygen (%)	-	34.1	88.7
Dissolved oxygen (mg/l)	-	3.6	9.7
Specific conductivity (µS/cm)	-	1,171.8	289.7
Conductivity (µS/cm)	-	894.5	212.9
pH	-	6.9	7.8
pHmv	-	- 16.9	- 65.0

	GW01	GW02	GW03
Odour	No	No	No
Sheen	No	No	No
Silt	Very high	High	Low
Colour	Brown / opaque	Light brown / opaque	Cloudy
Free product	No	No	No

Well purged dry	No	No	No

Any other field observations:

GW01: Live aquatroll multiprode sonde data saved incorrectly on-site and is not available. Attempted to pump with Waterra but the water was too deep and only a trickle would come up through tubing. Tubing length adjusted twice but no different. Not enough water emerging to purge the well for representative sample. Pump re-fueled >10m from the well. Bailed well to collect enough water for a grab sample.

GW02: Water in well was deeper than at GW02 so attempted to bail instead and collected a grab sample.

GW03: Attempted to pump with Waterra due to shallower water in well. Pump mechanism would not move correctly – possibly damaged due to strain of pumping at GW01. Collected a grab sample with bailer so as not to damage pump further.

ONE WELL VOLUME (50mm diameter casing)	BS 10175
Terrier Borehole with 50mm Pipe	4l/m
6" Borehole with 50mm Pipe	5.5l/m
6" Borehole with 100mm Pipe	11.5l/m
8" Borehole with 50mm Pipe	8.25l/m
8" Borehole with 100mm Pipe	14.25l/m
Note : *Purging should continue until Removal of at least three well volumes, or pH, conductivity and temperature readings have stabilised (any two successive reading are within 10% of eachother). If well is not recovering and it is not possible to meet these criteria then a grab sample should be obtained.*	

Groundwater Sampling Field Record Sheet

Date:	7 August 2024	**Time:**	8.30 – 16.00 on site	**Location:**	Killough, Thurles, Co. Tipperary
Staff:	Mairead Brown, Michelle Sherry			**SLR Project No.:**	501.064999.00002
Equipment	Dip meter, Aquatroll, Watterra, Bailer				

Table 1- Water Measurements

	GW1	GW2	GW3
Groundwater level (m bgl)	48.35	70.91	42
Total depth (m)	101	101	101
Volume of water in borehole (litres)	289.58	165.5	324.5
Volume purged (L)	15	7.5	15
Waterra / Bailer	Bailer	Bailer	Bailer

Table 2 – Visual field parameters

Parameter	GW1	GW2	GW3
Odour	No	Hydrocarbon/ petrol like smell	No
Sheen	No	No	No
Silt	High	Low	Very High
Colour	Light brown / Opaque	Milky light brown / Opaque	Light brown / Opaque
Free product	No	No	No

Table 3 – Aquatroll Field Parameters

Field Record Sheet

Parameter	GW1	GW2	GW3
Temperature (°C)	11.55	12.38	11.25
Specific conductivity (µS/cm)	624.1	1146.37	309.1
Salinity (PSU)	0.3	0.57	0.15
pH	7.04	7.21	7.37
Total Dissolved Solids (ppt)	0.41	0.75	0.2
Turbidity (NTU)	4690.84	2062.28	6383.52
RDO Concentration (mg/L)	6.18	3.55	8.44

Other field observations:

GW1– As the pump did not work in GW3, the shallowest well, it was decided this well would be bailed to get a grab sample

GW2– As this was the deepest well, the bailer was used to get a grab sample. 10m of string was added to the logger as the water volume was very low. A black substance with a hydrocarbon smell was present on the logger and the end of the string. Indicating that the substance is sitting on the water surface.

GW3 – Pump refuelled >10m away. As this well was the shallowest, an attempt was made to purge the well with the Waterra pump, however, no water came up. Bailed enough water for a grab sample as it was not viable to flush out the well via bailing.

Appendix 7-D

Laboratory Results

Unit 7-8 Hawarden Business Park
Manor Road (off Manor Lane)
Hawarden
Deeside
CH5 3US
Tel: (01244) 528700
Fax: (01244) 528701
email: hawardencustomerservices@alsglobal.com
Website: www.alsenvironmental.co.uk

SLR Consulting Ireland
CSA House
Unit 7
Dundrum Business Park
Windy Harbour
Dublin
Dublin14

Attention: Jake Shiel

CERTIFICATE OF ANALYSIS

Date of report Generation:	15 February 2022
Customer:	SLR Consulting Ireland
Sample Delivery Group (SDG):	220207-14
Your Reference:	501.00180A.00356
Location:	Killough
Report No:	633565
Order Number:	7665

We received 3 samples on Monday February 07, 2022 and 3 of these samples were scheduled for analysis which was completed on Tuesday February 15, 2022. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

Chemical testing (unless subcontracted) performed at ALS Life Sciences Ltd Hawarden.

All sample data is provided by the customer. The reported results relate to the sample supplied, and on the basis that this data is correct.
Incorrect sampling dates and/or sample information will affect the validity of results.
The customer is not permitted to reproduce this report except in full without the approval of the laboratory.

Approved By:

Sonia McWhan

Operations Manager

CERTIFICATE OF ANALYSIS

SDG: 220207-14 **Report Number:** 633565 **Superseded Report:**
Client Ref.: 501.00180A.00356 **Location:** Killough

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
25776269	GW1		0.00 - 0.00	03/02/2022
25776281	GW2		0.00 - 0.00	03/02/2022
25776294	GW3		0.00 - 0.00	03/02/2022

Only received samples which have had analysis scheduled will be shown on the following pages.

CERTIFICATE OF ANALYSIS

SDG: 220207-14 **Report Number:** 633565 **Superseded Report:**
Client Ref.: 501.00180A.00356 **Location:** Killough

RECEIVED: 13/01/2025

Results Legend

- X Test
- N No Determination Possible

Sample Types -
S - Soil/Solid
UNS - Unspecified Solid
GW - Ground Water
SW - Surface Water
LE - Land Leachate
PL - Prepared Leachate
PR - Process Water
SA - Saline Water
TE - Trade Effluent
TS - Treated Sewage
US - Untreated Sewage
RE - Recreational Water
DW - Drinking Water Non-regulatory
UNL - Unspecified Liquid
SL - Sludge
G - Gas
OTH - Other

Lab Sample No(s)			25776269								25776281								25776294		
Customer Sample Reference			GW1								GW2								GW3		
AGS Reference																					
Depth (m)			0.00 - 0.00								0.00 - 0.00								0.00 - 0.00		
Container			0.5l glass bottle (ALE227)	500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	HNO3 Unfiltered (ALE204)	NaOH (ALE245)	Vial (ALE297)	ZnAc (ALE246)	0.5l glass bottle (ALE227)	500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	HNO3 Unfiltered (ALE204)	NaOH (ALE245)	Vial (ALE297)	ZnAc (ALE246)	0.5l glass bottle (ALE227)	500ml Plastic (ALE208)	H2SO4 (ALE244)
Sample Type			GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW
Ammonium Low	All	NDPs: 0 Tests: 3			X								X								X
Anions by Kone (w)	All	NDPs: 0 Tests: 3		X								X								X	
Dissolved Metals by ICP-MS	All	NDPs: 0 Tests: 3				X								X							
EPH CWG (Aliphatic) Aqueous GC (W)	All	NDPs: 0 Tests: 3	X								X								X		
EPH CWG (Aromatic) Aqueous GC (W)	All	NDPs: 0 Tests: 3	X								X								X		
Fluoride	All	NDPs: 0 Tests: 3		X								X								X	
GRO by GC-FID (W)	All	NDPs: 0 Tests: 3							X								X				
Low Level Cyanide (W)	All	NDPs: 0 Tests: 3						X								X					
Mercury Dissolved	All	NDPs: 0 Tests: 3				X								X							
Nitrite by Kone (w)	All	NDPs: 0 Tests: 3						X								X					
pH Value	All	NDPs: 0 Tests: 3		X								X								X	
Phosphate by Kone (w)	All	NDPs: 0 Tests: 3		X								X								X	
Sulphide	All	NDPs: 0 Tests: 3								X								X			
Total Metals by ICP-MS	All	NDPs: 0 Tests: 3					X								X						
TPH CWG (W)	All	NDPs: 0 Tests: 3	X								X								X		

25776294	GW3		0.00 - 0.00	ZnAc (ALE246)	GW															X		
				Vial (ALE297)	GW							X										
				NaOH (ALE245)	GW								X			X						
				HNO3 Unfiltered (ALE204)	GW																X	
				HNO3 Filtered (ALE204)	GW			X							X							

Validated

CERTIFICATE OF ANALYSIS

SDG: 220207-14 **Report Number:** 633565 **Superseded Report:**
Client Ref.: 501.00180A.00356 **Location:** Killough

Results Legend

X Test

N No Determination Possible

Sample Types -
S - Soil/Solid
UNS - Unspecified Solid
GW - Ground Water
SW - Surface Water
LE - Land Leachate
PL - Prepared Leachate
PR - Process Water
SA - Saline Water
TE - Trade Effluent
TS - Treated Sewage
US - Untreated Sewage
RE - Recreational Water
DW - Drinking Water Non-regulatory
UNL - Unspecified Liquid
SL - Sludge
G - Gas
OTH - Other

Lab Sample No(s)								25776269										25776281				25776294	
Customer Sample Reference								GW1										GW2				GW3	
AGS Reference																							
Depth (m)								0.00 - 0.00										0.00 - 0.00				0.00 - 0.00	
Container	0.5l glass bottle (ALE227)	500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	HNO3 Unfiltered (ALE204)	NaOH (ALE245)	Vial (ALE297)	ZnAc (ALE246)	0.5l glass bottle (ALE227)	500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	HNO3 Unfiltered (ALE204)	NaOH (ALE245)	Vial (ALE297)	ZnAc (ALE246)	0.5l glass bottle (ALE227)	500ml Plastic (ALE208)	H2SO4 (ALE244)				
Sample Type	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW				
VOC MS (W)																							
All																							
NDPs: 0 Tests: 3							X								X								

25776294	GW3		0.00 - 0.00	ZnAc (ALE246)	GW		
				Vial (ALE297)	GW		X
				NaOH (ALE245)	GW		
				HNO3 Unfiltered (ALE204)	GW		
				HNO3 Filtered (ALE204)	GW		

CERTIFICATE OF ANALYSIS

SDG: 220207-14 **Report Number:** 633565 **Superseded Report:**
Client Ref.: 501.00180A.00356 **Location:** Killough

Results Legend
- # ISO17025 accredited.
- M mCERTS accredited.
- aq Aqueous / settled sample.
- diss.filt Dissolved / filtered sample.
- tot.unfilt Total / unfiltered sample.
- * Subcontracted - refer to subcontractor report for accreditation status.
- ** % recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
- (F) Trigger breach confirmed
- 1-4+$@ Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	GW1	GW2	GW3			
			Depth (m)	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00			
			Sample Type	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)			
			Date Sampled	03/02/2022	03/02/2022	03/02/2022			
			Sample Time	.	.	.			
			Date Received	07/02/2022	07/02/2022	07/02/2022			
			SDG Ref	220207-14	220207-14	220207-14			
			Lab Sample No.(s)	25776269	25776281	25776294			
			AGS Reference						
Ammoniacal Nitrogen as N (low level)	<0.01 mg/l	TM099		0.023 #	0.029 #	0.025 #			
Ammoniacal Nitrogen Low as NH3	<0.01 mg/l	TM099		0.0279 #	0.0352 #	0.0304 #			
Ammoniacal Nitrogen Low as NH4	<0.01 mg/l	TM099		0.0296 #	0.0373 #	0.0321 #			
Sulphide	<0.01 mg/l	TM101		<0.05 #	0.0135 #	0.0261 #			
Fluoride	<0.5 mg/l	TM104		<0.5 #	0.668 #	1.21 #			
Aluminium (diss.filt)	<10 µg/l	TM152		<10 #	<10 #	<10 #			
Aluminium (tot.unfilt)	<10 µg/l	TM152		11700 #	4720 #	2370 #			
Arsenic (diss.filt)	<0.5 µg/l	TM152		<0.5 #	<0.5 #	<0.5 #			
Barium (diss.filt)	<0.2 µg/l	TM152		16.6 #	26.4 #	10.1 #			
Boron (diss.filt)	<10 µg/l	TM152		<10 #	79.6 #	<10 #			
Cadmium (diss.filt)	<0.08 µg/l	TM152		<0.08 #	<0.08 #	<0.08 #			
Chromium (diss.filt)	<1 µg/l	TM152		<1 #	<1 #	<1 #			
Copper (diss.filt)	<0.3 µg/l	TM152		1.01 #	0.519 #	0.355 #			
Manganese (tot.unfilt)	<1 µg/l	TM152		1310 #	898 #	107 #			
Lead (diss.filt)	<0.2 µg/l	TM152		<0.2 #	0.21 #	<0.2 #			
Nickel (diss.filt)	<0.4 µg/l	TM152		7.92 #	39.1 #	2.11 #			
Phosphorus (diss.filt)	<10 µg/l	TM152		<10 #	10.6 #	<10 #			
Selenium (diss.filt)	<1 µg/l	TM152		<1 #	<1 #	12.8 #			
Vanadium (diss.filt)	<1 µg/l	TM152		<1 #	<1 #	<1 #			
Zinc (diss.filt)	<1 µg/l	TM152		5.87 #	49.6 #	18.1 #			
Sodium (Dis.Filt)	<0.076 mg/l	TM152		8.07 #	21.6 #	5.89 #			
Potassium (Dis.Filt)	<0.2 mg/l	TM152		0.466 #	2.78 #	0.658 #			
Calcium (Dis.Filt)	<0.2 mg/l	TM152		131 #	210 #	55.3 #			
Iron (Dis.Filt)	<0.019 mg/l	TM152		<0.019 #	<0.019 #	<0.019 #			
Magnesium (Tot. Unfilt.)	<0.05 mg/l	TM152		16.3 #	24.4 #	6.04 #			
Mercury (diss.filt)	<0.01 µg/l	TM183		<0.01 #	<0.01 #	<0.01 #			
Nitrite as NO2	<0.05 mg/l	TM184		<0.05 #	<0.05 #	<0.05 #			
Sulphate	<2 mg/l	TM184		30.4 #	319 #	42.5 #			
Chloride	<2 mg/l	TM184		15.3 #	53.5 #	8.5 #			
Phosphate (Ortho as P)	<0.02 mg/l	TM184		<0.02 #	<0.02 #	<0.02 #			
Nitrate as NO3	<0.3 mg/l	TM184		17.2	<0.3	5.08			
Total Oxidised Nitrogen as N	<0.1 mg/l	TM184		3.9 #	<0.1 #	1.15 #			
pH	<1 pH Units	TM256		7.44 #	7.39 #	8.06 #			

Validated

CERTIFICATE OF ANALYSIS

SDG: 220207-14 **Report Number:** 633565 **Superseded Report:**
Client Ref.: 501.00180A.00356 **Location:** Killough

Results Legend								
#	ISO17025 accredited.	Customer Sample Ref.	GW1	GW2	GW3			
M	mCERTS accredited.							
aq	Aqueous / settled sample.	Depth (m)	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00			
diss.filt	Dissolved / filtered sample.	Sample Type	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)			
tot.unfilt	Total / unfiltered sample.	Date Sampled	03/02/2022	03/02/2022	03/02/2022			
*	Subcontracted - refer to subcontractor report for accreditation status.	Sample Time	.	.	.			
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery	Date Received	07/02/2022	07/02/2022	07/02/2022			
		SDG Ref	220207-14	220207-14	220207-14			
(F)	Trigger breach confirmed	Lab Sample No.(s)	25776269	25776281	25776294			
1-4+§@	Sample deviation (see appendix)	AGS Reference						

Component	LOD/Units	Method						
Conductivity @ 20 deg.C	<0.02 mS/cm	TM256	0.601 #	1.02 #	0.309 #			
Cyanide, Total (low level)	<5 µg/l	TM279	<5 #	<5 #	<5 #			
Cyanide, Free (low level)	<2.5 µg/l	TM279	<2.5 #	<2.5 #	<2.5 #			

CERTIFICATE OF ANALYSIS

SDG: 220207-14 **Report Number:** 633565 **Superseded Report:**
Client Ref.: 501.00180A.00356 **Location:** Killough

TPH CWG (W)

Results Legend
- # ISO17025 accredited.
- M mCERTS accredited.
- aq Aqueous / settled sample.
- diss.filt Dissolved / filtered sample.
- tot.unfilt Total / unfiltered sample.
- * Subcontracted - refer to subcontractor report for accreditation status.
- ** % recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
- (F) Trigger breach confirmed
- 1-4+$@ Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	GW1	GW2	GW3			
			Depth (m)	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00			
			Sample Type	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)			
			Date Sampled	03/02/2022	03/02/2022	03/02/2022			
			Sample Time	.	.	.			
			Date Received	07/02/2022	07/02/2022	07/02/2022			
			SDG Ref	220207-14	220207-14	220207-14			
			Lab Sample No.(s)	25776269	25776281	25776294			
			AGS Reference						
GRO Surrogate % recovery**	%	TM245		96	98	103			
GRO >C5-C12	<50 µg/l	TM245		<50 #	<50 #	<50 #			
Aliphatics >C5-C6	<10 µg/l	TM245		<10	<10	<10			
Aliphatics >C6-C8	<10 µg/l	TM245		<10	<10	<10			
Aliphatics >C8-C10	<10 µg/l	TM245		<10	<10	<10			
Aliphatics >C10-C12	<10 µg/l	TM245		<10	<10	<10			
Aliphatics >C12-C16 (aq)	<10 µg/l	TM174		<10	<10	<10			
Aliphatics >C16-C21 (aq)	<10 µg/l	TM174		<10	<10	<10			
Aliphatics >C21-C35 (aq)	<10 µg/l	TM174		<10	229	<10			
Total Aliphatics >C12-C35 (aq)	<10 µg/l	TM174		<10	229	<10			
Aromatics >EC5-EC7	<10 µg/l	TM245		<10	<10	<10			
Aromatics >EC7-EC8	<10 µg/l	TM245		<10	<10	<10			
Aromatics >EC8-EC10	<10 µg/l	TM245		<10	<10	<10			
Aromatics >EC10-EC12	<10 µg/l	TM245		<10	<10	<10			
Aromatics >EC12-EC16 (aq)	<10 µg/l	TM174		<10	<10	<10			
Aromatics >EC16-EC21 (aq)	<10 µg/l	TM174		<10	<10	<10			
Aromatics >EC21-EC35 (aq)	<10 µg/l	TM174		<10	<10	<10			
Total Aromatics >EC12-EC35 (aq)	<10 µg/l	TM174		<10	<10	<10			
Total Aliphatics & Aromatics >C5-35 (aq)	<10 µg/l	TM174		<10	229	<10			
Aliphatics >C16-C35 Aqueous	<10 µg/l	TM174		<10	229	<10			

Validated

CERTIFICATE OF ANALYSIS

SDG: 220207-14 **Report Number:** 633565 **Superseded Report:**

Client Ref.: 501.00180A.00356 **Location:** Killough

VOC MS (W)

Results Legend

#	ISO17025 accredited.
M	mCERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-4+$@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	GW1	GW2	GW3
			Depth (m)	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00
			Sample Type	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)
			Date Sampled	03/02/2022	03/02/2022	03/02/2022
			Sample Time	.	.	.
			Date Received	07/02/2022	07/02/2022	07/02/2022
			SDG Ref	220207-14	220207-14	220207-14
			Lab Sample No.(s)	25776269	25776281	25776294
			AGS Reference			
Methyl tertiary butyl ether (MTBE)	<1 µg/l	TM208		<1 #	<1 #	<1 #
Benzene	<1 µg/l	TM208		<1 #	<1 #	<1 #
Toluene	<1 µg/l	TM208		<1 #	<1 #	<1 #
Ethylbenzene	<1 µg/l	TM208		<1 #	<1 #	<1 #
m,p-Xylene	<1 µg/l	TM208		<1 #	<1 #	<1 #
o-Xylene	<1 µg/l	TM208		<1 #	<1 #	<1 #
Sum of detected Xylenes	<2 µg/l	TM208		<2	<2	<2
Sum of BTEX	<5 µg/l	TM208		<5	<5	<5

Table of Results - Appendix

Method No	Reference	Description
TM099	BS 2690: Part 7:1968 / BS 6068: Part2.11:1984	Determination of Ammonium in Water Samples using the Kone Analyser
TM101	Method 4500B & C, AWWA/APHA, 20th Ed., 1999	Determination of Sulphide in soil and water samples using the Kone Analyser
TM104	Method 4500F, AWWA/APHA, 20th Ed., 1999	Determination of Fluoride using the Kone Analyser
TM152	ISO 17294-2:2016 Water quality - Application of inductively coupled plasma mass spectrometry (ICP-MS)	Analysis of Aqueous Samples by ICP-MS
TM174	Analysis of Petroleum Hydrocarbons in Environmental Media – Total Petroleum Hydrocarbon Criteria	Determination of Speciated Extractable Petroleum Hydrocarbons in Waters by GC-FID
TM183	BS EN 23506:2002, (BS 6068-2.74:2002) ISBN 0 580 38924 3	Determination of Trace Level Mercury in Waters and Leachates by PSA Cold Vapour Atomic Fluorescence Spectrometry
TM184	EPA Methods 325.1 & 325.2,	The Determination of Anions in Aqueous Matrices using the Kone Spectrophotometric Analysers
TM208	Modified: US EPA Method 8260b & 624	Determination of Volatile Organic Compounds by Headspace / GC-MS in Waters
TM245	By GC-FID	Determination of GRO by Headspace in waters
TM256	The measurement of Electrical Conductivity and the Laboratory determination of pH Value of Natural, Treated and Wastewaters. HMSO, 1978. ISBN 011 751428 4, Standard Methods for the examination of waters and wastewaters 20th Edition, PHA, Washington DC, USA. ISBN 0-87553-235-7 and The Determination of Alkalinity and Acidity in water HMSO, 1981, ISBN 0 11 751601 5.	Determination of pH, EC, TDS and Alkalinity in Aqueous samples
TM279		Determination of Low Level Easily Liberatable (Free) Cyanides and Total Cyanides in Waters using the Skalar SANS+ System Segmented Flow Analyser

NA = not applicable.

Chemical testing (unless subcontracted) performed at ALS Life Sciences Ltd Hawarden.

CERTIFICATE OF ANALYSIS

SDG: 220207-14 **Report Number:** 633565 **Superseded Report:**
Client Ref.: 501.00180A.00356 **Location:** Killough

Test Completion Dates

Lab Sample No(s)	25776269	25776281	25776294
Customer Sample Ref.	GW1	GW2	GW3
AGS Ref.			
Depth	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00
Type	Ground Water	Ground Water	Ground Water
Ammonium Low	11-Feb-2022	11-Feb-2022	11-Feb-2022
Anions by Kone (w)	14-Feb-2022	14-Feb-2022	14-Feb-2022
Dissolved Metals by ICP-MS	09-Feb-2022	09-Feb-2022	10-Feb-2022
EPH CWG (Aliphatic) Aqueous GC (W)	14-Feb-2022	14-Feb-2022	14-Feb-2022
EPH CWG (Aromatic) Aqueous GC (W)	14-Feb-2022	14-Feb-2022	14-Feb-2022
Fluoride	10-Feb-2022	10-Feb-2022	10-Feb-2022
GRO by GC-FID (W)	14-Feb-2022	14-Feb-2022	14-Feb-2022
Low Level Cyanide (W)	10-Feb-2022	10-Feb-2022	10-Feb-2022
Mercury Dissolved	10-Feb-2022	10-Feb-2022	10-Feb-2022
Nitrite by Kone (w)	09-Feb-2022	09-Feb-2022	09-Feb-2022
pH Value	09-Feb-2022	09-Feb-2022	09-Feb-2022
Phosphate by Kone (w)	10-Feb-2022	10-Feb-2022	10-Feb-2022
Sulphide	10-Feb-2022	10-Feb-2022	10-Feb-2022
Total Metals by ICP-MS	10-Feb-2022	10-Feb-2022	10-Feb-2022
TPH CWG (W)	14-Feb-2022	15-Feb-2022	14-Feb-2022
VOC MS (W)	11-Feb-2022	11-Feb-2022	11-Feb-2022

Appendix General

1. Results are expressed on a dry weight basis (dried at 35ºC) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH4 by the BRE method, VOC TICs and SVOC TICs.

2. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALS reserve the right to charge for samples received and stored but not analysed.

3. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

4. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

5. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

6. NDP - No determination possible due to insufficient/unsuitable sample.

7. Results relate only to the items tested.

8. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

9. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

10. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

11. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

12. For dried and crushed preparations of soils volatile loss may occur e.g volatile mercury.

13. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

14. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

15. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

16. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

17 Data retention. All records, communications and reports pertaining to the analysis are archived for seven years from the date of issue of the final report.

18. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as "mixed hydrocarbons". Non-target compounds identified from the GCMS data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

19. **Sample Deviations**

If a sample is classed as deviated then the associated results may be compromised.

1	**Container with Headspace provided for volatiles analysis**
2	**Incorrect container received**
3	**Deviation from method**
4	**Matrix interference**
♦	**Sample holding time exceeded in laboratory**
@	**Sample holding time exceeded due to late arrival of instructions or samples**
§	**Sampled on date not provided**

20. **Asbestos**

When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2021), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as "Not detected". If no asbestos fibre types are found all will be reported as "Not detected" and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of asbestos present is not determined unless specifically requested.

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials and soils are obtained from supplied bulk materials andd soils which have been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2021).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than: - Trace - Where only one or two asbestos fibres were identified.

Respirable Fibres

Respirable fibres are defined as fibres of <3 µm diameter, longer than 5 µm and with aspect ratios of at least 3:1 that can be inhaled into the lower regions of the lung and are generally acknowledged to be most important predictor of hazard and risk for cancers of the lung.

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.

Unit 7-8 Hawarden Business Park
Manor Road (off Manor Lane)
Hawarden
Deeside
CH5 3US
Tel: (01244) 528777
email: hawardencustomerservices@alsglobal.com
Website: www.alsenvironmental.co.uk

SLR Consulting Ireland
CSA House
Unit 7
Dundrum Business Park
Windy Harbour
Dublin
Dublin14

Attention: Orlaith Tyrrell

CERTIFICATE OF ANALYSIS

Date of report Generation:	01 June 2023
Customer:	SLR Consulting Ireland
Sample Delivery Group (SDG):	230524-79
Your Reference:	501.064999.00001
Location:	Roadstone Killough
Report No:	690945
Order Number:	8650

We received 3 samples on Wednesday May 24, 2023 and 3 of these samples were scheduled for analysis which was completed on Thursday June 01, 2023. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

Chemical testing (unless subcontracted) performed at ALS Laboratories (UK) Limited Hawarden.

All sample data is provided by the customer. The reported results relate to the sample supplied, and on the basis that this data is correct.
Incorrect sampling dates and/or sample information will affect the validity of results.
The customer is not permitted to reproduce this report except in full without the approval of the laboratory.

Approved By:

Sonia McWhan

Operations Manager

1291

CERTIFICATE OF ANALYSIS

SDG: 230524-79 **Report Number:** 690945 **Superseded Report:**
Client Ref.: 501.064999.00001 **Location:** Roadstone Killough

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
28046516	GW1		0.00 - 0.00	22/05/2023
28046529	GW2		0.00 - 0.00	22/05/2023
28046539	GW3		0.00 - 0.00	22/05/2023

Only received samples which have had analysis scheduled will be shown on the following pages.

CERTIFICATE OF ANALYSIS

SDG: 230524-79 **Report Number:** 690945 **Superseded Report:**
Client Ref.: 501.064999.00001 **Location:** Roadstone Killough

Results Legend

X Test

N No Determination Possible

Sample Types -
S - Soil/Solid
UNS - Unspecified Solid
GW - Ground Water
SW - Surface Water
LE - Land Leachate
PL - Prepared Leachate
PR - Process Water
SA - Saline Water
TE - Trade Effluent
TS - Treated Sewage
US - Untreated Sewage
RE - Recreational Water
DW - Drinking Water Non-regulatory
UNL - Unspecified Liquid
SL - Sludge
G - Gas
OTH - Other

Lab Sample No(s)			28046516								28046529								28046539		
Customer Sample Reference			GW1								GW2								GW3		
AGS Reference																					
Depth (m)			0.00 - 0.00								0.00 - 0.00								0.00 - 0.00		
Container			0.5l glass bottle (ALE227)	500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	HNO3 Unfiltered (ALE204)	NaOH (ALE245)	Vial (ALE297)	ZnAc (ALE246)	0.5l glass bottle (ALE227)	500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	HNO3 Unfiltered (ALE204)	NaOH (ALE245)	Vial (ALE297)	ZnAc (ALE246)	0.5l glass bottle (ALE227)	500ml Plastic (ALE208)	H2SO4 (ALE244)
Sample Type			GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW
Ammonium Low	All	NDPs: 0 Tests: 3			X								X								X
Anions by Kone (w)	All	NDPs: 0 Tests: 3		X								X								X	
Dissolved Metals by ICP-MS	All	NDPs: 0 Tests: 3				X								X							
EPH CWG (Aliphatic) Aqueous GC (W)	All	NDPs: 0 Tests: 3	X								X								X		
EPH CWG (Aromatic) Aqueous GC (W)	All	NDPs: 0 Tests: 3	X								X								X		
Fluoride	All	NDPs: 0 Tests: 3		X								X								X	
GRO by GC-FID (W)	All	NDPs: 0 Tests: 3							X								X				
Low Level Cyanide (W)	All	NDPs: 0 Tests: 3						X								X					
Mercury Dissolved	All	NDPs: 0 Tests: 3				X								X							
Nitrite by Kone (w)	All	NDPs: 0 Tests: 3						X								X					
pH Value	All	NDPs: 0 Tests: 3		X								X								X	
Phosphate by Kone (w)	All	NDPs: 0 Tests: 3		X								X								X	
Sulphide	All	NDPs: 0 Tests: 3								X								X			
Total Metals by ICP-MS	All	NDPs: 0 Tests: 3					X								X						
TPH CWG (W)	All	NDPs: 0 Tests: 3	X								X								X		

RECEIVED: 13/01/2025

28046539	GW3		0.00 - 0.00	ZnAc (ALE246)	GW															X			
				Vial (ALE297)	GW							X											
				NaOH (ALE245)	GW								X			X							
				HNO3 Unfiltered (ALE204)	GW																X		
				HNO3 Filtered (ALE204)	GW			X							X								

Validated

CERTIFICATE OF ANALYSIS

SDG: 230524-79 **Report Number:** 690945 **Superseded Report:**
Client Ref.: 501.064999.00001 **Location:** Roadstone Killough

Results Legend

X Test

N No Determination Possible

Sample Types -
S - Soil/Solid
UNS - Unspecified Solid
GW - Ground Water
SW - Surface Water
LE - Land Leachate
PL - Prepared Leachate
PR - Process Water
SA - Saline Water
TE - Trade Effluent
TS - Treated Sewage
US - Untreated Sewage
RE - Recreational Water
DW - Drinking Water Non-regulatory
UNL - Unspecified Liquid
SL - Sludge
G - Gas
OTH - Other

Lab Sample No(s)			28046516	28046529	28046539
Customer Sample Reference			GW1	GW2	GW3
AGS Reference					
Depth (m)			0.00 - 0.00	0.00 - 0.00	0.00 - 0.00
Container			0.5l glass bottle (ALE227)	0.5l glass bottle (ALE227)	0.5l glass bottle (ALE227)
			500ml Plastic (ALE208)	500ml Plastic (ALE208)	500ml Plastic (ALE208)
			H2SO4 (ALE244)	H2SO4 (ALE244)	H2SO4 (ALE244)
			HNO3 Filtered (ALE204)	HNO3 Filtered (ALE204)	
			HNO3 Unfiltered (ALE204)	HNO3 Unfiltered (ALE204)	
			NaOH (ALE245)	NaOH (ALE245)	
			Vial (ALE297)	Vial (ALE297)	
			ZnAc (ALE246)	ZnAc (ALE246)	
Sample Type			GW	GW	GW
VOC MS (W)	All	NDPs: 0 Tests: 3	X	X	

28046539	GW3		0.00 - 0.00	ZnAc (ALE246)	GW		
				Vial (ALE297)	GW		X
				NaOH (ALE245)	GW		
				HNO3 Unfiltered (ALE204)	GW		
				HNO3 Filtered (ALE204)	GW		

CERTIFICATE OF ANALYSIS

SDG: 230524-79 **Report Number:** 690945 **Superseded Report:**
Client Ref.: 501.064999.00001 **Location:** Roadstone Killough

Results Legend
- # ISO17025 accredited.
- M mCERTS accredited.
- aq Aqueous / settled sample.
- diss.filt Dissolved / filtered sample.
- tot.unfilt Total / unfiltered sample.
- * Subcontracted - refer to subcontractor report for accreditation status.
- ** % recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
- (F) Trigger breach confirmed
- 1-4+§@ Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	GW1	GW2	GW3			
			Depth (m)	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00			
			Sample Type	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)			
			Date Sampled	22/05/2023	22/05/2023	22/05/2023			
			Sample Time	-	-	-			
			Date Received	24/05/2023	24/05/2023	24/05/2023			
			SDG Ref	230524-79	230524-79	230524-79			
			Lab Sample No.(s)	28046516	28046529	28046539			
			AGS Reference						
Ammoniacal Nitrogen as N (low level)	<0.01 mg/l	TM099		0.062 #	0.0245 #	0.0261 #			
Ammoniacal Nitrogen Low as NH3	<0.01 mg/l	TM099		0.0752 #	0.0297 #	0.0317 #			
Ammoniacal Nitrogen Low as NH4	<0.01 mg/l	TM099		0.0797 #	0.0315 #	0.0336 #			
Sulphide	<0.01 mg/l	TM101		<0.01 #	<0.01 #	0.0221 #			
Fluoride	<0.5 mg/l	TM104		<0.5 #	0.52 #	0.979 #			
Aluminium (diss.filt)	<10 µg/l	TM152		<10 #	<10 #	<10 #			
Aluminium (tot.unfilt)	<10 µg/l	TM152		5070 #	1610 #	286 #			
Arsenic (diss.filt)	<0.5 µg/l	TM152		<0.5 #	<0.5 #	<0.5 #			
Barium (diss.filt)	<0.2 µg/l	TM152		21.6 #	30.1 #	8.79 #			
Boron (diss.filt)	<10 µg/l	TM152		20.9 #	53.7 #	<10 #			
Cadmium (diss.filt)	<0.08 µg/l	TM152		<0.08 #	<0.08 #	<0.08 #			
Chromium (diss.filt)	<1 µg/l	TM152		<1 #	<1 #	<1 #			
Copper (diss.filt)	<0.3 µg/l	TM152		0.803 #	0.618 #	<0.3 #			
Manganese (tot.unfilt)	<1 µg/l	TM152		745 #	515 #	36.1 #			
Lead (diss.filt)	<0.2 µg/l	TM152		0.502 #	<0.2 #	<0.2 #			
Nickel (diss.filt)	<0.4 µg/l	TM152		36 #	35.6 #	1.33 #			
Phosphorus (diss.filt)	<10 µg/l	TM152		<10 #	<10 #	<10 #			
Selenium (diss.filt)	<1 µg/l	TM152		<1 #	1.32 #	9.48 #			
Vanadium (diss.filt)	<1 µg/l	TM152		<1 #	<1 #	<1 #			
Zinc (diss.filt)	<1 µg/l	TM152		19.1 #	23.7 #	19.8 #			
Sodium (Dis.Filt)	<0.076 mg/l	TM152		9.41 #	25.4 #	5.62 #			
Potassium (Dis.Filt)	<0.2 mg/l	TM152		0.794 #	2.66 #	0.578 #			
Calcium (Dis.Filt)	<0.2 mg/l	TM152		138 #	219 #	48.7 #			
Iron (Dis.Filt)	<0.019 mg/l	TM152		<0.019 #	<0.019 #	<0.019 #			
Magnesium (Tot. Unfilt.)	<0.05 mg/l	TM152		10.6 #	15.9 #	3.42 #			
Mercury (diss.filt)	<0.01 µg/l	TM183		<0.01 #	<0.01 #	<0.01 #			
Nitrite as NO2	<0.05 mg/l	TM184		<0.05 #	<0.05 #	<0.05 #			
Sulphate	<2 mg/l	TM184		32.3 #	359 #	26.3 #			
Chloride	<2 mg/l	TM184		15.7 #	40.6 #	8.6 #			
Phosphate (Ortho as P)	<0.02 mg/l	TM184		<0.02 #	<0.02 #	<0.02 #			
Nitrate as NO3	<0.3 mg/l	TM184		25.1 #	2.9 #	5.59 #			
Total Oxidised Nitrogen as N	<0.1 mg/l	TM184		5.68 #	0.655 #	1.26 #			
pH	<1 pH Units	TM256		7.67 #	7.52 #	8.09 #			

Validated

CERTIFICATE OF ANALYSIS

SDG: 230524-79 **Report Number:** 690945 **Superseded Report:**
Client Ref.: 501.064999.00001 **Location:** Roadstone Killough

Results Legend	
#	ISO17025 accredited.
M	mCERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-4+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	GW1	GW2	GW3
			Depth (m)	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00
			Sample Type	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)
			Date Sampled	22/05/2023	22/05/2023	22/05/2023
			Sample Time	.	.	.
			Date Received	24/05/2023	24/05/2023	24/05/2023
			SDG Ref	230524-79	230524-79	230524-79
			Lab Sample No.(s)	28046516	28046529	28046539
			AGS Reference			
Conductivity @ 20 deg.C	<0.02 mS/cm	TM256		0.596 #	1.03 #	0.279 #
Cyanide, Total (low level)	<5 µg/l	TM279		<5 #	<5 #	<5 #
Cyanide, Free (low level)	<2.5 µg/l	TM279		<2.5 #	<2.5 #	<2.5 #

RECEIVED: 13/01/2025

CERTIFICATE OF ANALYSIS

SDG: 230524-79 **Report Number:** 690945 **Superseded Report:**
Client Ref.: 501.064999.00001 **Location:** Roadstone Killough

TPH CWG (W)

Results Legend
- # ISO17025 accredited.
- M mCERTS accredited.
- aq Aqueous / settled sample.
- diss.filt Dissolved / filtered sample.
- tot.unfilt Total / unfiltered sample.
- * Subcontracted - refer to subcontractor report for accreditation status.
- ** % recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
- (F) Trigger breach confirmed
- 1-4+$@ Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	GW1	GW2	GW3			
			Depth (m)	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00			
			Sample Type	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)			
			Date Sampled	22/05/2023	22/05/2023	22/05/2023			
			Sample Time	-	-	-			
			Date Received	24/05/2023	24/05/2023	24/05/2023			
			SDG Ref	230524-79	230524-79	230524-79			
			Lab Sample No.(s)	28046516	28046529	28046539			
			AGS Reference						
GRO Surrogate % recovery**	%	TM245		92	88	87			
GRO >C5-C12	<50 µg/l	TM245		<50 #	<50 #	<50 #			
Aliphatics >C5-C6	<10 µg/l	TM245		<10	<10	<10			
Aliphatics >C6-C8	<10 µg/l	TM245		<10	<10	<10			
Aliphatics >C8-C10	<10 µg/l	TM245		<10	<10	<10			
Aliphatics >C10-C12	<10 µg/l	TM245		<10	<10	<10			
Aliphatics >C12-C16 (aq)	<10 µg/l	TM174		<10	<10	<10			
Aliphatics >C16-C21 (aq)	<10 µg/l	TM174		<10	<10	<10			
Aliphatics >C21-C35 (aq)	<10 µg/l	TM174		<10	<10	<10			
Total Aliphatics >C12-C35 (aq)	<10 µg/l	TM174		<10	<10	<10			
Aromatics >EC5-EC7	<10 µg/l	TM245		<10	<10	<10			
Aromatics >EC7-EC8	<10 µg/l	TM245		<10	<10	<10			
Aromatics >EC8-EC10	<10 µg/l	TM245		<10	<10	<10			
Aromatics >EC10-EC12	<10 µg/l	TM245		<10	<10	<10			
Aromatics >EC12-EC16 (aq)	<10 µg/l	TM174		<10	<10	<10			
Aromatics >EC16-EC21 (aq)	<10 µg/l	TM174		<10	<10	<10			
Aromatics >EC21-EC35 (aq)	<10 µg/l	TM174		<10	<10	<10			
Total Aromatics >EC12-EC35 (aq)	<10 µg/l	TM174		<10	<10	<10			
Total Aliphatics & Aromatics >C5-35 (aq)	<10 µg/l	TM174		<10	<10	<10			
Aliphatics >C16-C35 Aqueous	<10 µg/l	TM174		<10	<10	<10			

Validated

CERTIFICATE OF ANALYSIS

SDG: 230524-79 **Report Number:** 690945 **Superseded Report:**
Client Ref.: 501.064999.00001 **Location:** Roadstone Killough

VOC MS (W)

Results Legend

#	ISO17025 accredited.
M	mCERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-4+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	GW1	GW2	GW3
			Depth (m)	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00
			Sample Type	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)
			Date Sampled	22/05/2023	22/05/2023	22/05/2023
			Sample Time	-	-	-
			Date Received	24/05/2023	24/05/2023	24/05/2023
			SDG Ref	230524-79	230524-79	230524-79
			Lab Sample No.(s)	28046516	28046529	28046539
			AGS Reference			
Methyl tertiary butyl ether (MTBE)	<1 µg/l	TM208		<1 #	<1 #	<1 #
Benzene	<1 µg/l	TM208		<1 #	<1 #	<1 #
Toluene	<1 µg/l	TM208		<1 #	<1 #	<1 #
Ethylbenzene	<1 µg/l	TM208		<1 #	<1 #	<1 #
m,p-Xylene	<1 µg/l	TM208		<1 #	<1 #	<1 #
o-Xylene	<1 µg/l	TM208		<1 #	<1 #	<1 #
Sum of detected Xylenes	<2 µg/l	TM208		<2	<2	<2
Sum of BTEX	<5 µg/l	TM208		<5	<5	<5

Table of Results - Appendix

Method No	Description
TM099	Determination of Ammonium in Water Samples using the Kone Analyser
TM101	Determination of Sulphide in soil and water samples using the Kone Analyser
TM104	Determination of Fluoride using the Kone Analyser
TM152	Analysis of Aqueous Samples by ICP-MS
TM174	Determination of Speciated Extractable Petroleum Hydrocarbons in Waters by GC-FID
TM183	Determination of Trace Level Mercury in Waters and Leachates by PSA Cold Vapour Atomic Fluorescence Spectrometry
TM184	The Determination of Anions in Aqueous Matrices using the Kone Spectrophotometric Analysers
TM208	Determination of Volatile Organic Compounds by Headspace / GC-MS in Waters
TM245	Determination of GRO by Headspace in waters
TM256	Determination of pH, EC, TDS and Alkalinity in Aqueous samples
TM279	Determination of Low Level Easily Liberatable (Free) Cyanides and Total Cyanides in Waters using the Skalar SANS+ System Segmented Flow Analyser

NA = not applicable.

Chemical testing (unless subcontracted) performed at ALS Laboratories (UK) Limited Hawarden (Method codes TM).

CERTIFICATE OF ANALYSIS

SDG: 230524-79 **Report Number:** 690945 **Superseded Report:**
Client Ref.: 501.064999.00001 **Location:** Roadstone Killough

Test Completion Dates

Lab Sample No(s)	28046516	28046529	28046539
Customer Sample Ref.	GW1	GW2	GW3
AGS Ref.			
Depth	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00
Type	Ground Water	Ground Water	Ground Water
Ammonium Low	31-May-2023	31-May-2023	31-May-2023
Anions by Kone (w)	27-May-2023	27-May-2023	27-May-2023
Dissolved Metals by ICP-MS	31-May-2023	31-May-2023	31-May-2023
EPH CWG (Aliphatic) Aqueous GC (W)	31-May-2023	31-May-2023	31-May-2023
EPH CWG (Aromatic) Aqueous GC (W)	31-May-2023	31-May-2023	31-May-2023
Fluoride	01-Jun-2023	01-Jun-2023	31-May-2023
GRO by GC-FID (W)	25-May-2023	25-May-2023	25-May-2023
Low Level Cyanide (W)	31-May-2023	31-May-2023	31-May-2023
Mercury Dissolved	30-May-2023	30-May-2023	30-May-2023
Nitrite by Kone (w)	26-May-2023	26-May-2023	26-May-2023
pH Value	31-May-2023	31-May-2023	31-May-2023
Phosphate by Kone (w)	27-May-2023	27-May-2023	31-May-2023
Sulphide	01-Jun-2023	01-Jun-2023	01-Jun-2023
Total Metals by ICP-MS	30-May-2023	30-May-2023	30-May-2023
TPH CWG (W)	31-May-2023	31-May-2023	31-May-2023
VOC MS (W)	25-May-2023	25-May-2023	25-May-2023

Appendix

General

1. Results are expressed on a dry weight basis (dried at 35ºC) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH4 by the BRE method, VOC TICs and SVOC TICs.

2. If sufficient sample is received a sub sample will be retained free of charge for 15 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALS reserve the right to charge for samples received and stored but not analysed.

3. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

4. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

5. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

6. NDP - No determination possible due to insufficient/unsuitable sample.

7. Results relate only to the items tested.

8. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

9. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

10. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

11. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

12. For dried and crushed preparations of soils volatile loss may occur e.g volatile mercury.

13. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

14. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

15. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

16. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

17 Data retention. All records, communications and reports pertaining to the analysis are archived for seven years from the date of issue of the final report.

18. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as “mixed hydrocarbons”. Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

19. **Sample Deviations**

If a sample is classed as deviated then the associated results may be compromised.

1	**Container with Headspace provided for volatiles analysis**
2	**Incorrect container received**
3	**Deviation from method**
4	**Matrix interference**
♦	**Sample holding time exceeded in laboratory**
@	**Sample holding time exceeded due to late arrival of instructions or samples**
§	**Sampled on date not provided**

20. **Asbestos**

When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2021), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as “Not detected”. If no asbestos fibre types are found all will be reported as “Not detected” and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of asbestos present is not determined unless specifically requested.

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials and soils are obtained from supplied bulk materials andd soils which have been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2021).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining.

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than: - Trace - Where only one or two asbestos fibres were identified.

Respirable Fibres

Respirable fibres are defined as fibres of <3 µm diameter, longer than 5 µm and with aspect ratios of at least 3:1 that can be inhaled into the lower regions of the lung and are generally acknowledged to be most important predictor of hazard and risk for cancers of the lung.

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.

Unit 7-8 Hawarden Business Park
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Deeside
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SLR Consulting Ireland
CSA House
Unit 7
Dundrum Business Park
Windy Harbour
Dublin
Dublin14

Attention: Orlaith Tyrrell

CERTIFICATE OF ANALYSIS

Date of report Generation:	16 August 2024
Customer:	SLR Consulting Ireland
Sample Delivery Group (SDG):	240809-75
Your Reference:	501.064999.00001
Location:	Roadstone Killough
Report No:	737881
Order Number:	8650

We received 3 samples on Friday August 09, 2024 and 3 of these samples were scheduled for analysis which was completed on Friday August 16, 2024. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

Chemical testing (unless subcontracted) performed at ALS Laboratories (UK) Limited Hawarden.

All sample data is provided by the customer. The reported results relate to the sample supplied, and on the basis that this data is correct.
Incorrect sampling dates and/or sample information will affect the validity of results.
The customer is not permitted to reproduce this report except in full without the approval of the laboratory.

Approved By:

Lauren Ellis
General Manager Western Europe Environmental

CERTIFICATE OF ANALYSIS

SDG: 240809-75 **Report Number:** 737881 **Superseded Report:**
Client Ref.: 501.064999.00001 **Location:** Roadstone Killough

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
30197060	GW1		0.00 - 0.00	07/08/2024
30197073	GW2		0.00 - 0.00	07/08/2024
30197084	GW3		0.00 - 0.00	07/08/2024

Only received samples which have had analysis scheduled will be shown on the following pages.

Validated

CERTIFICATE OF ANALYSIS

SDG: 240809-75 **Report Number:** 737881 **Superseded Report:**
Client Ref.: 501.064999.00001 **Location:** Roadstone Killough

RECEIVED: 13/01/2025

Results Legend

X Test

N No Determination Possible

Sample Types -
S - Soil/Solid
UNS - Unspecified Solid
GW - Ground Water
SW - Surface Water
LE - Land Leachate
PL - Prepared Leachate
PR - Process Water
SA - Saline Water
TE - Trade Effluent
TS - Treated Sewage
US - Untreated Sewage
RE - Recreational Water
DW - Drinking Water
Non-regulatory
UNL - Unspecified Liquid
SL - Sludge
G - Gas
OTH - Other

			Lab Sample No(s)	30197060	30197073	30197084
			Customer Sample Reference	GW1	GW2	GW3
			AGS Reference			
			Depth (m)	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00
			Container	0.5l glass bottle (ALE227)	500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	HNO3 Unfiltered (ALE204)	NaOH (ALE245)	Vial (ALE297)	ZnAc (ALE246)	0.5l glass bottle (ALE227)	500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	HNO3 Unfiltered (ALE204)	NaOH (ALE245)	Vial (ALE297)	ZnAc (ALE246)	0.5l glass bottle (ALE227)	500ml Plastic (ALE208)	H2SO4 (ALE244)
			Sample Type	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW
Ammonium Low	All	NDPs: 0 Tests: 3				X								X								X
Anions by Kone (w)	All	NDPs: 0 Tests: 3		X									X								X	
Dissolved Metals by ICP-MS	All	NDPs: 0 Tests: 3					X								X							
EPH and CWG by FID	All	NDPs: 0 Tests: 3	X								X									X		
Fluoride	All	NDPs: 0 Tests: 3		X								X									X	
GRO by GC-FID (W)	All	NDPs: 0 Tests: 3							X									X				
Low Level Cyanide (W)	All	NDPs: 0 Tests: 3						X									X					
Mercury Dissolved	All	NDPs: 0 Tests: 3				X									X							
Nitrite by Kone (w)	All	NDPs: 0 Tests: 3						X									X					
pH Value	All	NDPs: 0 Tests: 3		X								X									X	
Phosphate by Kone (w)	All	NDPs: 0 Tests: 3		X								X									X	
Sulphide	All	NDPs: 0 Tests: 3								X									X			
Total Metals by ICP-MS	All	NDPs: 0 Tests: 3					X									X						
TPH CWG (W)	All	NDPs: 0 Tests: 3	X								X									X		
VOC MS (W)	All	NDPs: 0 Tests: 3							X									X				

					30197084
					GW3
					0.00 - 0.00
HNO3 Filtered (ALE204)	HNO3 Unfiltered (ALE204)	NaOH (ALE245)	Vial (ALE297)	ZnAc (ALE246)	
GW	GW	GW	GW	GW	
X					
			X		
		X			
X					
		X			
				X	
	X				
			X		

Validated

CERTIFICATE OF ANALYSIS

SDG: 240809-75 **Report Number:** 737881 **Superseded Report:**
Client Ref.: 501.064999.00001 **Location:** Roadstone Killough

Results Legend
- # ISO17025 accredited.
- M mCERTS accredited.
- aq Aqueous / settled sample.
- diss.filt Dissolved / filtered sample.
- tot.unfilt Total / unfiltered sample.
- * Subcontracted - refer to subcontractor report for accreditation status.
- ** % recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
- (F) Trigger breach confirmed
- 1-4+$@ Sample deviation (see appendix)

Customer Sample Ref.	GW1	GW2	GW3			
Depth (m)	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00			
Sample Type	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)			
Date Sampled	07/08/2024	07/08/2024	07/08/2024			
Sample Time	.	.	.			
Date Received	09/08/2024	09/08/2024	09/08/2024			
SDG Ref	240809-75	240809-75	240809-75			
Lab Sample No.(s)	30197060	30197073	30197084			
AGS Reference						

Component	LOD/Units	Method						
Ammoniacal Nitrogen as N (low level)	<0.01 mg/l	TM099	0.014	#	0.015	#	0.012	#
Ammoniacal Nitrogen Low as NH3	<0.01 mg/l	TM099	0.017	#	0.0182	#	0.0146	#
Ammoniacal Nitrogen Low as NH4	<0.01 mg/l	TM099	0.018	#	0.0193	#	0.0154	#
Sulphide	<0.01 mg/l	TM101	<0.01	#	<0.01	#	<0.01	#
Fluoride	<0.5 mg/l	TM104	<0.5	#	0.817	#	1.2	#
Aluminium (diss.filt)	<10 µg/l	TM152	<10	#	<10	#	<10	#
Aluminium (tot.unfilt)	<10 µg/l	TM152	15200	#	2740	#	8150	#
Arsenic (diss.filt)	<0.5 µg/l	TM152	<0.5	#	2.68	#	<0.5	#
Barium (diss.filt)	<0.2 µg/l	TM152	16.5	#	26.2	#	10.2	#
Boron (diss.filt)	<10 µg/l	TM152	15.2	#	60.4	#	43.5	#
Cadmium (diss.filt)	<0.08 µg/l	TM152	<0.08	#	<0.08	#	<0.08	#
Chromium (diss.filt)	<1 µg/l	TM152	<1	#	<1	#	<1	#
Copper (diss.filt)	<0.3 µg/l	TM152	1.48	#	<0.3	#	1.89	#
Manganese (tot.unfilt)	<1 µg/l	TM152	2380	#	853	#	1430	#
Lead (diss.filt)	<0.2 µg/l	TM152	0.345	#	<0.2	#	0.28	#
Nickel (diss.filt)	<0.4 µg/l	TM152	9.98	#	23.6	#	2.58	#
Phosphorus (diss.filt)	<10 µg/l	TM152	<10	#	<10	#	19.6	#
Selenium (diss.filt)	<1 µg/l	TM152	<1	#	<1	#	13.4	#
Vanadium (diss.filt)	<1 µg/l	TM152	<1	#	<1	#	<1	#
Zinc (diss.filt)	<1 µg/l	TM152	20.6	#	14.2	#	18.4	#
Sodium (Dis.Filt)	<0.076 mg/l	TM152	7.55	#	21.8	#	5.04	#
Potassium (Dis.Filt)	<0.2 mg/l	TM152	0.648	#	2.82	#	0.743	#
Calcium (Dis.Filt)	<0.2 mg/l	TM152	116	#	206	#	52	#
Iron (Dis.Filt)	<0.019 mg/l	TM152	<0.019	#	2.25	#	<0.019	#
Magnesium (Tot. Unfilt.)	<0.05 mg/l	TM152	18.8	#	26.8	#	13.8	#
Mercury (diss.filt)	<0.01 µg/l	TM183	0.0101	#	<0.01	#	<0.01	#
Nitrite as NO2	<0.05 mg/l	TM184	<0.05	#	<0.05	#	<0.05	#
Sulphate	<2 mg/l	TM184	47.3	#	345	#	31.3	#
Chloride	<2 mg/l	TM184	13.1	#	45	#	7.9	#
Phosphate (Ortho as P)	<0.02 mg/l	TM184	<0.02	#	<0.02	#	<0.02	#
Nitrate as NO3	<0.3 mg/l	TM184	28.9	#	<0.3	#	4.93	#
Total Oxidised Nitrogen as N	<0.1 mg/l	TM184	6.52	#	<0.1	#	1.11	#
pH	<1 pH Units	TM256	7.62	#	7.26	#	7.92	#

Validated

CERTIFICATE OF ANALYSIS

SDG: 240809-75 **Report Number:** 737881 **Superseded Report:**
Client Ref.: 501.064999.00001 **Location:** Roadstone Killough

Results Legend					
#	ISO17025 accredited.				
M	mCERTS accredited.				
aq	Aqueous / settled sample.				
diss.filt	Dissolved / filtered sample.				
tot.unfilt	Total / unfiltered sample.				
*	Subcontracted - refer to subcontractor report for accreditation status.				
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery				
(F)	Trigger breach confirmed				
1-4+§@	Sample deviation (see appendix)				
	Customer Sample Ref.	GW1	GW2	GW3	
	Depth (m)	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	
	Sample Type	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	
	Date Sampled	07/08/2024	07/08/2024	07/08/2024	
	Sample Time	.	.	.	
	Date Received	09/08/2024	09/08/2024	09/08/2024	
	SDG Ref	240809-75	240809-75	240809-75	
	Lab Sample No.(s)	30197060	30197073	30197084	
	AGS Reference				

Component	LOD/Units	Method						
Conductivity @ 20 deg.C	<0.02 mS/cm	TM256	0.57 #	1.03 #	0.297 #			
Cyanide, Total (low level)	<5 µg/l	TM279	<5 #	<5 #	<5 #			
Cyanide, Free (low level)	<2.5 µg/l	TM279	<2.5 #	<2.5 #	<2.5 #			

Validated

CERTIFICATE OF ANALYSIS

SDG: 240809-75 **Report Number:** 737881 **Superseded Report:**
Client Ref.: 501.064999.00001 **Location:** Roadstone Killough

TPH CWG (W)

Results Legend
- # ISO17025 accredited.
- M mCERTS accredited.
- aq Aqueous / settled sample.
- diss.filt Dissolved / filtered sample.
- tot.unfilt Total / unfiltered sample.
- * Subcontracted - refer to subcontractor report for accreditation status.
- ** % recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
- (F) Trigger breach confirmed
- 1-4+$@ Sample deviation (see appendix)

Customer Sample Ref.			GW1	GW2	GW3			
Depth (m)			0.00 - 0.00	0.00 - 0.00	0.00 - 0.00			
Sample Type			Ground Water (GW)	Ground Water (GW)	Ground Water (GW)			
Date Sampled			07/08/2024	07/08/2024	07/08/2024			
Sample Time			.	.	.			
Date Received			09/08/2024	09/08/2024	09/08/2024			
SDG Ref			240809-75	240809-75	240809-75			
Lab Sample No.(s)			30197060	30197073	30197084			
AGS Reference								
Component	**LOD/Units**	**Method**						
GRO Surrogate % recovery**	%	TM245	101	101	102			
GRO >C5-C12 (HS_1D_TOTAL)	<50 µg/l	TM245	<50 #	<50 #	<50 #			
Aliphatics >C5-C6 (HS_1D_AL)	<10 µg/l	TM245	<10	<10	<10			
Aliphatics >C6-C8 (HS_1D_AL)	<10 µg/l	TM245	<10	<10	<10			
Aliphatics >C8-C10 (HS_1D_AL)	<10 µg/l	TM245	<10	<10	<10			
Aliphatics >C10-C12 (HS_1D_AL)	<10 µg/l	TM245	<10	<10	<10			
Aliphatics >C12-C16 (aq) (SPECD_AL1_W)	<10 µg/l	TM439	<20	<10	<10			
Aliphatics >C16-C21 (aq) (SPECD_AL2_W)	<10 µg/l	TM439	<20	<10	<10			
Aliphatics >C21-C35 (aq) (SPECD_AL3_W)	<10 µg/l	TM439	<20	<10	<10			
Total Aliphatics >C12-C35 (aq) (EPHAL12_35T_GC_W)	<10 µg/l	TM439	<20	<10	<10			
Aromatics >EC5-EC7 (HS_1D_AR)	<10 µg/l	TM245	<10	<10	<10			
Aromatics >EC7-EC8 (HS_1D_AR)	<10 µg/l	TM245	<10	<10	<10			
Aromatics >EC8-EC10	<10 µg/l	TM245	<10	<10	<10			
Aromatics >EC10-EC12	<10 µg/l	TM245	<10	<10	<10			
Aromatics >EC12-EC16 (aq) (SPECD_AROM1_W)	<10 µg/l	TM439	<20	<10	<10			
Aromatics >EC16-EC21 (aq) (SPECD_AROM2_W)	<10 µg/l	TM439	<20	<10	<10			
Aromatics >EC21-EC35 (aq) (SPECD_AROM3_W)	<10 µg/l	TM439	<20	<10	<10			
Total Aromatics >EC12-EC35 (aq) (EPHAR12_35T_GC_W)	<10 µg/l	TM439	<20	<10	<10			
Total Aliphatics & Aromatics >C5-35 (aq)	<10 µg/l	TM439	<10	<10	<10			

CERTIFICATE OF ANALYSIS

SDG: 240809-75 **Report Number:** 737881 **Superseded Report:**
Client Ref.: 501.064999.00001 **Location:** Roadstone Killough

VOC MS (W)

Results Legend
- # ISO17025 accredited.
- M mCERTS accredited.
- aq Aqueous / settled sample.
- diss.filt Dissolved / filtered sample.
- tot.unfilt Total / unfiltered sample.
- * Subcontracted - refer to subcontractor report for accreditation status.
- ** % recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
- (F) Trigger breach confirmed
- 1-4+$@ Sample deviation (see appendix)

Customer Sample Ref.	GW1	GW2	GW3			
Depth (m)	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00			
Sample Type	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)			
Date Sampled	07/08/2024	07/08/2024	07/08/2024			
Sample Time	.	.	.			
Date Received	09/08/2024	09/08/2024	09/08/2024			
SDG Ref	240809-75	240809-75	240809-75			
Lab Sample No.(s)	30197060	30197073	30197084			
AGS Reference						

Component	LOD/Units	Method						
Methyl tertiary butyl ether (MTBE)	<1 µg/l	TM208	<1 #	<1 #	<1 #			
Benzene	<1 µg/l	TM208	<1 #	<1 #	<1 #			
Toluene	<1 µg/l	TM208	<1 #	<1 #	<1 #			
Ethylbenzene	<1 µg/l	TM208	<1 #	<1 #	<1 #			
m,p-Xylene	<1 µg/l	TM208	<1 #	<1 #	<1 #			
o-Xylene	<1 µg/l	TM208	<1 #	<1 #	<1 #			
Sum of detected Xylenes	<2 µg/l	TM208	<2	<2	<2			
Sum of BTEX	<5 µg/l	TM208	<5	<5	<5			

Table of Results - Appendix

Method No	Description
TM152	Analysis of Aqueous Samples by ICP-MS
TM208	Determination of Volatile Organic Compounds by Headspace / GC-MS in Waters
TM256	Determination of pH, EC, TDS and Alkalinity in Aqueous samples
TM279	Determination of Low Level Easily Liberatable (Free) Cyanides and Total Cyanides in Waters using the Skalar SANS+ System Segmented Flow Analyser
TM439	Determination of Extractable Petroleum Hydrocarbons (EPH) CWG banding by GC-FID on liquids
TM099	Determination of Ammonium in Water Samples using the Kone Analyser
TM101	Determination of Sulphide in soil and water samples using the Kone Analyser
TM104	Determination of Fluoride using the Kone Analyser
TM183	Determination of Trace Level Mercury in Waters and Leachates by PSA Cold Vapour Atomic Fluorescence Spectrometry
TM184	The Determination of Anions in Aqueous Matrices using the Kone Spectrophotometric Analysers
TM245	Determination of GRO by Headspace in waters

NA = not applicable.

Chemical testing (unless subcontracted) performed at ALS Laboratories (UK) Limited Hawarden (Method codes TM).

CERTIFICATE OF ANALYSIS

SDG: 240809-75 **Report Number:** 737881 **Superseded Report:**
Client Ref.: 501.064999.00001 **Location:** Roadstone Killough

Test Completion Dates

Lab Sample No(s)	30197060	30197073	30197084
Customer Sample Ref.	GW1	GW2	GW3
AGS Ref.			
Depth	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00
Type	Ground Water	Ground Water	Ground Water
Ammonium Low	14-Aug-2024	14-Aug-2024	14-Aug-2024
Anions by Kone (w)	13-Aug-2024	13-Aug-2024	13-Aug-2024
Dissolved Metals by ICP-MS	14-Aug-2024	13-Aug-2024	16-Aug-2024
EPH and CWG by FID	16-Aug-2024	16-Aug-2024	16-Aug-2024
Fluoride	13-Aug-2024	13-Aug-2024	13-Aug-2024
GRO by GC-FID (W)	13-Aug-2024	13-Aug-2024	13-Aug-2024
Low Level Cyanide (W)	13-Aug-2024	13-Aug-2024	13-Aug-2024
Mercury Dissolved	15-Aug-2024	15-Aug-2024	15-Aug-2024
Nitrite by Kone (w)	12-Aug-2024	12-Aug-2024	12-Aug-2024
pH Value	14-Aug-2024	14-Aug-2024	14-Aug-2024
Phosphate by Kone (w)	12-Aug-2024	12-Aug-2024	12-Aug-2024
Sulphide	13-Aug-2024	13-Aug-2024	13-Aug-2024
Total Metals by ICP-MS	15-Aug-2024	15-Aug-2024	15-Aug-2024
TPH CWG (W)	16-Aug-2024	16-Aug-2024	16-Aug-2024
VOC MS (W)	15-Aug-2024	15-Aug-2024	15-Aug-2024

Appendix

General

1. Results are expressed on a dry weight basis (dried at 35ºC) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH4 by the BRE method, VOC TICs and SVOC TICs.

2. If sufficient sample is received a sub sample will be retained free of charge for 15 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of 15 days after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALS reserve the right to charge for samples received and stored but not analysed.

3. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

4. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

5. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

6. NDP - No determination possible due to insufficient/unsuitable sample.

7. Results relate only to the items tested.

8. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

9. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

10. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

11. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

12. For dried and crushed preparations of soils volatile loss may occur e.g volatile mercury

13. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

14. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

15. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

16. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

17 Data retention. All records, communications and reports pertaining to the analysis are archived for seven years from the date of issue of the final report.

18. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as “mixed hydrocarbons”. Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

19. **Sample Deviations**

If a sample is classed as deviated then the associated results may be compromised.

1	**Container with Headspace provided for volatiles analysis**
2	**Incorrect container received**
3	**Deviation from method**
4	**Matrix interference**
♦	**Sample holding time exceeded in laboratory**
@	**Sample holding time exceeded due to late arrival of instructions or samples**
§	**Sampled on date not provided**

20. **Asbestos**

When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2021), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as “Not detected”. If no asbestos fibre types are found all will be reported as “Not detected” and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of asbestos present is not determined unless specifically requested.

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials and soils are obtained from supplied bulk materials andd soils which have been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2021).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining.

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than: - Trace - Where only one or two asbestos fibres were identified.

Respirable Fibres

Respirable fibres are defined as fibres of <3 µm diameter, longer than 5 µm and with aspect ratios of at least 3:1 that can be inhaled into the lower regions of the lung and are generally acknowledged to be most important predictor of hazard and risk for cancers of the lung.

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.

Appendix 7-E

Rating of Existing Environment Significance / Sensitivity

Rating of Existing Environment Significance / Sensitivity (IGI, 2013 Guidelines)

Importance	Criteria	Typical Example
High	Attribute has a high quality or value on an international scale	Groundwater/ Surface Water supports river, wetland or surface water body ecosystem protected by EU legislation e.g. SAC or SPA status
	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 – e.g. NHA status. Regionally important potable water source supplying >2,500 homes Inner source protection area for regionally important water source. Drinking water supply from river. Amenity use of waterbody
	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. No specific recreational use of waterbody
Low	Attribute has a low quality or value on a local scale	Poor Bedrock Aquifer. Potable water source supplying <50 homes. No water supply from surface water, no abstraction designation for watercourse No amenity value of waterbody
Negligible	Attribute has negligible quality or value on a local site scale	No groundwater supply from a bedrock aquifer inn vicinity of site. Surface water not used for any specific purpose.

Appendix 7-F

Descriptions of Effects (EPA, 2022)

Descriptions of Effects (EPA, 2022)

Impact Characteristic	Term	Description
Quality of Effects	Positive Effects	A change which improves the quality of the environment
	Neutral Effects	No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error
	Negative / Adverse Effects	A change which reduces the quality of the environment
Describing the Significance of Effects	Imperceptible	An effect capable of measurement but without significant consequences
	Not significant	An effect which causes noticeable2 changes in the character of the environment but without significant consequences.
	Slight Effects	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities
	Moderate Effects	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.
	Significant Effects	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 Effects	An effect which obliterates sensitive characteristics
Describing the Extent and Context of Effects	Extent	Describe the size of the area, the 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 (is it the biggest, longest effect ever?)
Describing the Probability of Effects	Likely Effects	Describe the size of the area, the number of sites, and the proportion of a population affected by an effect.
	Unlikely Effects	Describe whether the extent, duration, or frequency will conform or contrast with established (baseline) conditions (is it the biggest, longest effect ever?)
	Momentary Effects	Effects lasting from seconds to minutes

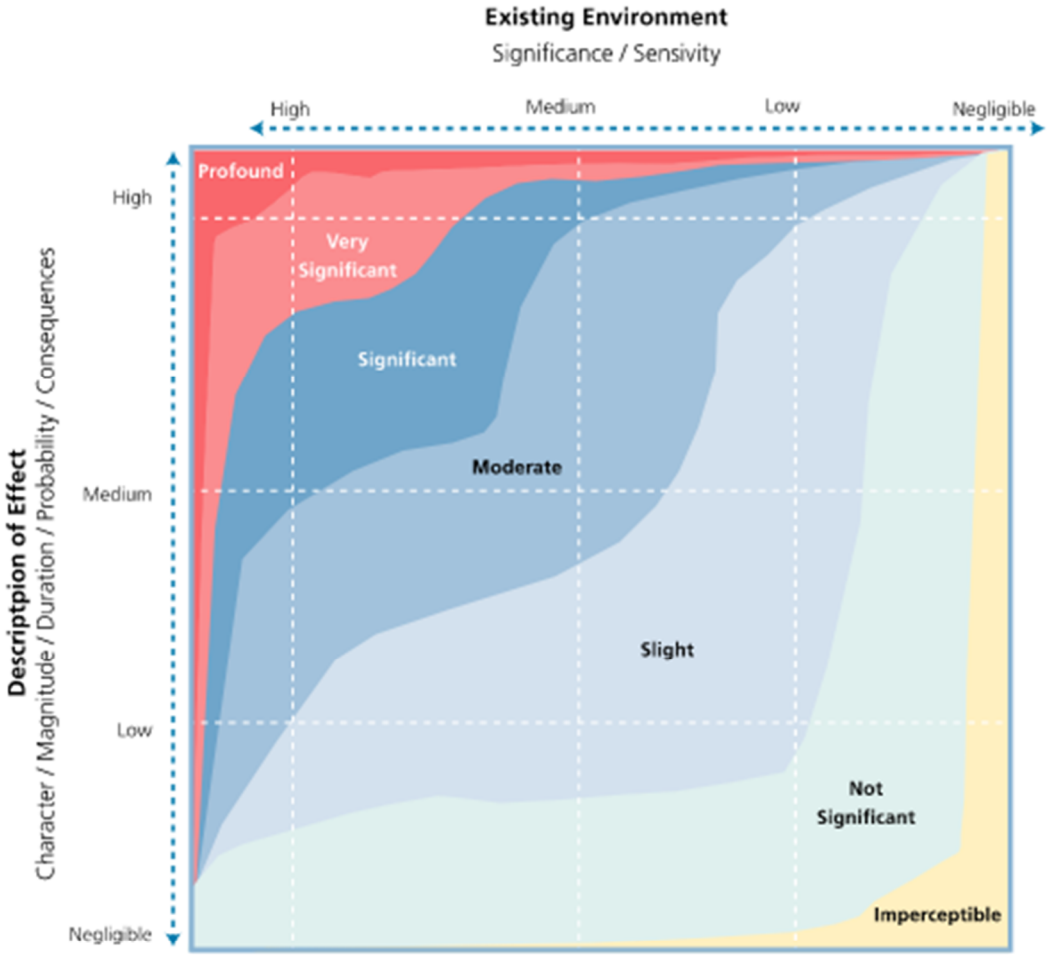
Describing the Duration and Frequency of Effects	Brief Effects	Effects lasting less than a day
	Temporary Effects	Effects lasting less than a year
	Short-term Effects	Effects lasting one to seven years
	Medium-term Effects	Effects lasting seven to fifteen years
	Long-term Effects	Effects lasting fifteen to sixty years
	Permanent Effects	Effects lasting over sixty years
	Reversible Effects	Effects that can be undone, for example through remediation or restoration
	Frequency of Effects	Describe how often the effect will occur. (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually.
Describing the Types of Effects	Indirect / Secondary Effects	Likely, significant effects 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 Effects	The addition of many minor or significant effects, including effects of other projects, to create larger, more significant effects.
	Do-Nothing Effects	The environment as it would be in the future should the subject project not be carried out.
	Worst Case Effects	The effects arising from a project in the case where mitigation measures substantially fail.
	Indeterminable Effects	When the full consequences of a change in the environment cannot be described.
	Irreversible Effects	When the character, distinctiveness, diversity or reproductive capacity of an environment is permanently lost.
	Residual Effects	The degree of environmental change that will occur after the proposed mitigation measures have taken effect.
	Synergistic Effects	Where the resultant effect is of greater significance than the sum of its constituents, (e.g. combination of SOx and NOx to produce smog).

Appendix 7-G

Classification of the Significance of Impacts

Determining Significance

Figure 3.4 shows how comparing the character of the predicted effect to the sensitivity of the receiving environment can determine the significance of the effect.



There are seven generalised degrees of effect significance that are commonly used in EIA. Imperceptible, Not Significant, Slight, Moderate, Significant, Very Significant and Profound. Generalised definitions of each of these are provided in Table 3.4. When more specific definitions exist within a specialised factor or topic, e.g. biodiversity, these should be used in preference to these generalised definitions. (ref. Advice Notes[68].)

(Source: Figure 3.4 Environmental Protection Agency (May 2022), *'Guidelines on the Information to be contained in Environmental Impact Assessment Reports'*).