6 WATER

6.1 INTRODUCTION

This Chapter of the remedial Environmental Impact Assessment Report (rEIAR) provides an assessment of the hydrological (surface water) and hydrogeological (groundwater) aspects of the Shillelagh Quarry (the 'Site'), in support of an application for Substitute Consent for the existing quarry. This Chapter considers and assesses any potential impacts on the surface and groundwater resulting from quarrying related activities that have been carried out at the Site.

It is noted that activity at the Site involved the extraction of rock (greywacke and shale) utilising blasting techniques, with active dewatering of the pit floor taking place.

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

6.1.1 TECHNICAL SCOPE

The technical scope of this assessment is to consider the potential impacts and effects that changes in activities at the Site (as detailed in Chapter 2, Project Description) may have had on the water environment throughout the review period. This assessment considers the potential sources of change resulting from various activities at the Site on hydrological and hydrogeological receptors. It considers water levels, flow regimes, water resources and uses, water quality, flood risk and water management.

The potential effects of secondary changes in the water environment on ecology (including water dependent habitats or ecological receptors) and infrastructure are considered further in the following chapters of the rEIAR:

- Chapter 4 – Ecology and Biodiversity;
- Chapter 13 – Material Assets; and
- Chapter 15 – Interactions.

Potential secondary effects of changes in land quality on water quality is addressed in the chapter and in Chapter 5 – Land, Soils and Geology.

6.1.2 GEOGRAPHICAL AND TEMPORAL SCOPE

The geographical study area for the assessment covers the area within the EIA boundary (Site) and a buffer zone that nominally extends to 500 m from the boundary (Figure 6-1). However, where deemed appropriate, the buffer zone is increased to allow for identification of downstream or downgradient hydraulic connectivity with off-Site water features or users that may have been affected by Site related activities.

The temporal scope of the assessment covers the period of 29 December 2019 ('baseline conditions') to the present day ('current conditions'). This timeframe from December 2019 to the present is subsequently referred to as the 'review/assessment period'. This assessment period equates to approximately five years and is identified as 'short-term' duration (lasting one to seven years). The assessment establishes what the baseline water environment conditions were for the Site, and then assesses what impacts may have occurred due to subsequent activities at the Site during the review period.

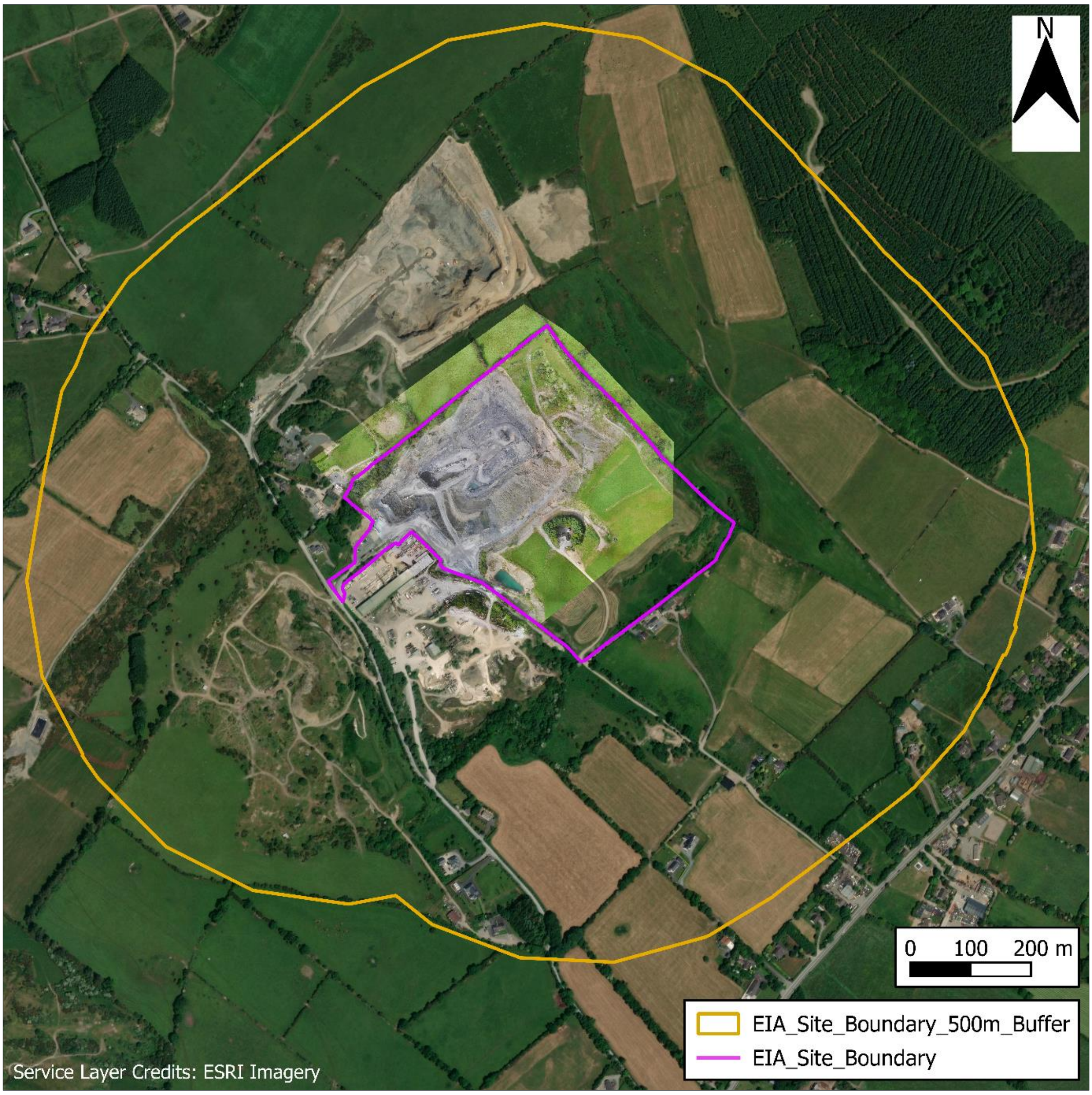

Figure 6-1 - EIA Site Boundary and 500m Buffer

6.2 LEGISLATIVE AND POLICY CONTEXT

This section addresses the legislation and guidance that has been considered when preparing this chapter, and key policy context relevant to the water environment that has guided the focus of the assessment.

6.2.1 LEGISLATION

This assessment has been made with cognisance of relevant guidance, advice and legislation relating to the water environment, including but not limited to:

- The Local Government (Water Pollution) Act 1977 (as amended) and associated Statutory Instrument Regulations made under that Act outline the general prohibition of entry of polluting matter to water, the requirement to licence both trade and sewage effluent discharges, licencing of water abstractions, controlling discharges to aquifers, and notification of accidental damages;

- The European Union (EU) Water Framework Directive (WFD) (2000/60/EC) is the European legislation that establishes a framework for the protection of groundwater and surface water, including the establishment of river basin districts, the requirement to prevent further deterioration by preventing or limiting inputs of pollutants into groundwater, reducing pollution, and promoting sustainable water use. The Groundwater Daughter Directive (GWDD) (2006/118/EC) sits beneath the WFD and relates to water protection and management. It establishes measures to prevent and control groundwater pollution, including criteria for assessing good chemical status and identifying trends; and
- The WFD and GWDD have been transposed into Irish law by means of many Regulations. These Regulations cover governance, the shape of the WFD characterisation, monitoring, and status assessment programmes in terms of assigning responsibilities for the monitoring of different water categories, determining the quality elements and undertaking the characterisation and classification assessments. They include, but are not limited to, the following:
    - European Communities (Water Policy) Regulations 2003 and its subsequent amendments;
    - European Communities Environmental Objectives (Surface Waters) Regulations, 2009 and its subsequent amendments;
    - European Communities Environmental Objectives (Groundwater) Regulations, 2010 and its subsequent amendments; and
    - European Communities (Technical Specifications for the Chemical Analysis and Monitoring of Water Status) Regulations 2011.

  Many of these regulations contain threshold values or environmental quality standards which, when exceeded, can reflect a degradation in water quality. A degradation in water quality can be reflective of negative effects caused by the development, but it should be noted that a poor water quality can be naturally occurring due to the environmental setting; and
- The EU Directive on the Assessment and Management of Flood Risks (2007/60/EC) is transposed into Irish law by the European Communities (Assessment and Management of Flood Risks) Regulations 2010 and its subsequent amendment. The aim of the legislation is to reduce the adverse consequences of flooding on human health and the environment, and it outlines the requirements for flood risk assessments to be completed as part of the planning process.

6.2.2 RELEVANT POLICIES AND PLANS

The National Planning Framework (Project Ireland 2040) includes National Policy Objective 60 to "Conserve and enhance the rich qualities of natural and cultural heritage of Ireland in a manner appropriate to their significance".

At a national level, the River Basin Management Plan (RBMP) for Ireland 2018-2021 (Department of Housing, Planning and Local Government, 2018) outlines the measures that will be taken to improve the water quality in Ireland's groundwater and surface water. This plan focuses on the following priorities:

- Ensuring compliance with relevant EU legislation;
- Preventing deterioration;
- Meeting the objectives for designated protected areas;
- Protecting high-status waters; and

- Implementing targeted actions and pilot schemes in focused sub-catchments aimed at targeting water bodies close to meeting their objectives and addressing more complex issues that will build knowledge for the next cycle in the RBMP.

The Kildare County Development Plan 2023-2029 (KCDP) (and preceding 2017-2023 plan, which covers the majority of the temporal scope) is the key strategy document which structures the proper planning and sustainable development of land-use across County Kildare over the six-year statutory period of the plan.

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

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

- **IN P2 –** (It is the policy of KCC to) Ensure the protection and enhancement of water quality throughout Kildare in accordance with the EU WFD and facilitate the implementation of the associated programme of measures in the River Basin Management Plan 2018-2021 (and subsequent updates);
- **IN O5** – (It is the objective of KCC to) Manage, protect, and enhance surface water and groundwater quality to meet the requirements of the EU Water Framework Directive;
- **IN O8** – (It is the objective of KCC to) Support the implementation of Irish Water’s Water Safety Plans to ensure that public drinking water sources and their contributing catchments are protected from pollution;
- **IN O19 –** (It is the objective of KCC to) Ensure that existing and permitted private wastewater treatment plants are operated in compliance with their wastewater discharge licenses, to protect water quality;
- **RD P8 –** (It is the policy of KCC to) Support and manage the appropriate future development of Kildare’s natural aggregate resources in appropriate locations to ensure adequate supplies are available to meet the future needs of the county and the region in line with the principles of sustainable development and environmental management and to require operators to appropriately manage extraction sites when extraction has ceased;
- **RD O42 –** (It is the objective of KCC to) Ensure that development for aggregate extraction, processing and associated concrete production does not significantly impact the following:
  - Special Areas of Conservation (SACs)
  - Special Protection Areas (SPAs)
  - Natural Heritage Areas (NHAs)
  - Other areas of importance for the conservation of flora and fauna.
  - Zones of Archaeological Potential.

    - The vicinity of a recorded monument.
    - Sensitive landscape areas as identified in Chapter 13 of this Plan.
    - Scenic views and prospects.
    - Protected Structures.
    - Established rights of way and walking routes.
    - Potential World Heritage Sites in Kildare on the UNESCO Tentative List, Ireland.
- **RD O44** – (It is the objective of KCC to) Require applications for mineral or other extraction to include (but not limited to):
    - An Appropriate Assessment Screening where there is any potential for effects on a Natura 2000 site.
    - An Environmental Impact Assessment Report (EIAR).
    - An Ecological Impact Assessment may also be required for subthreshold developments to evaluate the existence of any protected species / habitats on site.
- **RD O49** – (It is the objective of KCC to) Have regard to the following guidance documents (as may be amended, replaced, or supplemented) in the assessment of planning applications for quarries, ancillary services, restoration and after-use:
    - Quarries and Ancillary Activities: Guidelines for Planning Authorities, DEHLG (2004). - Environmental Management Guidelines
    - Environmental Management in the Extractive Industry (Non-Scheduled Minerals), EPA (2006). - Archaeological Code of Practice between the DEHLG an ICF (2009).
    - Geological Heritage Guidelines for the Extractive Industry (2008).
    - Wildlife, Habitats, and the Extractive Industry – Guidelines for the protection of biodiversity within the extractive industry, NPWS (2009).

6.2.3 RELEVANT GUIDANCE

Guidance relating to the EIA process that has been used to guide the assessment of potential impacts to the water environment and the identification of relevant mitigation includes:

- AA-EQS - European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. No. 272/2009 including amendments S.I. No. 327/2012, S.I. No. 386/2015 and S.I. No. 77/2019) - European Communities Environmental Objectives (Surface Waters) Regulations is the 2022 amendment (S.I. No. 288/2022);
- GTV - Groundwater Regulations (SI No. 9 of 2010 as updated by SI No. 366 of 2016);
- Relevant European Commission guidance – Guidance on the Preparation of the Environmental Impact Assessment Report (2017);
- EPA Guidelines on the Information to be Contained in Environmental Impact Assessment Reports, Environmental Protection Agency (May 2022);
- Department of Housing, Planning and Local Government. Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (August 2018);
- The National Roads Authority (NRA) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (2008) in relation to aspects to be considered and assessment approach (including relative receptor importance and cross discipline interactions);
- The National Roads Authority (NRA) Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan (2007) in relation to impact mitigation;

- Institute of Geologists of Ireland (IGI) Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements (April 2013);
- CIRIA C532: Control of water pollution from construction sites. Guidance for consultants and contractors (2001);
- CIRIA C741: Environmental Good Practice on Site (2015, Fourth Edition) in relation to source of impact and mitigation. CIRIA C811: Environmental Good Practice on Site (2023, Fifth Edition);
- CIRIA C750: Groundwater control – design and practice (2016, Second Edition);
- The EPA guidelines on Environmental Management in the Extractive Industry (Non-Scheduled Minerals) (2006), for a more environmentally sustainable quarry & pit industrial sector, greater protection for the environment and human health; and
- The CIRIA guidance Publication C532 Control of water pollution from construction sites: guidance for consultants and contractors (2001), which provides advice on environmental good practice for the control of water pollution arising from construction activities.

6.3 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

This section presents the method used to assess the impacts and effects of activities at the Site on the water environment during the review period, and to identify potential secondary effects from changes to the water environment. It establishes the stages of the assessment, and the qualitative criteria used to assess impact magnitude and determine the level of effect significance.

6.3.1 SOURCES OF INFORMATION

The assessment has been carried out using the following sources of information:

- Site walkovers during the review period;
- Field monitoring and sampling campaigns carried out over the review period;
- Correspondence with the Applicant/Site Owner;
- Desktop reviews of the previous impact assessment by Golder (2019);
- Desktop reviews of literature and publicly available information (including interactive mapping services);
- Review of historic surface water monitoring information provided by the EPA;
- Review of drone surveys (aerial imagery and topography) carried out in 2019 and September 2023 and,
- Review of publicly available aerial imagery (Google Earth) for 2019, 2020 and 2022.

6.3.2 QUALITATIVE ASSESSMENT METHOD

The assessment of potential effects has been undertaken using the qualitative assessment method outlined below. The assessment is supported by the available baseline condition information, historical records of Site activities, previous hydrological and hydrogeological studies, historical monitoring data and recent monitoring and survey data collected to supplement the historical dataset. The assessment follows a staged approach with a summary of the stages involved below:

1) Confirm baseline conditions – determine baseline and develop conceptual site model by consideration of available records and data sets, site reports and published information;

2) Confirm the key receptors and their value/importance;

3) Qualitatively characterise the magnitude of impacts on the receptors – describe what potential changes could have occurred to each receptor because of Site activities, identify

source-pathway receptor linkages, and assign the magnitudes of impact. This stage considers embedded design mitigation, historical and existing site practices including good practice in construction environment management and pollution prevention;

4) Determine the effect significance of each potential impact on each sensitive receptor;
5) Consider the need for remedial measures if it is considered necessary to reduce the magnitude of any impact and associated effect. If remedial measures are considered necessary, a timeline will be presented in which the measures would be implemented;
6) Assess the residual impact magnitude and residual effect significance after all mitigation is carried out; and
7) Identify any monitoring that may be required to measure the success of the remedial measures.

Stages 1 and 2 have been completed using published literature, guidance, and available information specific to the Development, which is presented in Chapter 2 of this rEIAR. For the identification of receptor value/importance that completes Stage 2, and for the description of impact magnitude (Stage 3), a common framework of assessment criteria and terminology has been used based on the EPA's draft Guidelines on the Information to be Contained in EIARs (EPA, 2022), with some modifications based on the additional guidance outlined in Section 6.2.3, such as those by the NRA and IGI. The descriptions for sensitivity of receptors are provided in Table 6-1 and the descriptions for magnitude of impact are provided in Table 6-2.

The potential for an impact to have occurred at a receptor has been determined using the understanding of the baseline environment and its properties and consideration of whether there is a feasible linkage between a source of impact and each receptor (i.e. a conceptual site model).

Table 6-1 – Environmental value (sensitivity) and descriptions

Value (sensitivity) of Receptor / Resource	Typical Description
High	High importance and rarity, national scale, and limited potential for substitution. For example: – Global/European/National designation. – Human health. – WFD river designation of 'High' and in hydraulic connectivity with the Site. – Regionally important aquifer with multiple wellfields. – Inner source protection area for a regional resource. – Regionally important potable water source supplying >2500 homes (surface water or aquifer). – Floodplain protecting more than 50 residential or commercial properties or nationally important infrastructure (e.g. motorways/national roads) from flooding.
Medium	Medium or high importance and rarity, regional scale, limited potential for substitution. For example: – Regionally important sites. – Regionally important aquifer.

Value (sensitivity) of Receptor / Resource	Typical Description
	– WFD river designation of ‘Good’ or ‘Moderate’” and in hydraulic connectivity with the Site. – Outer source protection area for a regional resource. – Locally important potable water source supplying >1000 homes (surface water or aquifer). – Floodplain protecting between 6 and 50 residential or commercial properties or regionally important infrastructure (e.g. regional roads) from flooding.
Low	Low or medium importance and rarity, local scale. For example: – Locally important aquifer. – WFD river designation of ‘Poor’ or ‘Bad’ and in hydraulic connectivity with the Site. – Outer source protection area for a local resource. – Local potable water source supplying >50 homes (surface water or aquifer). – Floodplain protecting between 2 and 5 residential or commercial properties or locally important infrastructure (e.g. local roads) from flooding.
Negligible	Very low importance and rarity, local scale. For example: – Environmental equilibrium is stable and is resilient to impacts that are greater than natural fluctuations, without detriment to its present character. – Poorly productive aquifer. – Any WFD river quality designation not in hydraulic connectivity with the Site. – Local potable water source supplying <50 homes (surface water or aquifer). – Floodplain protecting up to 1 residential or commercial properties from flooding.

Table 6-2 – Magnitude of impact and descriptions

Magnitude of impact (change)		Typical description
High	Adverse	• Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features or elements. • Significant harm to human health - death, disease, serious injury, genetic mutation, birth defects or the impairment of reproductive functions. • Significant harm to buildings/infrastructure/plant - Structural failure, substantial damage or substantial interference with any right of occupation. • Significant pollution of the water environment, as defined by: – A breach of, or failure to meet any statutory quality standard for the water environment at an appropriate pollution assessment point. – A breach of, or a failure to meet, any operational standard adopted by EPA for the protection of the water environment.

Magnitude of impact (change)		Typical description
		– Pollution results in an increase in treatment required for an existing drinking water supply. – Pollution results in an increased level of treatment required of water abstracted for industrial purposes. – Pollution results in deterioration in the status of a water body, failure to meet good status objectives defined by the Water Framework Directive, or failure of a protected drinking water area to meet its objectives as defined by the Water Framework Directive. – There is a significant and sustained upwards trend in concentration of pollutants in groundwater being affected by the land in question. • There is a material and adverse impact on the economic, social and/or amenity use associated with a particular water environment.
	Beneficial	• Large scale or major improvement of resource quality; extensive restoration; major improvement of attribute quality.
Medium	Adverse	• Loss of resource, but not adversely affecting the integrity; partial loss of/damage to key characteristics, features or elements.
	Beneficial	• Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality.
Low	Adverse	• Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements.
	Beneficial	• Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring.
Negligible	Adverse	• Very minor loss or alteration to one or more characteristics, features or elements.
	Beneficial	• Very minor benefit to or positive addition of one or more characteristics, features or elements.

The assessment of magnitude of impact considers whether the change that causes the impact is positive or negative, and whether the impact is direct or indirect, short, medium or long-term, temporary or permanent, and if it is reversible.

For the purposes of this assessment, a direct impact is one that occurred as a direct result of the activities on Site and was likely to have occurred at or near the Site itself. Indirect impacts (or secondary/tertiary impacts) are those where a direct impact on one receptor has another knock-on impact on one or more other related receptor(s) (e.g. the Site activities result in a change in groundwater quality, which then has an indirect impact on surface water quality and/or users of the water, such as human health or ecology). Indirect impacts can occur within the study area or away from the Site.

For the purposes of this assessment, the following definitions of duration have been used:

- Temporary – effect likely to last less than 1 year without intervention (i.e. less than the construction phase);
- Short term – effect likely to last 1 to 7 years without intervention;
- Medium term – effect likely to last 7 to 15 years without intervention;
- Long term – effect likely to last 15 to 60 years without intervention; and,
- Permanent – effect likely to last over 60 years without intervention.

An irreversible impact is defined as a change to the baseline that would not reverse itself naturally. Such impacts will usually be long-term and irreversible, such as the removal of best and most versatile agricultural soils. A reversible impact is defined as a change to the baseline conditions that would reverse naturally once the source of the impact is exhausted or has stopped. For example, impacts to groundwater quality from contamination may only last as long as the source of the impacts is present. If it is removed, groundwater quality may naturally improve or could be remediated.

6.3.3 SIGNIFICANCE CRITERIA

The approach followed to derive effects significance from receptor value and magnitude of impacts (Stage 4) is shown in Table 6-3. Where it includes two significance categories, reasoning is provided in the topic chapter if a single significance category is reported. A description of the significance categories used is provided in Table 6-4.

Table 6-3 – Significance Matrix

	Magnitude of Impact (Degree of Change)				
Environmental Value (Sensitivity)		**Negligible**	**Low**	**Medium**	**High**
	High	Slight	Slight or moderate	Moderate or large	Profound
	Medium	Imperceptible or slight	Slight or moderate	Moderate	Large or profound
	Low	Imperceptible	Slight	Slight	Slight or moderate
	Negligible	Imperceptible	Imperceptible or slight	Imperceptible or slight	Slight

Table 6-4 – Significance categories and typical descriptions

Significance Category	Typical Description
Profound	An effect which obliterates sensitive characteristics.
Large	An effect which, by its character, magnitude, duration or intensity alters a significant proportion of a sensitive aspect of the environment.
Moderate	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.

Significance Category	Typical Description
Slight	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
Imperceptible	An effect capable of measurement but without significant consequences.

Residual adverse effects of ‘large’ or ‘profound’ significance are considered to be ‘significant’ for the purposes of this assessment.

If required following the assessment of the current level of effect significance, additional mitigation measures (remedial measures) may be presented that will be used to avoid, prevent, or reduce the magnitude of the impact (Stage 5). The significance of the effect considering the additional mitigation is then assessed (Stage 6) to give the residual effect significance. Any monitoring that will be required to measure the success of the mitigation is included (Stage 7) (see Section 6.11).

The effects of the activities at the Site are also considered cumulatively, with those that could foreseeably have resulted from other known developments that have occurred in the assessment study area (see Section 6.10 and Chapter 14 Interactions).

6.4 BASELINE AND SUBSEQUENT CONDITIONS (DECEMBER 2019 TO PRESENT)

This Section presents a summary of the baseline (29 December 2019) and subsequent conditions to present time for the water environment (hydrology, hydrogeology, and flooding).

6.4.1 SITE SETTING

The Site is on lands at Hempstown, Co. Kildare, along the Kildare/Wicklow border. The nearest town to the Site is Blessington which is located approximately 4 km to the south of the Site via the N81 National Road. Beyond this there are several other small towns and the suburbs of Dublin.

The study area (500 m from the Site boundary) is characterised as rural with land uses in the area being mainly agricultural (predominantly pasture lands), industrial, forestry and single-house residential land. Immediately adjacent to the southwest of the Site, the land is industrial with a precast concrete manufacturing facility (Stresslite Floors ltd.). There are scattered residential properties in the vicinity of the site, mostly adjacent to the L6030 roadway. The L6030 roadway is a privately owned roadway which also provided access to the site from the south. It connects to the N81, national road.

The Red Bog SAC is located approximately 1.2 km southwest of the Site and is a similar elevation (approximately 260 m AOD), to the southern boundary of the Site.

The aggregate produced is used to supply to the construction industry and support the continued development of the local area and surrounding counties as a whole

6.4.2 SITE TOPOGRAPHY

The site is situated to the northwest of the Wicklow Mountain range, which peak at an elevation of 925 m AOD at Lugnaquilla, which is approximately 30km south of the Site. The closest large peak to the Site in this range is Kippure, which reaches a maximum elevation of 757 m AOD and is located approximately 12.5 km to the east of the Site.

The Site is located on the southeast facing slope of a southwest-northeast trending ridge of hills. This ridge reaches a peak to the north of the Site at Cupidstown Hill, which has an elevation of 431 m AOD (located 2.5 km to the north of the Site). The slope decreases in elevation towards the Goldenhill river and Pollaphuca Reservoir to the south, which sits at an elevation of 184 m AOD.

The topography within the vicinity of the Site (excluding the quarried areas) drops from 295 m AOD in the north (vicinity of GW4) to 233 m AOD in the south (vicinity of GW5), dropping by approximately 62 m.

The lowest elevation of the quarry void was approximately 230 m AOD in 2019, in the location of the quarry sump at the time. With deepening of the quarry floor to the south over the review period, the lowest elevation of the excavated pit is now at approximately 207.55 m AOD (September 2023), in the location of the quarry sump. This is a change of at least 22.45 m over the review period. See Figure 5.4 and Figure 5.5 in Chapter 5 for the changes in location of the deepest parts of the quarry. The area of the quarry void has extended by approximately 0.4 hectares over the review period (Chapter 5), in addition to the deepening of the quarry floor.

6.4.3 SITE WATER MANAGEMENT

The lowest elevation of the excavated pit is the quarry sump, at approximately 207.55 m AOD in September 2023. The images of the pit walls (Figure 6-2, Figure 6-3 and Figure 6-4), show seepages of groundwater (predominantly from the grey shale bedrock) into the pit, which then collects at the lowest elevation (quarry sump). The largest seepages are currently seen in the eastern and southern walls. The seepages in the eastern wall are along strike of the bedding planes in the shale and the seepages in the southern wall coincide with the northeast-southwest orientated fault. There are lesser seepages from the northern wall, where the tops of the bedding planes are exposed. See section 6.4.5.3 for more details on the bedrock geology and structure. Seepages appear to have increased in comparison to those reported in the 2019 EIAR (Planning Reg. Ref. 07/443 ABP PL09253338), which is in relation to the quarry void being extended and deepened.

Figure 6-2 - Eastern Wall Seepages

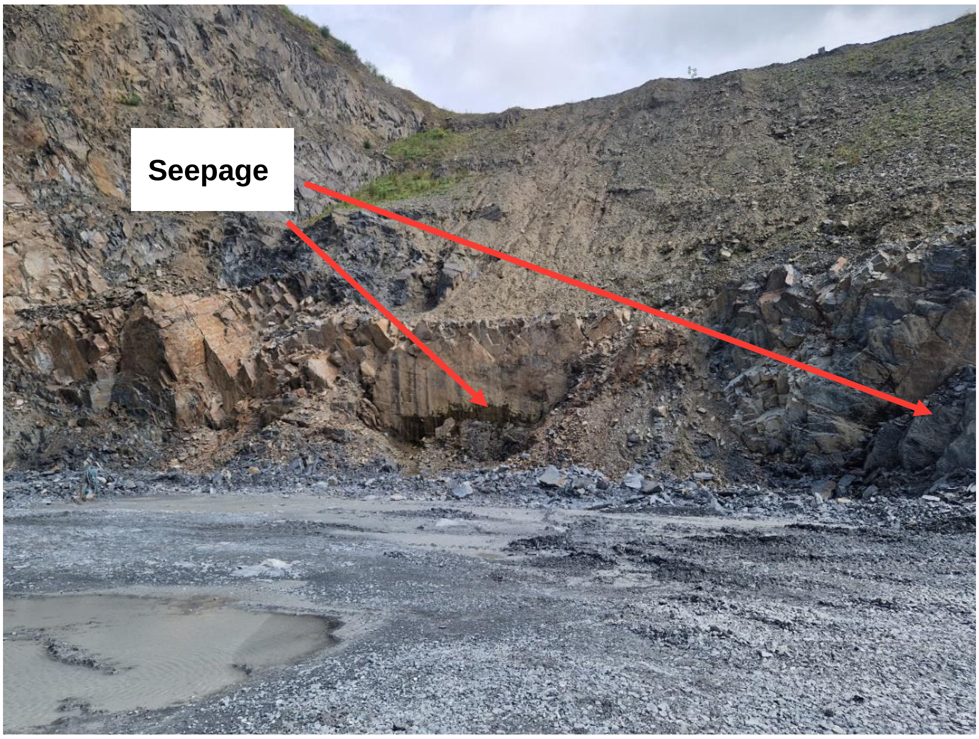

Figure 6-3 – Southern Wall Seepages

Figure 6-4 - Southern Wall and Ramp Seepages

The locations of the quarry sump and associated pump, pipeline, soakaway pond and overflow pond are shown in Figure 6-5 below. The quarry is currently dewatered to maintain dry working conditions in the base of the quarry. Increased dewatering is required following heavy rainfall, which leads to flooding of the quarry floor. The seepage and rainfall water that collects in the quarry sump is pumped via a buried pipeline up to the southern quarry terrace (approximately 249 m AOD, then the buried pipeline drops slightly to discharge into the large soakaway pond shown in Figure 6-5. A drain allows water to overflow from the soakaway pond to the overflow pond when the level gets too high.

Both the soakaway pond and the overflow pond are dug down through the sand and gravels into the bedrock. It is understood that the joining overflow, from the large soakaway pond into the smaller overflow pond is also within the bedrock.

Discharge rates are not currently recorded, although dewatering is reported by the Applicant to occur for approximately 2 hours per day. Dewatering is currently carried out using a Xylem Flygt BIBO 2870 50hz pump, the technical specification for which is provided as Appendix 6A. The pump is capable of up to 120 m^3/hr. Given the reported duration and estimated capability of the pump, dewatering is thought to currently occur at a maximum rate of 240 m^3/day (when required). This is higher than the estimated rate in the 2019 EIAR of 120 m^3/day, indicating that higher dewatering volumes occurred over the review period in comparison to baseline conditions.

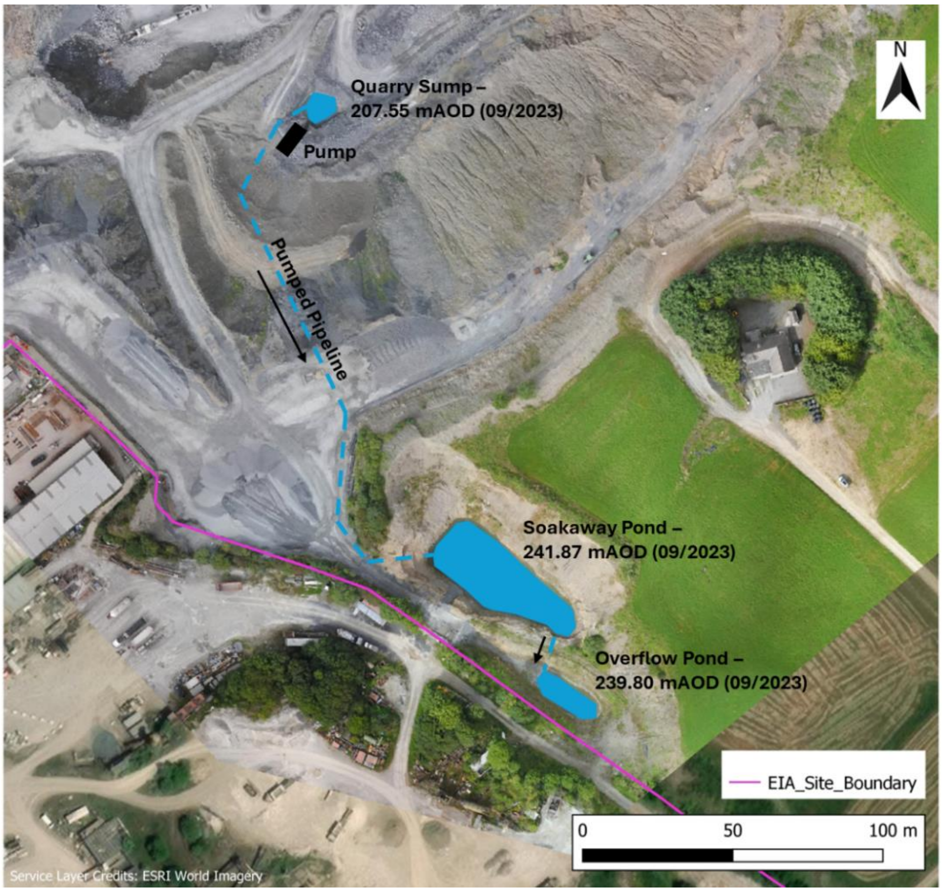

Figure 6-5 - Layout of September 2024 dewatering and discharge system (on September 2023 Aerial)

Water is only taken from the 'Wheelwash' borehole (Figure 6-16) to top up the Wheelwash as and when required. This is understood to be infrequently due to the Wheelwash being a closed loop system. This infrequent use is supported by the Wheelwash borehole water levels not reflecting any obvious or sustained drawdown (see Section 6.4.9.1).

Note that the planned hydrocarbon interceptor has not yet been installed for discharge to the soakaway pond.

6.4.4 GEOLOGY

The underlying geology of the Site is presented in Chapter 5 of this rEIAR. A brief summary of the geology is provided below.

6.4.4.1 Soils

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

6.4.4.2 Superficial Deposits

The Site and surrounding region is underlain by glacial deposits ranging from tills to glaciofluvial sands and gravels with glaciolacustrine deposits. Glacial and fluvial deposits (the Blessington Gravels) are generally thick in the area, with deposits commonly > 30 m in thickness, into the base of the valleys. Borehole logs from the Site indicate the drift (overburden, and sands and gravels) thickness ranges from ca. 5.4 m (GW4) to the north of the Site, to ca. 9 m (GW5) to the south of the Site. The sands and gravels of the drift therefore thicken to the south of the Site, towards the base of the valley. Monitoring well locations are presented in Figure 6-16 later in this Chapter. The respective borelogs are compiled in Appendix 6B.

6.4.4.3 Bedrock

The bedrock relative to the site boundary is presented in Figure 6-6 below. The underlying bedrock geology consists of the Pollaphuca Formation comprising of coarse graded greywackes, medium grey in colour, and dark grey shales. Approximately 2.3 km northwest of the Site is a major north-east trending fault (the Athgarrett Fault). The Athgarrett Fault is displaced by smaller scale east-west orientated strike slip faults. One of these strike slip faults is seen 75 m northeast of the quarry void (and within the Site boundary). Site photos indicate that there is a northeast-trending fault exposed in the eastern corner of the quarry (Figure 6-2 and Figure 6-3), which has a similar orientation to the Athgarrett Fault.

Within the quarry the greywacke and shale has bedding planes orientated similar to that of the exposed fault, dipping roughly southeast (as evidenced by the smooth bedding surfaces on the northern wall of the quarry). On a regional scale, the Pollaphuca Formation is understood to dip to the northwest, beneath the overlying Slate Quarries and Glen Ding Formations. Borehole logs record a brown shale (or greywackes) of up to 16 m thick overlying a grey-blue shale, which extends to the maximum recorded depth of 77.4 mbgl (GW04).

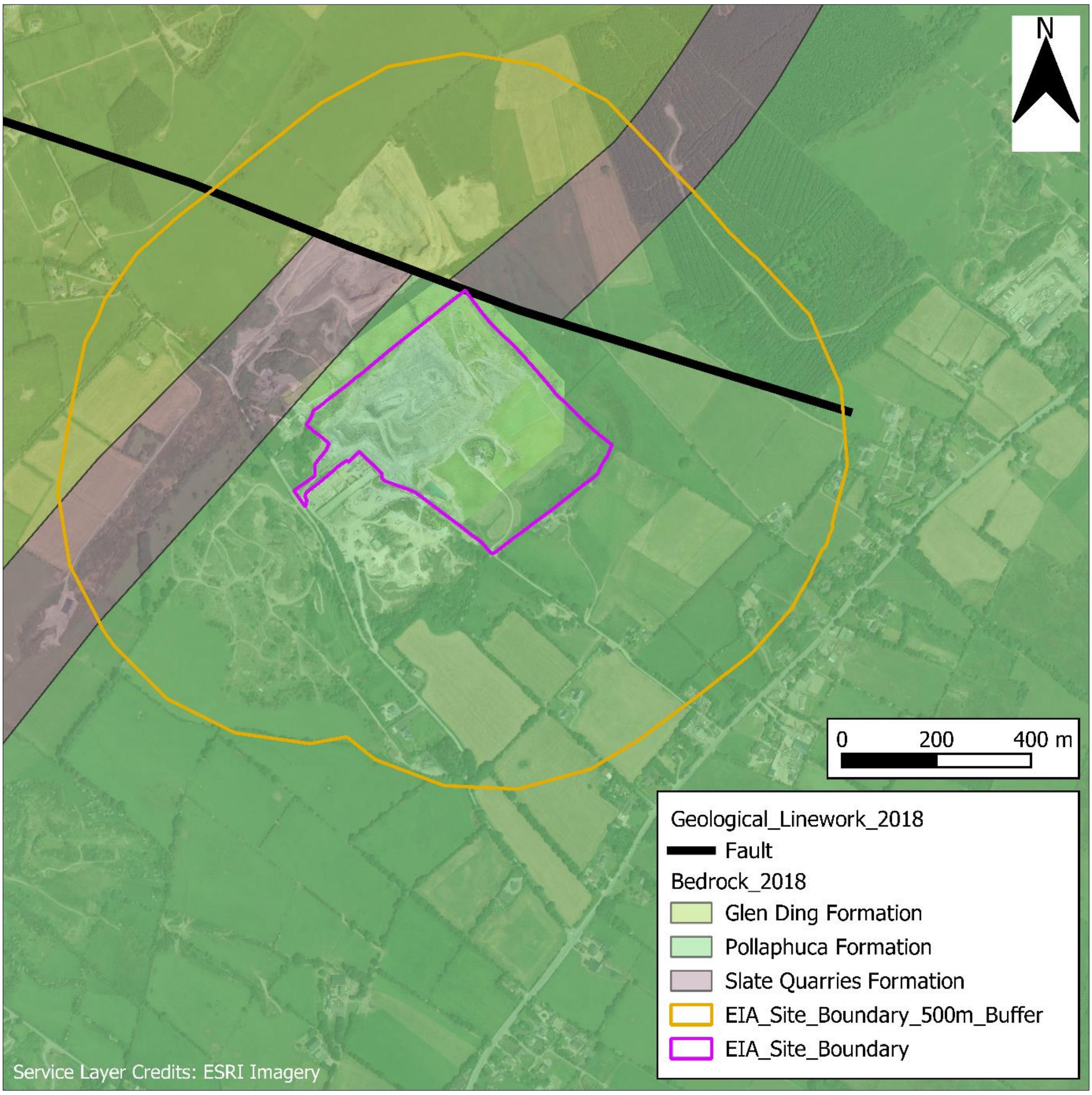

Figure 6-6 - Bedrock Geology Overlay

6.4.5 RAINFALL AND CLIMATE DATA

Table 6-5 below presents rainfall data recorded at the Blessington (Hempstown) meteorological station (number 8623), which is located ca. 0.8 km south of the Site, for the period January 2020 to August 2022 (Met Eireann, 2024). Historical data is not available for Blessington (Hempstown) meteorological station beyond August 2022. Brittas (Glenaraneen) meteorological station (number 7923), which is ca. 6 km northeast of the Site, has been used for data from the period September 2022 to June 2024 (Met Eireann, 2024).

The yearly totals indicate that the 2023 rainfall total of 1203.9 mm has been significantly higher than totals over 2021 (920.7 mm), 2022 (923.5 mm) and long-term historical average (1990 to 2022) of 955 mm/a, from Blessington (Hempstown) meteorological station.

GSI mapping (2024) indicates an effective rainfall (rainfall minus actual evapotranspiration) value of 543 mm/a for the area of the quarry void.

Table 6-5 - Monthly Rainfall Totals

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly Totals
2020	66.6	156.3	47.9	30.8	13.5	114.6	102.8	90.1	63.2	143.5	76.6	105.6	**1011.5**
2021	119.8	90.6	39.8	18.3	149.5	22.0	121.3	71.0	48.7	118.8	32.3	88.6	**920.7**
2022	24.1	101.8	41.1	59.6	74.9	96.7	42.9	21.0	144.8	127.7	73.6	115.3	**923.5**
2023	78.1	26.2	164.5	69.7	61.7	35.6	179.3	98.2	162.0	171.3	48.8	108.5	**1203.9**
2024	77.9	100.0	111.4	93.1	36.9	51.1	-	-	-	-	-	-	**-**
Avg.	-	-	-	-	-	-	-	-	-	-	-	-	**1014.9**

Note: Yearly data is based on monthly rainfall data measured at Blessington and Brittas meteorological Station. Full 12 months of data not available for 2024.

The monthly rainfall data over the period is presented in Figure 6-7 below and alongside water level plots within section 6.4.8.1.

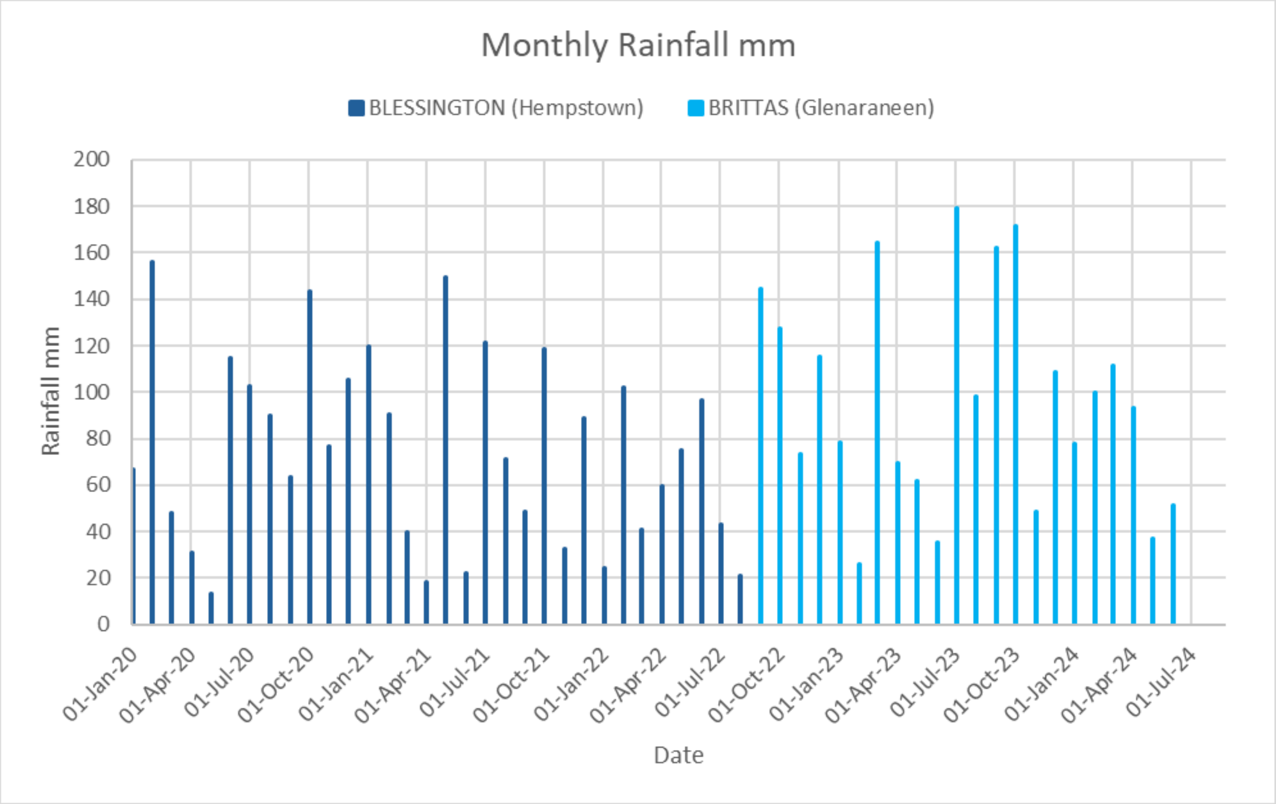

Figure 6-7 - Monthly Rainfall Graph for Review Period

6.4.6 SURFACE WATER – HYDROLOGY

The Site is located in the WFD (Water Framework Directive) Kilcullen Groundwater body (which is generally described as poorly productive. The WFD (Water Framework Directive) designations has the Site situated within the River Sub-Basin Liffey_040 (Sub-Catchment Liffey_SC_020_09_12). There is a catchment divide to the north of the Site as depicted in Figure 6-8, with the River Sub-Basin Morell_020 (Sub-Catchment Liffey_SC_070_09_14) to the north of this divide. The catchment divide closely follows the northeast trending ridgeline, which the Site is situated on the southern flank of.

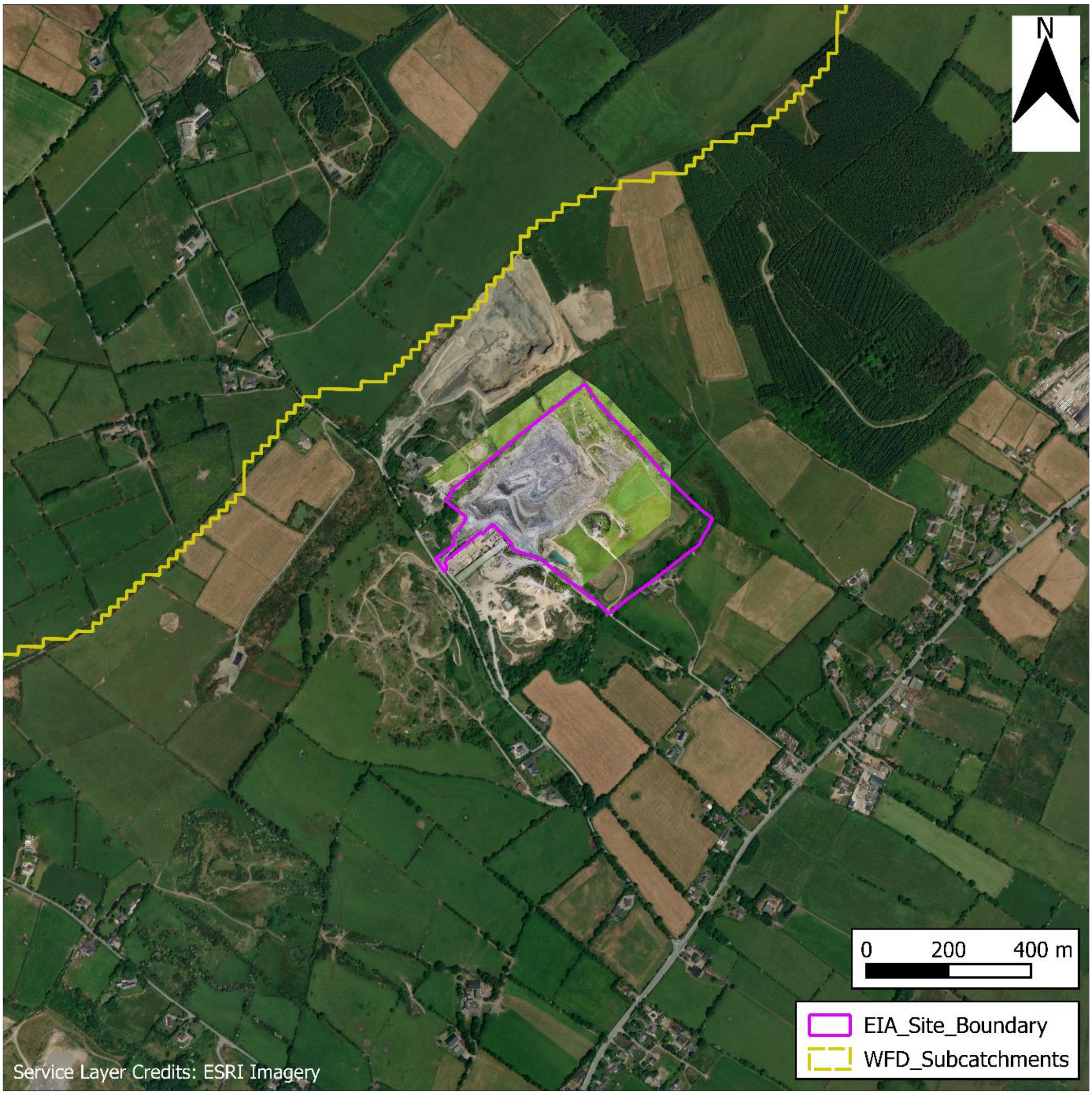

Figure 6-8 - Sub-Basin and Sub-Catchment Divide Across the Site (EPA, 2022)

6.4.6.1 Local Surface Water Features and Flows

The surface water bodies and river network in the area surrounding the Site is shown in Figure 6-9. The closest surface water feature to the Site is a small naturally occurring pond approximately 445 m to the south of the Site, situated at ca. 219m AOD. Further southwest of the Site (approximately 1.2 km) is the Red Bog, a designated Special Area of Conservation (SAC), situated at an elevation of ca. 260 m AOD. The Red Bog SAC is understood to be perched above the main water table, due to a clay rich layer in the underlying sands and gravels at this location (GSI, 2017) and the presence of a peat layer as shown in GSI mapping of Soils (see Chapter 5). The Red Bog SAC is largely recharged by rainwater percolating through the topsoil and unsaturated sand. The local surface water features are labelled on Figure 6-9 below.

No streams occur within the Site boundary due to the permeable nature of the near surface sands and gravels. Approximately 900m to the north of the site is the origin of the Hartwell stream in the form of several springs which flow northwest. Additionally, several other headwaters (Hempstown Commons, Slate Quarries, Punchestown Lower) are located approximately 800m to the northwest of the site which flow north to feed the Hartwell stream. The Hartwell stream flows west where it meets the Rathmore stream, approximately 3.5 km northwest of the site.

The Goldenhill river is located within 1.2 km to the southeast of the Site and flows south to the Poulaphouca Reservoir (locally known as Blessington Lake). The Poulaphouca Reservoir is located approximately 2.8 km to the south of the Site and is designated as a Special Protection Area (SPA) and National Heritage Area (NHA). It is an important water resource as it supplies County Dublin with drinking water.

It is likely that any surface water flows within the vicinity of the Site will flow towards the Goldenhill river, based on the catchment divide in Figure 6-8 and the topography described in Section 6.4.3. Due to the relative distance and current vegetated nature of the area surrounding the Site, it is considered likely that runoff would infiltrate to ground (into the superficial sands and gravels as groundwater baseflow) prior to reaching the Goldenhill river.

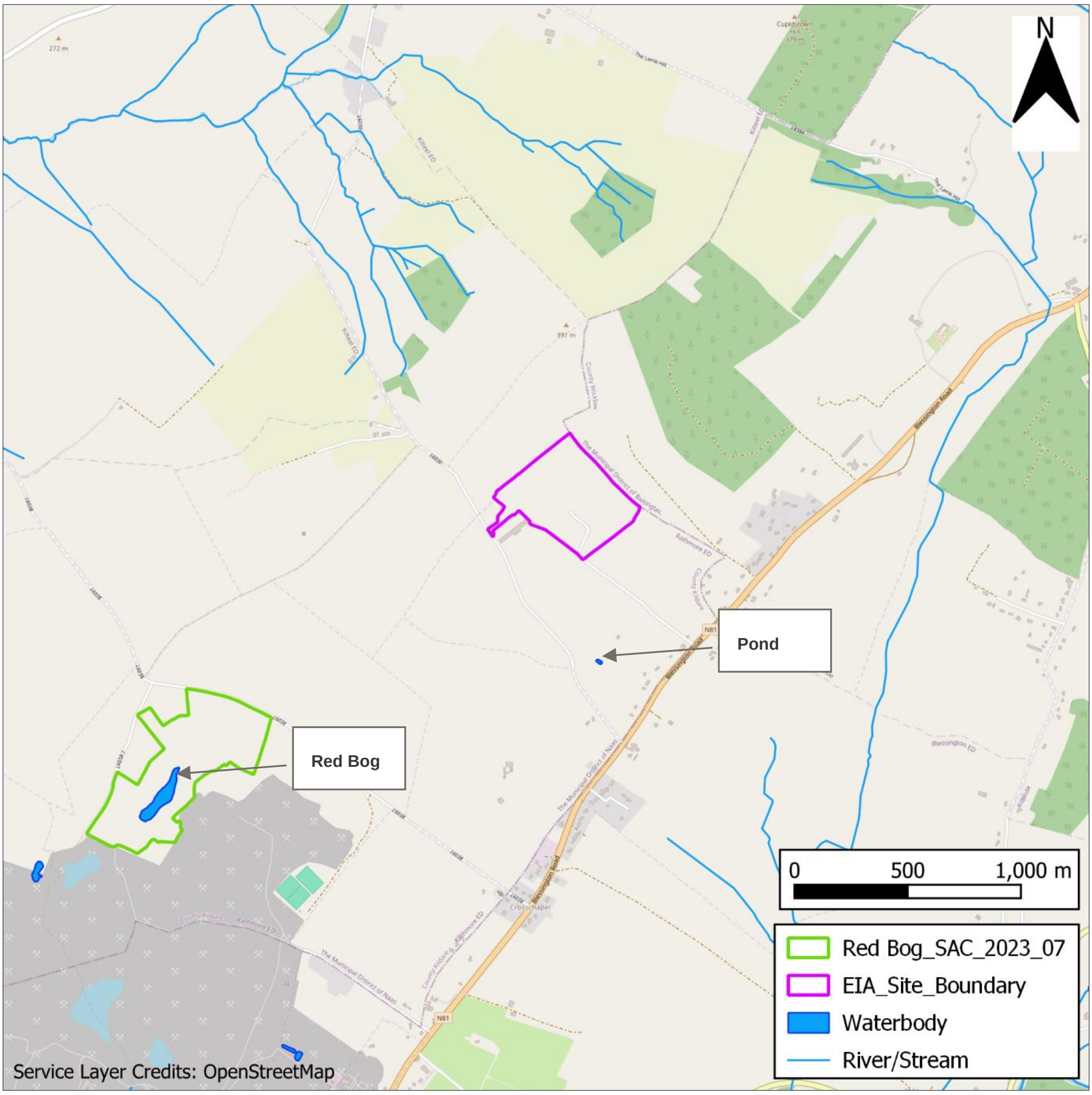

Figure 6-9 - Local Surface Water Bodies and River Network in the Vicinity of the Site

6.4.6.2 Site Surface Water

Available aerial imagery from baseline (June 2019) and over the review period is presented in Figure 6-10 and shows the changing nature of the quarry sump in the base of the quarry and the soakaway ponds to the south of the Site.

Figure 6-10 - Site Aerials with Surface Water in June 2019, June 2020, March 2022 and September 2023 (Images from Google Earth and site surveys)

Prior to the review period, a small settlement pond (approximately 50x20 m) existed to the south of the Site. This soakaway pond was infilled by January 2020 and moved approximately 50 m northwest to its current location (June 2020 image), adjacent to the southwest trending track on the Site boundary. The current small soakaway pond is of similar dimensions but 1 to 2 m deeper than the infilled pond. The small soakaway is filled with discharge water in the March 2022 aerial, with an increased volume of water in the base of the quarry. By the September 2023 aerial, there has been the construction of a large 2nd soakaway north of the small soakaway. This large soakaway measures approximately 60x30 m and approximately 20 m deep. Both ponds are currently utilised (with the small soakaway acting as an overflow) indicating increased volumes of dewatering over the reporting period. The decreased size of the quarry sump is accounted for by the increased volume of water in the soakaway ponds in the 2023 aerial.

Neither of the current soakaway ponds are lined and are both embedded into the bedrock. See Section 6.4.11.2 for a cross section through the soakaway ponds using the September 2023 surveyed ground surface.

6.4.6.3 Local Surface Water Quality

The local surface water quality through the review period has been derived using publicly available data from the EPA Geo Portal website.

The WFD Status (2013-2018) and latest (2023) River Quality (Q) Values of surface water features in the vicinity of the Site, as assigned by the EPA, are shown in Figure 6-11 and summarised in Table 6-6.

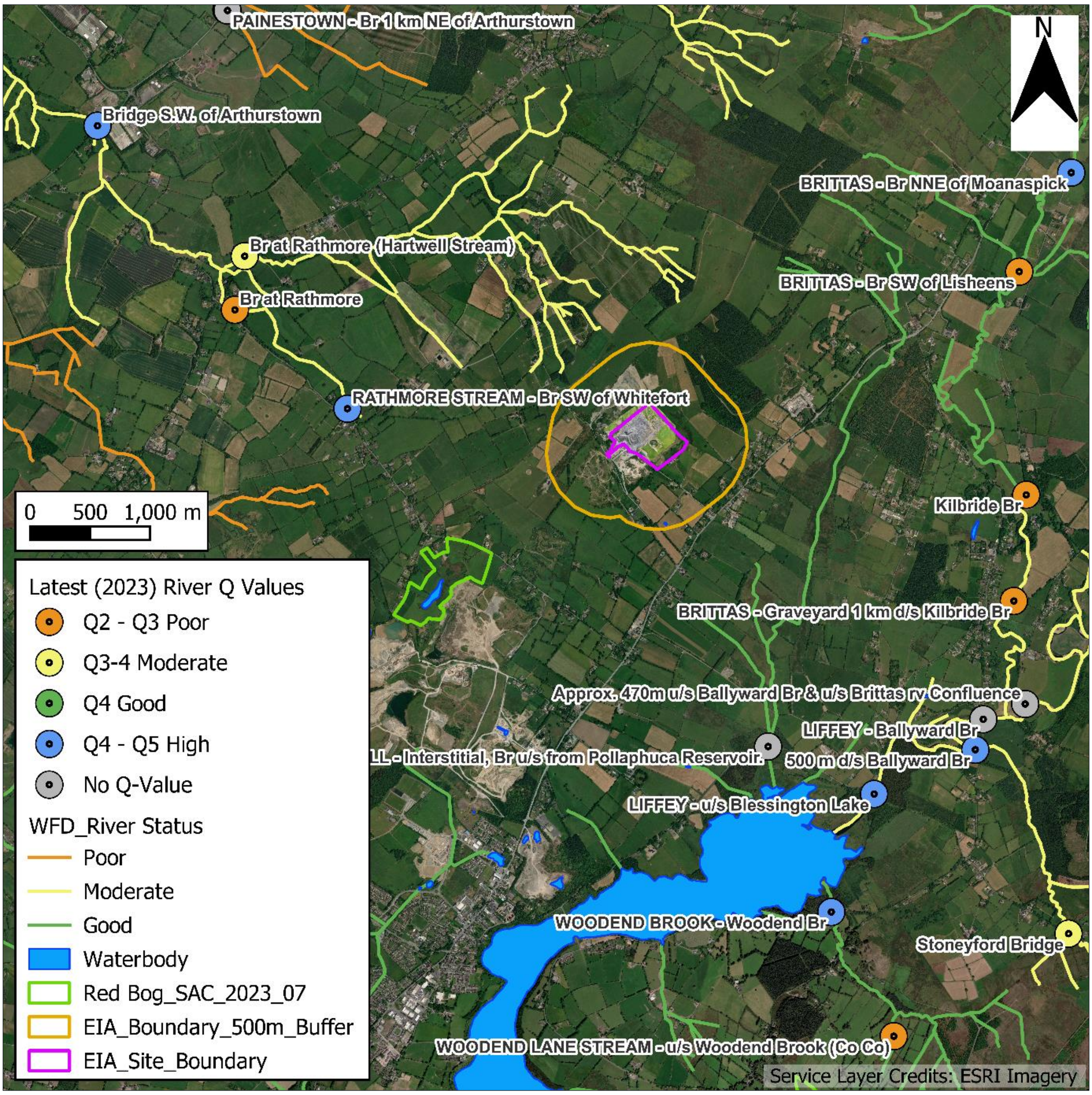

Figure 6-11 - Local River WFD Status (2016-2021), EPA River Quality Values and EPA Monitoring Stations (after EPA, 2023)

Table 6-6 - Summary of WFD Status and Latest River Q Value in Surface Water Features Close to Site (EPA, 2023)

River Name	WFD Status (2016-2021)	Station Name	River Q Value (year recorded)
Goldenhill_010	Good	Goldenhill - Interstitial, Br u/s from Pollaphuca Reservoir.	No Q-Value (N/A)
Rathmore Stream_010	Moderate	Rathmore Stream - Br SW of Whitefort	4 - Good (2023)
Rathmore Stream_010	Moderate	Br at Rathmore	3 - Poor (2023)
Rathmore Stream_010	Moderate	Br at Rathmore (Hartwell Stream)	3-4 - Moderate (2023)

To the southeast of the Site, the Goldenhill river is classified as ‘good’ under the WFD (2016-2021) Status. There is not, however, a River Quality (Q) status available from the associated EPA monitoring station.

To the north of the Site, the Rathmore Stream (which is a tributary of River Morell), is classified as ‘moderate’, which is an improvement on the 2013-2018 status of ‘poor’. The most recent River Quality (Q) status varies between Q3 ‘poor’ and Q4 ‘good’ for the tributaries of the Rathmore Stream. These indicate a slight reduction in quality since 2022 (Br at Rathmore (Hartwell Stream) of Q4). Note, however, that activities at the Site are highly unlikely to impact these streams due to the presence of a catchment and groundwater divide.

The latest ecological status of the Pollaphuca Reservoir (waterbody code; IE_EA_09_71) is given as ‘Good’ from the WFD 2016-2021 status.

6.4.6.4 Site Surface Water Quality

The water quality in the large soakaway pond has not been monitored historically. Samples were therefore collected and analysed from the large soakaway pond (SW01) in August, September and October 2024.

Details of the locations of the monitored soakaway pond is given in Table 6-7 and presented on the September 2023 aerial in Figure 6-12.

Table 6-7 – Surface Water Locations

Surface Water ID	Easting	Northing
SW01	699465.53	718328.21

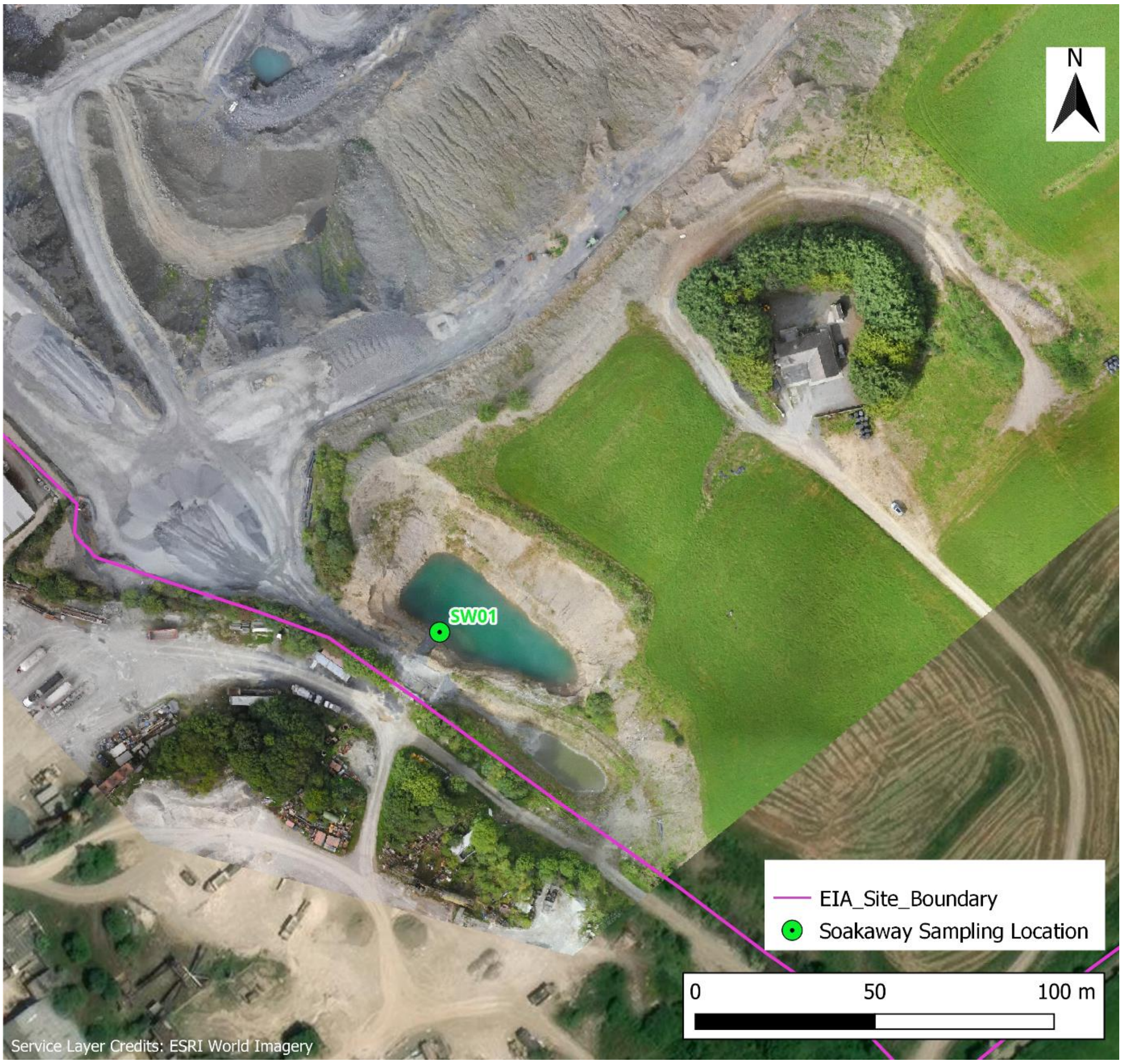

Figure 6-12 - Surface Water Monitoring Locations - Artificial Ponds

Laboratory Water Quality Results

Full laboratory results are presented in Appendix 6C (Table C6-1 to Table AC-9), which includes results from November 2019 from the 2019 EIA (Table 6C-1), prior to the review period for completeness. Table A6-9 includes an additional sample round collected for SW01 in October 2024. The laboratory certificates for the results are included in Appendix 6D.

The laboratory results for the soakaway pond (SW01) were screened against GTV (2016) and AA-EQS (2019) thresholds.

Nitrate in SW01 exceeds the GTV in August 2024 (38.6 mg/l) and exceeds both the GTV and AA-EQS in September 2024 (50.2 mg/l). Nitrite in SW01 exceeds both the AA-EQS and GTV in August 2024 (1.59 mg/l) and September 2024 (1.23 mg/l). Nitrate and nitrite are not recorded above 25.2 mg/l or 0.2 mg/l, respectively, in the groundwater monitoring bores (GW2, GW3, GW4 and Wheelwash), targeting the deep shale bedrock adjacent to the quarry (see Section 6.4.10.1). The source of the nitrate and nitrate is therefore unlikely to be from the groundwater seepage pumped from the base of the quarry. The large soakaway pond is adjacent to farmed land (based on evidence from aerials in Figure 6-10). The source of the nitrate and nitrite is therefore likely to be from agricultural processes and run-off from the farmed fields. The nitrate and nitrite fall back below the relevant GTV and AA-EQS threshold in October 2024.

Arsenic in SW01 exceeds the GTV and AA-EQS in August 2024 (50.2 ug/l), September 2024 (51.9 ug/l) and October 2024 (82 ug/l). The exceedances for arsenic indicate that there are elevated natural levels in the seepage collecting in the quarry void, which are then transferred to the soakaway pond (SW01). This is supported by elevated arsenic levels in the groundwater in GW04 (see Section 6.4.10.1). There are only 3 months in which water quality has been tested at these locations. It cannot therefore be confirmed if this is a rising, stable or falling trend. A full year of monitoring is required to be able to comment on the annual average against the AA-EQS standard and comment on any seasonal trends (it is anticipated that arsenic concentration would fall following periods of heavy rainfall, when the seepage pumped from the base of the quarry is diluted with rainwater). The presence of arsenic in the groundwater and environment is discussed further below.

Table 6-8 – Summary of Surface Water Screening Exceedances over the Reporting Period

Parameter	Units	GTV	AA-EQS	SW01		
				Aug-24	Sep-24	Oct-24
Nitrate as NO_3	mg/l	**37.5**	**50**	**38.6**	**50.2**	34.6
Nitrite as NO_2	mg/l	**0.375**	**0.2**	**1.59**	**1.23**	0.14
Arsenic	µg/l	**7.5**	**50**	**50.2**	**51.9**	**82**

Naturally Occurring Arsenic in the Kilcullen Group

Arsenic can be found almost ubiquitously in the environment at natural (geogenic) baseline concentrations (Smedley & Kinniburgh, 2002). In Ireland, elevated groundwater arsenic concentrations have been found to be associated with poorly productive greywacke or shale bedrock aquifers (McGrory et al., 2017), similar to the Pollaphuca Formation and wider Kilcullen Group units in the study area.

Russell (2020) found geogenic arsenic contamination in private water supplies up to 871 µg/L in tap water samples sourced from private wells in an area approximately 5 km to the north of the quarry site, in the area surrounding Slievethoul. Samples collected directly from the wells with low-flow sampling techniques reached up to 69 µg/L, and surface water samples collected in streams draining off Slievethoul had concentrations up to 84.7 µg/L.

The source of the arsenic was found to arise from the presence of naturally occurring arsenopyrite associated with quartz veins cutting through the local greywacke Pollaphuca Formation. Oxidation of the arsenopyrite either from surface exposure or groundwater interactions leads to arsenic dissolving into the waters with which the arsenopyrite is in contact. In some locations this may lead to elevated arsenic concentrations in waters.

Russell (2020) also notes the presence of high arsenic in natural stream sediment samples collected by the Geological Survey Ireland's (GSI) Tellus project (GSI, 2024) in the nearby vicinity. Elevated arsenic concentrations up to 217 mg/kg are recorded in stream sediments feeding into the River

Camac, near Gortnum Cottages, approximately 5 km to the southeast of the Quarry. For context, Smedley and Kinniburgh (2002) suggest global averages of arsenic in stream sediments to be in the range of 2 to 8 mg/kg.

Four soil samples collected as part of the SURGE soil sampling (GSI, 2023), between the Site and Rathcoole village (c. 2.5 km), have concentrations of 55.7 mg/kg (Sample 4357), 26.70 mg/kg (Sample 4358), 42.70 mg/kg (Sample 4360), and 38.80 mg/kg (Sample 4359). Baseline arsenic concentrations in soils are generally between 5 to 10 mg/kg (Smedley & Kinniburgh, 2002). Arsenic concentrations are therefore considered to be naturally elevated in the area.

The elevated arsenic concentrations are therefore interpreted by WSP to be naturally occurring rather than related to processes or facilities at the site.

6.4.7 GROUNDWATER – HYDROGEOLOGY

Based on a review of borehole logs (0) and published information, it is understood that two hydrogeological units underlie the Site; permeable sands and gravels - Locally important aquifer - Lg; and underlying low permeability greywackes and shales of the Pollaphuca Formation - Poor aquifer - PI. The GSI aquifer designation (GSI, 2023) for the sand and gravel and bedrock aquifers underlying the Site is shown in Figure 6-13 below.

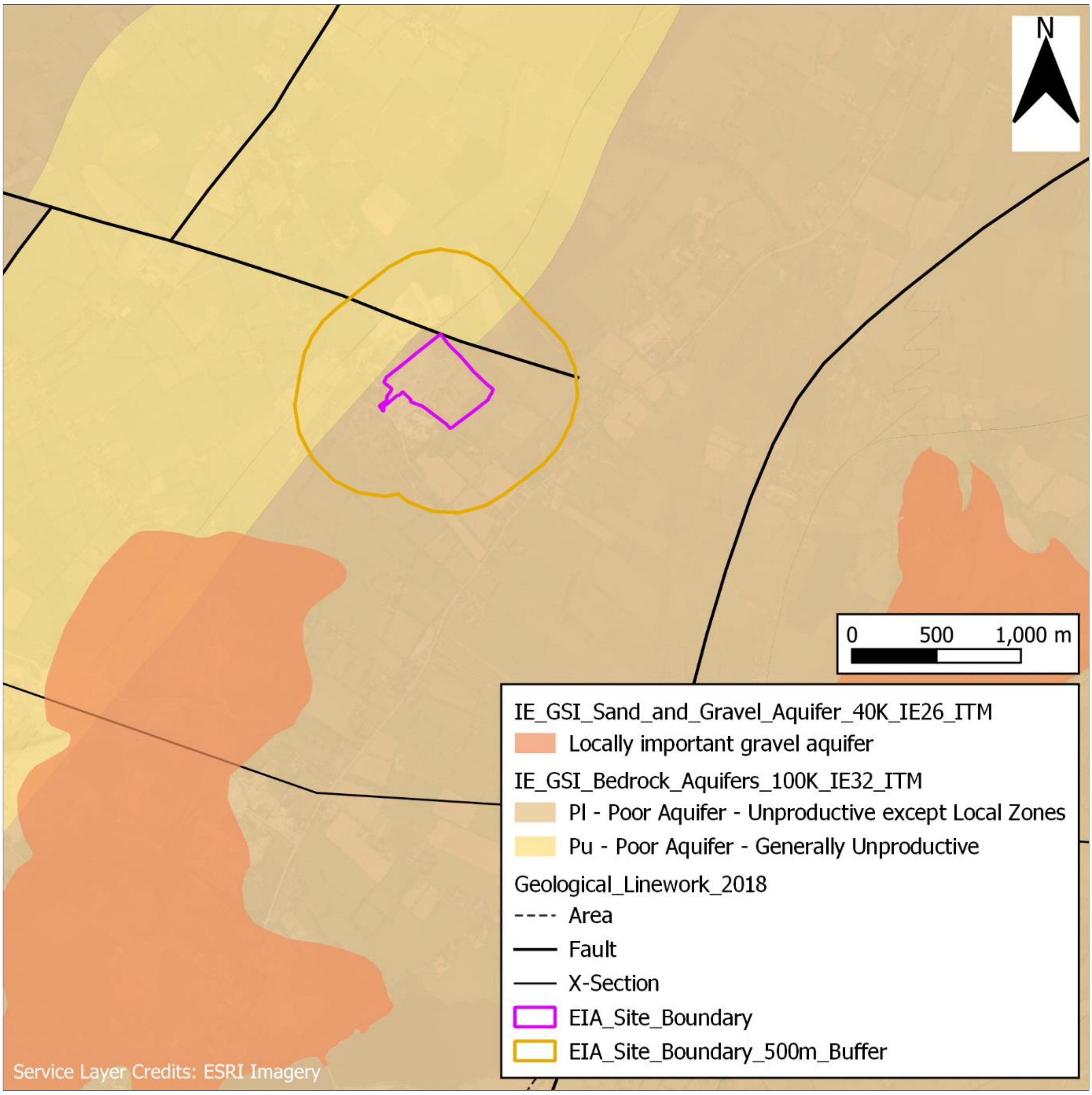

Figure 6-13 - Aquifer Designation Map (GSI, 2023)

Sand and Gravel Aquifer

The sands and gravels underlying the footprint of the Site (where present) are not designated as an aquifer due to the thin nature of the deposits (<10 m thickness). The Blessington Gravels have been classified as a locally important sand and gravel aquifer (Lg) (GSI, 2023) (Figure 6-13). The Blessington Gravels are not, however, mapped beneath the Site and are mapped 908 m south of the Site at their closest. Based on the borehole logs, the sands and gravels beneath the Site are between 4.2 and 9 m thick and are therefore unlikely to support the vertical saturated thickness of 5 m, which would designate them as an aquifer. This is supported by drilling records (from GW5) that did not intercept groundwater until drilling 6 m past the sand and gravels into the shale bedrock.

Bedrock Aquifer

Bedrock underlying the Site (the Pollaphuca Formation) is classified as a ‘Pl’ poor aquifer, which is described as “generally unproductive except for local zones”. The bedrock to the immediate north and west of the Site is classified as a ‘Pu’ poor aquifer, which is described as “generally unproductive” without the localised zones of increased permeability / water bearing potential of the Pollaphuca Formation.

Estimated values for hydraulic conductivity bedrock geology in the area are given in Driscoll (1986), with the hydraulic conductivity for shale summarised in Table 6-9 below.

Table 6-9 – Hydraulic conductivity values (Driscol, 1986)

Rock Type	Hydraulic Conductivity Ranges	
	Minimum	Maximum
Shale	1.00x10^{-9} m/d	1.00x10^{-4} m/d
	1.16x10^{-14} m/s	1.16x10^{-9} m/s

Groundwater Vulnerability

Groundwater Vulnerability (DELG/EPA/GSI, 1999) defines how easily groundwater may be contaminated by human activities. According to the GSI online mapping tool (GSI, 2023) the footprint of the Site is classified as ‘High’ to ‘Extreme’ (Figure 6-14). This is appropriate given the thin nature of the sands and gravels overlying the bedrock greywacke and shale aquifer beneath the Site. The groundwater vulnerability classification has not taken into account the presence of bedrock now at the surface within the quarry void, with extraction.

The higher topographies to the northwest of the Site are characterised as having rock at or near the surface. This ridgeline forms the main areas of recharge for the bedrock aquifer (along weathered horizons) and the overlying sands and gravels, where they thinken into the valley to the south. An area of ‘low’ to ‘moderate’ aquifer vulnerability exists to the south-east of Site where low permeability till and lacustrine deposits offer increased protection (see Chapter 5 of this EIAR for further information on soils and geology).

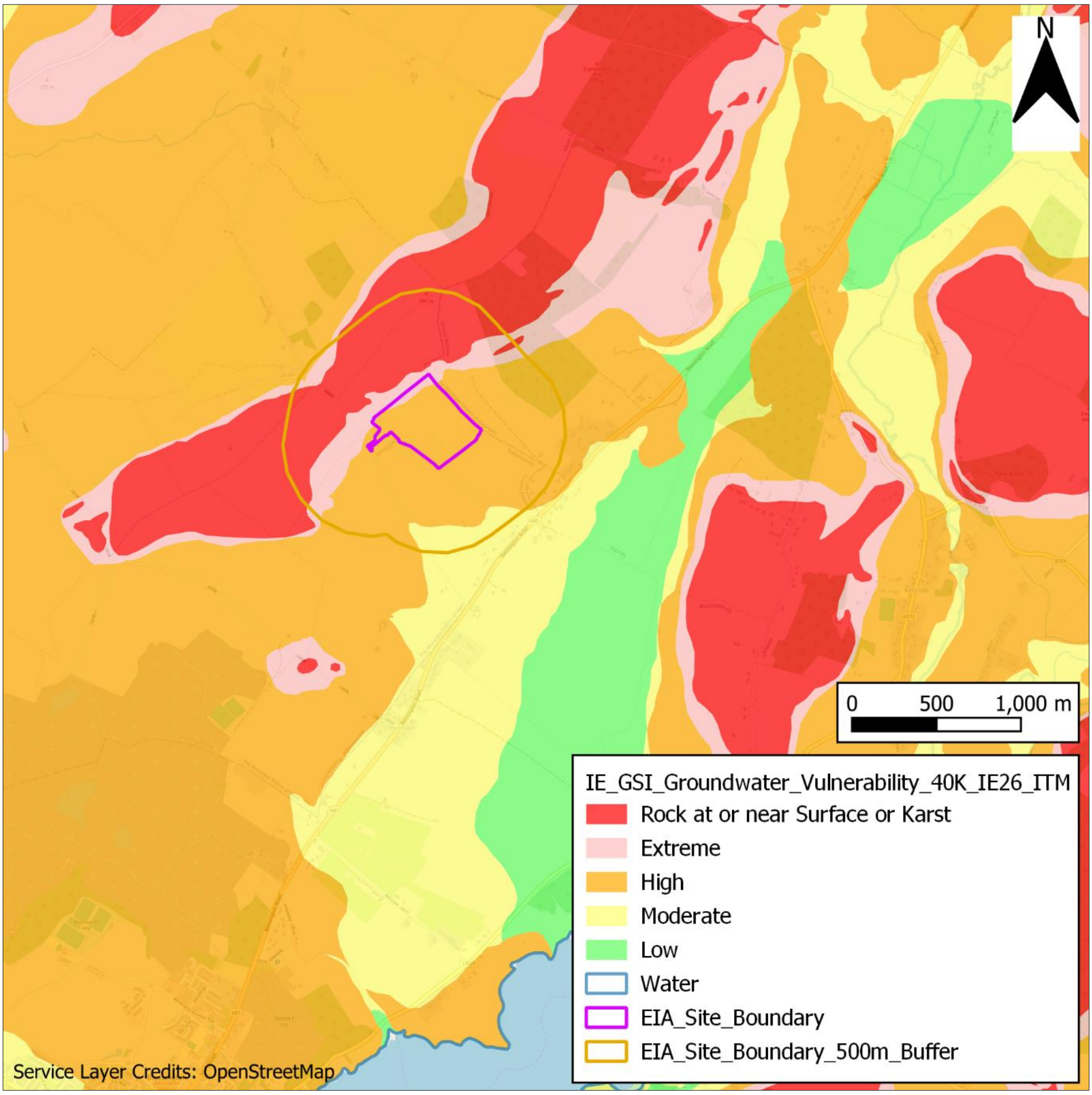

Figure 6-14 - Groundwater Vulnerability Map (GSI, 2023)

Groundwater Recharge

The groundwater recharge map for the Site is presented in Figure 6-15. GSI mapping (2023) indicates an effective rainfall of approximately 543 mm/year across the majority of the Site, with a smaller eastern portion of the Site estimated to receive approximately 922 mm/year effective rainfall. Soils and subsoils under the Site are classified by the GSI website as being high permeability and well drained, with a potential recharge coefficient of 85%. However, the ability of the underlying bedrock aquifer to accept all available groundwater recharge is considered to be low. The groundwater recharge map therefore presents a maximum estimated recharge to bedrock of 100 mm/year (Figure 6-15).

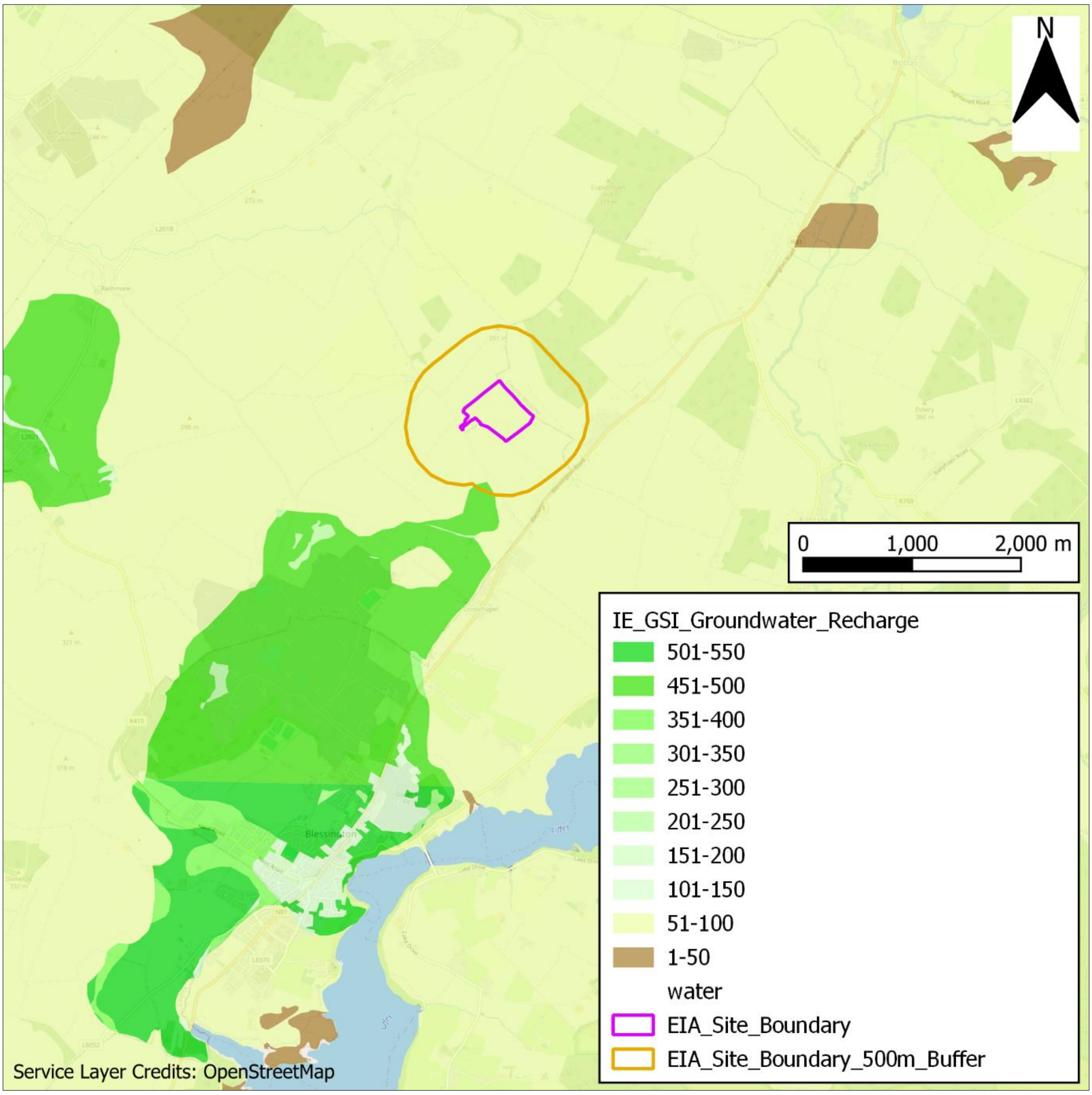

Figure 6-15 - Groundwater Recharge Map (GSI, 2023)

6.4.8 GROUNDWATER ELEVATION INVESTIGATIONS

There have previously been five existing monitoring wells reported (GW1 to GW5). Since then, the Wheelwash borehole has been incorporated into the monitoring schedule, with water levels and quality taken (from June 2024 and August 2024 respectively).

The locations of the existing monitoring wells are presented in Figure 6-16 and Table 6-10, with details on construction and lithology are provided in Table 6-11, where available. Note that there is limited information on construction and lithology for a number of wells due to detailed borehole logs not being available. The borehole logs are provided in Appendix 6B.

The depth of the water strikes for available monitoring wells (GW4 and GW5) show that the main aquifer beneath the Site is within the bedrock rather than the superficial sand and gravels.

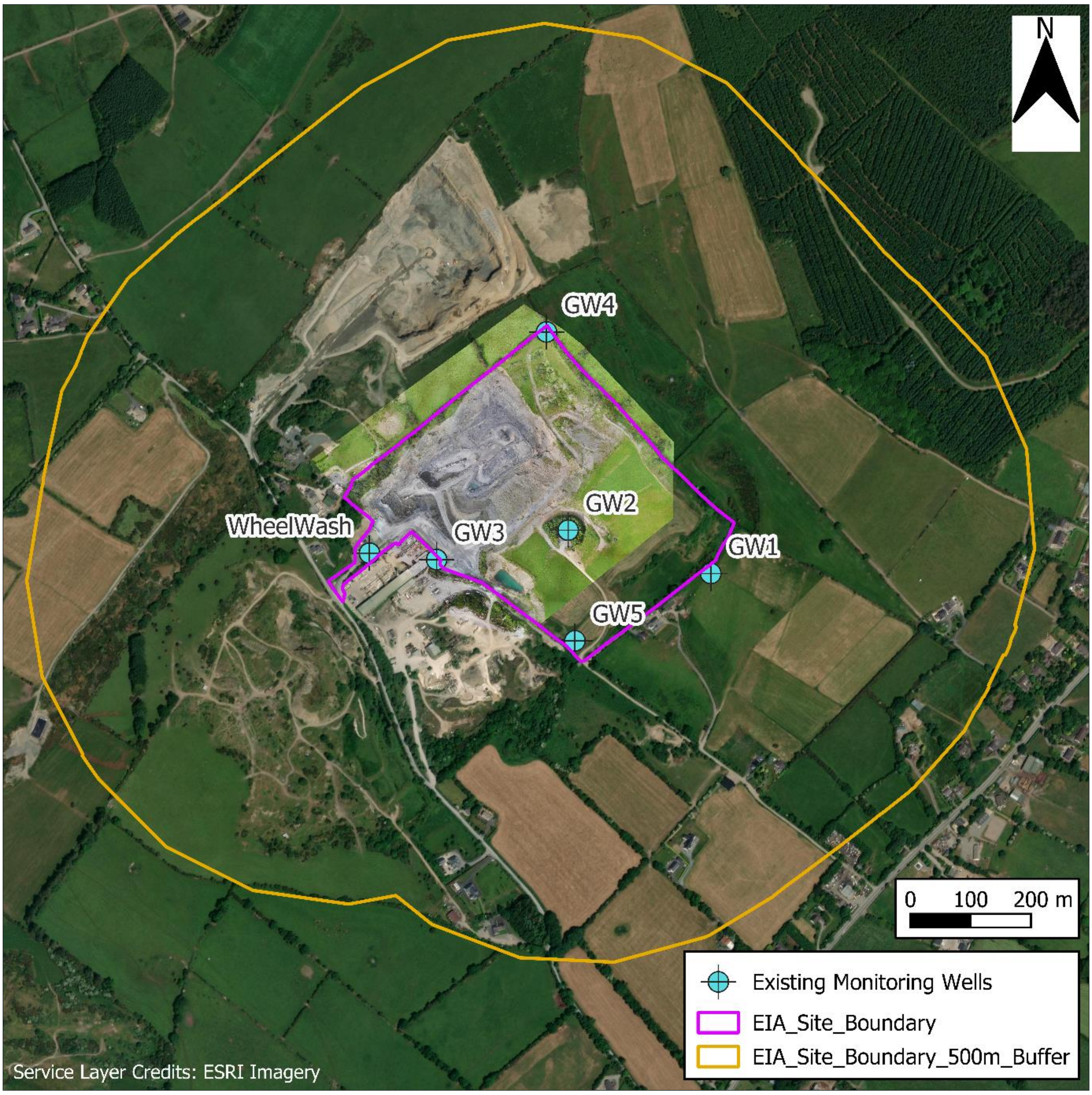

Figure 6-16 - Monitoring Well Locations

Table 6-10 – Monitoring Well Locations

Monitoring Well ID	Easting	Northing	Elevation (m AOD)
GW1	699813.2	718350.2	240.98
GW2	699575.0	718417.0	259.00
GW3	699357.9	718363.7	248.51
GW4	699532.3	718744.2	297.00
GW5	699590.1	718234.2	234.08
Wheelwash	699246.3	718372.1	253.05

Table 6-11 – Monitoring Well Construction and Lithology

Monitoring Well ID	Installed Depth (m)[1]	Measured Depth Range (m)[2]	First Water Strike Depth (m)	Screened Interval (m)	Lithology Interval Summary (m)
GW1	37.0	6.29 - 35.2	-	-	-
GW2	-	17.92 – 49.68	-	-	-
GW3	100.0	13.65 – 44.6	-	-	-
GW4	75	76.91 - 77.43	22.4 (274.6 m AOD)		0.0 – 1.2 Overburden (Made Ground) 1.2 – 5.4 Sands & Gravels 5.4 – 7.0 Weathered Shale 7.0 – 23.2 Blue/Brown Shale 23.2 – 75.0 Blue/Grey Shale
GW5	15.0	20.86 – 21.27	15 (219.08 m AOD)		0.0 - 3.5 Overburden (Clay) 3.5 - 9 Sands & Gravels 9 - 15 Brown Shale
Wheelwash	73.0	-	-	-	-

[1] Installed depth from borehole log

[2] Depth to base as a range from groundwater monitoring rounds between July 2020 and September 2024

6.4.8.1 2020-2024 Groundwater Elevations

Manual groundwater elevations in Metres Above Ordnance Datum (m AOD) over the review period are displayed in Figure 6-17 for the monitoring wells shown in Figure 6-16. There are noticeable gaps in the recording frequency of water levels. Between October 2020 and February 2022 this is understood to be in relation to the restrictions as a result of the Covid pandemic.

Water levels remain relatively stable throughout the review period, which is reflective of the locally productive and isolated nature of the groundwater within fractures and seams of the bedrock greywacke and shale. There are small water level rises noted in all monitoring wells in response to rainfall events. In response to the rainfall event in July 2023 of 179.3 mm, water levels rose between 1.1 m (GW5) and 3.1 m (GW4). GW5 is the southernmost well and GW4 is the northernmost well at the Site. It is understood that the superficial sand and gravels are thinnest at GW4 and thickest at GW5, moving downslope into the valley. A thinner layer of sand and gravel therefore results in a flashy response with direct rainfall recharge (GW4) to the bedrock aquifer. A thicker layer of sand and gravel (GW5) appears to result in a more muted recharge to the underlying bedrock aquifer, with more recharge being stored in the superficial deposits. It is likely that clay or silt within the sand and gravel unit helps to retain the meteoric recharge and inhibit vertical recharge to the underlying bedrock.

There is some indication of a decline in groundwater levels in GW2, GW3, GW4 and GW5 between October 2023 and October 2024. Rainfall data indicates that there weren't any months with totals over 120 mm during this period. Prior to the period there were three months with rainfall totals over 160 mm (July to October 2023). The drier than normal period (October 2023 and October 2024) could be responsible for the consistent water level decline across the monitoring wells.

The groundwater elevations in GW4 are approximately 15 m above the first water strike elevation observed with drilling (see Table 6-11). This indicates that the groundwater within the shale bedrock (in GW4) is under pressure within isolated fractures, which supports the aquifer description of there being local productive zones.

The water level records show no obvious declining trend in response to the seepages observed in the pit walls and associated dewatering from the quarry sump. For example, the lowest groundwater elevation in GW4 is 285 m AOD and the current base of the quarry is approximately 207.55 m AOD (September 2023) giving a difference of 77.45 m. It is likely that the seepage rates and volumes are so low that the response cannot be seen clearly in the water levels, due to a limited connectivity between the quarry void and the monitoring wells, through discontinuous fractures and joins.

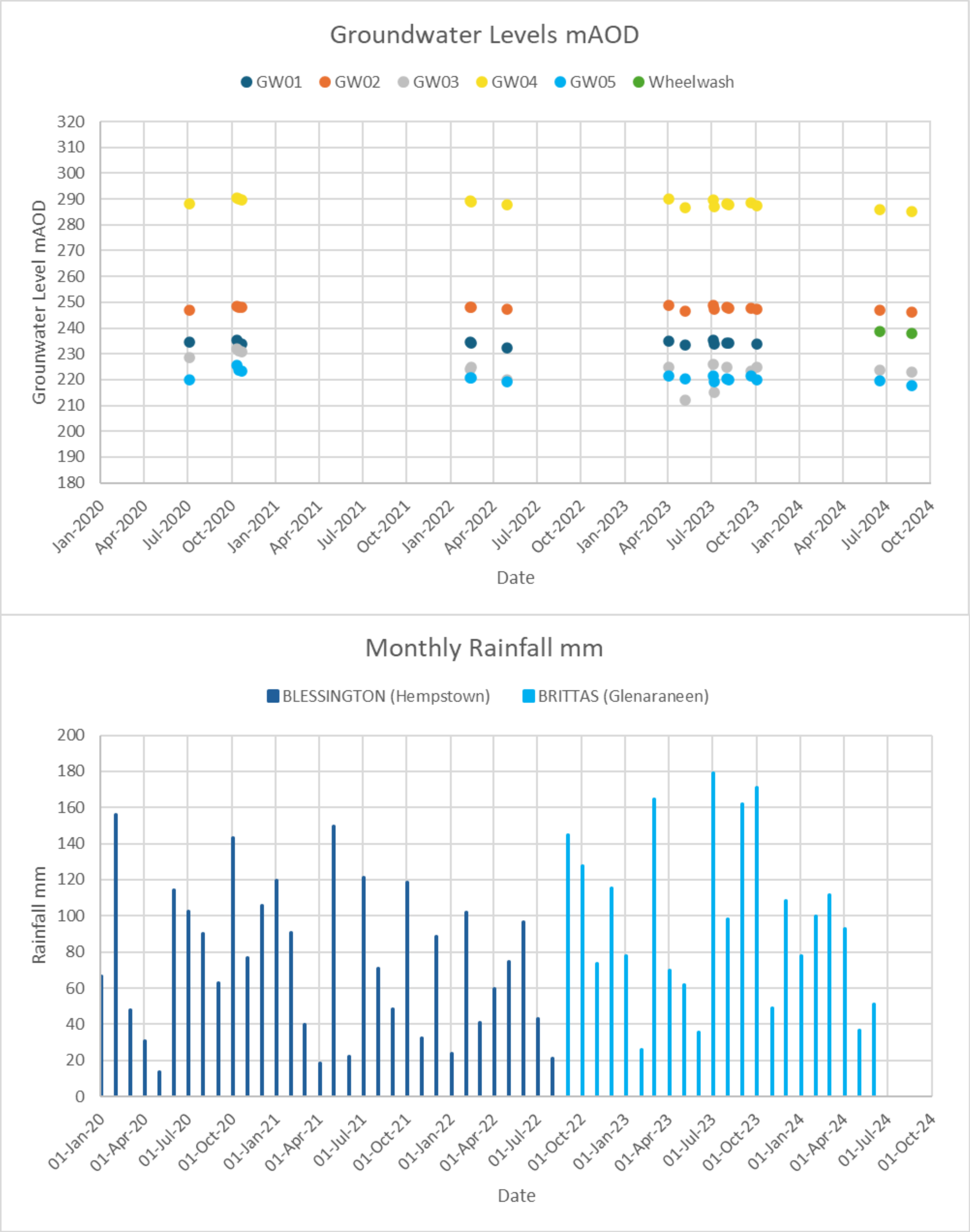

Figure 6-17 - Groundwater Elevations Over Period 2020-2024

Groundwater Contours

Groundwater contours generated for October 2023 indicate that groundwater movement is in a southerly direction across the Site (Figure 6-18), following topography. The groundwater contours confirm that recharge to the bedrock occurs to the north of the Site, likely in the vicinity of Cupidstown Hill. The deviation in the 230 m contour around Wheelwash and GW3 monitoring wells indicates a possible change to the natural flow regime with the presence of the quarry void. A comparison to the colour banded elevation in Figure 6-19 gives a clear representation of the close relationship between the topographical highs and areas of recharge and direction of flow.

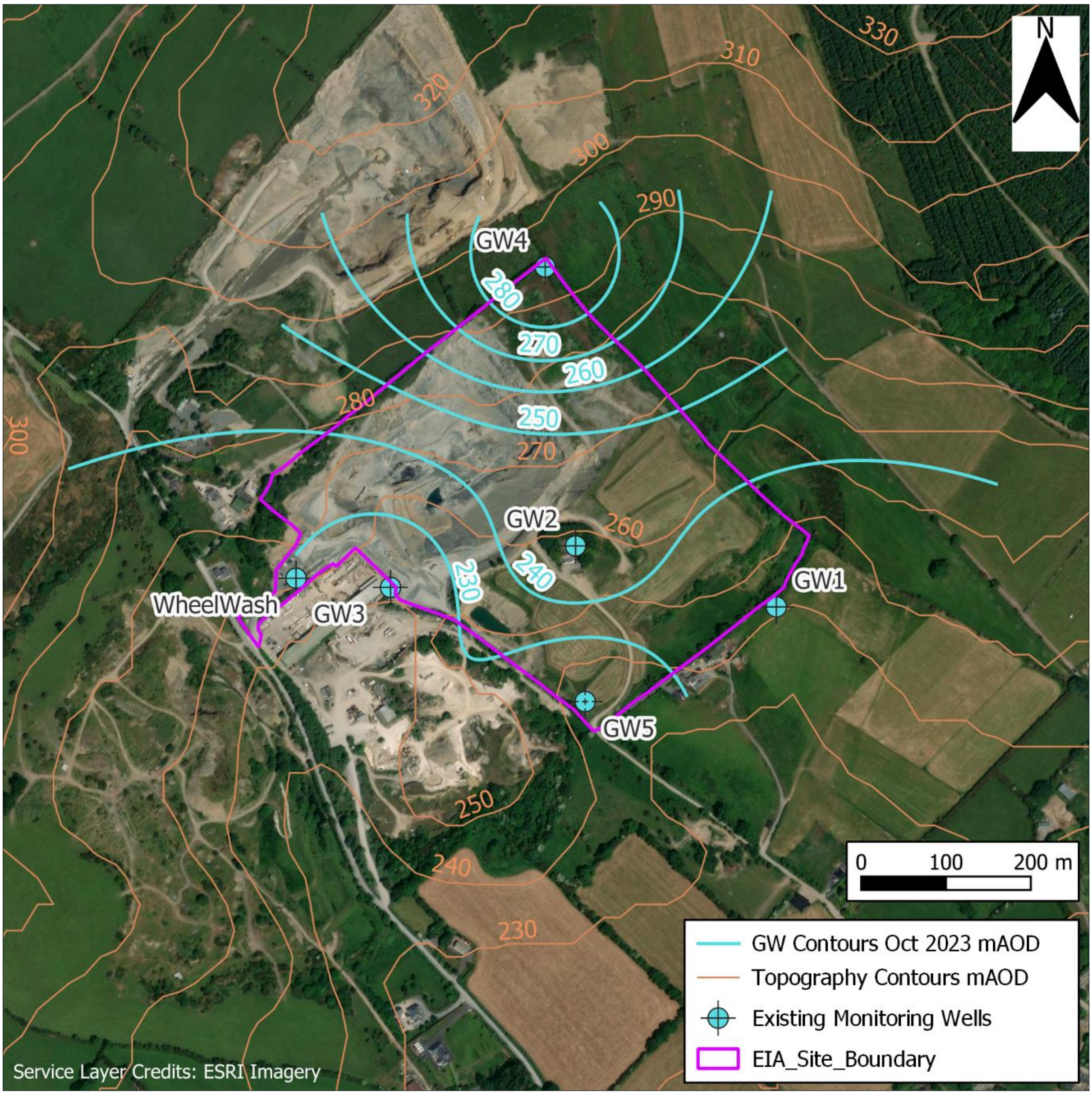

Figure 6-18 - Groundwater Contours October 2023 with aerial and Topography

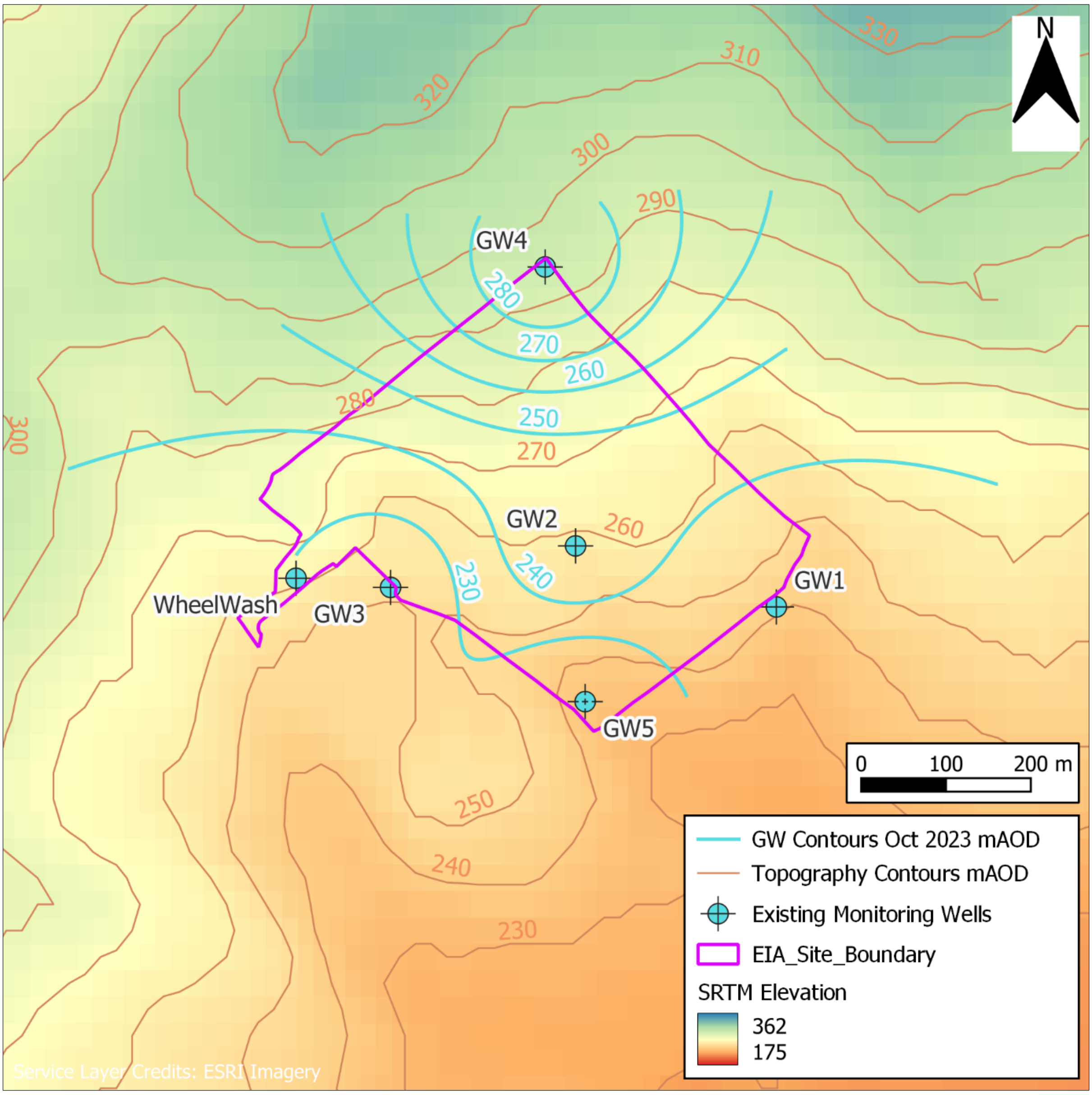

Figure 6-19 - Groundwater Contours October 2023 with Topography

6.4.9 LOCAL GROUNDWATER QUALITY

A total of six groundwater monitoring wells (Figure 6-16) are now used to monitor groundwater quality across the Site, compared to there being five at the start of the review period.

There was no water quality sampling conducted between December 2019 and October 2021. From 2022 to 2024, water quality sampling was conducted on a biannual basis. In 2024, samples were collected in August and September. Samples have been collected for all available monitoring wells. Samples were occasionally not possible (from GW1 in October 2022 and GW5 in August 2024) due to blockages or kinks in the well casing preventing equipment from reaching the water column.

A summary of laboratory results with reference to threshold values is presented in Table 6-12. Full laboratory results are presented in Appendix 6C from Table 6C-1 to Table 6C-8, with comparison to relevant threshold values (note that Table 6C-1 includes results from 2019 for reference). A number of key analytes are shown graphically in Figure 6C-1 to represent long term trends relative to the threshold values. The laboratory certificates for the results are included in Appendix 6D.

6.4.9.1 Laboratory Water Quality

The laboratory results for groundwater were screened against GTV and AA-EQS thresholds. A summary of the screening exceedances is presented below in Table 6-12.

The GTV threshold for arsenic (7.5 µg/l) was exceeded on four occasions in the sample from GW4 (7.8, 7.8, 7.9 and 15.2 µg/l) and on two occasions in the sample from Wheelwash (9.5 and 12.6 µg/l). Elevated arsenic concentrations are interpreted by WSP to be naturally occurring rather than related to plant or facilities at the Site. Arsenic is not utilised on site in reagents or for inputs to plant site processes.

Arsenic is often naturally elevated in groundwater hosted in greywacke or shales, with poorly productive bedrock having increased probability of higher concentrations (McGrory et al., 2017). The arsenic concentrations in GW4 and Wheelwash both rise in the September 2024 samples, which may be representative of reduced meteoric recharge (following an observed dry period) and reduced dilution of the arsenic within the groundwater. The naturally elevated arsenic in GW4 and Wheelwash suggests the likely source of the elevated arsenic in the soakaway pond (SW01) as discussed in Section 6.4.7.4.

The AA-EQS threshold (100 µg/l) for barium was exceeded on five occasions in the sample from GW4 (104, 208, 185, 191 and 208 µg/l) and on two occasions in the sample from Wheelwash (126 and 123 µg/l).

Elevated barium concentrations are consistent with the elevated arsenic concentrations and are again understood to be naturally occurring rather than related to plant or facilities at the Site. The graph for barium (Figure 6A-1) shows that the long-term trend for most of the monitoring location is stable. Only GW4 shows the rising trend. GW4 is up hydraulic gradient from the quarry void (see Figure 6-18). Changes in groundwater chemistry in GW4 are therefore most likely to be in response to groundwater inputs north of the Site.

There is a single AA-EQS (30 µg/l) exceedance of copper in GW2 of 32 µg/l.

The GTV threshold (7.5 µg/l) and AA-EQS threshold (10 µg/l) for lead was exceeded at GW5 with values of 25, 9 and 12 µg/l (in April 2022, March 2023 and September 2023). This doesn’t appear to be part of a long-term trend, since levels reduced to below detection in 2024. GW5 borders the neighbouring fabrication site. It is unknown whether lead is used in the fabrication process at this site.

The GTV threshold (75 µg/l) for zinc was exceeded in both GW1 (83 µg/l) and GW2 (90 µg/l) on a single occasion (in September 2024 and August 2024 respectively).

Nitrate as NO_3 exceeded the GTV threshold (37.5 mg/l) in both GW1 (38.3 mg/l in October 2022) and GW5 (47.8 mg/l in August 2024) and exceeded the AA-EQS threshold (50 mg/l) in GW5 in September 2023 (66.3 mg/l) and September 2024 (51.1 mg/l). Higher nitrate levels are consistently seen in monitoring locations south of the Site, near areas of farmed land (see graph in Figure A6-1 and land changes in Figure 6-10). This indicates that elevated nitrate may be caused by off-Site activities, such as applying fertiliser to agricultural land.

Table 6-12 – Summary of Groundwater Screening Exceedances over the Reporting Period

Analyte	Units	GTV	AA-EQS	GW1		GW2		GW4							GW5					Wheelwash	
				Oct-22	Sep-24	Sep-23	Aug-24	Dec-21	Apr-22	Oct-22	Mar-23	Sep-23	Aug-24	Sep-24	Apr-22	Mar-23	Sep-23	Aug-24	Sep-24	Aug-24	Sep-24
Arsenic	µg/l	7.5	50	-	-	-	-	-	-	7.8	-	7.8	7.9	15.2	-	-	-	-	-	9.5	12.6
Barium	µg/l	-	100	-	-	-	-			104	208	185	191	208	-	-	-	-	-	126	123
Copper	µg/l	-	30	-	-	32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lead	µg/l	7.5	10	-	-	-	-	-	-	-	-	-	-	-	25	9	12	-	-	-	-
Zinc	µg/l	75	100	-	83	-	90	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate as NO_3	mg/l	37.5	50	38.3	-	-	-	-	-	-	-	-	-	-	-	-	66.3	47.8	51.1	-	-

12 Shaded background indicates both GTV and AA-EQS exceedance

6.4.10 DESIGNATED SITES

On a regional scale, GSI mapping (2023) indicates that there are no groundwater source protection zones within the Site boundary. The nearest groundwater source protection zones are located ca. 2.9 km to the north of Site for the Kilteel Group Water Scheme and ca. 3.5 km south of the Site for the Blessington Public Supply Scheme (Figure 6-20). The Blessington public supply is reported to be supported by both surface water (from the Poulaphouca Reservoir) and groundwater abstraction from the ‘Blessington Gravels’ groundwater body (GSI, 2003). The area of the Red Bog SAC is also presented in Figure 6-18 and located approximately 1.3 km to the southwest of the Site.

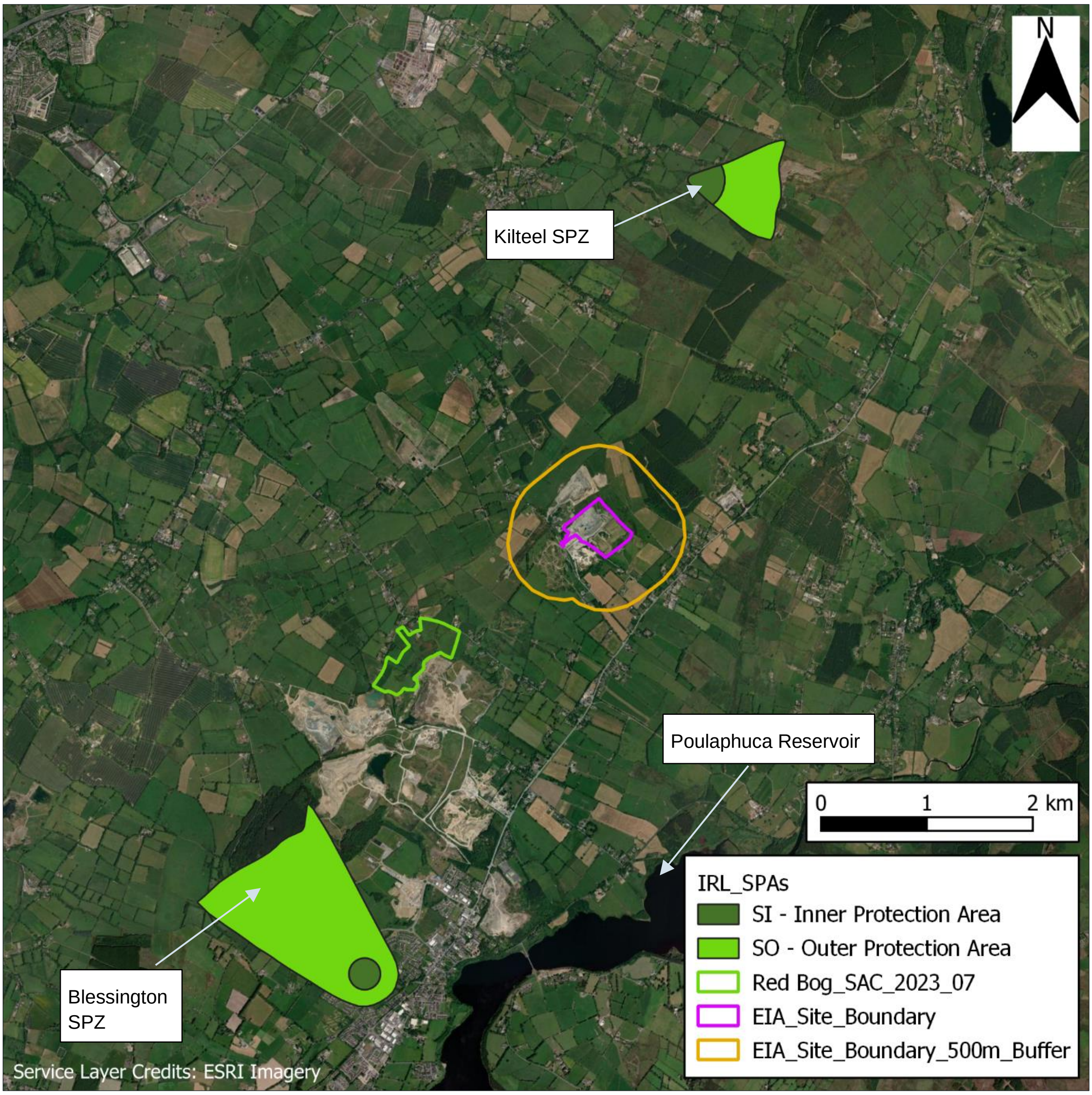

Figure 6-20 - Source Protection Zones (SPZ) near Site (GSI, 2023) and Red Bog SAC

6.4.10.1 Red Bog

A cross-section is presented in Figure 6-21 from the Red Bog surface water feature in the southwest to the location of the quarry void in the northeast. The subsurface geology is interpreted from surface mapping and an understanding of the regional orientation of the bedrock formations.

The quarry void is excavated into the Pollaphuca Formation beneath the Site and the Red Bog is situated over the younger Glen Ding Formation, which outcrops to the northwest of the Site. The Red Bog is understood to be a perched water feature, which is underlain by peat and the Blessington gravels aquifer. Layers of clay in the sand and gravels and the low permeability support this perched water feature, which responds to seasonal rainfall. The Blessington gravels are not mapped beneath the Site. The classification of the Red Bog being a perched water feature is supported by the elevation at which it is situated (~ 262 m AOD), compared to the groundwater in the vicinity of the Site (~238 m AOD at Wheelwash), which is a water level difference of 24 m at a similar surface elevation.

The topographical high with bedrock exposed at/near surface shown in Figure 6-21, between the Red Bog and the quarry void is likely to create a groundwater divide, with rainfall recharge either flowing southwest, into the sand and gravels and bedrock towards the Red Bog or flowing northeast into the sand and gravels and bedrock towards the quarry void.

The information gathered and interpreted in this conceptual section indicates that it is highly unlikely that there is any hydraulic connectivity between the quarry void and the Red Bog. The dewatering activities in the base of the quarry will therefore not impact quantity or quality of the water within Red Bog.

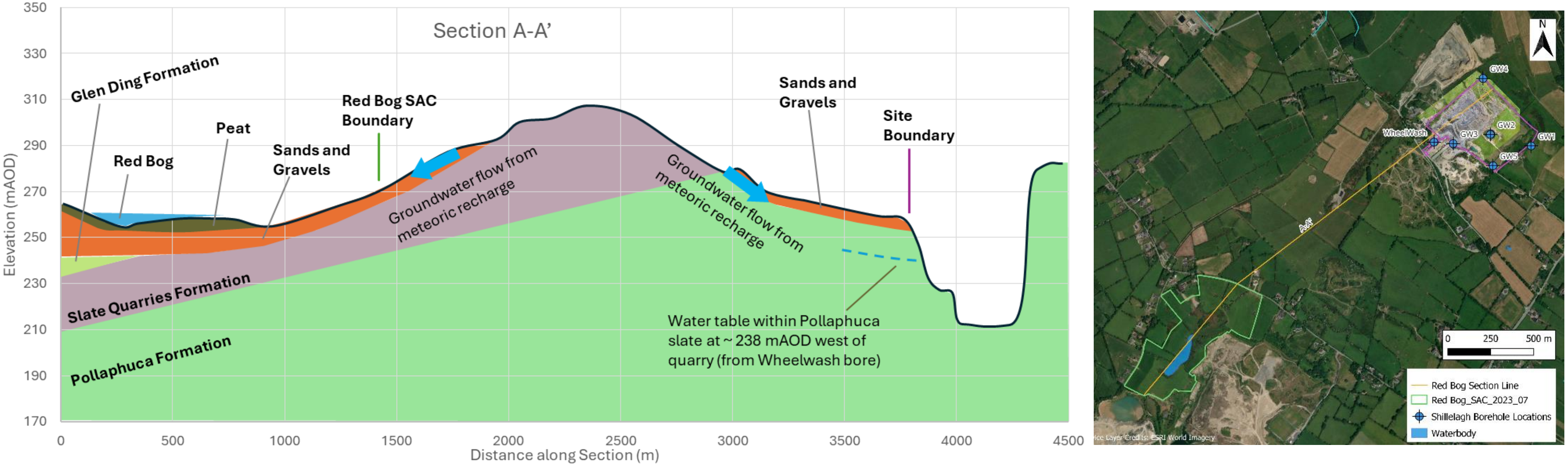

Figure 6-21 - Conceptual Section – Red Bog to Quarry Void

6.4.10.2 Poulaphouca Reservoir SPA

The Poulaphouca Reservoir SPA is located approximately 2.9 km south of the Site and is at a lower altitude. The Poulaphouca Reservoir is fed by a number of rivers. The Goldenhill river is the closest river to the Site that feeds the Poulaphouca Reservoir, being 1.13 km at the closest point (Figure 6-11).

A conceptual section through the Site (centre of quarry void, soakaway and overflow ponds) to the Goldenhill river is presented in Figure 6-22. This presents the nature of the topography and the geology between the Site and the Goldenhill river (and therefore the Poulaphouca Reservoir). The thickness of the superficial sand and gravels is shown to be approximately 9 m in the vicinity of the soakaway ponds (based on log from GW5). It is assumed that the sand and gravels thicken into the valley to the south, towards the Goldenhill river. It is also highly likely that the contact between the sand and gravels and underlying Pollaphuca Formation bedrock follows a similar southerly dip.

Based on correspondence with the Site Owner and presentation of survey data, it is understood that the soakaway pond and overflow pond are both dug down into the Pollaphuca Formation bedrock (as presented in) and that neither of the ponds are lined. It is understood that the current water level in these ponds does not rise above the top of the Pollaphuca Formation bedrock. The discharge water entering the soakaway and overflow ponds is therefore likely to infiltrate into the underlying bedrock shale aquifer, at a rate that is near equal to the dewatering rate (preventing the ponds from overtopping). This indicates that the top of the shale bedrock unit is more permeable (potentially due to increased jointing / weathering) allowing the water in the soakaway ponds to drain.

Based on the conceptual section, there would be a potential linkage between the soakaway and overflow ponds and the Goldenhill river, if the level in the ponds was to rise above the top of the Pollaphuca Formation bedrock, allowing flows either along the contact or within the overlying sand and gravel. The nature of the contact of the sand and gravels into the valley is not well known. It's possible that a high clay content in the sand and gravels or at the weathered contact could limit groundwater flow. It is currently not possible to monitor water levels or water quality within the sand and gravels south of the Site. Drilling on site has only intercepted a thin sand and gravel layer, which was not water bearing at the time of drilling.

Although it is understood that arsenic is ubiquitous in the area and present in river sediments, there is still a risk that activities at the Site, with dewatering, could contribute to increasing the levels in the local rivers and Poulaphouca Reservoir.

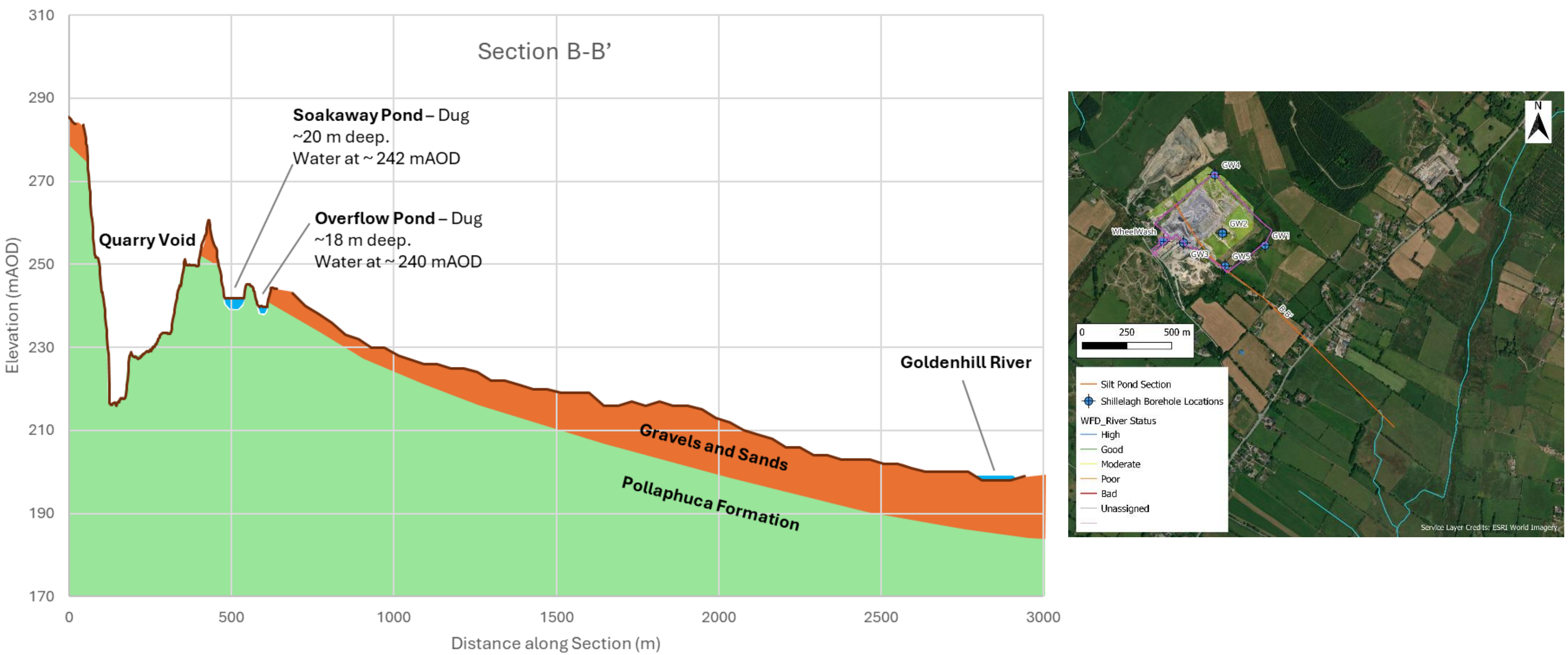

Figure 6-22 - Conceptual Section - Silt Pond to Goldenhill river

6.4.11 LOCAL WATER USERS

A well survey was carried out by SLR in June 2019 identifying a total of three abstraction wells within a radius of 0.5 km of the aggregate extraction area of the Site (GW1, GW2 and GW3) as previously presented in Figure 6-16 with borelogs in Appendix 6B. Two wells were identified as domestic supply wells; one (GW2) supplying the household located in the central portion of Site (within the Site boundary and owned by the Applicant) and the other (GW1) supplying a further household located immediately adjacent to the southeastern Site boundary. The third abstraction well (GW3) was identified as an abstraction well owned and operated by the concrete precast facility owned by Stresslite Flooring Ltd situated adjacent to the southwestern Site boundary. Further to this, the ‘Wheelwash’ borehole is periodically used to top up the Site Wheelwash facility. All of these locations were used to monitor water level and water quality over the review period. It is understood that there was no pump assembly noted installed in GW1, GW2 or GW3 and that these were not utilised for private supply over the review period.

The locations of other known private abstraction wells are presented in Figure 6-21 below, taken after the 2019 EIAR. The private abstraction wells presented and listed below were in use at the time of the BCL 2008 report, but their current status is unknown.

Abstraction wells noted in previous reporting (BCL, 2008):

- Cullen - located to the west of the Site, approximately 100 m west from the nearest pit edge;
- Gerard Murphy - located to the west of the Site, approximately 120 m southwest from the nearest pit edge;
- Factory Borehole - located adjacent to the Site access road, approximately 177 m southwest from the nearest pit edge;
- Merns - located to the south of the Site, approximately 430 m south from the nearest pit edge; and
- Quinn - located to the south of the Site, approximately 445 m south from the nearest pit edge.

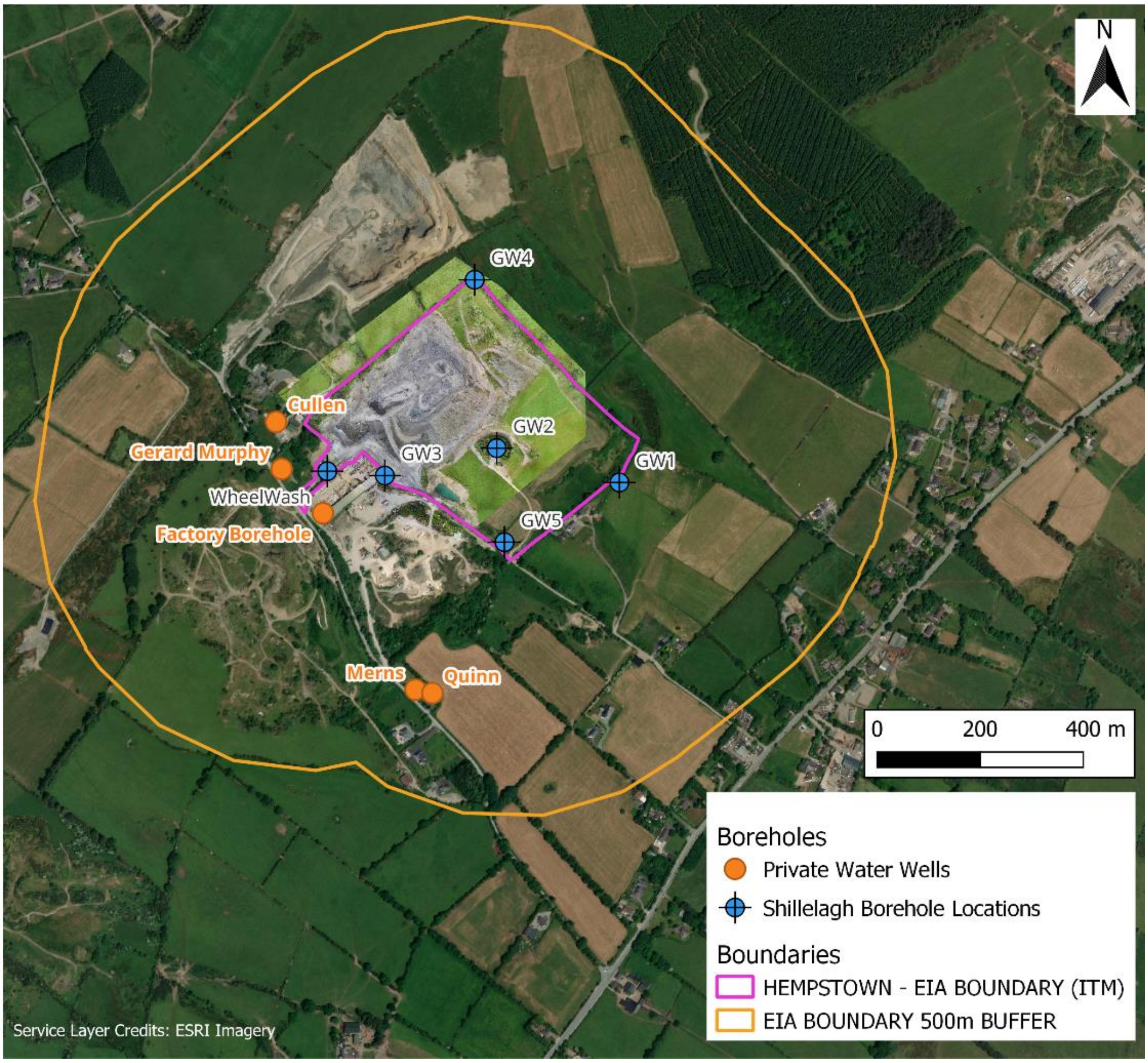

Figure 6-23 - Location of Private Abstraction Boreholes in the Vicinity of the Site

6.4.12 WATER BALANCE

6.4.12.1 Rainfall Recharge

The climate/meteorological data for the Site is presented in Chapter 8 of this rEIAR. Rainfall values for the Site have been used from Blessington (Hempstown), which is located ca. 0.8 km south of the Site and BRITTAS (Glenaraneen), which is located ca. 6 km northeast of the Site.

Using the rainfall data from Blessington (Hempstown) weather station and the potential evapotranspiration data for Casement Aerodrome Synoptic Station (located ca. 12 km northeast of the Site), the effective rainfall for the Site has been calculated (Table 6-13) over the assessment period.

6.4.12.2 Seepage Inflows

Using the information characterised in Section 6.4, a preliminary estimate of inflows to the pit at the end of the review period (i.e. maximum lateral and vertical extraction from the pit as taken from the

September 2023 survey) has been calculated using the methodology outlined by Marinelli and Nicolli (2000). Calculations are presented as Appendix 6E and estimate groundwater seepage into the pit of 15 m^3/day. In comparing this to the available daily rainfall of 155.7 m^3/day (3), the majority of the inflows to the pit are due to direct rainfall capture within the pit, rather than seepage. The final discharge volume of 62,306 m^3 (or 170.7 m^3/day) (5) assumes that all water entering the pit is pumped to the soakaway ponds from the quarry sump and that this occurs prior to any significant evaporation losses. Note that this is a fairly conservative approach, as in reality there will be evaporation losses and potentially some recharges to the bedrock aquifer.

Table 6-13 - Estimated Annual Average Water Balance (mean values are between 2020 - 2023)

Rainfall Recharge	**Annual Average**
(1) Estimated Area of Operational Site (m^2)	56,000 m^2
(2) Mean Annual Precipitation (m)	1.015 m
(3) Available water (m^3) (1) x (2)	56,840 m^3 (155.7 daily)
Seepage and Discharge	**Annual Average**
(4) Current Estimated Annual Volume of Seepage	5,475 m^3 (15 daily)
(5) Current Estimated Average Annual Volume of Discharge (3) + (4)	62,306 m^3 (170.7 daily)
Soakaway Ponds Volume	**Annual Average**
(6) Estimated Area of Ponds (Soakaway + Overflow) (m^2)	1,300 m^2 (980 + 320)
(7) Annual Potential Evapotranspiration (m)	0.591 m
(8) Actual Annual Evapotranspiration (m) 90% of (3)	0.532 m
(9) Effective Annual Precipitation (m) (2)-(8)	0.483 m
(10) Recharge to groundwater (m) (GSI, 2023)	0.1 m
(11) Available rainfall to Soakaways (m) (9) – (10)	0.383 m
(12) Volume of rainfall to Soakaway and Overflow Ponds (6) x (11)	498 m^3
(13) Annual residual water in Soakaway and Overflow Ponds (5) + (12)	62,558 m^3

The estimated volume of discharge (5) from the quarry sump is 170.7 m^3/day, which is accounted for by the maximum pumping rates reported in Section 6.4.3 of 240 m^3/day.

As the discharged water is pumped to the two soakaway ponds, the water in these will be subject to additional direct rainfall but will have deductions from evapotranspiration (8). In reality, a small volume will also re-enter the groundwater through the bedrock (10). The volume of rainfall contributing to the soakaway ponds (12) is calculated based on the area of the ponds and the assumptions of deductions based on evapotranspiration and groundwater recharge.

Based on the September 2023 aerial, the volume of water in the main soakaway pond is estimated to be 2,760 m^3 (surface area of 920 m^2 x water depth of 3 m) and in the overflow pond is estimated to be 330 m^3 (area of 165 m^2 x water depth of 2 m). This gives a combined capacity of 3,090 m^3, which is significantly less than the calculated annual residual water in the ponds (13) of 62,558 m^3. This indicates that the recharge to groundwater (10) is underestimated in the water balance and will be higher for the Pollaphuca Formation bedrock beneath the soakaway ponds and possibly the quarry void, allowing the majority of the discharged water to recharge the groundwater in the bedrock.

6.5 SELECTION OF SENSITIVE RECEPTORS

The nearest surface water features to the Site are the Goldenhill River to the south (ca. 1.2 km south of the Site boundary), the Poulaphouca Reservoir (ca. 2.8 km south-east of the boundary) and a small naturally occurring pond approximately 445 m to the south of the Site. The Red Bog SAC (ca. 1.2 km to the southwest) is understood to be part of a separate aquifer (as determined in Section 6.4.10.1) and up hydraulic gradient from the Site and is therefore not at risk of potential pollution from the Site. The streams and rivers to the north of the Site are part of a separate catchment (beyond a groundwater divide) and are therefore also not considered as receptors.

Considering the conceptual model for the Site presented in the 2019 EIAR and the conceptual section for the Goldenhill River and Poulaphouca Reservoir in Section 6.4.10.2 and the methodology for assessment presented in Section 6.3, the receptors and their assigned sensitivity are presented in Table 6-12.

Table 6-14 – Water Receptors

Receptor	Importance and Reasoning	Sensitivity
Poulaphouca Reservoir SPA - degradation of protected sites due to changes in water quality or quantity. The reservoir supplies substantial volumes of water to the surrounding areas.	The Poulaphouca Reservoir is ca. 2.8 km south-east of the Site and is fed by the Goldenhill River, which is ca. 1.2 km south of the Site. Both the reservoir and the river are down hydraulic gradient from the Site and are potential sensitive receptors to impacts on the water environment at the Site.	High
Goldenhill River (Surface Water) - quality and availability due to use as a resource and wider regulatory requirement to maintain good quality status.	The Goldenhill river is ca. 1.2 km downstream to the south of the Site. There are no surface water features connecting the Site to the river. However, the river likely receives surface run-off and groundwater baseflow within the superficial sand and gravels (although typical recharge distances are unknown). Surface run off is unlikely to cover large distances before it enters the sand and gravels as baseflow.	Medium
Groundwater - quality and availability due to use as a resource and wider regulatory requirement to maintain good quality status	Bedrock under the Site is classified as a poorly productive aquifer with limited fracture connectivity (tens of metres). Local supplies are generally low yield, supporting single household domestic properties, targeting the bedrock.	Negligible

Receptor	Importance and Reasoning	Sensitivity
	Extraction and dewatering has not resulted in a sustained decline in the groundwater levels in monitoring wells surrounding the quarry void – proving limited connectivity at depth.	
Flooding – changes in presence and water flows for on-Site plant and infrastructure.	Quarrying into the confined water table within the bedrock has the potential to cause flooding, although encountered seepages indicate limited connectivity, allowing collected water to be pumped from the quarry sump. Accumulations of ponded water following rainfall events, however, with no evidence of plant being affected. Pump in quarry sump is able to maintain dry working conditions at the base of the quarry.	Low
Flooding – changes in presence and impacts of water flows on infrastructure immediately adjacent and downstream of the Site.	There are no discharges of water from the quarry to the surface, with all water from the soakaway and overflow ponds returning to the groundwater. There is a risk of flooding if the discharge to the ponds exceeds the rate of infiltration to groundwater	Negligible
Local abstraction points – existing off-Site water users, water availability and quality	Existing water well users are located adjacent to the Site and source water from the bedrock aquifer. The closest residential property is within 100 m of the pit edge. Extraction and dewatering has not resulted in a sustained decline in the groundwater levels in monitoring wells surrounding the quarry void – proving limited connectivity at depth.	Low

6.6 CHARACTERISTICS OF THE DEVELOPMENT

The characteristics of the Development with regards to water are previously outlined in Sections 6.4.1 to 6.4.3 and 6.4.12 for the water balance.

6.6.1 EMBEDDED MITIGATION

To avoid the potential impacts to the water environment during activities at the Site, embedded design and commonly undertaken good practice mitigation measures were in place over the review period, these include/included:

- Dewatering – dewatering will only take place during excavation and only when flooding of the quarry occurs. This is anticipated to be required predominantly following rainfall events;
- Runoff - the floor (and faces) of all areas of the extraction area slope towards a low elevation point, helping water to collect the location of the quarry sump and pump, preventing any surface water runoff from the Site;
- Soakaway – the runoff water (combination of rainfall water and seepage) is pumped from the quarry sump into the soakaway and overflow ponds. The ponds are dug down into the bedrock shale (and unlined), allowing the discharged water to infiltrate back into the bedrock shale

aquifer. There is therefore no discharge to surface water (assuming the water level in the ponds remains below the superficial Sands and Gravels as discussed in Section 6.4.10.2);
- Refuelling takes place on hardstanding in a designated area of the Site and plant is well maintained to prevent uncontained releases of hydrocarbons to the ground;
- All plant and machinery utilised in the quarrying process is and will continue to be regularly serviced and maintained;
- Hydrocarbons are stored in bunded tanks on an impermeable hardstanding surface. All diesel fuel and hydraulic fluid is stored in bunded fuel tanks;
- Monitoring of groundwater and surface water quality using available monitoring wells and soakaway ponds, to ensure that no pollution of groundwater or surface water is occurring. Note that monitoring of surface water in the soakaway ponds was not undertaken over the entirety of the review period;
- Phased restoration – the Site will be subject to phased restoration during the proposed activities. This will reduce the stockpile of raw material and materials will be stabilised once vegetation has been established;
- Restoration materials – only materials which have been stockpiled at the Site during overburden stripping will be used during restoration and there will be no importation of off-site materials;
- Environmental Management System (EMS) – an EMS document was produced for the Site in 2007 (Byrne Environmental, 2007); however, the 2007 EMS is not appropriate for the current Site as it was produced when the quarry was previously owned and operated by Stresslite Flooring Ltd and incorporated the adjacent Stresslite facility (located outside of the application area);
- Wheelwash – an existing wheelwash is present at the Site. The wheelwash is a contained recycling system and will be maintained appropriately to avoid discharges of wash water; and
- Welfare facilities – the welfare facilities consist of an inbuilt holding tank, will continue to be collected by a suitable disposal contractor on a regular basis, to avoid discharges of wastewater. The applicant confirms that a current agreement exists for the servicing of the welfare facilities as required.

6.6.2 2019 MITIGATION REQUIRED

Note that the following mitigation measures stated in the 2019 EIAR have not been implemented over the review period:

- Interceptor – an interceptor should be installed at the Site and any discharges to ground (e.g. pumped from pit or wheelwash) should be passed through the interceptor prior to discharge to the Soakaway Pond. The interceptor should be designed to exceed the maximum pump capacity presented in Section 6.4.3. The provision of an interceptor will be included in a concurrent application for development under Section 37L of the PADA Act;
- Dust suppression – any water used for dust suppression should be obtained after passing through the proposed interceptor, to reduce the risk of contamination spreading;
- Decommissioning – proposed decommissioning of the homestead/farm should be completed in such a way that it does not lead to discharges of chemicals such as hydrocarbons or oils (should they be present). The homestead borehole GW2 is understood to no longer be in use but is currently monitored for water level and quality; and
- An updated EMS for the Site will be prepared by the current site owners, Shillelagh Quarries Ltd, the regulatory guidance and mitigations measures within which will be adhered to.

6.7 POTENTIAL EFFECTS

The main activities which have been conducted during the development of the Site over the review period and may cause an impact upon the water environment are as follows:

- Quarrying activities (e.g. excavation of quarry, movement of material);
- Dewatering of seepage water from the pit void;
- Collection of discharge water in the soakaway and overflow ponds;
- Use and parking of mechanical plant on the Site for excavation activities;
- Storage of hydrocarbons associated with the refuelling; and
- Use of welfare facilities and holding tank.

Although there is already embedded mitigation in the Site infrastructure and design, activities at the Site still had potential to have caused the following impacts over the review period:

- (1) Changes in groundwater or surface water quality due to excavation;
- (2) Changes in groundwater or surface water quantity due to dewatering;
- (3) Changes in surface water or groundwater quality from discharges/infiltration from the soakaway and overflow ponds;
- (4) Changes in surface water or groundwater quantity from discharges/infiltration from the soakaway and overflow ponds;
- (5) Changes in surface water or groundwater quality from wastewater generated by on-Site welfare, holding tank and wheel wash facilities;
- (6) Changes in surface water or groundwater quality from uncontrolled material storage;
- (7) Changes in surface water or ground water quality caused by hydrocarbon leaks from fuel storage tanks or the unmanaged spillage of fuels or lubricants from Site plant or vehicles;
- (8) Increased flooding risk to the quarry floor due to elevated rainfall; and
- (9) Increased flooding risk due to elevated rainfall and/or discharge of seepage water into the soakaway and overflow ponds, resulting in uncontrolled overflow to surface water down gradient of the Site.

6.7.1 EVALUATION OF POTENTIAL EFFECTS

Using the methodology set out in Section 6.3 and the potential effects detailed above, an evaluation and assessment of the potential effects on the identified sensitive receptors is presented in Table 6.15. This assessment takes the embedded mitigation into consideration.

The magnitudes associated with the potential impacts at the Site are assigned either a negligible or low value due to:

- Monitoring of groundwater and surface water quality in the available monitoring wells and soakaway ponds has not detected any long-term deteriorating trends;
- Limited off-Site hydraulic connectivity of groundwater, (as observed in monitoring wells water levels) has prevented the migration of any (possible) contaminants from the Site;
- Undetected concentrations of hydrocarbons in groundwater and surface water throughout the review period;
- No sustained exceedances of AA-EQS threshold values for groundwater, apart from that for barium, which is naturally occurring and some for nitrate, which is common in the area in relation to agricultural processes;

- No sustained exceedances of AA-EQS threshold values for surface water, apart from that for arsenic, which is naturally occurring in the bedrock and generally good quality of water in the River Goldenhill observed throughout the review period; and
- No significant flooding of the Site as a result of large seepage volumes, rainfall or an uncontrolled release from the soakaway or overflow pond.

Combined with the sensitivities of the identified receptors, the potential adverse effects caused by the Site through the review period are mostly imperceptible or slight. The Poulaphouca Reservoir SAC is given a high sensitivity as a conservative approach, although in reality, there is unlikely to be significant hydraulic connectivity between the groundwater in the bedrock in the vicinity of the Site and the reservoir. Human health has not been considered as the changes to quality for the local abstractions have been assigned an imperceptible level of effect.

Table 6-15 - Evaluation of Initial Impacts and their Effect Significance taking into account embedded mitigation

Receptor	Sensitivity	Source of Impact/Description of Change	Impact Magnitude	Level of Effect
Poulaphouca Reservoir SAC	High	(1) Changes in quality due to excavation. *Excavation has led to increased arsenic in discharge water. Although connection between discharge water and reservoir unlikely*	Negligible	Slight
Poulaphouca Reservoir SAC	Medium	(2) Changes in quantity due to dewatering. *No obvious long-term declining trend in groundwater levels in bedrock with increased dewatering. Only thin superficial deposits in connection with quarry void*	Negligible	Imperceptible or slight
Poulaphouca Reservoir SAC	High	(3) Changes in quality from discharges/infiltration from the soakaway and overflow ponds. *No discharges to surface water from the ponds. Soakaways into bedrock and not gravels and sands.*	Negligible	Slight
Poulaphouca Reservoir SAC	High	(4) Changes in quantity from discharges/infiltration from the soakaway and overflow ponds. *No discharges to surface water from the ponds. Soakaways into bedrock and not superficial gravels and sands.*	Negligible	Slight
Poulaphouca Reservoir SAC	High	(5) Changes in quality from wastewater generated by on-Site welfare, holding tank and wheel wash facilities. *No deterioration in monitored Site surface water quality.*	Negligible	Slight

Receptor	Sensitivity	Source of Impact/Description of Change	Impact Magnitude	Level of Effect
Poulaphouca Reservoir SAC	High	(6) Changes in quality from uncontrolled material storage. *No deterioration in monitored Site surface water quality.*	Negligible	Slight
Poulaphouca Reservoir SAC	High	(7) Changes in quality caused by hydrocarbon leaks from fuel storage tanks or the unmanaged spillage of fuels or lubricants from Site plant or vehicles. *No deterioration in monitored Site surface water quality.*	Negligible	Slight
Goldenhill River (Surface Water)	Medium	(1) Changes in quality due to excavation. *Excavation has led to increased arsenic in discharge water. Although likely connection between discharge water and river low. Arsenic ubiquitous in river sediments*	Negligible	Imperceptible or slight
Goldenhill River (Surface Water)	Medium	(2) Changes in quantity due to dewatering. *No obvious long-term declining trend in groundwater levels in bedrock with increased dewatering. Only thin superficial deposits in connection with quarry void*	Negligible	Imperceptible or slight
Goldenhill River (Surface Water)	Medium	(3) Changes in quality from discharges/infiltration from the soakaway and overflow ponds. *No discharges to surface water from the ponds. Soakaways into bedrock and not gravels and sands. Arsenic ubiquitous in river sediments*	Negligible	Imperceptible or slight
Goldenhill River (Surface Water)	Medium	(4) Changes in quantity from discharges/infiltration from the soakaway and overflow ponds. *No discharges to surface water from the ponds. Soakaways into bedrock and not superficial gravels and sands.*	Negligible	Imperceptible or slight
Goldenhill River (Surface Water)	Medium	(5) Changes in quality from wastewater generated by on-Site welfare, holding tank and wheel wash facilities. *No deterioration in monitored Site surface water quality.*	Negligible	Imperceptible or slight
Goldenhill River (Surface Water)	Medium	(6) Changes in quality from uncontrolled material storage. *No*	Negligible	Imperceptible or slight

Receptor	Sensitivity	Source of Impact/Description of Change	Impact Magnitude	Level of Effect
		deterioration in monitored Site surface water quality.		
Goldenhill River (Surface Water)	Medium	(7) Changes in quality caused by hydrocarbon leaks from fuel storage tanks or the unmanaged spillage of fuels or lubricants from Site plant or vehicles. *No deterioration in monitored Site surface water quality.*	Negligible	Imperceptible or slight
Groundwater	Negligible	(1) Changes in quality due to excavation. *No continued deterioration in monitored Site groundwater quality.*	Low	Imperceptible or slight
Groundwater	Negligible	(2) Changes in quantity due to dewatering. *No obvious long-term declining trend in groundwater levels in bedrock with increased dewatering.*	Low	Imperceptible or slight
Groundwater	Negligible	(3) Changes in quality from discharges/infiltration from the soakaway and overflow ponds. *Soakaways into bedrock and not gravels and sands. Groundwater therefore returned to source. Elevated Nitrate/Nitrite likely originating from farming*	Low	Imperceptible or slight
Groundwater	Negligible	(4) Changes in quantity from discharges/infiltration from the soakaway and overflow ponds. *Soakaways into bedrock and not superficial gravels and sands. Beneficial in returning groundwater seepage to bedrock aquifer.*	Medium (beneficial)	Imperceptible or slight
Groundwater	Negligible	(5) Changes in quality from wastewater generated by on-Site welfare, holding tank and wheel wash facilities. *No deterioration in monitored Site groundwater quality.*	Negligible	Imperceptible
Groundwater	Negligible	(6) Changes in quality from uncontrolled material storage. *No deterioration in monitored Site groundwater quality.*	Negligible	Imperceptible
Groundwater	Negligible	(7) Changes in quality caused by hydrocarbon leaks from fuel storage tanks or the unmanaged spillage of fuels or lubricants from	Negligible	Imperceptible

Receptor	**Sensitivity**	**Source of Impact/Description of Change**	**Impact Magnitude**	**Level of Effect**
		Site plant or vehicles. *No deterioration in monitored Site groundwater quality.*		
Flooding	Medium	(8) Increased flooding risk to the quarry floor due to elevated rainfall. *Pooled water with rainfall but no uncontrolled overflow reported. Pooled water removed with pumping.*	Low	Slight
Flooding	Medium	(9) Increased flooding risk due to elevated rainfall and/or discharge of seepage water into the soakaway and overflow ponds, resulting in uncontrolled overflow to surface water down gradient of the Site. *No uncontrolled overflow reported.*	Negligible	Imperceptible or slight
Local abstraction	Low	Changes in quality due to excavation. *No continued deterioration in monitored Site groundwater quality.*	Negligible	Imperceptible
Local abstraction	Low	Changes in quantity due to dewatering. *No obvious long-term declining trend in groundwater levels in bedrock with increased dewatering.*	Negligible	Imperceptible
Local abstraction	Low	Changes in quality from discharges/infiltration from the soakaway and overflow ponds. *Soakaways into bedrock and not gravels and sands. Groundwater therefore returned to source. Elevated Nitrate/Nitrite likely originating from farming*	Negligible	Imperceptible
Local abstraction	Low	Changes in quantity from discharges/infiltration from the soakaway and overflow ponds. *Soakaways into bedrock and not superficial gravels and sands. Beneficial in returning groundwater seepage to bedrock aquifer.*	Negligible (beneficial)	Imperceptible

6.8 REMEDIAL MEASURES REQUIRED

Although there are no effects reported at the sensitive receptors, the following remedial measures are required to assist in restriction / early detection of potential effects:

- Implementation of the mitigation measures (Section 6.6.2) still required from the 2019 EIAR;
- Lining of the soakaway and overflow ponds to prevent against discharges to the superficial sand and gravels; and

- Install of a shallow monitoring bore in the sand and gravels south of the soakaway pond. To monitor water level and quality to detect any potential discharges to the sand and gravels from the soakaway ponds.

6.9 RESIDUAL EFFECTS

The assessment concludes that the activities at the Site have not given rise to significant adverse effects on the water environment at or surrounding the Site during the review period of December 2019 to present. In all cases the residual adverse effect is **not significant** and not greater than slight.

Enacting on the remedial measures detailed in Section 6.8will lower the residual adverse effect, compared to that reported in Section 6.7.1.

6.10 CUMULATIVE EFFECTS

The cumulative effects associated with other permitted / under construction third-party developments have been considered in Chapter 15 of this rEIAR. Cumulative effects are considered to be **Not Significant**.

6.11 MONITORING

The monitoring programme is to continue at the Site for the following:

- Groundwater level – groundwater levels should be monitored at the six existing monitoring well locations (Table 6-10) on a monthly basis. It is recommended that loggers be used in the wells (especially those that are actively pumped such as Wheelwash), in order to capture punctuated responses to abstraction or recharge;
- Groundwater quality – groundwater quality monitored on a quarterly basis to capture any off-Site migration of impacts on water quality. Water quality should continue in all six available monitoring wells, where access permits. Note that water quality monitoring only took place on a bi-annual basis over the review period; and
- Surface Water quality – surface water quality from the large soakaway pond (SW01) to be monitored quarterly (full laboratory water quality suite) to capture any impact on water quality from continued discharge of seepage water. Once the interceptor is installed, sampling should also take place of the water in the quarry sump, prior to it passing through the interceptor.

6.12 DIFFICULTIES ENCOUNTERED

During this assessment the following have been noted which have caused difficulty in assessing the impacts on the water environment retrospectively, although they are not considered likely to have affected the outcome of the assessment:

- Groundwater quality sampling was conducted on a bi-annual basis, with no results available from 2021 (due to the impact of COVID). Sampling was stated to be undertaken on a quarterly basis during in the 2019 EIAR;
- Water samples were only collected from the large soakaway pond from August 2024 onwards. It is therefore not possible to assess the water quality trends (which may be related to seasonal changes in rainfall) over a full year. It is understood that the large soakaway pond was constructed by September 2023;

- On certain occasions GW1 (August 2024) and GW5 (October 2022) could not be sampled from due to obstructions within the casing preventing sampling equipment from reaching the water table; and
- Water usage rates are not measured on-Site and are therefore estimated with the consideration of worst-case pump capacity rates and estimated daily pumping duration.

6.13 SUMMARY AND CONCLUSIONS

This assessment considers the potential impacts and effects on the water environment over the review period from 29 December 2019 to present.

The main receptors that could be affected by changes to the water environment due to activities undertaken at the Site through the review period were identified and potential effects were assessed. Receptor linkages are limited by the low potential for hydraulic connectivity of groundwater in the bedrock at the Site with the surrounding area. Identified receptors in potential hydraulic connectivity with the Site were groundwater, surface water (Poulaphouca Reservoir SAC and Goldenhill River), flood risk areas and local abstractions. A receptor pathway for the Red Bog SAC was not identified.

Known design and embedded mitigation measures were considered during the initial assessment of impacts and effects. Where additional mitigation measures could be incorporated to reduce the impacts and effects further, these were identified.

6.14 REFERENCES

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McGrory, E. R., Brown, C., Bargary, N., Williams, N. H., Mannix, A., Zhang, C., Henry, T., Daly, E., Nicholas, S., Petrunic, B. M., Lee, M., and Morrison, L., 2017, Arsenic contamination of drinking water in Ireland: A spatial analysis of occurrence and potential risk: Science of The Total Environment, v. 579, p. 1863-1875.

Russell, A., 2020, Geogenic arsenic contamination in selected Lower Palaeozoic bedrock aquifers in Ireland. University College Dublin, PhD Thesis.

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Appendix 6A

TECHNICAL SPECIFICATION FOR DEWATERING PUMP

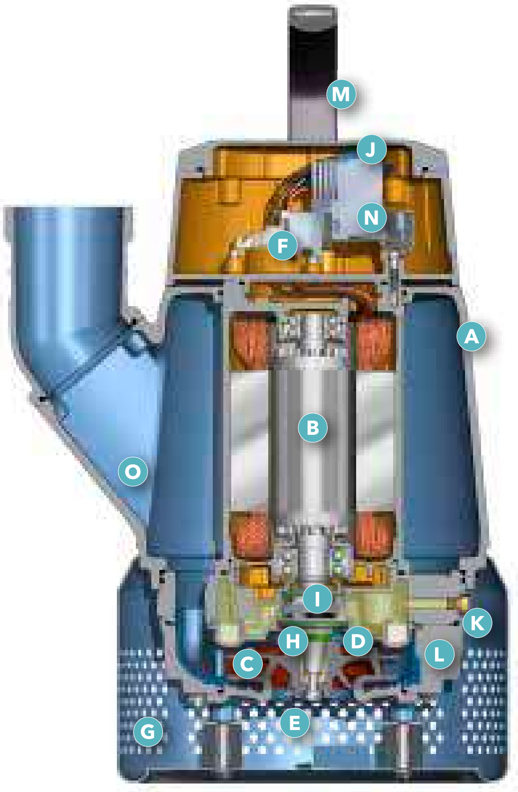
50Hz

Flygt BIBO 2870

SOME THINGS MAKE A LASTING IMPRESSION

For decades whenever a dewatering challenge seemed too tough or too harsh, the answer has been simple, Flygt BIBO. So how do you improve upon a legend? Simple, we created a new one.

It still has the iconic look; a shape that means stability and robustness. We took our proven hydraulic design and merged it with features that once set the standard in dewatering pumping. For mining, quarrying, construction and tunneling, Flygt BIBO, still a choice you never regret.



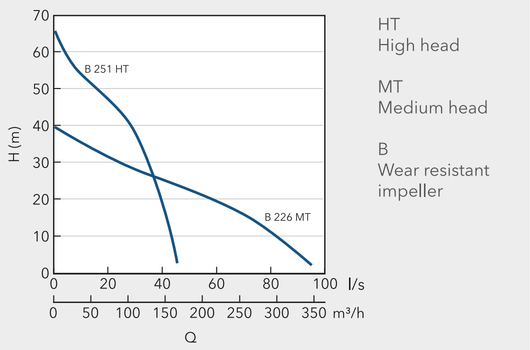
- **A Air valve**
  The cooler the motor, the better the performance.
- **B Class H motor**
- **C Dura-Spin™**
  The unique closed impeller and the suction cover which reduces wear.
- **D Spin-Out™**
  Protects the outer seal from abrasive particles.
- **E Hard-Iron™ impeller and suction cover.**
- **F Sealed off terminal board**
- **G Strainer bottom with shock absorbers**
- **H Single impeller-adjustment screw**
- **I Plug-in™ seal with aluminum housing**
- **J Inspection cover**
- **K External inspection and oil plugs**
- **L PolyLife™ coated wear parts**
- **M Handle with adjustable height**
- **N Less risk of cable damage with a protected cable entry**
- **O Wide base and low discharge**

FLYGT
a xylem brand

2870 50Hz

1725 . Flygt Bibo 2870 . 1 . Master . 1 . 20130502

Performance



Rating

18 kW / 3-phase / 2,895 rpm

Voltage V	Rated current A	Starting current A
220 D	58	355
240 D	55	390
380 D	34	239
380 Y	33	203
400 D	33	238
400 Y	32	215
415 D	32	222
440 D	32	238
500 D	26	187
525 D	24	153
550 D	24	162
660 Y	20	138
690 Y	19	137
1000 Y	14	99

Denomination

Product code	2870.180
Installation	Portable
Discharge connection	3″/4″/6″
Impeller characeristics	High head/medium head (HT/MT) Wear resistant impeller (B) with Dura-Spin™

Process data

Liquid temperature	40°C (standard)
Depth of immersion	max 20 m
Liquid density	max 1100 kg/m^3
Strainer hole dimension	ø 12.0 mm
The pH of the pumped liquid	pH 5-8

Motor data

Frequency	50 Hz
Insulation class	H, 180°C
Voltage variation	max ± 10% – continuously running max ± 10% – intermittent running
Voltage imbalance	max 2% - between phases max 30 - No. of starts/hour

Monitoring equipment

Thermal contacts	140°C opening temperature

Cables

SUBCAB®	SUBCAB® Submersible cable

Materials

Outer casing	Aluminium
Impeller	Hard-Iron®
Wear parts	PolyLife/Nitrile rubber/Hard-Iron®
Stator housing	Aluminum
Strainer	Stainless steel
Shaft	Stainless steel
O-rings	Nitrile rubber
Discharge connection	Aluminium

Mechanical face seals

Inner Active Seal™	Tungsten carbide/Tungsten carbide
Outer	Tungsten carbide/Tungsten carbide

Weight and dimensions

Weight (excl. cable)	154 Kg
Height	991 mm
Width	ø 500 mm

Options

Warm liquid version	Warm liquid version max 70°C
Quick couplings	
Starters	
Softstarter	

Accessories

Tandem connections, hose connections. Electrical accessories such as pump controllers, control panels and monitoring relays. Zink anodes.

xylem
Let's Solve Water

XYLEM
Gesällvägen 33
174 87 Sundbyberg, Sweden
Tel +46 8 475 60 00
www.xyleminc.com
www.flygt.com

Environmental Product Declaration
EPD-declared product
EPD®

Appendix 6B

BORELOGS

PUBLIC

SLR Consulting Ireland
7 Dundrum Business Park
Windy Arbour
Dublin 14
Tel:+353 (0)1 296 4667
Fax:+353 (0)1 296 4676
www.slrconsulting.com

WATER WELL (SURVEY) DATA SHEET

SITE: Hempstown	**JOB No: 501.00066.00024**

Location:				
Well ID:	1	Date & Time:	05/03/2019	09:15:00
Owner: Ger		Grid Ref.: n/a		
Address: Farm to the east of quarry				
Weather: Overcast, dry				

Well Details:				
Well Type: (bored / dug / screened well / open hole)			Bored well	
Well Location:			East of Quarry	
Supply Type: (i.e. domestic/commercial/farm)			Farm	
Number of persons supplied:			1 house	
Water Quality: (i.e. taste/colour etc.)			n/a	
Current Status of Well (i.e. in use etc):			in use	
Elevation of well cover above ground:				m
Elevation of inner casing pipe above ground:			0.3	m
Depth to water (from top of pipe) (RWL):			7.2	m
Depth of well (from top of pipe):			37	m

Well Construction Details:		
Diameter of pipe:		m
Borehole Diameter:		m
Depth to top of Screen (ftp):		m
Screen Length:		m
Slot Size:		m
Screen + casing Material:		m
Gravel Pack Details:		m
Well Yield:		m^3/day
Dynamic water level:		m
Depth of Pump (ftp):		
Pump type:		
Pump Rate:		
Pump Use (Hours per day + Days per year):		
Driller:	Date Drilled:	

Comments: (i.e. Potential sources of pollution, septic tanks or adjacent farmyard)

downhill from farmyard

SLR Consulting Ireland
7 Dundrum Business Park
Windy Arbour
Dublin 14
Tel:+353 (0)1 296

WATER WELL (SURVEY) DATA SHEET

SITE:	**Hempstown**	**JOB No:501.00066.00024**

Location:				
Well ID:	2	Date & Time:	05/03/2019	09:40
Owner:	Quarry Staff House	Grid Ref.:	n/a	
Address:	East of quarry			
Weather:	Overcast, dry			

Well Details:			
Well Type: (bored / dug / screened well / open hole)			
Well Location:		Bored Well	
Supply Type: (i.e. domestic/commercial/farm)		East of Quarry	
Number of persons supplied:		Domestic	
Water Quality: (i.e. taste/colour etc.)			
Current Status of Well (i.e. in use etc):		In use	
Elevation of well cover above ground:			m
Elevation of inner casing pipe above ground:		0.27	m
Depth to water (from top of pipe) (RWL):		11.19	m
Depth of well (from top of pipe):			m

Well Construction Details:		
Diameter of pipe:		m
Borehole Diameter:		m
Depth to top of Screen (ftp):		m
Screen Length:		m
Slot Size:		m
Screen + casing Material:		m
Gravel Pack Details:		m
Well Yield:		m^3/day
Dynamic water level:		m
Depth of Pump (ftp):		
Pump type:		
Pump Rate:		
Pump Use (Hours per day + Days per year):		
Driller:	Date Drilled:	

Comments: (i.e. Potential sources of pollution, septic tanks or adjacent farmyard)

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WATER WELL (SURVEY) DATA SHEET

SLR

SITE:	**Hemptstown**	**JOB No:501.00066.00024**

Location:

Well ID:	3	Date & Time:	05/03/2019	10:00
Owner:	Stresslite Floors Ltd	Grid Ref.:		
Address:	South of quarry			
Weather:	Overcast, dry			

Well Details:

Well Type: (bored / dug / screened well / open hole)	Bored well	
Well Location:	south of quarry	
Supply Type: (i.e. domestic/commercial/farm)	commercial	
Number of persons supplied:	1 company	
Water Quality: (i.e. taste/colour etc.)		
Current Status of Well (i.e. in use etc):	in use	
Elevation of well cover above ground:	gl	m
Elevation of inner casing pipe above ground:	gl	m
Depth to water (from top of pipe) (RWL):	15.5	m
Depth of well (from top of pipe):	100	m

Well Construction Details:

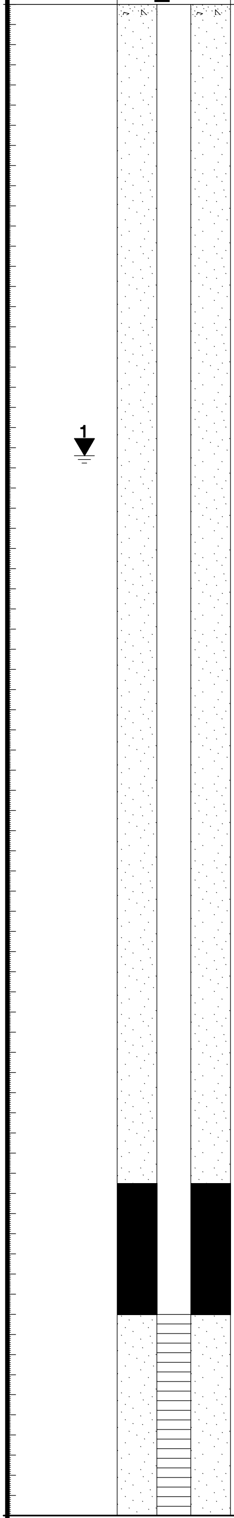
Diameter of pipe:		m
Borehole Diameter:		m
Depth to top of Screen (ftp):		m
Screen Length:		m
Slot Size:		m
Screen + casing Material:		m
Gravel Pack Details:		m
Well Yield:		m^3/day
Dynamic water level:		m
Depth of Pump (ftp):		
Pump type:		
Pump Rate:		
Pump Use (Hours per day + Days per year):		
Driller:	Date Drilled:	

Comments: (i.e. Potential sources of pollution, septic tanks or adjacent farmyard)

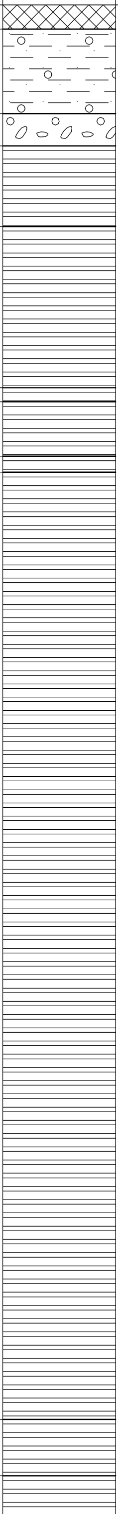
GOLDER

Client : Shillelagh Quarries Ltd.		**Hole No.** GW4
Site : Hempstown Commons, Blessington	**Project :** Shillelagh Quarries	**Project No :** 19124167
Equipment & Methods : Truck mounted rig, air rotary with occasional water flush	**Contractor :** Aidan Dempsey Well Drilling **Date Started :** 03/12/2019 **Completed :** 03/12/2019 **Logged by :** AD	**Ground Level (mAOD) :** **Co-ordinates :** E N

WATER/ PROGRESS | INSTALLATION /BACKFILL | SPT Results: SPT 'N' | SAMPLES: Sample Type, PID



STRATA RECORD



Level (mAOD)	Depth (Thickness) m	Description
	1.20	MADE GROUND comprising fill. Drill pad installed by site.
	(4.20) 5.40	Clay, sand and gravel
	7.00	Gravel / Brown Shale
	(4.00) 11.00	Brown Shale
	(8.00) 19.00	Blue Shale
	19.70	Brown Shale
	22.40	Blue Shale
	23.20	Brown Shale
	(47.00) 70.20	Blue/grey Shale White calcite chips at 52 m bGL
	73.00	Blue/grey Shale with visible pyrite mineralisation in chippings
	75.00	Blue/grey Shale

End of Hole at 75.00m

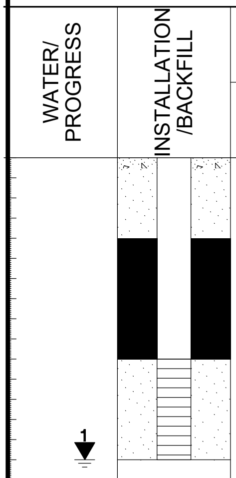
Remarks :
Groundwater encountered at approximately 22.4 m bGL.
The installation comprised the following:
0.0 - 0.5 m bGL: Cement, 0.5 - 58.5 m bGL: Arisings and plain pipe, 58.5 - 65.0 m bGL: Bentonite and plain pipe, 65.0 - 75.0 m bGL: Gravel pack and slotted pipe with geosock

Checked By: RT

Scale 1:375

GAUKENV+GEO(1) April 2008

GOLDER	**Client :** Shillelagh Quarries Ltd.	**Hole No.** **GW5**
Site : Hempstown Commons, Blessington	**Project :** Shillelagh Quarries	**Project No :** 19124167
Equipment & Methods : Truck mounted rig, air rotary with occasional water flush	**Contractor :** Aidan Dempsey Well Drilling **Date Started :** 03/12/2019 **Completed :** 03/12/2019 **Logged by :** AD	**Ground Level (mAOD) :** **Co-ordinates :** E N



SPT Results	SAMPLES		STRATA RECORD			
SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description
					1.30	Clay
					3.50	Clay / gravels
					(5.50) 9.00	Sands and large gravels
					(6.00) 15.00	Brown Mudstone / Brown Shale
						End of Hole at 15.00m

Remarks :
Groundwater encountered at approximately 15.0 m bGL.
The installation comprised the following:
0.0 - 0.5 m bGL: Cement, 0.5 - 4.0 m bGL: Arisings and plain pipe, 4.0 - 10.0 m bGL: Bentonite and plain pipe, 10.0 - 15.0 m bGL: Gravel pack and slotted pipe with geosock

Checked By: RT

Scale 1:375

GAUKENV+GEO(1)
April 2008

Appendix 6C

LABORATORY RESULTS

Table 6C-1 - Laboratory Results - November 2019

Parameter	Units	GTV [1]	EQS 2019 [2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Dissolved Arsenic	ug/l	7.5	50	<2.5	3.6	<2.5	7.5	<2.5	-	-
Dissolved Barium	ug/l	none	100	41	71	28	102	72	-	-
Dissolved Beryllium	ug/l	none	-	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
Dissolved Boron	ug/l	none	2000	<12	14	<12	15	20	-	-
Dissolved Cadmium	ug/l	none	3	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
Dissolved Calcium	mg/l	none	-	47.5	78.3	69.2	49.1	123.5	-	-
Total Dissolved Chromium	ug/l	37.5	30	<1.5	<1.5	<1.5	<1.5	<1.5	-	-
Dissolved Copper	ug/l	none	30	<7	16	<7	<7	<7	-	-
Dissolved Lead	ug/l	7.5	10	<5	<5	<5	<5	<5	-	-
Dissolved Magnesium	mg/l	none	-	7.7	7.1	5.1	26	5.4	-	-
Dissolved Mercury	ug/l	0.75	1	<1	<1	<1	<1	<1	-	-
Dissolved Nickel	ug/l	none	50	<2	<2	<2	<2	<2	-	-
Dissolved Potassium	mg/l	none	-	0.7	0.4	0.3	1	1.8	-	-

Parameter	Units	GTV [1]	EQS 2019 [2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Dissolved Selenium	ug/l	none	-	<3	<3	<3	<3	<3	-	-
Dissolved Sodium	mg/l	none	-	9.5	8.8	7.8	19.5	8.7	-	-
Dissolved Vanadium	ug/l	none	-	<1.5	<1.5	<1.5	<1.5	<1.5	-	-
Dissolved Zinc	ug/l	75	100	19	59	11	7	4	-	-
GRO (>C4-C8)	ug/l	-	-	<10	<10	<10	<10	<10	-	-
GRO (>C8-C12)	ug/l	-	-	<10	<10	<10	<10	<10	-	-
GRO (>C4-C12)	ug/l	-	-	<10	<10	<10	<10	<10	-	-
MTBE	ug/l	10	none	<5	<5	<5	<5	<5	-	-
Benzene	ug/l	none	10	<5	<5	<5	<5	<5	-	-
Toluene	ug/l	525	74	<5	<5	<5	<5	<5	-	-
Ethylbenzene	ug/l	none	none	<5	<5	<5	<5	<5	-	-
m/p-Xylene	ug/l	none	30	<5	<5	<5	<5	<5	-	-
o-Xylene	ug/l	none	30	<5	<5	<5	<5	<5	-	-
EPH (C8-C40)	ug/l	-	-	<10	<10	<10	<10	<10	-	-

Parameter	Units	GTV [1]	EQS 2019 [2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Sulphate as SO4	mg/l	187.5	200	9.6	16.1	24	12.3	23.2	-	-
Chloride	mg/l	187.5	250	15.1	9.6	9.5	9.6	8.4	-	-
Nitrate as NO3	mg/l	37.5	50	13.4	14.6	45	0.4	19.6	-	-
Nitrite as NO2	mg/l	0.375	0.2	<0.02	<0.02	0.07	0.19	0.02	-	-
Ortho Phosphate as PO4	mg/l	none	-	<0.06	<0.06	<0.06	<0.06	<0.06	-	-
Nitrate as N	mg/l	-	-	3.02	3.3	10.17	0.08	4.43	-	-
Nitrite as N	mg/l	-	-	<0.006	<0.006	0.021	0.059	0.007	-	-
Ortho Phosphate as P	mg/l	-	-	<0.03	<0.03	<0.03	<0.03	<0.03	-	-
Ammoniacal Nitrogen as N	mg/l	none	-	0.05	<0.03	<0.03	<0.03	0.05	-	-
Ammoniacal Nitrogen as NH4	mg/l	-	-	0.07	<0.03	<0.03	<0.03	0.06	-	-
Hexavalent Chromium	ug/l	7.5	3.4	<6	<6	<6	<6	<6	-	-
Total Dissolved Chromium III	ug/l	-	4.7	<6	<6	<6	<6	<6	-	-
Total Alkalinity as CaCO3	mg/l	-	-	142	242	162	282	368	-	-

Parameter	**Units**	**GTV [1]**	**EQS 2019 [2]**	**GW01**	**GW02**	**GW03**	**GW04**	**GW05**	**SW01**	**WHEEL WASH**
COD (Settled)	mg/l	none	-	<7	<7	<7	<7	<7	-	-
Total Suspended Solids	mg/l	none	-	<10	<10	<10	<10	<10	-	-

1 Groundwater Regulations 2010 (S.I. No. 9 of 2010) and amendment S.I. No. 366/2016.

2 AA-EQS - European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. No. 272/2009 including amendments S.I. No. 327/2012, S.I. No. 386/2015 and S.I. No. 77/2019)

Table 6C-2 - Laboratory Results - December 2021

Parameter	Units	GTV[1]	EQS 2019[2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Dissolved Arsenic	ug/l	7.5	50	<2.5	2.6	<2.5	6.8	<2.5	-	-
Dissolved Barium	ug/l	none	100	36	67	15	146	71	-	-
Dissolved Beryllium	ug/l	none	-	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
Dissolved Boron	ug/l	none	2000	<12	<12	<12	22	14	-	-
Dissolved Cadmium	ug/l	none	3	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
Dissolved Calcium	mg/l	none	-	51.4	69	72	36.1	95.8	-	-
Total Dissolved Chromium	ug/l	37.5	30	<1.5	<1.5	1.9	<1.5	<1.5	-	-
Dissolved Copper	ug/l	none	30	<7	14	15	<7	<7	-	-
Dissolved Lead	ug/l	7.5	10	<5	<5	<5	<5	<5	-	-
Dissolved Magnesium	mg/l	none	-	6.9	7.1	5.9	19.6	4.6	-	-
Dissolved Mercury	ug/l	0.75	1	<1	<1	<1	<1	<1	-	-
Dissolved Nickel	ug/l	none	50	<2	<2	<2	<2	<2	-	-
Dissolved Potassium	mg/l	none	-	0.4	0.4	0.3	6.2	2.4	-	-

Parameter	**Units**	**GTV [1]**	**EQS 2019 [2]**	**GW01**	**GW02**	**GW03**	**GW04**	**GW05**	**SW01**	**WHEEL WASH**
Dissolved Selenium	ug/l	none	-	<3	<3	<3	<3	<3	-	-
Dissolved Sodium	mg/l	none	-	7.9	8.4	9.4	17.7	8.6	-	-
Dissolved Vanadium	ug/l	none	-	<1.5	<1.5	<1.5	<1.5	<1.5	-	-
Dissolved Zinc	ug/l	75	100	5	40	28	<3	<3	-	-
GRO (>C4-C8)	ug/l	-	-	<10	<10	<10	<10	<10	-	-
GRO (>C8-C12)	ug/l	-	-	<10	<10	<10	<10	<10	-	-
GRO (>C4-C12)	ug/l	-	-	<10	<10	<10	<10	<10	-	-
MTBE	ug/l	10	none	<5	<5	<5	<5	<5	-	-
Benzene	ug/l	none	10	<5	<5	<5	<5	<5	-	-
Toluene	ug/l	525	74	<5	<5	<5	<5	<5	-	-
Ethylbenzene	ug/l	none	none	<5	<5	<5	<5	<5	-	-
m/p-Xylene	ug/l	none	30	<5	<5	<5	<5	<5	-	-
o-Xylene	ug/l	none	30	<5	<5	<5	<5	<5	-	-
EPH (C8-C40)	ug/l	-	-	<10	<10	<10	<10	<10	-	-

Parameter	Units	GTV [1]	EQS 2019 [2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Sulphate as SO4	mg/l	187.5	200	9.8	21.7	20.2	13.2	27.6	-	-
Chloride	mg/l	187.5	250	11.6	9.7	14	8.9	13.1	-	-
Nitrate as NO3	mg/l	37.5	50	14.2	18	25.2	1.9	34.4	-	-
Nitrite as NO2	mg/l	0.375	0.2	<0.02	<0.02	<0.02	<0.02	<0.02	-	-
Ortho Phosphate as PO4	mg/l	none	-	<0.06	<0.06	<0.06	<0.06	<0.06	-	-
Nitrate as N	mg/l	-	-	3.21	4.07	5.69	0.42	7.77	-	-
Nitrite as N	mg/l	-	-	<0.006	<0.006	<0.006	<0.006	<0.006	-	-
Ortho Phosphate as P	mg/l	-	-	<0.03	<0.03	<0.03	<0.03	<0.03	-	-
Total Oxidised Nitrogen as N	mg/l	-	-	3.2	4.1	5.7	0.4	7.8	-	-
Ammoniacal Nitrogen as N	mg/l	none	-	<0.03	<0.03	<0.03	<0.03	<0.03	-	-
Ammoniacal Nitrogen as NH4	mg/l	-	-	<0.03	<0.03	<0.03	0.03	<0.03	-	-
Hexavalent Chromium	ug/l	7.5	3.4	<6	<6	<6	<6	<6	-	-
Total Dissolved Chromium III	ug/l	-	4.7	<6	<6	<6	<6	<6	-	-

Parameter	**Units**	**GTV [1]**	**EQS 2019 [2]**	**GW01**	**GW02**	**GW03**	**GW04**	**GW05**	**SW01**	**WHEEL WASH**
Total Alkalinity as CaCO3	mg/l	-	-	162	212	182	244	262	-	-
COD (Settled)	mg/l	none	-	<7	<7	<7	<7	<7	-	-
Electrical Conductivity @25C	uS/cm	-	-	328	417	406	427	528	-	-
pH	pH units	-	-	7.25	7.67	8.13	8.14	7.72	-	-
Total Suspended Solids	mg/l	none	-	<10	<10	<10	37	38	-	-

1 Groundwater Regulations 2010 (S.I. No. 9 of 2010) and amendment S.I. No. 366/2016.

2 AA-EQS - European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. No. 272/2009 including amendments S.I. No. 327/2012, S.I. No. 386/2015 and S.I. No. 77/2019)

Table 6C-3 - Laboratory Results - April 2022

Parameter	Units	GTV [1]	EQS 2019 [2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Dissolved Arsenic	ug/l	7.5	50	<2.5	<2.5	<2.5	7.4	<2.5	-	-
Dissolved Barium	ug/l	none	100	33	63	13	148	45	-	-
Dissolved Beryllium	ug/l	none	-	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
Dissolved Boron	ug/l	none	2000	<12	<12	<12	<12	<12	-	-
Dissolved Cadmium	ug/l	none	3	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
Dissolved Calcium	mg/l	none	-	51.7	70.9	74	48.5	75.9	-	-
Total Dissolved Chromium	ug/l	37.5	30	<1.5	<1.5	<1.5	<1.5	<1.5	-	-
Dissolved Copper	ug/l	none	30	<7	18	8	<7	<7	-	-
Dissolved Lead	ug/l	7.5	10	<5	<5	<5	<5	25	-	-
Dissolved Magnesium	mg/l	none	-	6.9	7.4	6.1	28.2	4.2	-	-
Dissolved Mercury	ug/l	0.75	1	<1	<1	<1	<1	<1	-	-
Dissolved Nickel	ug/l	none	50	<2	<2	<2	<2	<2	-	-
Dissolved Potassium	mg/l	none	-	0.4	0.4	0.4	0.6	1.8	-	-

Parameter	Units	GTV [1]	EQS 2019 [2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Dissolved Selenium	ug/l	none	-	<3	<3	<3	<3	<3	-	-
Dissolved Sodium	mg/l	none	-	8.7	9.2	9.5	12.4	9.1	-	-
Dissolved Vanadium	ug/l	none	-	<1.5	<1.5	<1.5	<1.5	<1.5	-	-
Dissolved Zinc	ug/l	75	100	3	39	13	<3	18	-	-
GRO (>C4-C8)	ug/l	-	-	<10	<10	<10	<10	<10	-	-
GRO (>C8-C12)	ug/l	-	-	<10	<10	<10	<10	<10	-	-
GRO (>C4-C12)	ug/l	-	-	<10	<10	<10	<10	<10	-	-
MTBE	ug/l	10	none	<5	<5	<5	<5	<5	-	-
Benzene	ug/l	none	10	<5	<5	<5	<5	<5	-	-
Toluene	ug/l	525	74	<5	<5	<5	<5	<5	-	-
Ethylbenzene	ug/l	none	none	<5	<5	<5	<5	<5	-	-
m/p-Xylene	ug/l	none	30	<5	<5	<5	<5	<5	-	-
o-Xylene	ug/l	none	30	<5	<5	<5	<5	<5	-	-
EPH (C8-C40)	ug/l	-	-	<10	<10	<10	<10	<10	-	-

Parameter	Units	GTV [1]	EQS 2019 [2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Sulphate as SO4	mg/l	187.5	200	10.5	22.7	18.1	12.7	33.4	-	-
Chloride	mg/l	187.5	250	12.7	10.3	15.8	9.8	11.1	-	-
Nitrate as NO3	mg/l	37.5	50	14.7	17.5	23.7	<0.2	25.3	-	-
Nitrite as NO2	mg/l	0.375	0.2	<0.02	<0.02	<0.02	<0.02	0.1	-	-
Ortho Phosphate as PO4	mg/l	none	-	<0.06	<0.06	<0.06	<0.06	<0.06	-	-
Nitrate as N	mg/l	-	-	3.32	3.95	5.36	<0.05	5.72	-	-
Nitrite as N	mg/l	-	-	<0.006	<0.006	<0.006	<0.006	0.03	-	-
Ortho Phosphate as P	mg/l	-	-	<0.03	<0.03	<0.03	<0.03	<0.03	-	-
Total Oxidised Nitrogen as N	mg/l	-	-	3.3	3.9	5.4	<0.2	5.7	-	-
Ammoniacal Nitrogen as N	mg/l	none	-	<0.03	<0.03	<0.03	<0.03	0.12	-	-
Ammoniacal Nitrogen as NH4	mg/l	-	-	<0.03	<0.03	<0.03	0.03	0.16	-	-
Hexavalent Chromium	ug/l	7.5	3.4	<6	<6	<6	<6	<6	-	-
Total Dissolved Chromium III	ug/l	-	4.7	<6	<6	<6	<6	<6	-	-

Parameter	Units	GTV [1]	EQS 2019 [2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Total Alkalinity as CaCO3	mg/l	-	-	156	212	188	264	184	-	-
COD (Settled)	mg/l	none	-	<7	<7	<7	<7	11	-	-
Electrical Conductivity @25C	uS/cm	-	-	341	437	442	475	444	-	-
pH	pH units	-	-	7.08	7.64	7.58	8.16	7.82	-	-
Total Suspended Solids	mg/l	none	-	<10	<10	<10	808	196	-	-

1 Groundwater Regulations 2010 (S.I. No. 9 of 2010) and amendment S.I. No. 366/2016.

2 AA-EQS - European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. No. 272/2009 including amendments S.I. No. 327/2012, S.I. No. 386/2015 and S.I. No. 77/2019)

Table 6C-4 - Laboratory Results - October 2022

Parameter	Units	GTV [1]	EQS 2019 [2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Dissolved Arsenic	ug/l	7.5	50	<2.5	<2.5	<2.5	7.8	-	-	-
Dissolved Barium	ug/l	none	100	37	70	13	104	-	-	-
Dissolved Beryllium	ug/l	none	-	<0.5	<0.5	<0.5	<0.5	-	-	-
Dissolved Boron	ug/l	none	2000	<12	<12	<12	<12	-	-	-
Dissolved Cadmium	ug/l	none	3	<0.5	<0.5	<0.5	<0.5	-	-	-
Dissolved Calcium	mg/l	none	-	54	70.9	70.7	49.8	-	-	-
Total Dissolved Chromium	ug/l	37.5	30	<1.5	<1.5	<1.5	<1.5	-	-	-
Dissolved Copper	ug/l	none	30	<7	12	<7	<7	-	-	-
Dissolved Lead	ug/l	7.5	10	<5	<5	<5	<5	-	-	-
Dissolved Magnesium	mg/l	none	-	7	7.4	6	27.7	-	-	-
Dissolved Mercury	ug/l	0.75	1	<1	<1	<1	<1	-	-	-
Dissolved Nickel	ug/l	none	50	<2	<2	<2	<2	-	-	-
Dissolved Potassium	mg/l	none	-	0.5	0.4	0.4	0.6	-	-	-

Parameter	Units	GTV [1]	EQS 2019 [2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Dissolved Selenium	ug/l	none	-	<3	<3	<3	<3	-	-	-
Dissolved Sodium	mg/l	none	-	9.1	9.1	9.5	12	-	-	-
Dissolved Vanadium	ug/l	none	-	<1.5	<1.5	<1.5	<1.5	-	-	-
Dissolved Zinc	ug/l	75	100	4	23	5	3	-	-	-
GRO (>C4-C8)	ug/l	-	-	<10	<10	<10	<10	-	-	-
GRO (>C8-C12)	ug/l	-	-	<10	20	<10	<10	-	-	-
GRO (>C4-C12)	ug/l	-	-	<10	20	<10	<10	-	-	-
MTBE	ug/l	10	none	<5	<5	<5	<5	-	-	-
Benzene	ug/l	none	10	<5	<5	<5	<5	-	-	-
Toluene	ug/l	525	74	<5	<5	<5	<5	-	-	-
Ethylbenzene	ug/l	none	none	<5	<5	<5	<5	-	-	-
m/p-Xylene	ug/l	none	30	<5	<5	<5	<5	-	-	-
o-Xylene	ug/l	none	30	<5	<5	<5	<5	-	-	-
EPH (C8-C40)	ug/l	-		<10	<10	<10	<10	-	-	-

Parameter	Units	GTV [1]	EQS 2019 [2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Sulphate as SO4	mg/l	187.5	200	11.1	21.2	21.3	13	-	-	-
Chloride	mg/l	187.5	250	13.3	10	17.1	9.8	-	-	-
Nitrate as NO3	mg/l	37.5	50	38.3	18.1	24.4	4	-	-	-
Nitrite as NO2	mg/l	0.375	0.2	<0.02	<0.02	<0.02	<0.02	-	-	-
Ortho Phosphate as PO4	mg/l	none	-	<0.06	<0.06	<0.06	<0.06	-	-	-
Nitrate as N	mg/l	-	-	8.64	4.09	5.52	0.91	-	-	-
Nitrite as N	mg/l	-	-	<0.006	<0.006	<0.006	<0.006	-	-	-
Ortho Phosphate as P	mg/l	-	-	<0.03	<0.03	<0.03	<0.03	-	-	-
Total Oxidised Nitrogen as N	mg/l	-	-	8.6	4.1	5.5	0.9	-	-	-
Ammoniacal Nitrogen as N	mg/l	none	-	<0.03	<0.03	<0.03	<0.03	-	-	-
Ammoniacal Nitrogen as NH4	mg/l	-	-	<0.03	<0.03	<0.03	<0.03	-	-	-
Hexavalent Chromium	ug/l	7.5	3.4	<6	<6	<6	<6	-	-	-
Total Dissolved Chromium III	ug/l	-	4.7	<6	<6	<6	<6	-	-	-

Parameter	Units	GTV [1]	EQS 2019 [2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Total Alkalinity as CaCO3	mg/l	-	-	128	192	166	252	-	-	-
COD (Settled)	mg/l	none	-	8	<7	<7	<7	-	-	-
Electrical Conductivity @25C	uS/cm	-	-	375	437	442	485	-	-	-
pH	pH units	-	-	7	7.65	7.57	8.12	-	-	-
Total Suspended Solids	mg/l	none	-	<10	<10	<10	906	-	-	-

1 Groundwater Regulations 2010 (S.I. No. 9 of 2010) and amendment S.I. No. 366/2016.

2 AA-EQS - European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. No. 272/2009 including amendments S.I. No. 327/2012, S.I. No. 386/2015 and S.I. No. 77/2019)

Table 6C-5 - Laboratory Results - March 2023

Parameter	Units	GTV [1]	EQS 2019 [2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Dissolved Arsenic	ug/l	7.5	50	<2.5	<2.5	<2.5	7.2	3.1	-	-
Dissolved Barium	ug/l	none	100	36	68	15	208	22	-	-
Dissolved Beryllium	ug/l	none	-	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
Dissolved Boron	ug/l	none	2000	<12	<12	<12	<12	<12	-	-
Dissolved Cadmium	ug/l	none	3	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
Dissolved Calcium	mg/l	none	-	52.1	74	77	51.7	46.8	-	-
Total Dissolved Chromium	ug/l	37.5	30	<1.5	<1.5	<1.5	<1.5	<1.5	-	-
Dissolved Copper	ug/l	none	30	<7	27	<7	<7	<7	-	-
Dissolved Lead	ug/l	7.5	10	<5	<5	<5	<5	9	-	-
Dissolved Magnesium	mg/l	none	-	7	7.4	6	28.5	2.9	-	-
Dissolved Mercury	ug/l	0.75	1	<1	<1	<1	<1	<1	-	-
Dissolved Nickel	ug/l	none	50	<2	<2	<2	<2	<2	-	-
Dissolved Potassium	mg/l	none	-	0.4	0.4	0.4	0.6	1.4	-	-

Parameter	**Units**	**GTV [1]**	**EQS 2019 [2]**	**GW01**	**GW02**	**GW03**	**GW04**	**GW05**	**SW01**	**WHEEL WASH**
Dissolved Selenium	ug/l	none	-	<3	<3	<3	<3	<3	-	-
Dissolved Sodium	mg/l	none	-	9	9.3	10.1	12.7	8.2	-	-
Dissolved Vanadium	ug/l	none	-	<1.5	<1.5	<1.5	<1.5	<1.5	-	-
Dissolved Zinc	ug/l	75	100	17	56	6	7	15	-	-
GRO (>C4-C8)	ug/l	-	-	<10	<10	<10	<10	<10	-	-
GRO (>C8-C12)	ug/l	-	-	<10	<10	<10	<10	<10	-	-
GRO (>C4-C12)	ug/l	-	-	<10	<10	<10	<10	<10	-	-
MTBE	ug/l	10	none	<5	<5	<5	<5	<5	-	-
Benzene	ug/l	none	10	<5	<5	<5	<5	<5	-	-
Toluene	ug/l	525	74	<5	<5	<5	<5	<5	-	-
Ethylbenzene	ug/l	none	none	<5	<5	<5	<5	<5	-	-
m/p-Xylene	ug/l	none	30	<5	<5	<5	<5	<5	-	-
o-Xylene	ug/l	none	30	<5	<5	<5	<5	<5	-	-
EPH (C8-C40)	ug/l	-	-	<10	<10	<10	<10	<10	-	-

Parameter	Units	GTV [1]	EQS 2019 [2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Sulphate as SO4	mg/l	187.5	200	9.6	21.7	20	12.9	42.1	-	-
Chloride	mg/l	187.5	250	12.5	9.1	15.9	9.1	5.6	-	-
Nitrate as NO3	mg/l	37.5	50	15.6	18.7	25.2	<0.2	16.7	-	-
Nitrite as NO2	mg/l	0.375	0.2	<0.02	<0.02	<0.02	<0.02	0.14	-	-
Ortho Phosphate as PO4	mg/l	none	-	<0.06	<0.06	<0.06	<0.06	0.16	-	-
Nitrate as N	mg/l	-	-	3.53	4.22	5.7	<0.05	3.78	-	-
Nitrite as N	mg/l	-	-	<0.006	<0.006	<0.006	<0.006	0.043	-	-
Ortho Phosphate as P	mg/l	-	-	<0.03	<0.03	<0.03	<0.03	0.05	-	-
Total Oxidised Nitrogen as N	mg/l	-	-	3.5	4.2	5.7	<0.2	3.8	-	-
Ammoniacal Nitrogen as N	mg/l	none	-	<0.03	<0.03	<0.03	<0.03	0.04	-	-
Ammoniacal Nitrogen as NH4	mg/l	-	-	<0.03	<0.03	<0.03	<0.03	0.05	-	-
Hexavalent Chromium	ug/l	7.5	3.4	<6	<6	<6	<6	<6	-	-
Total Dissolved Chromium III	ug/l	-	4.7	<6	<6	<6	<6	<6	-	-

Parameter	Units	GTV [1]	EQS 2019 [2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Total Alkalinity as CaCO3	mg/l	-	-	136	184	166	246	82	-	-
COD (Settled)	mg/l	none	-	<7	<7	<7	<7	<7	-	-
Electrical Conductivity @25C	uS/cm	-	-	354	447	461	491	317	-	-
pH	pH units	-	-	7.15	7.63	7.68	8.17	7.47	-	-
Total Suspended Solids	mg/l	none	-	<10	<10	<10	62	22	-	-

1 Groundwater Regulations 2010 (S.I. No. 9 of 2010) and amendment S.I. No. 366/2016.

2 AA-EQS - European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. No. 272/2009 including amendments S.I. No. 327/2012, S.I. No. 386/2015 and S.I. No. 77/2019)

Table 6C-6 - Laboratory Results - September 2023

Parameter	Units	GTV [1]	EQS 2019 [2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Dissolved Arsenic	ug/l	7.5	50	<2.5	<2.5	<2.5	7.8	<2.5	-	-
Dissolved Barium	ug/l	none	100	36	68	13	185	63	-	-
Dissolved Beryllium	ug/l	none	-	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
Dissolved Boron	ug/l	none	2000	<12	<12	<12	<12	12	-	-
Dissolved Cadmium	ug/l	none	3	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
Dissolved Calcium	mg/l	none	-	54.5	71.9	70.4	49.9	92	-	-
Total Dissolved Chromium	ug/l	37.5	30	<1.5	<1.5	<1.5	<1.5	<1.5	-	-
Dissolved Copper	ug/l	none	30	<7	32	<7	<7	<7	-	-
Dissolved Lead	ug/l	7.5	10	<5	<5	<5	<5	12	-	-
Dissolved Magnesium	mg/l	none	-	7	7.7	5.8	25.5	6.8	-	-
Dissolved Mercury	ug/l	0.75	1	<1	<1	<1	<1	<1	-	-
Dissolved Nickel	ug/l	none	50	<2	<2	<2	<2	<2	-	-
Dissolved Potassium	mg/l	none	-	0.5	0.4	0.4	0.8	2.3	-	-

Parameter	Units	GTV [1]	EQS 2019 [2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Dissolved Selenium	ug/l	none	-	<3	<3	<3	<3	<3	-	-
Dissolved Sodium	mg/l	none	-	8.9	9.2	9.8	12.2	12.5	-	-
Dissolved Vanadium	ug/l	none	-	<1.5	<1.5	<1.5	<1.5	<1.5	-	-
Dissolved Zinc	ug/l	75	100	16	71	4	3	12	-	-
GRO (>C4-C8)	ug/l	-	-	<10	<10	<10	<10	<10	-	-
GRO (>C8-C12)	ug/l	-	-	<10	<10	<10	<10	<10	-	-
GRO (>C4-C12)	ug/l	-	-	<10	<10	<10	<10	<10	-	-
MTBE	ug/l	10	none	<5	<5	<5	<5	<5	-	-
Benzene	ug/l	none	10	<5	<5	<5	<5	<5	-	-
Toluene	ug/l	525	74	<5	<5	<5	<5	<5	-	-
Ethylbenzene	ug/l	none	none	<5	<5	<5	<5	<5	-	-
m/p-Xylene	ug/l	none	30	<5	<5	<5	<5	<5	-	-
o-Xylene	ug/l	none	30	<5	<5	<5	<5	<5	-	-
EPH (C8-C40)	ug/l	-	-	<10	<10	<10	<10	<10	-	-

Parameter	**Units**	**GTV [1]**	**EQS 2019 [2]**	**GW01**	**GW02**	**GW03**	**GW04**	**GW05**	**SW01**	**WHEEL WASH**
Sulphate as SO4	mg/l	187.5	200	10.1	23.3	22.4	13.2	38.9	-	-
Chloride	mg/l	187.5	250	13	9.5	15.4	9.7	15.8	-	-
Nitrate as NO3	mg/l	37.5	50	17.6	18.2	23.9	8.5	66.3	-	-
Nitrite as NO2	mg/l	0.375	0.2	<0.02	<0.02	<0.02	<0.02	0.16	-	-
Ortho Phosphate as PO4	mg/l	none	-	<0.06	<0.06	0.33	<0.06	<0.06	-	-
Nitrate as N	mg/l	-	-	3.98	4.12	5.4	1.92	14.98	-	-
Nitrite as N	mg/l	-	-	<0.006	<0.006	<0.006	<0.006	0.049	-	-
Ortho Phosphate as P	mg/l	-	-	<0.03	<0.03	0.11	<0.03	<0.03	-	-
Total Oxidised Nitrogen as N	mg/l	-	-	4	4.1	5.4	1.9	15	-	-
Ammoniacal Nitrogen as N	mg/l	none	-	0.03	0.05	<0.03	0.03	0.06	-	-
Ammoniacal Nitrogen as NH4	mg/l	-	-	0.04	0.06	<0.03	0.04	0.08	-	-
Hexavalent Chromium	ug/l	7.5	3.4	<6	<6	<6	<6	<6	-	-
Total Dissolved Chromium III	ug/l	-	4.7	<6	<6	<6	<6	<6	-	-

Parameter	Units	GTV [1]	EQS 2019 [2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Total Alkalinity as CaCO3	mg/l	-	-	140	180	164	220	112	-	-
COD (Settled)	mg/l	none	-	<7	<7	<7	<7	8	-	-
Electrical Conductivity @25C	uS/cm	-	-	365	450	438	498	642	-	-
pH	pH units	-	-	7.13	7.69	7.47	8.01	6.92	-	-
Total Suspended Solids	mg/l	none	-	<10	<10	<10	39	97	-	-

1 Groundwater Regulations 2010 (S.I. No. 9 of 2010) and amendment S.I. No. 366/2016.

2 AA-EQS - European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. No. 272/2009 including amendments S.I. No. 327/2012, S.I. No. 386/2015 and S.I. No. 77/2019)

Table 6C-7 - Laboratory Results - August 2024

Parameter	Units	GTV [1]	EQS 2019 [2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Dissolved Arsenic	ug/l	7.5	50	-	<2.5	<2.5	7.9	<2.5	50.2	9.5
Dissolved Barium	ug/l	none	100	-	65	10	191	51	69	126
Dissolved Beryllium	ug/l	none	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dissolved Boron	ug/l	none	2000	-	<12	<12	<12	<12	<12	<12
Dissolved Cadmium	ug/l	none	3	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dissolved Calcium	mg/l	none	-	-	74.8	74.4	50.3	84.7	76.5	64.2
Total Dissolved Chromium	ug/l	37.5	30	-	1.8	<1.5	<1.5	4	<1.5	<1.5
Dissolved Copper	ug/l	none	30	-	31	10	<7	<7	<7	<7
Dissolved Lead	ug/l	7.5	10	-	<5	<5	<5	<5	<5	<5
Dissolved Magnesium	mg/l	none	-	-	8.1	6.1	28.8	6.7	14	19
Dissolved Mercury	ug/l	0.75	1	-	<1	<1	<1	<1	<1	<1
Dissolved Nickel	ug/l	none	50	-	<2	<2	<2	<2	10	2
Dissolved Potassium	mg/l	none	-	-	0.4	0.4	0.7	2.2	2.3	0.4

Parameter	Units	GTV [1]	EQS 2019 [2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Dissolved Selenium	ug/l	none	-	-	<3	<3	<3	<3	<3	<3
Dissolved Sodium	mg/l	none	-	-	9.8	9.9	12.8	15	11.7	34.4
Dissolved Vanadium	ug/l	none	-	-	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Dissolved Zinc	ug/l	75	100	-	90	13	6	43	<3	17
GRO (>C4-C8)	ug/l	-	-	-	<10	<10	<10	<10	<10	<10
GRO (>C8-C12)	ug/l	-	-	-	<10	<10	<10	<10	<10	<10
GRO (>C4-C12)	ug/l	-	-	-	<10	<10	<10	<10	<10	<10
MTBE	ug/l	10	none	-	<5	<5	<5	<5	<5	<5
Benzene	ug/l	none	10	-	<5	<5	<5	<5	<5	<5
Toluene	ug/l	525	74	-	<5	<5	<5	<5	<5	<5
Ethylbenzene	ug/l	none	none	-	<5	<5	<5	<5	<5	<5
m/p-Xylene	ug/l	none	30	-	<5	<5	<5	<5	<5	<5
o-Xylene	ug/l	none	30	-	<5	<5	<5	<5	<5	<5
EPH (C8-C40)	ug/l	-	-	-	<10	<10	<10	<10	<10	<10

Parameter	Units	GTV [1]	EQS 2019 [2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Sulphate as SO4	mg/l	187.5	200	-	27.8	21.3	12.8	40.1	38	20.1
Chloride	mg/l	187.5	250	-	9.4	13.2	9.2	15.3	14.9	77.3
Nitrate as NO3	mg/l	37.5	50	-	15.5	19.5	1.2	47.8	38.6	1.5
Nitrite as NO2	mg/l	0.375	0.2	-	<0.02	<0.02	<0.02	<0.02	1.59	<0.02
Ortho Phosphate as PO4	mg/l	none	-	-	0.11	0.08	0.07	0.06	0.1	0.08
Nitrate as N	mg/l	-	-	-	3.5	4.4	0.28	10.8	8.72	0.34
Nitrite as N	mg/l	-	-	-	<0.006	<0.006	<0.006	<0.006	0.483	<0.006
Ortho Phosphate as P	mg/l	-	-	-	0.04	<0.03	<0.03	<0.03	0.03	<0.03
Total Oxidised Nitrogen as N	mg/l	-	-	-	3.5	4.4	0.3	10.8	9.2	0.3
Ammoniacal Nitrogen as N	mg/l	none	-	-	<0.03	<0.03	<0.03	0.04	1.76	<0.03
Ammoniacal Nitrogen as NH4	mg/l	-	-	-	<0.03	<0.03	<0.03	0.05	2.27	<0.03
Hexavalent Chromium	ug/l	7.5	3.4	-	<6	<6	<6	<6	<6	<6
Total Dissolved Chromium III	ug/l	-	4.7	-	<6	<6	<6	<6	<6	<6

Parameter	Units	GTV [1]	EQS 2019 [2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Total Alkalinity as CaCO3	mg/l	-	-	-	182	182	258	194	184	186
COD (Settled)	mg/l	none	-	-	<7	<7	37	<7	<7	83
Electrical Conductivity @25C	uS/cm	-	-	-	460	443	488	577	549	630
pH	pH units	-	-	-	7.87	7.6	8.06	7.72	8.23	8.08
Total Suspended Solids	mg/l	none	-	-	<10	<10	27	513	<10	22

1 Groundwater Regulations 2010 (S.I. No. 9 of 2010) and amendment S.I. No. 366/2016.

2 AA-EQS - European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. No. 272/2009 including amendments S.I. No. 327/2012, S.I. No. 386/2015 and S.I. No. 77/2019)

Table 6C-8 - Laboratory Results – September 2024

Parameter	Units	GTV [1]	EQS 2019 [2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Dissolved Arsenic	ug/l	7.5	50	<2.5	<2.5	<2.5	15.2	<2.5	51.9	12.6
Dissolved Barium	ug/l	none	100	37	69	11	208	50	69	123
Dissolved Beryllium	ug/l	none	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dissolved Boron	ug/l	none	2000	<12	<12	<12	<12	<12	<12	<12
Dissolved Cadmium	ug/l	none	3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dissolved Calcium	mg/l	none	-	47.1	73.8	69.8	47.3	76.4	77.6	55.4
Total Dissolved Chromium	ug/l	37.5	30	2.5	<1.5	<1.5	3.8	4.4	4.3	1.5
Dissolved Copper	ug/l	none	30	24	25	11	<7	<7	<7	<7
Dissolved Lead	ug/l	7.5	10	<5	<5	<5	<5	<5	<5	<5
Dissolved Magnesium	mg/l	none	-	7.2	7.8	5.6	27.2	6.1	16.7	17.7
Dissolved Mercury	ug/l	0.75	1	<1	<1	<1	<1	<1	<1	<1
Dissolved Nickel	ug/l	none	50	<2	<2	<2	<2	<2	11	<2
Dissolved Potassium	mg/l	none	-	0.4	0.4	0.4	0.6	1.9	2.7	0.4

Parameter	Units	GTV [1]	EQS 2019 [2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Dissolved Selenium	ug/l	none	-	<3	<3	<3	<3	<3	<3	<3
Dissolved Sodium	mg/l	none	-	9.7	9.8	10.1	12.8	19	13.2	36
Dissolved Vanadium	ug/l	none	-	<1.5	<1.5	<1.5	<1.5	2.5	<1.5	<1.5
Dissolved Zinc	ug/l	75	100	83	56	23	<3	20	3	20
GRO (>C4-C8)	ug/l	-	-	<10	<10	<10	<10	<10	<10	<10
GRO (>C8-C12)	ug/l	-	-	<10	<10	<10	<10	11	<10	<10
GRO (>C4-C12)	ug/l	-	-	<10	<10	<10	<10	11	<10	<10
MTBE	ug/l	10	none	<5	<5	<5	<5	<5	<5	<5
Benzene	ug/l	none	10	<5	<5	<5	<5	<5	<5	<5
Toluene	ug/l	525	74	<5	<5	<5	<5	<5	<5	<5
Ethylbenzene	ug/l	none	none	<5	<5	<5	<5	<5	<5	<5
m/p-Xylene	ug/l	none	30	<5	<5	<5	<5	<5	<5	<5
o-Xylene	ug/l	none	30	<5	<5	<5	<5	<5	<5	<5
EPH (C8-C40)	ug/l	-	-	<10	<10	<10	<10	120	<10	<10

Parameter	Units	GTV [1]	EQS 2019 [2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Sulphate as SO4	mg/l	187.5	200	10	26	22.5	12.3	42.6	48.8	22.8
Chloride	mg/l	187.5	250	14.2	9.4	13.2	9.4	14.3	15.2	64.3
Nitrate as NO3	mg/l	37.5	50	15.9	17.2	21.4	<0.2	51.1	50.2	<0.2
Nitrite as NO2	mg/l	0.375	0.2	<0.02	<0.02	<0.02	<0.02	0.02	1.23	<0.02
Ortho Phosphate as PO4	mg/l	none	-	<0.06	0.08	<0.06	<0.06	<0.06	0.68	<0.06
Nitrate as N	mg/l	-	-	3.6	3.89	4.84	<0.05	11.54	11.33	<0.05
Nitrite as N	mg/l	-	-	<0.006	<0.006	<0.006	<0.006	0.007	0.373	<0.006
Ortho Phosphate as P	mg/l	-	-	<0.03	<0.03	<0.03	<0.03	<0.03	0.22	<0.03
Total Oxidised Nitrogen as N	mg/l	-	-	3.6	3.9	4.8	<0.2	11.5	11.7	<0.2
Ammoniacal Nitrogen as N	mg/l	none	-	<0.03	<0.03	<0.03	<0.03	<0.03	1.26	<0.03
Ammoniacal Nitrogen as NH4	mg/l	-	-	<0.03	<0.03	<0.03	<0.03	<0.03	1.62	<0.03
Hexavalent Chromium	ug/l	7.5	3.4	<6	<6	<6	<6	<6	<6	<6
Total Dissolved Chromium III	ug/l	-	4.7	<6	<6	<6	<6	<6	<6	<6

Parameter	Units	GTV [1]	EQS 2019 [2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Total Alkalinity as CaCO3	mg/l	-	-	140	208	170	272	196	194	186
COD (Settled)	mg/l	none	-	<7	<7	<7	<7	<7	<7	<7
Electrical Conductivity @25C	uS/cm	-	-	348	472	459	502	589	301	600
pH	pH units	-	-	7.25	7.63	7.74	8.31	7.82	8.21	8.08
Total Suspended Solids	mg/l	none	-	<10	<10	<10	12	17	<10	<10

1 Groundwater Regulations 2010 (S.I. No. 9 of 2010) and amendment S.I. No. 366/2016.

2 AA-EQS - European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. No. 272/2009 including amendments S.I. No. 327/2012, S.I. No. 386/2015 and S.I. No. 77/2019)

Table 6C-9 - Laboratory Results – October 2024

Parameter	Units	GTV [1]	EQS 2019 [2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Dissolved Arsenic	ug/l	7.5	50	-	-	-	-	-	82	-
Dissolved Barium	ug/l	none	100	-	-	-	-	-	55	-
Dissolved Beryllium	ug/l	none	-	-	-	-	-	-	<0.5	-
Dissolved Boron	ug/l	none	2000	-	-	-	-	-	<12	-
Dissolved Cadmium	ug/l	none	3	-	-	-	-	-	<0.5	-
Dissolved Calcium	mg/l	none	-	-	-	-	-	-	80.9	-
Total Dissolved Chromium	ug/l	37.5	30	-	-	-	-	-	<1.5	-
Dissolved Copper	ug/l	none	30	-	-	-	-	-	<7	-
Dissolved Lead	ug/l	7.5	10	-	-	-	-	-	<5	-
Dissolved Magnesium	mg/l	none	-	-	-	-	-	-	14.2	-
Dissolved Mercury	ug/l	0.75	1	-	-	-	-	-	<1	-
Dissolved Nickel	ug/l	none	50	-	-	-	-	-	14	-
Dissolved Potassium	mg/l	none	-	-	-	-	-	-	1.4	-

Parameter	Units	GTV [1]	EQS 2019 [2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Dissolved Selenium	ug/l	none	-	-	-	-	-	-	<3	-
Dissolved Sodium	mg/l	none	-	-	-	-	-	-	11.1	-
Dissolved Vanadium	ug/l	none	-	-	-	-	-	-	<1.5	-
Dissolved Zinc	ug/l	75	100	-	-	-	-	-	5	-
GRO (>C4-C8)	ug/l	-	-	-	-	-	-	-	<10	-
GRO (>C8-C12)	ug/l	-	-	-	-	-	-	-	<10	-
GRO (>C4-C12)	ug/l	-	-	-	-	-	-	-	<10	-
MTBE	ug/l	10	none	-	-	-	-	-	<5	-
Benzene	ug/l	none	10	-	-	-	-	-	<5	-
Toluene	ug/l	525	74	-	-	-	-	-	<5	-
Ethylbenzene	ug/l	none	none	-	-	-	-	-	<5	-
m/p-Xylene	ug/l	none	30	-	-	-	-	-	<5	-
o-Xylene	ug/l	none	30	-	-	-	-	-	<5	-
EPH (C8-C40)	ug/l	-	-	-	-	-	-	-	<10	-

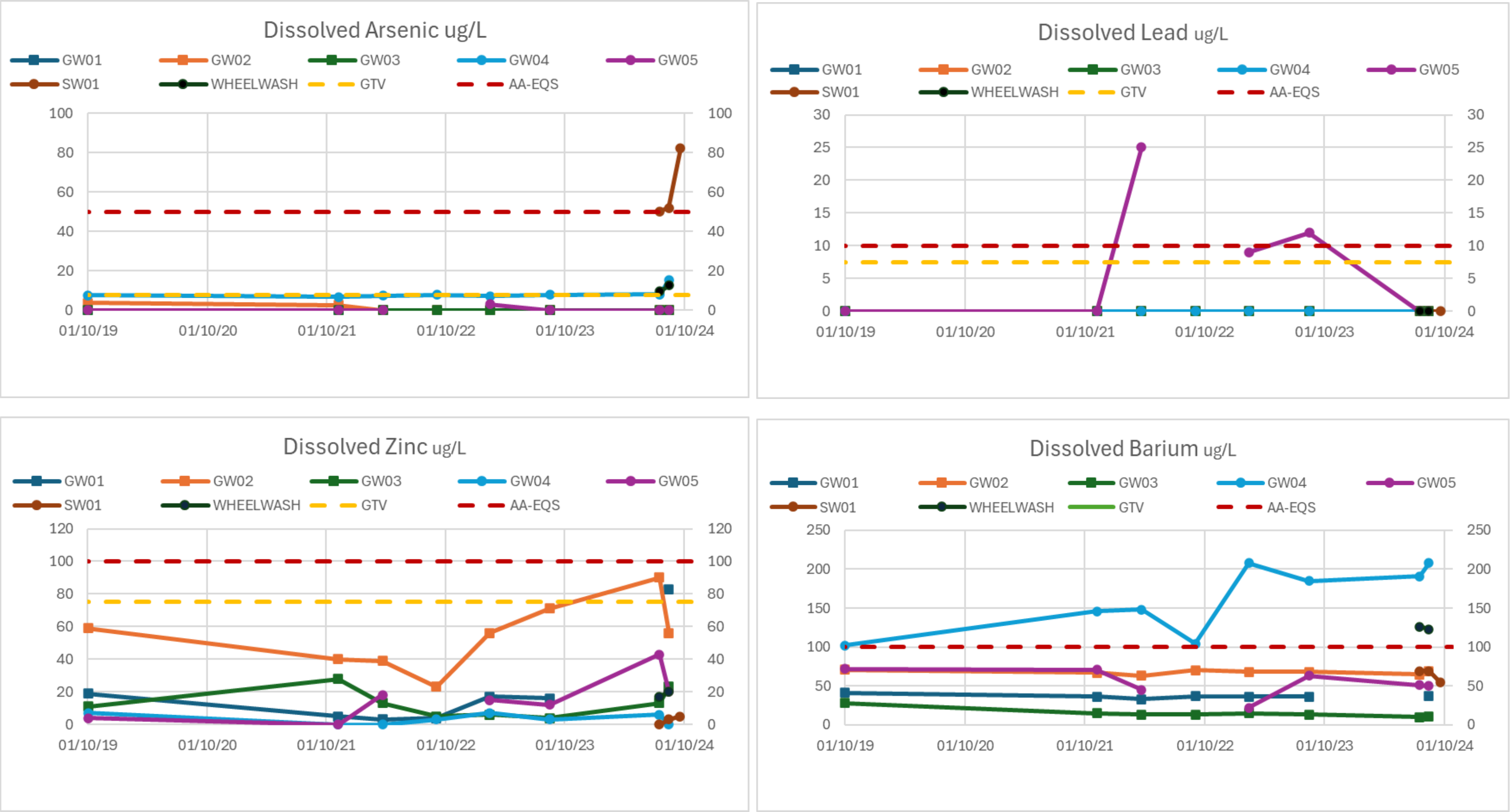
Parameter	Units	GTV [1]	EQS 2019 [2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Sulphate as SO4	mg/l	187.5	200	-	-	-	-	-	54.5	-
Chloride	mg/l	187.5	250	-	-	-	-	-	14	-
Nitrate as NO3	mg/l	37.5	50	-	-	-	-	-	34.6	-
Nitrite as NO2	mg/l	0.375	0.2	-	-	-	-	-	0.14	-
Ortho Phosphate as PO4	mg/l	none	-	-	-	-	-	-	<0.06	-
Nitrate as N	mg/l	-	-	-	-	-	-	-	7.82	-
Nitrite as N	mg/l	-	-	-	-	-	-	-	0.043	-
Ortho Phosphate as P	mg/l	-	-	-	-	-	-	-	<0.03	-
Total Oxidised Nitrogen as N	mg/l	-	-	-	-	-	-	-	7.9	-
Ammoniacal Nitrogen as N	mg/l	none	-	-	-	-	-	-	0.07	-
Ammoniacal Nitrogen as NH4	mg/l	-	-	-	-	-	-	-	0.09	-
Hexavalent Chromium	ug/l	7.5	3.4	-	-	-	-	-	<6	-
Total Dissolved Chromium III	ug/l	-	4.7	-	-	-	-	-	<6	-

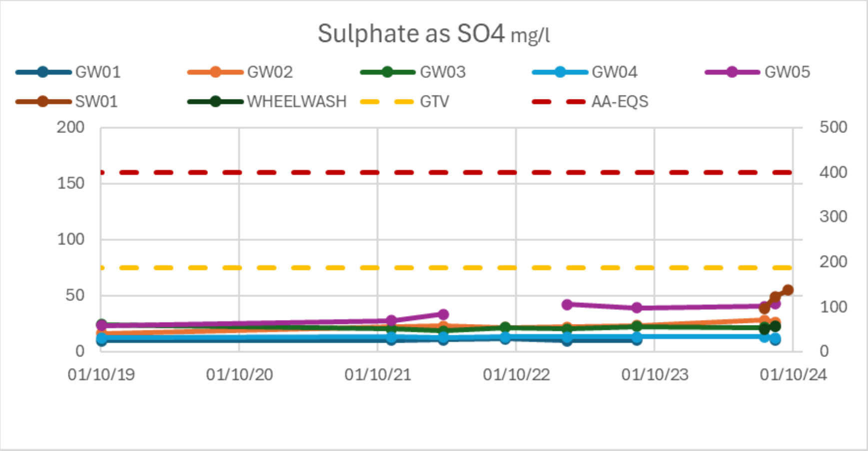
Parameter	Units	GTV [1]	EQS 2019 [2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Total Alkalinity as CaCO3	mg/l	-	-	-	-	-	-	-	204	-
COD (Settled)	mg/l	none	-	-	-	-	-	-	<7	-
Electrical Conductivity @25C	uS/cm	-	-	-	-	-	-	-	549	-
pH	pH units	-	-	-	-	-	-	-	8.11	-
Total Suspended Solids	mg/l	none	-	-	-	-	-	-	<10	-

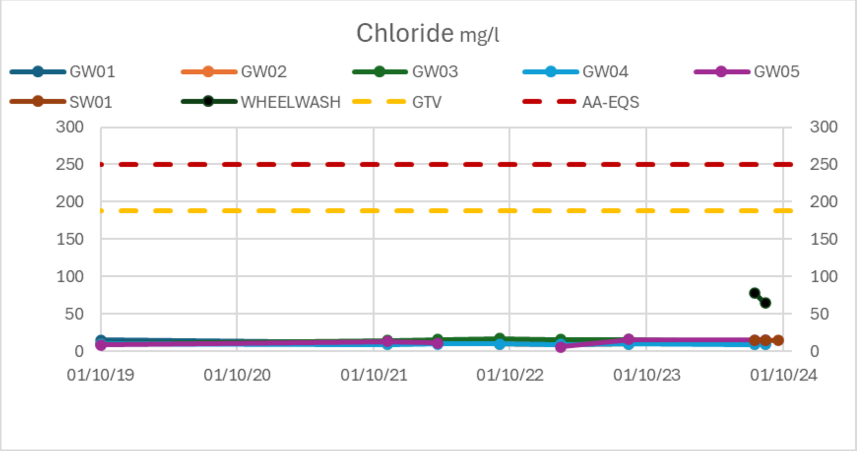
1 Groundwater Regulations 2010 (S.I. No. 9 of 2010) and amendment S.I. No. 366/2016.

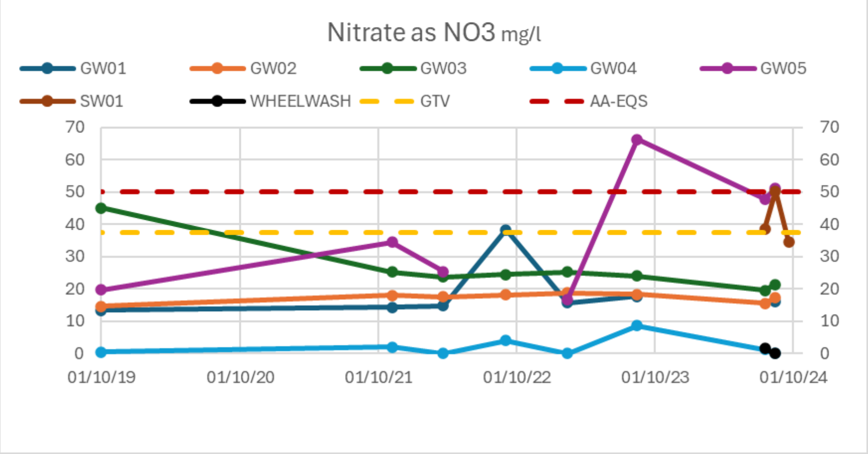
2 AA-EQS - European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. No. 272/2009 including amendments S.I. No. 327/2012, S.I. No. 386/2015 and S.I. No. 77/2019)

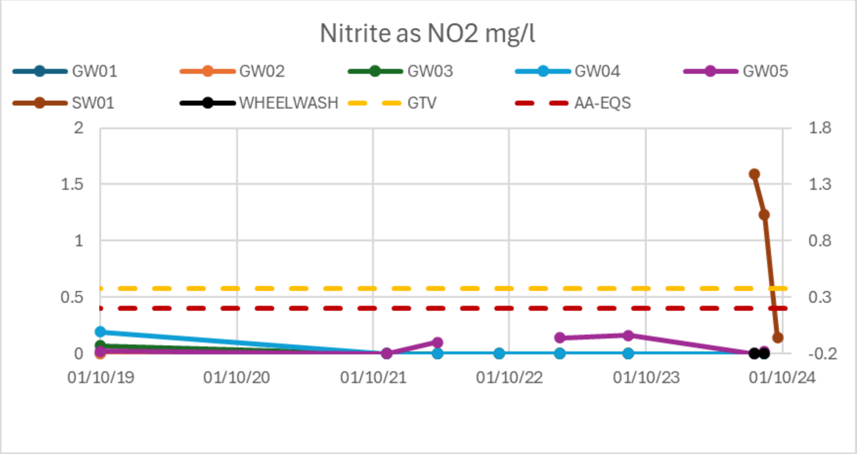
Figure 6C-1 - Time Series Graphs for Sampled Water Quality Parameters Max Values (Nov 2019 to Sep 2024)




Sulphate as SO4 mg/l
GW01
GW02
GW03
GW04
GW05
SW01
WHEELWASH
GTV
AA-EQS
200
150
100
50
0
500
400
300
200
100
0
01/10/19
01/10/20
01/10/21
01/10/22
01/10/23
01/10/24


Chloride mg/l
GW01
GW02
GW03
GW04
GW05
SW01
WHEELWASH
GTV
AA-EQS
300
250
200
150
100
50
0
300
250
200
150
100
50
0
01/10/19
01/10/20
01/10/21
01/10/22
01/10/23
01/10/24


Nitrate as NO3 mg/l
GW01
GW02
GW03
GW04
GW05
SW01
WHEELWASH
GTV
AA-EQS
70
60
50
40
30
20
10
0
70
60
50
40
30
20
10
0
01/10/19
01/10/20
01/10/21
01/10/22
01/10/23
01/10/24


Nitrite as NO2 mg/l
GW01
GW02
GW03
GW04
GW05
SW01
WHEELWASH
GTV
AA-EQS
2
1.5
1
0.5
0
1.8
1.3
0.8
0.3
-0.2
01/10/19
01/10/20
01/10/21
01/10/22
01/10/23
01/10/24

Appendix 6D

WATER QUALITY LABORATORY CERTIFICATES

Element Materials Technology
Unit 3 Deeside Point
Zone 3
Deeside Industrial Park
Deeside
CH5 2UA

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W: www.element.com

WSP Environmental
Citibase Edinburgh Gyleview
Gyleview House
3 Redheughs Rigg
Edinburgh West Office Park
South Gyle
EH12 9DQ

Attention : Emma Gilmartin

Date : 6th April, 2023

Your reference : 40000211

Our reference : Test Report 23/4714 Batch 1

Location : Shillelagh

Date samples received : 24th March, 2023

Status : Final Report

Issue : 1

Five samples were received for analysis on 24th March, 2023 of which five were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Authorised By:

Simon Gomery BSc
Project Manager

Client Name: WSP Environmental
Reference: 40000211
Location: Shillelagh
Contact: Emma Gilmartin
EMT Job No: 23/4714

Report : Liquid

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
H=H_2SO_4, Z=ZnAc, N=NaOH, HN=$HN0_3$

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-6	7-12	13-18	19-24	25-30								
Sample ID	GW1	GW2	GW3	GW4	GW5								
Depth													
COC No / misc													
Containers	V H HN P G	V H HN P G	V H HN P G	V H HN P G	V H HN P G								
Sample Date	22/03/2023	22/03/2023	22/03/2023	22/03/2023	22/03/2023								
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water								
Batch Number	1	1	1	1	1						LOD/LOR	Units	Method No.
Date of Receipt	24/03/2023	24/03/2023	24/03/2023	24/03/2023	24/03/2023								
Dissolved Arsenic#	<2.5	<2.5	<2.5	7.2	3.1						<2.5	ug/l	TM30/PM14
Dissolved Barium#	36	68	15	208	22						<3	ug/l	TM30/PM14
Dissolved Beryllium	<0.5	<0.5	<0.5	<0.5	<0.5						<0.5	ug/l	TM30/PM14
Dissolved Boron	<12	<12	<12	<12	<12						<12	ug/l	TM30/PM14
Dissolved Cadmium#	<0.5	<0.5	<0.5	<0.5	<0.5						<0.5	ug/l	TM30/PM14
Dissolved Calcium#	52.1	74.0	77.0	51.7	46.8						<0.2	mg/l	TM30/PM14
Total Dissolved Chromium#	<1.5	<1.5	<1.5	<1.5	<1.5						<1.5	ug/l	TM30/PM14
Dissolved Copper#	<7	27	<7	<7	<7						<7	ug/l	TM30/PM14
Dissolved Lead#	<5	<5	<5	<5	9						<5	ug/l	TM30/PM14
Dissolved Magnesium#	7.0	7.4	6.0	28.5	2.9						<0.1	mg/l	TM30/PM14
Dissolved Mercury#	<1	<1	<1	<1	<1						<1	ug/l	TM30/PM14
Dissolved Nickel#	<2	<2	<2	<2	<2						<2	ug/l	TM30/PM14
Dissolved Potassium#	0.4	0.4	0.4	0.6	1.4						<0.1	mg/l	TM30/PM14
Dissolved Selenium#	<3	<3	<3	<3	<3						<3	ug/l	TM30/PM14
Dissolved Sodium#	9.0	9.3	10.1	12.7	8.2						<0.1	mg/l	TM30/PM14
Dissolved Vanadium#	<1.5	<1.5	<1.5	<1.5	<1.5						<1.5	ug/l	TM30/PM14
Dissolved Zinc#	17	56	6	7	15						<3	ug/l	TM30/PM14
GRO (>C4-C8)#	<10	<10	<10	<10	<10						<10	ug/l	TM36/PM12
GRO (>C8-C12)#	<10	<10	<10	<10	<10						<10	ug/l	TM36/PM12
GRO (>C4-C12)#	<10	<10	<10	<10	<10						<10	ug/l	TM36/PM12
MTBE#	<5	<5	<5	<5	<5						<5	ug/l	TM36/PM12
Benzene#	<5	<5	<5	<5	<5						<5	ug/l	TM36/PM12
Toluene#	<5	<5	<5	<5	<5						<5	ug/l	TM36/PM12
Ethylbenzene#	<5	<5	<5	<5	<5						<5	ug/l	TM36/PM12
m/p-Xylene#	<5	<5	<5	<5	<5						<5	ug/l	TM36/PM12
o-Xylene#	<5	<5	<5	<5	<5						<5	ug/l	TM36/PM12
EPH (C8-C40)#	<10	<10	<10	<10	<10						<10	ug/l	TM5/PM30
Sulphate as SO4#	9.6	21.7	20.0	12.9	42.1						<0.5	mg/l	TM38/PM0
Chloride#	12.5	9.1	15.9	9.1	5.6						<0.3	mg/l	TM38/PM0
Nitrate as NO3#	15.6	18.7	25.2	<0.2	16.7						<0.2	mg/l	TM38/PM0
Nitrite as NO2#	<0.02	<0.02	<0.02	<0.02	0.14						<0.02	mg/l	TM38/PM0
Ortho Phosphate as PO4#	<0.06	<0.06	<0.06	<0.06	0.16						<0.06	mg/l	TM38/PM0
Nitrate as N#	3.53	4.22	5.70	<0.05	3.78						<0.05	mg/l	TM38/PM0
Nitrite as N#	<0.006	<0.006	<0.006	<0.006	0.043						<0.006	mg/l	TM38/PM0
Ortho Phosphate as P#	<0.03	<0.03	<0.03	<0.03	0.05						<0.03	mg/l	TM38/PM0
Total Oxidised Nitrogen as N#	3.5	4.2	5.7	<0.2	3.8						<0.2	mg/l	TM38/PM0
Ammoniacal Nitrogen as N#	<0.03	<0.03	<0.03	<0.03	0.04						<0.03	mg/l	TM38/PM0
Ammoniacal Nitrogen as NH4#	<0.03	<0.03	<0.03	<0.03	0.05						<0.03	mg/l	TM38/PM0
Hexavalent Chromium	<6	<6	<6	<6	<6						<6	ug/l	TM38/PM0
Total Dissolved Chromium III	<6	<6	<6	<6	<6						<6	ug/l	TM0/PM0

Client Name: WSP Environmental
Reference: 40000211
Location: Shillelagh
Contact: Emma Gilmartin
EMT Job No: 23/4714

Report : **Liquid**

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
$H=H_2SO_4$, Z=ZnAc, N=NaOH, $HN=HN0_3$

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-6	7-12	13-18	19-24	25-30						LOD/LOR	Units	Method No.
Sample ID	GW1	GW2	GW3	GW4	GW5								
Depth													
COC No / misc													
Containers	V H HN P G	V H HN P G	V H HN P G	V H HN P G	V H HN P G								
Sample Date	22/03/2023	22/03/2023	22/03/2023	22/03/2023	22/03/2023								
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water								
Batch Number	1	1	1	1	1								
Date of Receipt	24/03/2023	24/03/2023	24/03/2023	24/03/2023	24/03/2023								
Total Alkalinity as CaCO3 #	136	184	166	246	82						<1	mg/l	TM75/PM0
COD (Settled) #	<7	<7	<7	<7	<7						<7	mg/l	TM57/PM0
Electrical Conductivity @25C #	354	447	461	491	317						<2	uS/cm	TM76/PM0
pH #	7.15	7.63	7.68	8.17	7.47						<0.01	pH units	TM73/PM0
Total Suspended Solids #	<10	<10	<10	62	22						<10	mg/l	TM37/PM0

Client Name: WSP Environmental
Reference: 40000211
Location: Shillelagh
Contact: Emma Gilmartin

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
No deviating sample report results for job 23/4714						

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.
Only analyses which are accredited are recorded as deviating if set criteria are not met.

EMT Job No.: 23/4714

SOILS and ASH

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. Asbestos samples are retained for 6 months.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C. Ash samples are dried at 37°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

STACK EMISSIONS

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation for Dioxins and Furans and Dioxin like PCBs has been performed on XAD-2 Resin, only samples which use this resin will be within our MCERTS scope.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.
Laboratory records are kept for a period of no less than 6 years.

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

Customer Provided Information

Sample ID and depth is information provided by the customer.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above quantitative calibration range. The result should be considered the minimum value and is indicative only. The actual result could be significantly higher.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

HWOL ACRONYMS AND OPERATORS USED

HS	Headspace Analysis.
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent.
CU	Clean-up - e.g. by florisil, silica gel.
1D	GC - Single coil gas chromatography.
Total	Aliphatics & Aromatics.
AL	Aliphatics only.
AR	Aromatics only.
2D	GC-GC - Double coil gas chromatography.
#1	EH_Total but with humics mathematically subtracted
#2	EU_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +).
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total
MS	Mass Spectrometry.

EMT Job No: 23/4714

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM0	Not available	PM0	No preparation is required.				
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM14	Preparation of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for Dissolved metals, and remain unfiltered for Total metals then acidified				
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM14	Preparation of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for Dissolved metals, and remain unfiltered for Total metals then acidified	Yes			
TM36	Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested.	PM12	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM37	Modified methods - TSS: USEPA 160.2 (1983), EN872:2005 and APHA SMEWW 2540D:1999 22nd Edition; VSS: USEPA 1684 (Jan 2001), USEPA 160.4 (1971) and SMEWW 2540E:1999 22nd Edition. Gravimetric determination of Total Suspended Solids (TSS) and Volatile Suspended Solids (VSS). Sample is filtered through a 1.5um pore size glass fibre filter and the resulting residue is dried and weighed at 105°C for TSS and 550°C for VSS	PM0	No preparation is required.	Yes			
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l	PM0	No preparation is required.				
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l	PM0	No preparation is required.	Yes			
TM57	Modified US EPA Method 410.4. (Rev. 2.0 1993) Comparable with ISO 15705:2002. Chemical Oxygen Demand is determined by hot digestion with Potassium Dichromate and measured spectrophotometerically.	PM0	No preparation is required.	Yes			
TM73	Modified US EPA methods 150.1 (1982) and 9045D Rev. 4 - 2004) and BS1377-3:1990. Determination of pH by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			

EMT Job No: 23/4714

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM75	Modified US EPA method 310.1 (1978). Determination of Alkalinity by Metrohm automated titration analyser.	PM0	No preparation is required.	Yes			
TM76	Modified US EPA method 120.1 (1982). Determination of Specific Conductance by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			

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WSP Environmental
Town Centre House
Dublin Road
Naas
Co Kildare
Ireland

4225

Attention : Emma Gilmartin

Date : 9th October, 2023

Your reference : Sillelagh Blessigton

Our reference : Test Report 23/15870 Batch 1

Location : Shillelagh Quarries

Date samples received : 26th September, 2023

Status : Final Report

Issue : 1

Five samples were received for analysis on 26th September, 2023 of which five were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

The greenhouse gas emissions generated (in Carbon – Co2e) to obtain the results in this report are estimated as:

Scope 1&2 emissions - 7.964 kg of CO2

Scope 1&2&3 emissions - 18.821 kg of CO2

Authorised By:

Simon Gomery BSc
Senior Project Manager

Element Materials Technology

Client Name: WSP Environmental
Reference: Sillelagh Blessigton
Location: Shillelagh Quarries
Contact: Emma Gilmartin
EMT Job No: 23/15870

Report : Liquid

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
$H=H_2SO_4$, Z=ZnAc, N=NaOH, $HN=HN0_3$

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-6	7-12	13-18	19-24	25-30						LOD/LOR	Units	Method No.
Sample ID	GW5	GW3	GW2	GW4	GW1								
Depth													
COC No / misc													
Containers	V H HN P G	V H HN P G	V H HN P G	V H HN P G	V H HN P G								
Sample Date	21/09/2023	21/09/2023	21/09/2023	21/09/2023	21/09/2023								
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water								
Batch Number	1	1	1	1	1								
Date of Receipt	26/09/2023	26/09/2023	26/09/2023	26/09/2023	26/09/2023								
Dissolved Arsenic#	<2.5	<2.5	<2.5	7.8	<2.5						<2.5	ug/l	TM30/PM14
Dissolved Barium#	63	13	68	185	36						<3	ug/l	TM30/PM14
Dissolved Beryllium	<0.5	<0.5	<0.5	<0.5	<0.5						<0.5	ug/l	TM30/PM14
Dissolved Boron	12	<12	<12	<12	<12						<12	ug/l	TM30/PM14
Dissolved Cadmium#	<0.5	<0.5	<0.5	<0.5	<0.5						<0.5	ug/l	TM30/PM14
Dissolved Calcium#	92.0	70.4	71.9	49.9	54.5						<0.2	mg/l	TM30/PM14
Total Dissolved Chromium#	<1.5	<1.5	<1.5	<1.5	<1.5						<1.5	ug/l	TM30/PM14
Dissolved Copper#	<7	<7	32	<7	<7						<7	ug/l	TM30/PM14
Dissolved Lead#	12	<5	<5	<5	<5						<5	ug/l	TM30/PM14
Dissolved Magnesium#	6.8	5.8	7.7	25.5	7.0						<0.1	mg/l	TM30/PM14
Dissolved Mercury#	<1	<1	<1	<1	<1						<1	ug/l	TM30/PM14
Dissolved Nickel#	<2	<2	<2	<2	<2						<2	ug/l	TM30/PM14
Dissolved Potassium#	2.3	0.4	0.4	0.8	0.5						<0.1	mg/l	TM30/PM14
Dissolved Selenium#	<3	<3	<3	<3	<3						<3	ug/l	TM30/PM14
Dissolved Sodium#	12.5	9.8	9.2	12.2	8.9						<0.1	mg/l	TM30/PM14
Dissolved Vanadium#	<1.5	<1.5	<1.5	<1.5	<1.5						<1.5	ug/l	TM30/PM14
Dissolved Zinc#	12	4	71	3	16						<3	ug/l	TM30/PM14
GRO (>C4-C8)#	<10	<10	<10	<10	<10						<10	ug/l	TM36/PM12
GRO (>C8-C12)#	<10	<10	<10	<10	<10						<10	ug/l	TM36/PM12
GRO (>C4-C12)#	<10	<10	<10	<10	<10						<10	ug/l	TM36/PM12
MTBE#	<5	<5	<5	<5	<5						<5	ug/l	TM36/PM12
Benzene#	<5	<5	<5	<5	<5						<5	ug/l	TM36/PM12
Toluene#	<5	<5	<5	<5	<5						<5	ug/l	TM36/PM12
Ethylbenzene#	<5	<5	<5	<5	<5						<5	ug/l	TM36/PM12
m/p-Xylene#	<5	<5	<5	<5	<5						<5	ug/l	TM36/PM12
o-Xylene#	<5	<5	<5	<5	<5						<5	ug/l	TM36/PM12
EPH (C8-C40)#	<10	<10	<10	<10	<10						<10	ug/l	TM5/PM30
Sulphate as SO4#	38.9	22.4	23.3	13.2	10.1						<0.5	mg/l	TM38/PM0
Chloride#	15.8	15.4	9.5	9.7	13.0						<0.3	mg/l	TM38/PM0
Nitrate as NO3#	66.3	23.9	18.2	8.5	17.6						<0.2	mg/l	TM38/PM0
Nitrite as NO2#	0.16	<0.02	<0.02	<0.02	<0.02						<0.02	mg/l	TM38/PM0
Ortho Phosphate as PO4#	<0.06	0.33	<0.06	<0.06	<0.06						<0.06	mg/l	TM38/PM0
Nitrate as N#	14.98	5.40	4.12	1.92	3.98						<0.05	mg/l	TM38/PM0
Nitrite as N#	0.049	<0.006	<0.006	<0.006	<0.006						<0.006	mg/l	TM38/PM0
Ortho Phosphate as P#	<0.03	0.11	<0.03	<0.03	<0.03						<0.03	mg/l	TM38/PM0
Total Oxidised Nitrogen as N#	15.0	5.4	4.1	1.9	4.0						<0.2	mg/l	TM38/PM0
Ammoniacal Nitrogen as N#	0.06	<0.03	0.05	0.03	0.03						<0.03	mg/l	TM38/PM0
Ammoniacal Nitrogen as NH4#	0.08	<0.03	0.06	0.04	0.04						<0.03	mg/l	TM38/PM0
Hexavalent Chromium	<6	<6	<6	<6	<6						<6	ug/l	TM38/PM0
Total Dissolved Chromium III	<6	<6	<6	<6	<6						<6	ug/l	TM0/PM0

Client Name: WSP Environmental
Reference: Sillelagh Blessigton
Location: Shillelagh Quarries
Contact: Emma Gilmartin
EMT Job No: 23/15870

Report : **Liquid**

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
H=H_2SO_4, Z=ZnAc, N=NaOH, HN=$HN0_3$

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-6	7-12	13-18	19-24	25-30						LOD/LOR	Units	Method No.
Sample ID	GW5	GW3	GW2	GW4	GW1								
Depth													
COC No / misc													
Containers	V H HN P G	V H HN P G	V H HN P G	V H HN P G	V H HN P G								
Sample Date	21/09/2023	21/09/2023	21/09/2023	21/09/2023	21/09/2023								
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water								
Batch Number	1	1	1	1	1								
Date of Receipt	26/09/2023	26/09/2023	26/09/2023	26/09/2023	26/09/2023								
Total Alkalinity as CaCO3 #	112	164	180	220	140						<1	mg/l	TM75/PM0
COD (Settled) #	8	<7	<7	<7	<7						<7	mg/l	TM57/PM0
Electrical Conductivity @25C #	642	438	450	498	365						<2	uS/cm	TM76/PM0
pH #	6.92	7.47	7.69	8.01	7.13						<0.01	pH units	TM73/PM0
Total Suspended Solids #	97	<10	<10	39	<10						<10	mg/l	TM37/PM0

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

Element Materials Technology **Notification of Deviating Samples**

Client Name: WSP Environmental
Reference: Sillelagh Blessigton
Location: Shillelagh Quarries
Contact: Emma Gilmartin

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
No deviating sample report results for job 23/15870						

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating. Only analyses which are accredited are recorded as deviating if set criteria are not met.
It is a requirement under ISO 17025 that we inform clients if samples are deviating i.e. outside what is expected. A deviating sample indicates that the sample 'may' be compromised but not necessarily will be compromised. The result is still accredited and our analytical reports will still show accreditation on the relevant analytes.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 23/15870

SOILS and ASH

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. Asbestos samples are retained for 6 months.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C. Ash samples are dried at 37°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

STACK EMISSIONS

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation for Dioxins and Furans and Dioxin like PCBs has been performed on XAD-2 Resin, only samples which use this resin will be within our MCERTS scope.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a requirement of our Accreditation Body for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.
Laboratory records are kept for a period of no less than 6 years.

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

Customer Provided Information

Sample ID and depth is information provided by the customer.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above quantitative calibration range. The result should be considered the minimum value and is indicative only. The actual result could be significantly higher.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

HWOL ACRONYMS AND OPERATORS USED

HS	Headspace Analysis.
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent.
CU	Clean-up - e.g. by florisil, silica gel.
1D	GC - Single coil gas chromatography.
Total	Aliphatics & Aromatics.
AL	Aliphatics only.
AR	Aromatics only.
2D	GC-GC - Double coil gas chromatography.
#1	EH_Total but with humics mathematically subtracted
#2	EU_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +).
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total
MS	Mass Spectrometry.

EMT Job No: 23/15870

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM0	Not available	PM0	No preparation is required.				
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM14	Preparation of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for Dissolved metals, and remain unfiltered for Total metals then acidified				
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM14	Preparation of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for Dissolved metals, and remain unfiltered for Total metals then acidified	Yes			
TM36	Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested.	PM12	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM37	Modified methods - TSS: USEPA 160.2 (1983), EN872:2005 and APHA SMEWW 2540D:1999 22nd Edition; VSS: USEPA 1684 (Jan 2001), USEPA 160.4 (1971) and SMEWW 2540E:1999 22nd Edition. Gravimetric determination of Total Suspended Solids (TSS) and Volatile Suspended Solids (VSS). Sample is filtered through a 1.5um pore size glass fibre filter and the resulting residue is dried and weighed at 105°C for TSS and 550°C for VSS	PM0	No preparation is required.	Yes			
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l	PM0	No preparation is required.				
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l	PM0	No preparation is required.	Yes			
TM57	Modified US EPA Method 410.4. (Rev. 2.0 1993) Comparable with ISO 15705:2002. Chemical Oxygen Demand is determined by hot digestion with Potassium Dichromate and measured spectrophotometerically.	PM0	No preparation is required.	Yes			
TM73	Modified US EPA methods 150.1 (1982) and 9045D Rev. 4 - 2004) and BS1377-3:1990. Determination of pH by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			

EMT Job No: 23/15870

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM75	Modified US EPA method 310.1 (1978). Determination of Alkalinity by Metrohm automated titration analyser.	PM0	No preparation is required.	Yes			
TM76	Modified US EPA method 120.1 (1982). Determination of Specific Conductance by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			

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WSP Environmental
Town Centre House
Dublin Road
Naas
Co Kildare
Ireland

UKAS TESTING 4225

Attention : Zak Bursey

Date : 9th September, 2024

Your reference : 40000211

Our reference : Test Report 24/14690 Batch 1

Location : Shillelagh Hemstown

Date samples received : 28th August, 2024

Status : Final Report

Issue : 202409091039

Six samples were received for analysis on 28th August, 2024 of which six were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

The greenhouse gas emissions generated (in Carbon – Co2e) to obtain the results in this report are estimated as:

Scope 1&2 emissions - 9.702 kg of CO2

Scope 1&2&3 emissions - 22.927 kg of CO2

Authorised By:

Paul Boden BSc

Senior Project Manager

Client Name: WSP Environmental
Reference: 40000211
Location: Shillelagh Hemstown
Contact: Zak Bursey
EMT Job No: 24/14690

Report : **Liquid**

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
H=H_2SO_4, Z=ZnAc, N=NaOH, HN=$HN0_3$

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-6	7-10	11-18	19-24	25-30	31-36							
Sample ID	WHEELWASH	GW02	GW03	GW04	GW05	SW01							
Depth													
COC No / misc													
Containers	V H HN P G	H HN P G	V H HN P G	V H HN P G	V H HN P G	V H HN P G							
Sample Date	23/08/2024	23/08/2024	23/08/2024	23/08/2024	23/08/2024	23/08/2024							
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Surface Water							
Batch Number	1	1	1	1	1	1					LOD/LOR	Units	Method No.
Date of Receipt	28/08/2024	28/08/2024	28/08/2024	28/08/2024	28/08/2024	28/08/2024							
Dissolved Arsenic #	9.5	<2.5	<2.5	7.9	<2.5	50.2					<2.5	ug/l	TM30/PM14
Dissolved Barium #	126	65	10	191	51	69					<3	ug/l	TM30/PM14
Dissolved Beryllium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5					<0.5	ug/l	TM30/PM14
Dissolved Boron	<12	<12	<12	<12	<12	<12					<12	ug/l	TM30/PM14
Dissolved Cadmium #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5					<0.5	ug/l	TM30/PM14
Dissolved Calcium #	64.2	74.8	74.4	50.3	84.7	76.5					<0.2	mg/l	TM30/PM14
Total Dissolved Chromium #	<1.5	1.8	<1.5	<1.5	4.0	<1.5					<1.5	ug/l	TM30/PM14
Dissolved Copper #	<7	31	10	<7	<7	<7					<7	ug/l	TM30/PM14
Dissolved Lead #	<5	<5	<5	<5	<5	<5					<5	ug/l	TM30/PM14
Dissolved Magnesium #	19.0	8.1	6.1	28.8	6.7	14.0					<0.1	mg/l	TM30/PM14
Dissolved Mercury #	<1	<1	<1	<1	<1	<1					<1	ug/l	TM30/PM14
Dissolved Nickel #	2	<2	<2	<2	<2	10					<2	ug/l	TM30/PM14
Dissolved Potassium #	0.4	0.4	0.4	0.7	2.2	2.3					<0.1	mg/l	TM30/PM14
Dissolved Selenium #	<3	<3	<3	<3	<3	<3					<3	ug/l	TM30/PM14
Dissolved Sodium #	34.4	9.8	9.9	12.8	15.0	11.7					<0.1	mg/l	TM30/PM14
Dissolved Vanadium #	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5					<1.5	ug/l	TM30/PM14
Dissolved Zinc #	17	90	13	6	43	<3					<3	ug/l	TM30/PM14
GRO (>C4-C8) (HS_1D_Total) #	<10	<10	<10	<10	<10	<10					<10	ug/l	TM36/PM12
GRO (>C8-C12) (HS_1D_Total) #	<10	<10	<10	<10	<10	<10					<10	ug/l	TM36/PM12
GRO (>C4-C12) (HS_1D_Total) #	<10	<10	<10	<10	<10	<10					<10	ug/l	TM36/PM12
MTBE #	<5	<5	<5	<5	<5	<5					<5	ug/l	TM36/PM12
Benzene #	<5	<5	<5	<5	<5	<5					<5	ug/l	TM36/PM12
Toluene #	<5	<5	<5	<5	<5	<5					<5	ug/l	TM36/PM12
Ethylbenzene #	<5	<5	<5	<5	<5	<5					<5	ug/l	TM36/PM12
m/p-Xylene #	<5	<5	<5	<5	<5	<5					<5	ug/l	TM36/PM12
o-Xylene #	<5	<5	<5	<5	<5	<5					<5	ug/l	TM36/PM12
EPH (C8-C40) (EH_1D_Total) #	<10	<10	<10	<10	<10	<10					<10	ug/l	TM5/PM30
Sulphate as SO4 #	20.1	27.8	21.3	12.8	40.1	38.0					<0.5	mg/l	TM38/PM0
Chloride #	77.3	9.4	13.2	9.2	15.3	14.9					<0.3	mg/l	TM38/PM0
Nitrate as NO3 #	1.5	15.5	19.5	1.2	47.8	38.6					<0.2	mg/l	TM38/PM0
Nitrite as NO2 #	<0.02	<0.02	<0.02	<0.02	<0.02	1.59					<0.02	mg/l	TM38/PM0
Ortho Phosphate as PO4 #	0.08	0.11	0.08	0.07	0.06	0.10					<0.06	mg/l	TM38/PM0
Nitrate as N #	0.34	3.50	4.40	0.28	10.80	8.72					<0.05	mg/l	TM38/PM0
Nitrite as N #	<0.006	<0.006	<0.006	<0.006	<0.006	0.483					<0.006	mg/l	TM38/PM0
Ortho Phosphate as P #	<0.03	0.04	<0.03	<0.03	<0.03	0.03					<0.03	mg/l	TM38/PM0
Total Oxidised Nitrogen as N #	0.3	3.5	4.4	0.3	10.8	9.2					<0.2	mg/l	TM38/PM0
Ammoniacal Nitrogen as N #	<0.03	<0.03	<0.03	<0.03	0.04	1.76					<0.03	mg/l	TM38/PM0
Ammoniacal Nitrogen as NH4 #	<0.03	<0.03	<0.03	<0.03	0.05	2.27					<0.03	mg/l	TM38/PM0
Hexavalent Chromium	<6	<6	<6	<6	<6	<6					<6	ug/l	TM38/PM0
Total Dissolved Chromium III	<6	<6	<6	<6	<6	<6					<6	ug/l	TM0/PM0

Client Name: WSP Environmental
Reference: 40000211
Location: Shillelagh Hemstown
Contact: Zak Bursey
EMT Job No: 24/14690

Report : **Liquid**

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
H=H_2SO_4, Z=ZnAc, N=NaOH, HN=$HN0_3$

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-6	7-10	11-18	19-24	25-30	31-36					LOD/LOR	Units	Method No.
Sample ID	WHEELWASH	GW02	GW03	GW04	GW05	SW01							
Depth													
COC No / misc													
Containers	V H HN P G	H HN P G	V H HN P G	V H HN P G	V H HN P G	V H HN P G							
Sample Date	23/08/2024	23/08/2024	23/08/2024	23/08/2024	23/08/2024	23/08/2024							
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Surface Water							
Batch Number	1	1	1	1	1	1							
Date of Receipt	28/08/2024	28/08/2024	28/08/2024	28/08/2024	28/08/2024	28/08/2024							
Total Alkalinity as CaCO3 #	186	182	182	258	194	184					<1	mg/l	TM75/PM0
COD (Settled) #	83	<7	<7	37	<7	<7					<7	mg/l	TM57/PM0
Electrical Conductivity @25C #	630	460	443	488	577	549					<2	uS/cm	TM76/PM0
pH #	8.08	7.87	7.60	8.06	7.72	8.23					<0.01	pH units	TM73/PM0
Total Suspended Solids #	22	<10	<10	27	513	<10					<10	mg/l	TM37/PM0

Client Name: WSP Environmental
Reference: 40000211
Location: Shillelagh Hemstown
Contact: Zak Bursey

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
No deviating sample report results for job 24/14690						

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating. Only analyses which are accredited are recorded as deviating if set criteria are not met.
It is a requirement under ISO 17025 that we inform clients if samples are deviating i.e. outside what is expected. A deviating sample indicates that the sample 'may' be compromised but not necessarily will be compromised. The result is still accredited and our analytical reports will still show accreditation on the relevant analytes.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 24/14690

SOILS and ASH

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. Asbestos samples are retained for 6 months.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C. Ash samples are dried at 35°C ±5°C.

Where Mineral Oil is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil is quoted, this refers to Total Aliphatics C10-C40.

STACK EMISSIONS

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation for Dioxins and Furans and Dioxin like PCBs has been performed on XAD-2 Resin, only samples which use this resin will be within our MCERTS scope.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a requirement of our Accreditation Body for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.
Laboratory records are kept for a period of no less than 6 years.

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

Customer Provided Information

Sample ID and depth is information provided by the customer.

Age of Diesel

The age of release estimation is based on the nC17/pristane ratio only as prescribed by Christensen and Larsen (1993) and Kaplan, Galperin, Alimi et al., (1996).
Age estimation should be treated with caution as it can be influenced by site specific factors of which the laboratory are not aware.

Tentatively Identified Compounds (TICs)

Where Tentatively Identified Compounds (TICs) are reported, up to 10 Tentatively Identified Compounds will be listed where there is found to be a greater than 80% match with the NIST library. The reported concentration is determined semi-quantitively, with a matrix specific limit of detection. Note, other compounds may be present but are not reported.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above quantitative calibration range. The result should be considered the minimum value and is indicative only. The actual result could be significantly higher.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

HWOL ACRONYMS AND OPERATORS USED

HS	Headspace Analysis.
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent.
CU	Clean-up - e.g. by florisil, silica gel.
1D	GC - Single coil gas chromatography.
Total	Aliphatics & Aromatics.
AL	Aliphatics only.
AR	Aromatics only.
2D	GC-GC - Double coil gas chromatography.
#1	EH_Total but with humics mathematically subtracted
#2	EU_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +).
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total
MS	Mass Spectrometry.

EMT Job No: 24/14690

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM0	Not available	PM0	No preparation is required.				
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM14	Preparation of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for Dissolved metals, and remain unfiltered for Total metals then acidified				
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM14	Preparation of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for Dissolved metals, and remain unfiltered for Total metals then acidified	Yes			
TM36	Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested.	PM12	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM37	Modified methods - TSS: USEPA 160.2 (1983), EN872:2005 and APHA SMEWW 2540D:1999 22nd Edition; VSS: USEPA 1684 (Jan 2001), USEPA 160.4 (1971) and SMEWW 2540E:1999 22nd Edition. Gravimetric determination of Total Suspended Solids (TSS) and Volatile Suspended Solids (VSS). Sample is filtered through a 1.5um pore size glass fibre filter and the resulting residue is dried and weighed at 105°C for TSS and 550°C for VSS	PM0	No preparation is required.	Yes			
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l	PM0	No preparation is required.				
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l	PM0	No preparation is required.	Yes			
TM57	Modified US EPA Method 410.4. (Rev. 2.0 1993) Comparable with ISO 15705:2002. Chemical Oxygen Demand is determined by hot digestion with Potassium Dichromate and measured spectrophotometerically.	PM0	No preparation is required.	Yes			
TM73	Modified US EPA methods 150.1 (1982) and 9045D Rev. 4 - 2004) and BS1377-3:1990. Determination of pH by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			

EMT Job No: 24/14690

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM75	Modified US EPA method 310.1 (1978). Determination of Alkalinity by Metrohm automated titration analyser.	PM0	No preparation is required.	Yes			
TM76	Modified US EPA method 120.1 (1982). Determination of Specific Conductance by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			

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WSP Environmental
Town Centre House
Dublin Road
Naas
Co Kildare
Ireland

Attention : John Moran

Date : 2nd October, 2024

Your reference : 40000211

Our reference : Test Report 24/16277 Batch 1

Location : Shillelagh Hempstown

Date samples received : 24th September, 2024

Status : Final Report

Issue : 202410021052

Eight samples were received for analysis on 24th September, 2024 of which eight were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

The greenhouse gas emissions generated (in Carbon – Co2e) to obtain the results in this report are estimated as:

Scope 1&2 emissions - 12.742 kg of CO2

Scope 1&2&3 emissions - 30.114 kg of CO2

Authorised By:

Simon Gomery BSc
Senior Project Manager

Client Name:	WSP Environmental	**Report :**	**Liquid**
Reference:	40000211		
Location:	Shillelagh Hempstown		
Contact:	John Moran	**Liquids/products:**	V=40ml vial, G=glass bottle, P=plastic bottle
EMT Job No:	24/16277		H=H_2SO_4, Z=ZnAc, N=NaOH, HN=$HN0_3$

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-6	7-12	13-18	19-24	25-30	31-36	37-42	43-48					
Sample ID	Wheelwash	GW01	GW02	GW03	GW04	GW05	SW01	DUP01					
Depth													
COC No / misc													
Containers	V H HN P G	V H HN P G	V H HN P G	V H HN P G	V H HN P G	V H HN P G	V H HN P G	V H HN P G					
Sample Date	20/09/2024	20/09/2024	20/09/2024	20/09/2024	20/09/2024	20/09/2024	20/09/2024	20/09/2024					
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Surface Water	Ground Water					
Batch Number	1	1	1	1	1	1	1	1			LOD/LOR	Units	Method No.
Date of Receipt	24/09/2024	24/09/2024	24/09/2024	24/09/2024	24/09/2024	24/09/2024	24/09/2024	24/09/2024					
Dissolved Arsenic #	12.6	<2.5	<2.5	<2.5	15.2	<2.5	51.9	<2.5			<2.5	ug/l	TM30/PM14
Dissolved Barium #	123	37	69	11	208	50	69	63			<3	ug/l	TM30/PM14
Dissolved Beryllium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5			<0.5	ug/l	TM30/PM14
Dissolved Boron	<12	<12	<12	<12	<12	<12	<12	<12			<12	ug/l	TM30/PM14
Dissolved Cadmium #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5			<0.5	ug/l	TM30/PM14
Dissolved Calcium #	55.4	47.1	73.8	69.8	47.3	76.4	77.6	74.7			<0.2	mg/l	TM30/PM14
Total Dissolved Chromium #	1.5	2.5	<1.5	<1.5	3.8	4.4	4.3	<1.5			<1.5	ug/l	TM30/PM14
Dissolved Copper #	<7	24	25	11	<7	<7	<7	16			<7	ug/l	TM30/PM14
Dissolved Lead #	<5	<5	<5	<5	<5	<5	<5	<5			<5	ug/l	TM30/PM14
Dissolved Magnesium #	17.7	7.2	7.8	5.6	27.2	6.1	16.7	8.2			<0.1	mg/l	TM30/PM14
Dissolved Mercury #	<1	<1	<1	<1	<1	<1	<1	<1			<1	ug/l	TM30/PM14
Dissolved Nickel #	<2	<2	<2	<2	<2	<2	11	<2			<2	ug/l	TM30/PM14
Dissolved Potassium #	0.4	0.4	0.4	0.4	0.6	1.9	2.7	0.4			<0.1	mg/l	TM30/PM14
Dissolved Selenium #	<3	<3	<3	<3	<3	<3	<3	<3			<3	ug/l	TM30/PM14
Dissolved Sodium #	36.0	9.7	9.8	10.1	12.8	19.0	13.2	10.4			<0.1	mg/l	TM30/PM14
Dissolved Vanadium #	<1.5	<1.5	<1.5	<1.5	<1.5	2.5	<1.5	<1.5			<1.5	ug/l	TM30/PM14
Dissolved Zinc #	20	83	56	23	<3	20	3	37			<3	ug/l	TM30/PM14
GRO (>C4-C8) (HS_1D_Total) #	<10	<10	<10	<10	<10	<10	<10	<10			<10	ug/l	TM36/PM12
GRO (>C8-C12) (HS_1D_Total) #	<10	<10	<10	<10	<10	11	<10	<10			<10	ug/l	TM36/PM12
GRO (>C4-C12) (HS_1D_Total) #	<10	<10	<10	<10	<10	11	<10	<10			<10	ug/l	TM36/PM12
MTBE #	<5	<5	<5	<5	<5	<5	<5	<5			<5	ug/l	TM36/PM12
Benzene #	<5	<5	<5	<5	<5	<5	<5	<5			<5	ug/l	TM36/PM12
Toluene #	<5	<5	<5	<5	<5	<5	<5	<5			<5	ug/l	TM36/PM12
Ethylbenzene #	<5	<5	<5	<5	<5	<5	<5	<5			<5	ug/l	TM36/PM12
m/p-Xylene #	<5	<5	<5	<5	<5	<5	<5	<5			<5	ug/l	TM36/PM12
o-Xylene #	<5	<5	<5	<5	<5	<5	<5	<5			<5	ug/l	TM36/PM12
EPH (C8-C40) (EH_1D_Total) #	<10	<10	<10	<10	<10	120	<10	<10			<10	ug/l	TM5/PM30
Sulphate as SO4 #	22.8	10.0	26.0	22.5	12.3	42.6	48.8	26.4			<0.5	mg/l	TM38/PM0
Chloride #	64.3	14.2	9.4	13.2	9.4	14.3	15.2	9.5			<0.3	mg/l	TM38/PM0
Nitrate as NO3 #	<0.2	15.9	17.2	21.4	<0.2	51.1	50.2	17.2			<0.2	mg/l	TM38/PM0
Nitrite as NO2 #	<0.02	<0.02	<0.02	<0.02	<0.02	0.02	1.23	<0.02			<0.02	mg/l	TM38/PM0
Ortho Phosphate as PO4 #	<0.06	<0.06	0.08	<0.06	<0.06	<0.06	0.68	<0.06			<0.06	mg/l	TM38/PM0
Nitrate as N #	<0.05	3.60	3.89	4.84	<0.05	11.54	11.33	3.89			<0.05	mg/l	TM38/PM0
Nitrite as N #	<0.006	<0.006	<0.006	<0.006	<0.006	0.007	0.373	<0.006			<0.006	mg/l	TM38/PM0
Ortho Phosphate as P #	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.22	<0.03			<0.03	mg/l	TM38/PM0
Total Oxidised Nitrogen as N #	<0.2	3.6	3.9	4.8	<0.2	11.5	11.7	3.9			<0.2	mg/l	TM38/PM0
Ammoniacal Nitrogen as N #	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	1.26	<0.03			<0.03	mg/l	TM38/PM0
Ammoniacal Nitrogen as NH4 #	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	1.62	<0.03			<0.03	mg/l	TM38/PM0
Hexavalent Chromium	<6	<6	<6	<6	<6	<6	<6	<6			<6	ug/l	TM38/PM0
Total Dissolved Chromium III	<6	<6	<6	<6	<6	<6	<6	<6			<6	ug/l	TM0/PM0

Client Name: WSP Environmental
Reference: 40000211
Location: Shillelagh Hempstown
Contact: John Moran
EMT Job No: 24/16277

Report : **Liquid**

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
$H=H_2SO_4$, Z=ZnAc, N=NaOH, $HN=HN0_3$

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-6	7-12	13-18	19-24	25-30	31-36	37-42	43-48					
Sample ID	Wheelwash	GW01	GW02	GW03	GW04	GW05	SW01	DUP01					
Depth													
COC No / misc													
Containers	V H HN P G	V H HN P G	V H HN P G	V H HN P G	V H HN P G	V H HN P G	V H HN P G	V H HN P G					
Sample Date	20/09/2024	20/09/2024	20/09/2024	20/09/2024	20/09/2024	20/09/2024	20/09/2024	20/09/2024					
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Surface Water	Ground Water					
Batch Number	1	1	1	1	1	1	1	1			LOD/LOR	Units	Method No.
Date of Receipt	24/09/2024	24/09/2024	24/09/2024	24/09/2024	24/09/2024	24/09/2024	24/09/2024	24/09/2024					
Total Alkalinity as CaCO3#	186	140	208	170	272	196	194	202			<1	mg/l	TM75/PM0
COD (Settled)#	<7	<7	<7	<7	<7	<7	<7	7			<7	mg/l	TM57/PM0
Electrical Conductivity @25C#	600	348	472	459	502	589	301	238			<2	uS/cm	TM76/PM0
pH#	8.08	7.25	7.63	7.74	8.31	7.82	8.21	7.67			<0.01	pH units	TM73/PM0
Total Suspended Solids#	<10	<10	<10	<10	12	17	<10	<10			<10	mg/l	TM37/PM0

Client Name:	WSP Environmental
Reference:	40000211
Location:	Shillelagh Hempstown
Contact:	John Moran

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
No deviating sample report results for job 24/16277						

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating. Only analyses which are accredited are recorded as deviating if set criteria are not met.
It is a requirement under ISO 17025 that we inform clients if samples are deviating i.e. outside what is expected. A deviating sample indicates that the sample 'may' be compromised but not necessarily will be compromised. The result is still accredited and our analytical reports will still show accreditation on the relevant analytes.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 24/16277

SOILS and ASH

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. Asbestos samples are retained for 6 months.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C. Ash samples are dried at 35°C ±5°C.

Where Mineral Oil is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil is quoted, this refers to Total Aliphatics C10-C40.

STACK EMISSIONS

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation for Dioxins and Furans and Dioxin like PCBs has been performed on XAD-2 Resin, only samples which use this resin will be within our MCERTS scope.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a requirement of our Accreditation Body for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.
Laboratory records are kept for a period of no less than 6 years.

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

Customer Provided Information

Sample ID and depth is information provided by the customer.

Age of Diesel

The age of release estimation is based on the nC17/pristane ratio only as prescribed by Christensen and Larsen (1993) and Kaplan, Galperin, Alimi et al., (1996).
Age estimation should be treated with caution as it can be influenced by site specific factors of which the laboratory are not aware.

Tentatively Identified Compounds (TICs)

Where Tentatively Identified Compounds (TICs) are reported, up to 10 Tentatively Identified Compounds will be listed where there is found to be a greater than 80% match with the NIST library. The reported concentration is determined semi-quantitively, with a matrix specific limit of detection. Note, other compounds may be present but are not reported.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above quantitative calibration range. The result should be considered the minimum value and is indicative only. The actual result could be significantly higher.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

HWOL ACRONYMS AND OPERATORS USED

HS	Headspace Analysis.
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent.
CU	Clean-up - e.g. by florisil, silica gel.
1D	GC - Single coil gas chromatography.
Total	Aliphatics & Aromatics.
AL	Aliphatics only.
AR	Aromatics only.
2D	GC-GC - Double coil gas chromatography.
#1	EH_Total but with humics mathematically subtracted
#2	EU_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +).
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total
MS	Mass Spectrometry.

EMT Job No: 24/16277

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM0	Not available	PM0	No preparation is required.				
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma-Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM14	Preparation of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for Dissolved metals, and remain unfiltered for Total metals then acidified				
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma-Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM14	Preparation of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for Dissolved metals, and remain unfiltered for Total metals then acidified	Yes			
TM36	Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested.	PM12	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM37	Modified methods - TSS: USEPA 160.2 (1983), EN872:2005 and APHA SMEWW 2540D:1999 22nd Edition; VSS: USEPA 1684 (Jan 2001), USEPA 160.4 (1971) and SMEWW 2540E:1999 22nd Edition. Gravimetric determination of Total Suspended Solids (TSS) and Volatile Suspended Solids (VSS). Sample is filtered through a 1.5um pore size glass fibre filter and the resulting residue is dried and weighed at 105°C for TSS and 550°C for VSS.	PM0	No preparation is required.	Yes			
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) - All anions comparable to BS ISO 15923-1: 2013l	PM0	No preparation is required.				
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) - All anions comparable to BS ISO 15923-1: 2013l	PM0	No preparation is required.	Yes			
TM57	Modified US EPA Method 410.4. (Rev. 2.0 1993) Comparable with ISO 15705:2002. Chemical Oxygen Demand is determined by hot digestion with Potassium Dichromate and measured spectrophotometerically.	PM0	No preparation is required.	Yes			
TM73	Modified US EPA methods 150.1 (1982) and 9045D Rev. 4 - 2004) and BS1377-3:1990. Determination of pH by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			

EMT Job No: 24/16277

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM75	Modified US EPA method 310.1 (1978). Determination of Alkalinity by Metrohm automated titration analyser.	PM0	No preparation is required.	Yes			
TM76	Modified US EPA method 120.1 (1982). Determination of Specific Conductance by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			

6.0 WATER

6.1 Introduction

This chapter of the EIAR provides an assessment of the hydrological and hydrogeological aspects of the proposed pit extension works at Shillelagh Quarry (the 'Site'), including pre-extension 'baseline' conditions and consideration of the potential impacts of extension upon the surrounding surface water and groundwater environments. The extension proposes to expand the current operational pit to the north-eastern boundary of the application area.

Hydrological and hydrogeological aspects considered within this chapter include: characterisation of the current and planned Site activities and water usage; local hydrological system; identification of any hydrological receptors; surface water quality; characterisation of the underlying hydrogeological regime at the Site; groundwater vulnerability; aquifer status; other water users; and groundwater quality. The potential impacts upon the water environment have been assessed for impacts associated with the pit extension activities at the Site. Appropriate mitigation measures are proposed to offset possible negative impacts associated with the proposed works.

6.2 Study Methodology

The hydrogeological and hydrological impacts associated with the proposed pit excavation works at the Site were assessed by means of a desk study of the Site (review of available information), a number of freely available technical references (e.g. Geological Survey of Ireland (GSI) on-line publications), communications with the Applicant (Shillelagh Quarries Limited) review of an existing "Assessment of the Potential Impacts of the Continued Development of the Quarry upon the Water Environment" report for the Site (Included as Appendix V of Byrne (2008) submitted to Kildare County Council Planning Department in February 2008) and data from fieldwork carried out at the Site (e.g. Installation of groundwater monitoring wells and monitoring of groundwater monitoring boreholes. A list of the information referenced as part of the desk study is presented in Section 6.10.

6.3 Current Site Activities and Water Management

The Site is an operational greywacke and shale quarry which is seeking planning approval for an extension to the area of aggregate extraction.

The current on-Site activities within the application area are located in the north and west of the application area and largely comprises aggregate extraction (which is reported to be intermittently flooded after heavy rainfall events), aggregate sorting and processing (including rock crushing), site office and adjoining serviced welfare facilities, weighbridge, wheelwash and settlement pond areas. The east of the application area is currently largely used for overburden storage and planned for phased restoration to a sloped surface and seeded for future grassland habitat. It is noted that the eastern area contains a residential property (including private abstraction well) which is proposed to be decommissioned as part of the site restoration works. The Site location, project description and site structure are discussed further in Chapters 1.0 and 2.0 of this EIAR.

On-site water usage is currently reported to be 'low' by the Applicant and summarised as follows:

- When flooding of the quarry floor occurs (noted to be intermittent and largely as a result of heavy rainfall events), water is pumped from the quarry floor to an outfall area where overflow is drained under gravity via a drainage ditch to a soakaway area in the eastern portion of the Site (see Section 6.4.3.4);
- Seasonal dust suppression occurs as required using water which is abstracted from a sump in the quarry floor;

- An abstraction well (see Figure 6-12) was installed adjacent to the Site access road in 2019 to provide supply to the wheelwash and welfare facilities;
- Wheelwashing occurs prior to vehicles leaving the Site and utilises abstracted groundwater which is recycled within the wash as far as practicable and topped up from the borehole when required;
- Welfare facilities feed into an inbuilt tank and foul water/waste is removed off-Site on a regular basis by a liquid waste contractor;
- Private abstraction occurs at a residential property in the east of the Site area ('GW1', see Figure 6-12); and
- There is no washing of aggregate on-Site and therefore no water requirement associated with processing.

6.4 Existing Environment

The area around the Site is characterised as rural with land uses in the area being mainly agricultural, industrial, forestry and single-house residential land. Immediately surrounding the Site, the land is agricultural (predominantly pasture lands) and industrial with a precast concrete manufacturing facility (Stresslite Floors ltd.) immediately adjacent to the southwest of the Site. There are scattered residential properties in the vicinity of the site, mostly adjacent to the L6030 roadway. The L6030 roadway is a privately owned roadway which also provided access to the site from the south. It connects to the N81, national road. The nearest town to the Site is Blessington which is located approximately 4 km to the south of the Site via the N81 roadway. The Site is located in an area of historical quarrying activities. The existing operational quarry had been in use since the mid-1940's. The aggregate produced is used to supply to the construction industry and support the continued development of the local area and surrounding counties as a whole.

6.4.1 Geology

The geology of the Site is characterised in detail in Chapter 5.0 of this EIAR (Soils and Geology). Borehole logs are also provided as an Appendix to Chapter 5.0. The Site is reported to be underlain by clayey sands and gravels. This unit has an average depth of 3 m bGL in the vicinity of the Site but is logged to a maximum depth of 9 m bGL in GW5. The thickness of sand and gravel deposits are generally reported to increase in thickness to the south of the Site, with up to 100 m reported in the Blessington area (BCL, 2008). The sand and gravel deposits are underlain by the Pollaphuca Formation which comprises coarse, graded greywackes and shales, from which further mineral extraction is proposed by the Applicant.

6.4.2 Surface Water- Hydrology

6.4.2.1 Rainfall

Table 6-1 presents rainfall data recorded at the Blessington (Hempstown) meteorological station (number 8623), which is located approximately 1 km south of the Site, for the period 1999 to 2019 (Met Eireann, 2019). The average rainfall value for the area is 994 mm/a. GSI mapping (2019) indicates an effective rainfall (i.e. subject to evapotranspiration) value of 546 mm/a for the area (see Section 6.4.3.3).

Table 6-1: Rainfall Data for Blessington (Hempstown) 1999 - 2019

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Rainfall (mm/a)	989	1090	739	1166	866	946	855	962	1065	1228
Year	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Rainfall (mm/a)	1246	888	941	1271	862	1153	991	869	908	843

6.4.2.2 Topography

The site is situated to the west of the Wicklow Mountain range which peak at an elevation of 925 m AOD at Lugnaquilla which is 30km south of the Site. The closest peak, in this range, to the Site is Kippure which reaches a maximum elevation of 757 m AOD and is located approximately 12.5 km to the west of the Site.

The Site is located on the southeast facing slope of a southwest-northeast trending ridge of hills. This hill ridge reaches a peak to the north of the Site at Cupidstown Hill which has an elevation of 379 m AOD (located 2.5 km to the northeast of the Site). The slope decreases in elevation towards the Pollaphuca Reservoir which sits at an elevation of 184 m AOD.

The existing topography in the vicinity of the Site varies in level from ca. 235 to 295 m OD, with the topography rising towards the north of the Site.

6.4.2.3 Local Surface Water Features and Designations

The Site is located in the WFD (Water Framework Directive) Kilcullen Groundwater body (which is generally described as poorly productive) and the WFD Catchment for Liffey and Dublin Bay.

Approximately 900m to the north of the site is the origin of the Hartwell stream in the form of several springs which flow north west. Additionally, several other headwaters (Hempstown Commons, Slate Quarries, Punchestown Lower) are located approximately 800m to the north west of the site which flow north to feed the Hartwell stream. The Hartwell stream flows west where it meets the Rathmore stream approximately 3.5 km (straight line distance) north west of the site.

The Goldenhill river is located within 1.3 km to the east of the Site and flows to the south to the Pollaphuca Reservoir (locally known as Blessington lake). Approximately 2.5 km to the west of the is the River Brittas which also flows south joining the River Liffey before also feeding the Pollaphuca Reservoir. The Pollaphuca Reservoir is located approximately 2.8 km to the south of the Site and is used for water supply and electricity generation (surface area approx. 1,946m^2).

Topography suggests that any runoff from the Site could eventually contribute to the Goldenhill river, although due to the relative distance and current vegetated nature of the area surrounding the Site, it is considered likely that runoff would infiltrate to ground prior to reaching the Goldenhill river.

6.4.2.4 Local Surface Water Quality

The WFD Status and River Quality (Q) Values of each of the rivers, as assigned by the EPA are shown in Figure 6-1 and summarised in Figure 6-2.

Two hydrological systems are present in the vicinity of the Site. To the northwest a series of springs joins the Harwell stream before flowing into the Rathmore stream which flows in a northerly direction. The Water Framework Directive (WFD) River Waterbody Status (2013-2018) of this upper section of the Rathmore stream network is classified as Poor. The River Q values is 3-4 (moderate) in the Harwell Stream and 3 (poor) in the Rathmore stream. Further downstream after the Harwell Stream joins the Rathmore stream the Q value increases to 4 (good).

To the east of the Site both the Goldenhill stream and, the River Brittas and River Liffey flow south to feed into the Pollaphuca Reservoir. The Goldenhill stream is unclassified by the WFD and no River Q Values are given. The River Brittas has a WFD status of Good and a River Q value of 3-4 (moderate). Further downstream the River Liffey also has a WFD status of Good but the River Q values increase to 4-5 (good). The Pollaphuca reservoir has a WFD status of good and an Ecological Status of Good and is oligotrophic/mesotrophic.

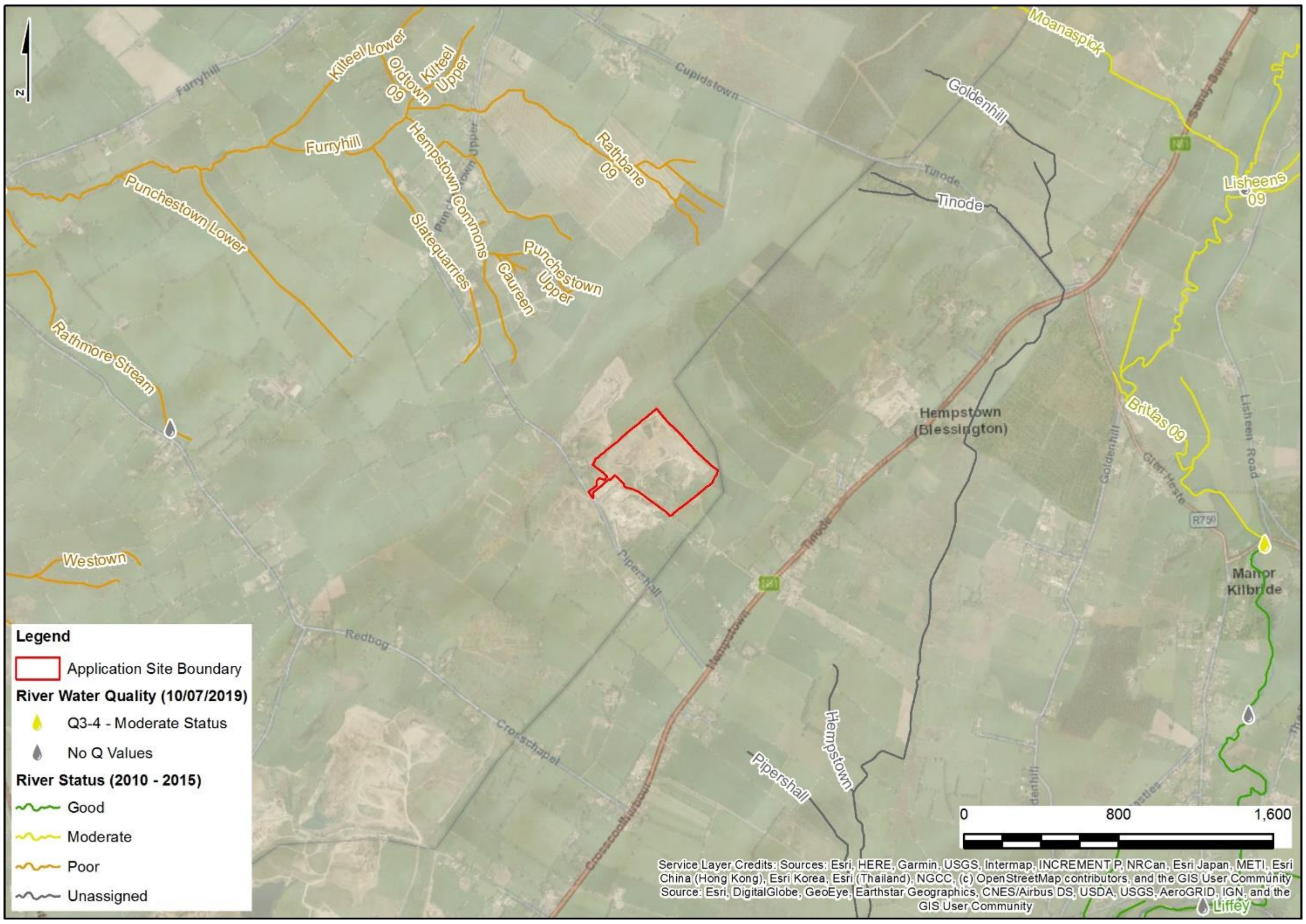


Figure 6-1: Local surface water features with WFD status (2013-2018) and river Q values (GSI, 2019)

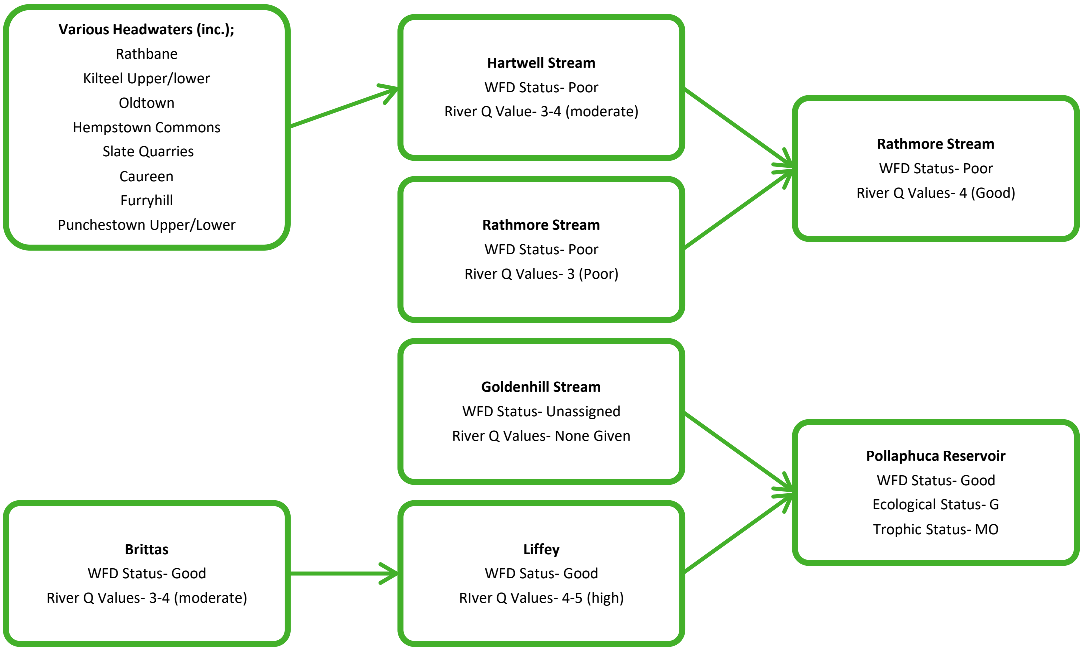


Figure 6-2: River network in the vicinity of the Site with WFD Status (2013-2018) and River Q values (GSI, 2019).

6.4.3 Groundwater- Hydrogeology

6.4.3.1 Aquifer Designation, Classification & Properties

Bedrock aquifer designations, as presented in GSI mapping (2019), are shown in Figure 6-3. Bedrock underlying the footprint of the Site (the Pollaphuca Formation) is classified as a ‘Pl’ poor aquifer which is described as “generally unproductive except for local zones”. Bedrock to the immediate north and west of the Site boundary is classified as a ‘Pu’ poor aquifer which is described as “generally unproductive” without localised zones of increased permeability / water bearing potential.

Where localised zones of increased permeability / water bearing potential are not present, poor aquifers are generally characterised by having a poor fissure network resulting in “poor aquifer storage, short flow paths (tens of metres) and low ‘recharge acceptance’. Groundwater discharge to streams (‘baseflow’) is very limited” (DELG, EPA, GSI, 1999).

Within 0.4 km to the west of the Site the bedrock aquifer designation changes to a ‘locally important’ aquifer (LI) within the Lucan formation; a designation indicating bedrock which is moderately productive only in local zones. Karst features are noted within this formation at Portarlington, 9 km west of Site.

Estimated values for hydraulic conductivity for the bedrock geology can be found in literature. Table 6-2 summarises the hydraulic conductivity for shale and cemented sandstone as found in Driscoll (1986).

Table 6-2: Hydraulic conductivity values (Driscoll, 1986)

Rock Type	Hydraulic Conductivity Ranges	
Shale	1.00×10^{-4} m/d **1.16×10^{-9} m/s**	1.00×10^{-9} m/d **1.16×10^{-14} m/s**
Sandstone (cemented)	1.00×10^{-5} m/d **1.16×10^{-10} m/s**	1.00×10^{-3} m/d **1.16×10^{-8} m/s**

As part of the 2008 hydrogeological investigation (BCL, 2008) as assessment of the hydraulic conductivity of the Pollaphuca Formation was undertaken and was reported as 5.25×10^{-7} m/s (0.045 m/d). It is noted that this value is elevated compared to the literature values for similar geology and the observed pit inflows, and therefore is given little confidence as a representative value for the bedrock.

Superficial aquifer designations, as presented in GSI mapping (2019), are shown in Figure 6-4. Superficial deposits underlying the footprint of the Site (where present) are not designated as an aquifer due to the thin nature of the deposits (<10 m thickness). The closest designated aquifer within the superficial deposits is a ‘locally important’ gravel aquifer located approximately 0.7 km to the south-west of Site, close to Blessington, and forms the ‘Blessington Gravels’ groundwater body.

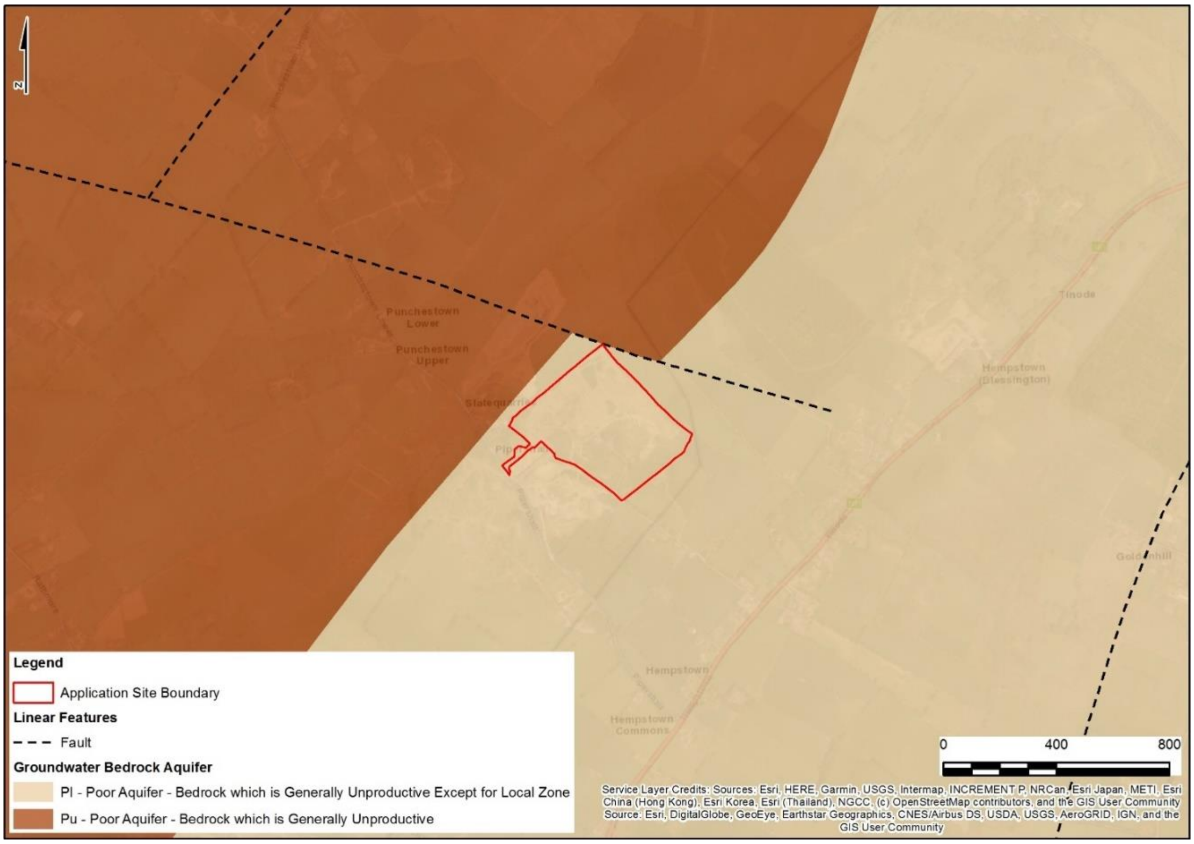


Figure 6-3: Bedrock aquifers around the Site (Site boundary in red).
Source: GSI, 2019

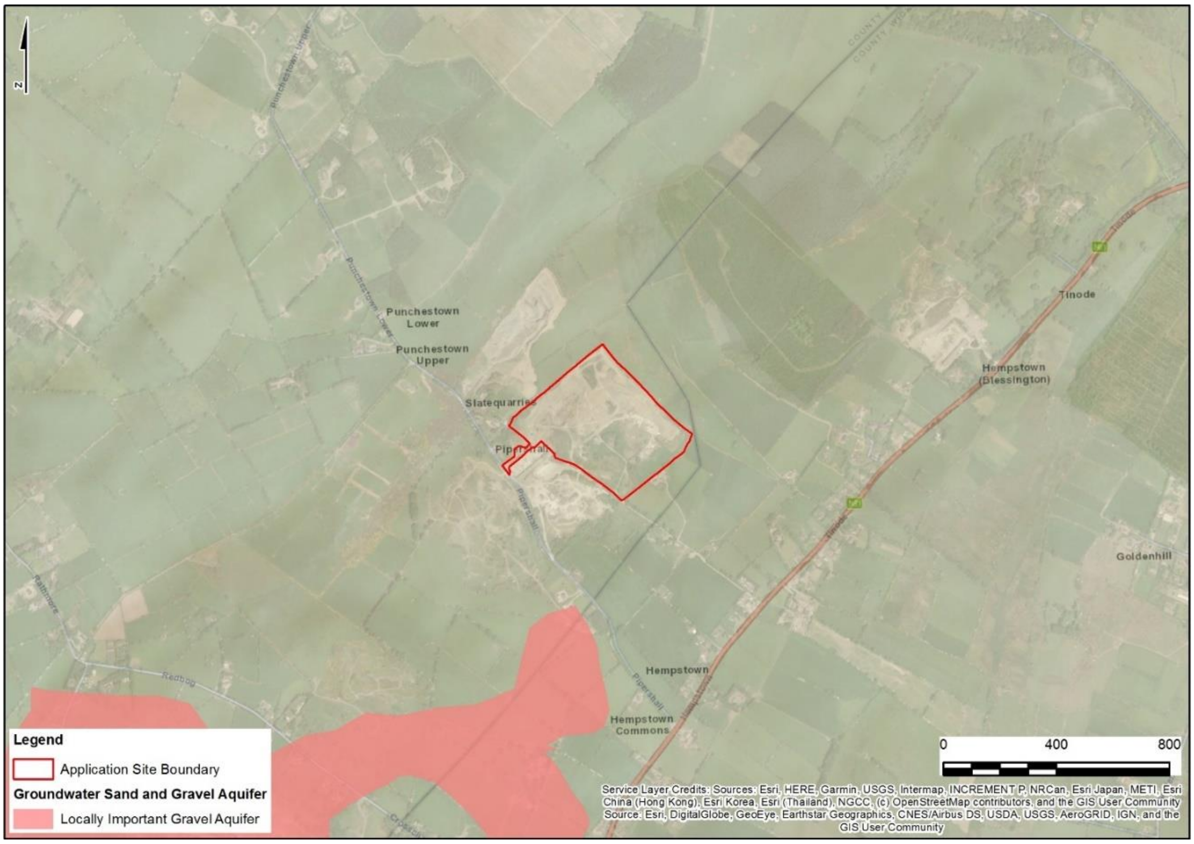


Figure 6-4: Superficial aquifers around the Site (Site boundary in red).
Source: GSI, 2019

6.4.3.2 Groundwater Vulnerability

'The vulnerability of groundwater depends on: (i) the time of travel of infiltrating water (and contaminants); (ii) the relative quantity of contaminants that can reach the groundwater; and (iii) the contaminant attenuation capacity of the geological materials through which the water and contaminants infiltrate. As all groundwater is hydrologically connected to the land surface, it is the effectiveness of this connection that determines the relative vulnerability to contamination. Groundwater that readily and quickly receives water (and contaminants) from the land surface is considered to be more vulnerable than groundwater that receives water (and contaminants) more slowly and in lower quantities. The travel time, attenuation capacity and quantity of contaminants are a function of the following natural geological and hydrogeological attributes of any area:

i) The sub-soils that overlie the groundwater;

ii) The type of recharge - whether point or diffuse; and

iii) The thickness of the unsaturated zone through which the contaminant moves.

In summary, the entire land surface is divided into four vulnerability categories Table 6-3*: extreme (E), high (H), moderate (M) and low (L) - based on the geological and hydrogeological factors described above. This subdivision is shown on a groundwater vulnerability map. The map shows the vulnerability of the first groundwater encountered (in either sand/gravel aquifers or in bedrock) to contaminants released at depths of 1-2 m below the ground surface. Where contaminants are released at significantly different depths, there will be a need to determine groundwater vulnerability using site-specific data. The characteristics of individual contaminants are not taken into account.'* (DELG, EPA, GSI, 1999).

Table 6-3: Extract from 'Groundwater Protection Schemes', Department of the Environment and Local Government (DELG), Environmental Protection Agency (EPA), Geological Survey of Ireland (GSI), 1999

Vulnerability Rating	Hydrogeological Characteristics				
	Subsoil Permeability (Type) and Thickness			**Unsaturated Zone**	**Karst Features**
	High Permeability (Sand/Gravel)	**Moderate Permeability (Sandy subsoil)**	**Low Permeability (Clayey Till, Clay, Peat)**	**(Sand/gravel aquifers only)**	**(<30 m radius)**
Extreme (E)	0 – 3.0 m	0 – 3.0 m	0 – 3.0 m	0 – 3.0 m	-
High (H)	> 3.0 m	3.0 – 10.0 m	3.0 – 5.0 m	> 3.0 m	N/A
Moderate (M)	N/A	> 10.0 m	5.0 – 10.0 m	N/A	N/A
Low (L)	N/A	N/A	> 10.0 m	N/A	N/A

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

According to the GSI online mapping tool (GSI, 2019), and the classification scheme in Table 6-3 (DELG, EPA, GSI, 1999), groundwater vulnerability under the footprint of the Site is classified as 'high' to 'extreme' (see Figure

6-5). This is appropriate due to the presence of only thin gravel cover or exposed bedrock across much of the Site; the area immediately surrounding the Site generally has a groundwater vulnerability classification of ‘high’ to ‘extreme’ for the same reason. An area of ‘low’ to ‘moderate’ aquifer vulnerability exists to the south-east of Site where low permeability till and lacustrine deposits offer increased protection (see Chapter 5.0 of this EIAR for further information on soils and geology).

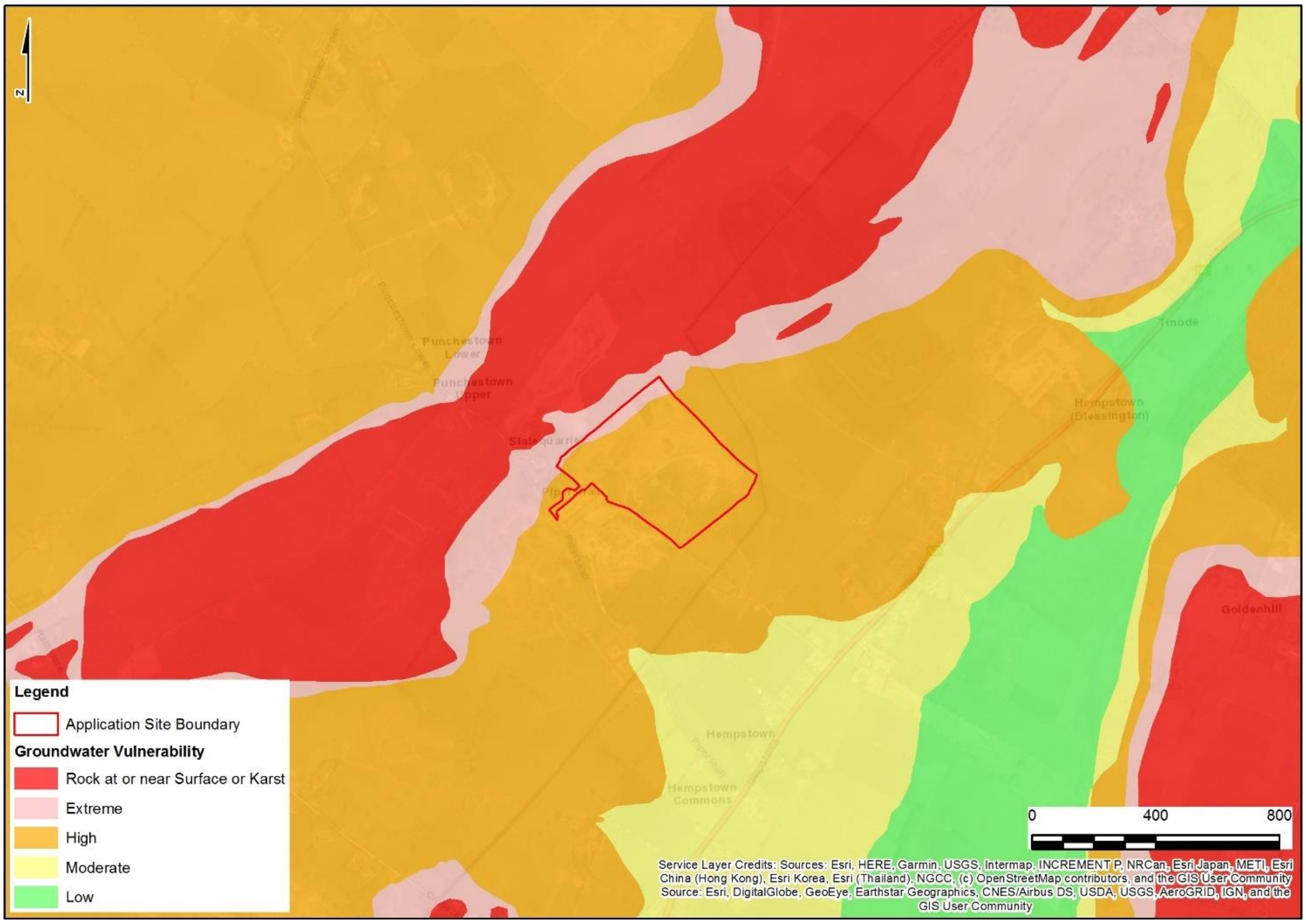
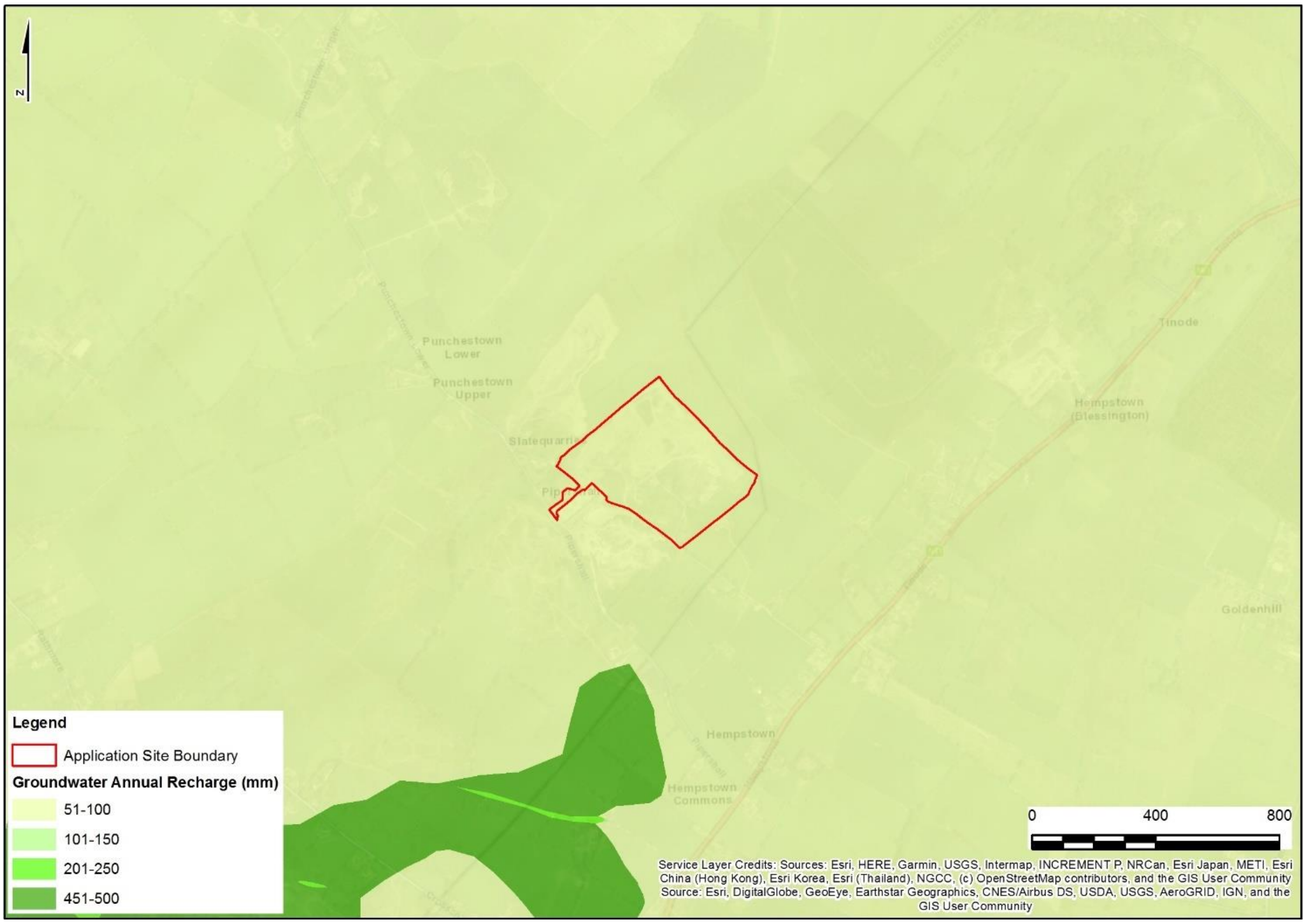


Figure 6-5: Groundwater vulnerability map (Site boundary in red). Source: GSI, 2019

6.4.3.3 Groundwater Recharge

GSI mapping (2019) indicates an effective rainfall of approximately 543 mm/year across the majority of the Site footprint, with the north-eastern portion of the Site estimated to receive approximately 922 mm/year effective rainfall. Soils and subsoils under the footprint of the Site are classified by the GSI website as being high permeability and well drained, with a potential recharge coefficient of 85%. However, the ability of the bedrock aquifer to accept all available groundwater recharge is considered to be low and therefore the groundwater recharge map presents a maximum estimated recharge to bedrock of 100 mm/year. The groundwater recharge map for the Site is presented as Figure 6-6.



Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure 6-6: Groundwater recharge (Site outline in red). Source: GSI, 2019

6.4.3.4 Site Dewatering and Discharges

The lowest elevation of the excavated pit is the quarry sump at approximately 230 mAOD in 2019. The pit is noted by the Applicant to be intermittently dry and with flooding of the pit floor coincident with rainfall events (anecedotal evidence); this suggests that water inflows to the pit are dominated by the collection of rainfall runoff within the pit as opposed to large seepage volumes. Aerial photography of the pit captured in July 2019 is consistent with these observations, with a shallow, partially sediment laden, pit lake (sediment suggests runoff from the aggregate processing area in the northern end of the excavation) and small areas of seepage observed on the western and northern quarry walls (see Figure 6-7 and Figure 6-8).

The Applicant reports that the pit is currently dewatered when flooding does occur, with water pumped to a 'settlement/holding area' where it drains via gravity through a drain to soakaway area in the eastern area of the Site; the locations of the settlement/holding area, drainage pipe and soakaway area are shown in Figure 6-9. Discharge rates are not currently recorded, although dewatering is reported by the Applicant to occur for approximately 1 hour per day when flooding occurs. Dewatering is currently carried out using a Xylem Flygt BIBO 2870 50hz pump, the technical specification for which is provided as Appendix 6.1. An approximate elevation change from the pump to the holding area of 30 m has been estimated using Site survey data, allowing the pump to operate at a rate of approximately 70 to 120 m^3/hr. Given the reported duration and estimated capability of the pump, dewatering is thought to currently occur at a maximum rate of 120 m^3/day.

Figure 6-7: Seepage observed on western quarry wall ~240 mAOD (July 2019).

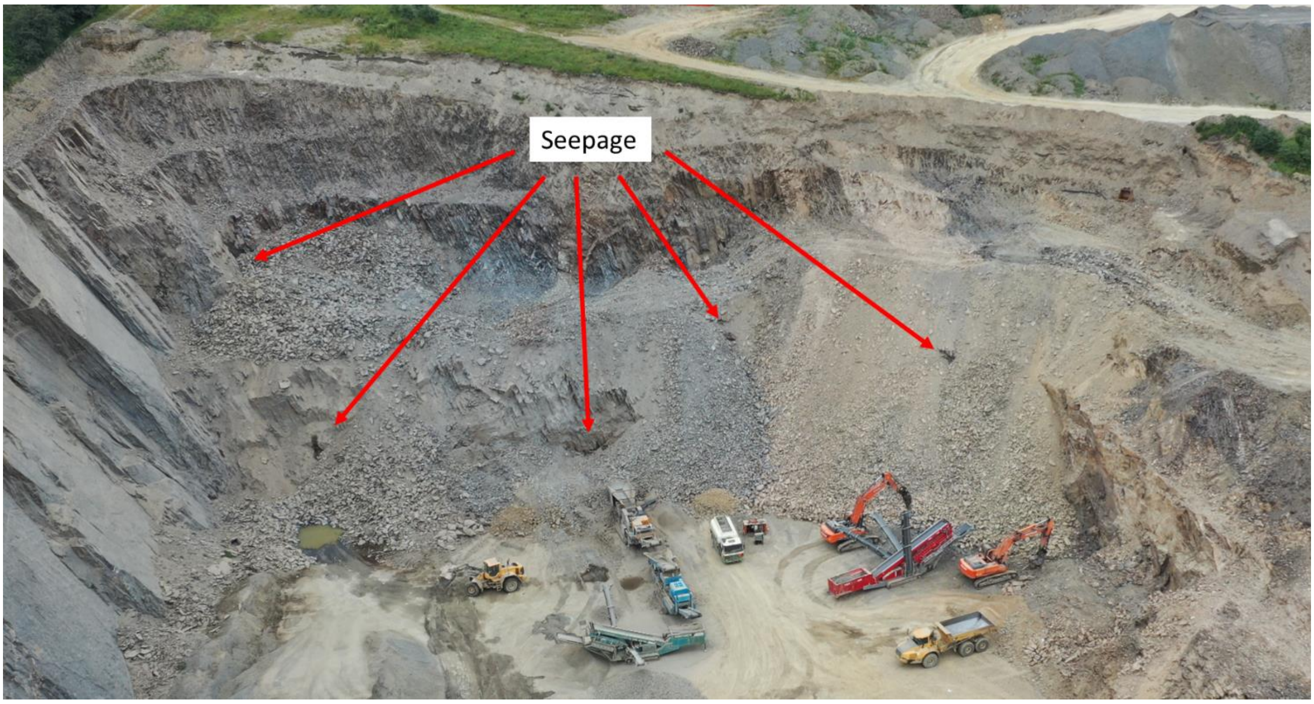


Figure 6-8: Seepage observed on northern quarry wall ~250-275 mAOD (July 2019).

Figure 6-9: Layout of December 2019 dewatering and discharge system

6.4.3.5 Source Protection and Other Groundwater Users

GSI mapping (2019) indicates that there are no groundwater source protection zones within the Site boundary. The nearest groundwater source protection zones are located approximately 2.5 km to the north of Site for the Kilteel group water scheme and 3.4 km south of the Site for the Blessington public supply scheme (See Figure 6-10). The Blessington public supply is reported to be supported by both surface water (from the Pollaphuca Reservoir) and groundwater abstraction from the 'Blessington Gravels' groundwater body (GSI, 2003).

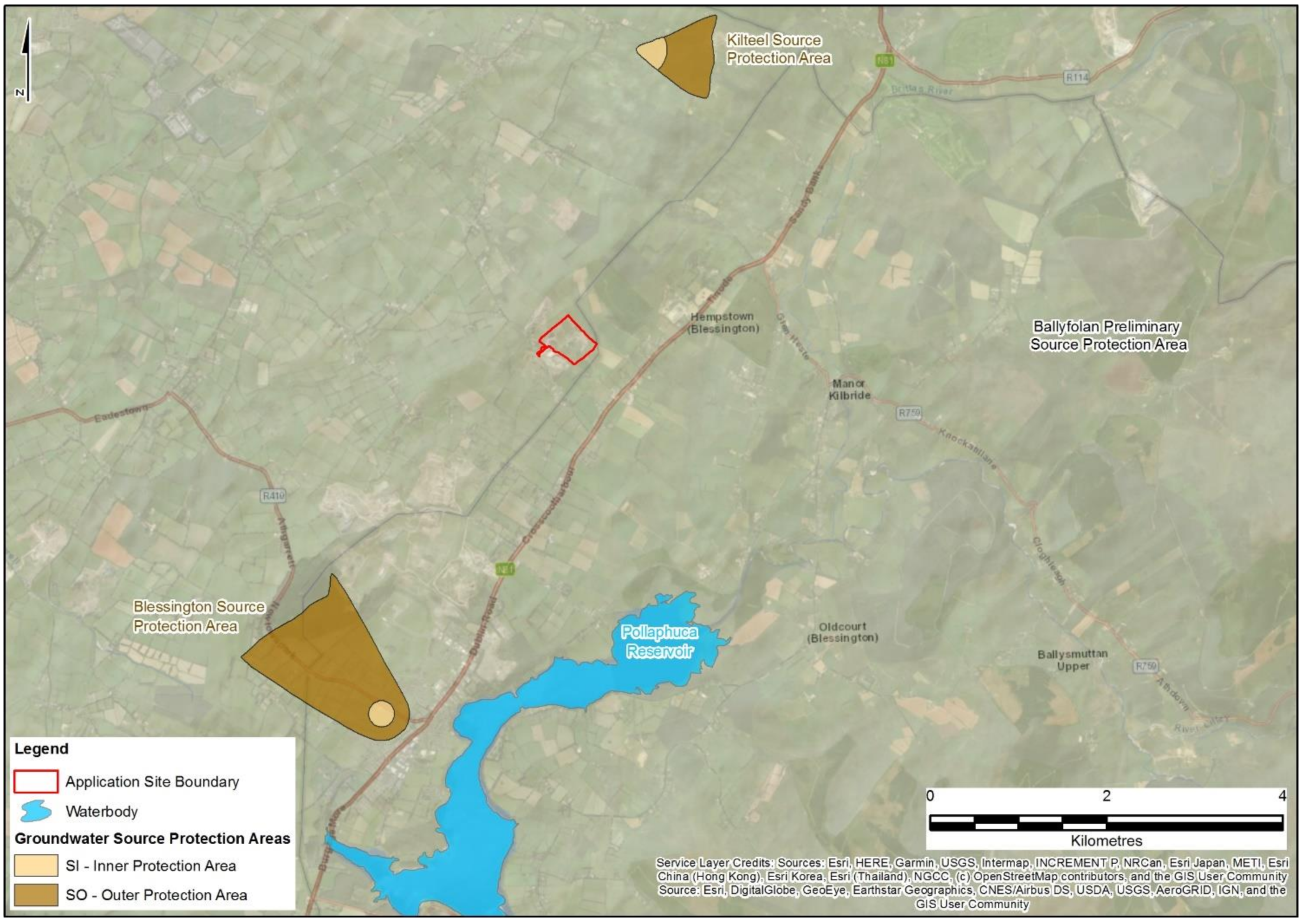


Figure 6-10: Source protection zones in the vicinity of the Site (Site outline marked in red). Source: GSI, 2019

A well survey was carried out by SLR in June 2019 (SLR, 2019) identifying a total of three abstraction wells within a radius of 0.5 km of the aggregate extraction area of the Site (GW1 to GW3, see Figure 6-12). Two wells were identified as domestic supply wells; one supplying the household located in the eastern portion of Site (within the Site boundary and owned by the Applicant) and the other supplying a further household located immediately adjacent to the eastern Site boundary. The third abstraction well was identified as an abstraction well owned and operated by the concrete precast facility owned by Stresslite Flooring Ltd situated adjacent to the southern Site boundary.

Further to the 2019 SLR well survey, several other abstraction wells were noted in previous reporting (BCL, 2008):

- Factory- located on the site, adjacent to the access road, approximately 190 m southwest from the nearest pit edge;
- Farm- located in the centre of the Site (now referred to as GW2), approximately 170 m southeast from the nearest pit edge;
- Cullen- located to the west of the Site, approximately 150 m west from the nearest pit edge;
- Gerard Murphy- located to the east of the Site, approximately 180 m southwest from the nearest pit edge;
- Gerry Phibbs- located to the southeast of the site (now referred to as GW1), approximately 400 m southeast from the nearest pit edge;

- Quinn- located to the south of the site, approximately 520 m south from the nearest pit edge; and,
- Merns- located to the south of the site, approximately 500 m south from the nearest pit edge.

The location of the above abstractions is shown in Figure 6-11.

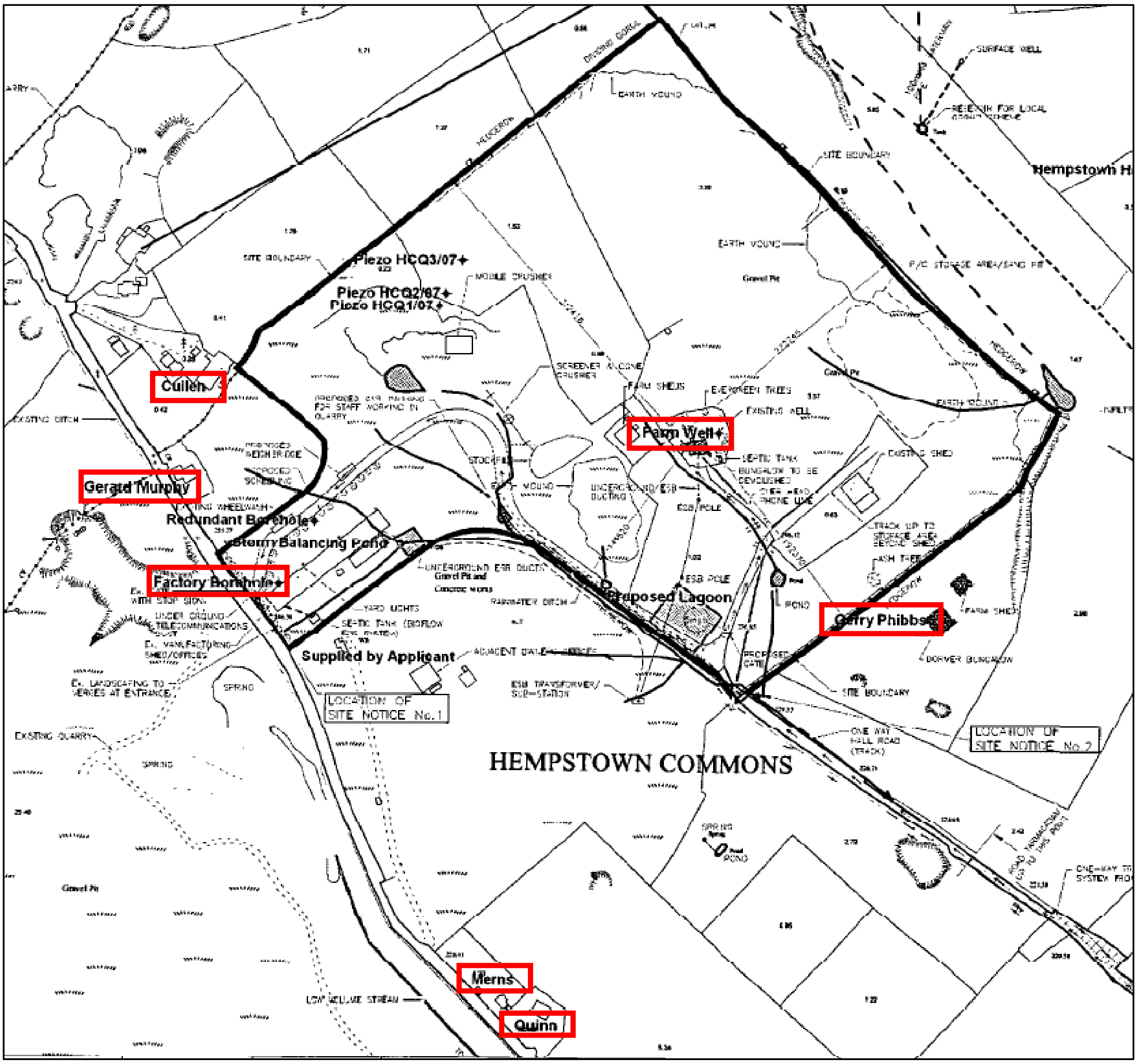


Figure 6-11: Location of abstraction boreholes in the vicinity of the site (BCL, 2008)

The Gerry Phibbs and Farm boreholes were identified as presently in use during the 2019 well survey (reported as GW1 and GW2 respectively). The remaining abstraction wells listed above were in use at the time of the 2008 report, but their current status is unknown.

The Hempstown Hill Groundwater Scheme can also be seen in the northeast corner of Figure 6-11. This is no longer in use, with supply to the area now via Public Supply from the Blessington / Pollaphuca reservoir area.

6.4.3.6 Groundwater Elevations and Flow Direction

Five groundwater monitoring boreholes are used to monitor the groundwater elevation at the Site (GW1 to GW5). GW1, GM2 and GW3 were identified in a Well Survey conducted by SLR (2019), additional boreholes

GW4 and GW5 were installed on the site in November 2019. Borehole locations are shown in Figure 6-12 and installation details/logs are provided in Chapter 6.0 (Soils and Geology).

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure 6-12: Borehole location plan

Groundwater level monitoring was undertaken at the site during November and December 2019. Additional groundwater level measurements for GW1-3 are available for March and September 2019 prior to the installation of the additional boreholes. A summary of the recorded groundwater elevations is presented in Table 6-4 and Figure 6-13.

Table 6-4: Groundwater elevation during monitoring rounds November- December 2019

BH ID	05/03/2019	12/09/2019	08/11/2019	22/11/2019	29/11/2019	13/12/2019	17/12/2019
GW1	233.85	234.32	237.69	235.20	234.80	235.08	235.50
GW2	248.14	247.73	248.97	248.45	248.00	248.39	248.53
GW3	232.81	231.00	237.45	232.89	234.58	235.52	232.49
GW4	-	-	290.86	289.43	290.10	289.79	290.12
GW5	-	-	227.26	225.38	222.43	225.09	224.36
WW	-	-	-	-	-	-	237.38

WW Wheel wash borehole
- Borehole not yet installed/ not monitored

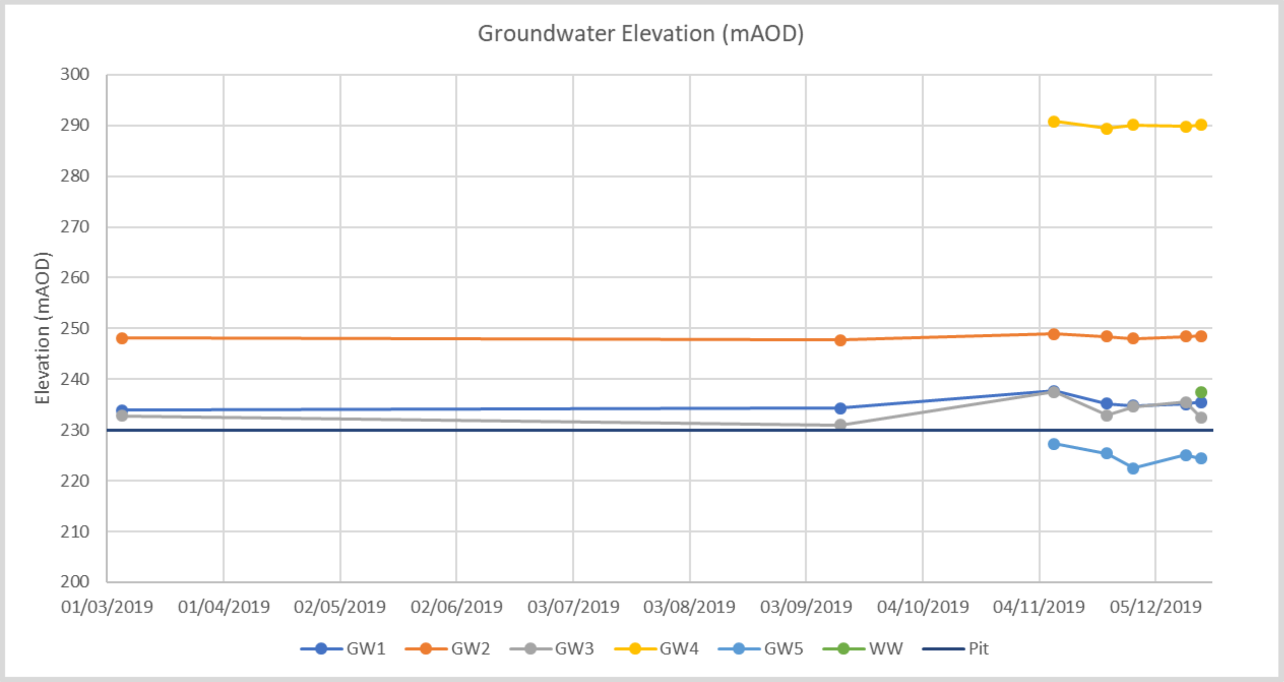


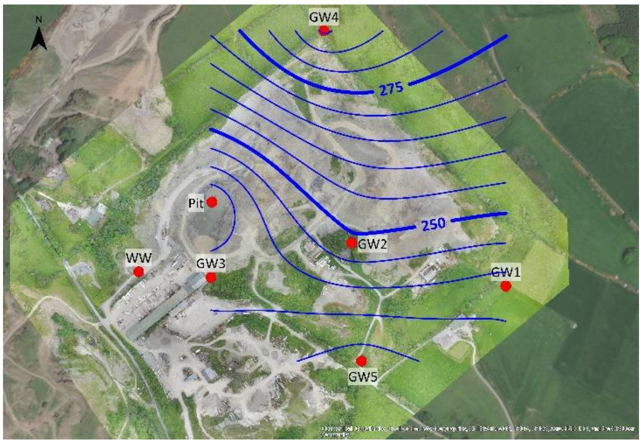
Figure 6-13: Groundwater elevation March- December 2019

A groundwater elevation contour plot for each of the full rounds of data are presented in Figure 6-14. For the purposes of contouring, water elevation in the pit on site is included as 230m AOD for all monitoring rounds. The general flow direction of groundwater is from north to south and generally is coincident with trends observed in topography at the Site. Most recent monitoring data from December 2019 indicates that groundwater levels close to the pit show evidence of groundwater table depression with a small drawdown cone extending beyond GW3 to the south (approximately 50 m offset from the pit) but limited to just beyond the wheelwash (‘WW’) borehole location to the west (approximately100 m offset from the pit). Both boreholes are noted to be in intermittent use as abstraction wells; the groundwater table depression in this area is thought to be a combined effect of pit dewatering and abstraction from these wells and extends to approximately 110 m from edge of the pit.

During drilling of blast holes in October 2007 (BCL, 2008) it was noted that groundwater was encountered at approximately 254 m AOD drill holes within 5m of the northern pit edge (approximate location of northern edge coincident with ‘Pit’ in Figure 6-14) and rose to 257 m AOD moving 15-20m north of this location. During the same site visit the groundwater level in the sump on the quarry floor (at the time of reporting) was recorded at 253 m AOD. Using this information, groundwater was thought to broadly flow from north to south and is consistent with recent monitoring.

Groundwater was also recorded in 2007 in three piezometers located to the northwest of the pit (shown in Figure 6-11; BCL, 2008). Groundwater levels for these piezometer locations were recorded between 265 and 276 m AOD during the 2007 monitoring period, while groundwater contours in 2019 indicate an equivalent groundwater elevation for these locations of approximately 250 m AOD, demonstrating further drawdown of groundwater in the bedrock immediately adjacent to the quarry since 2007. The radius of the cone of depression was estimated in 2007 to extend a maximum of 70 m from the edge of the pit, less than the current estimate of approximately 110 m.

08/11/19



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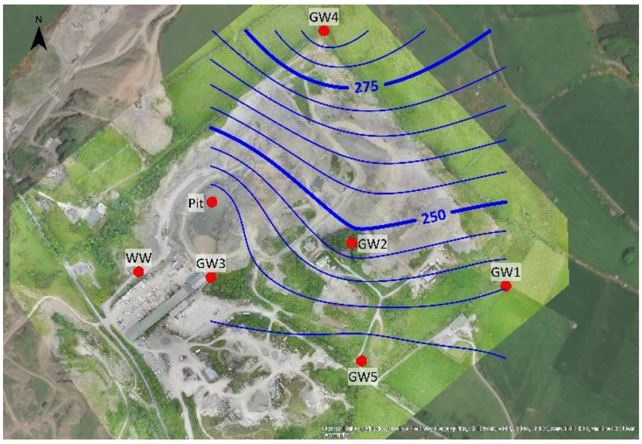

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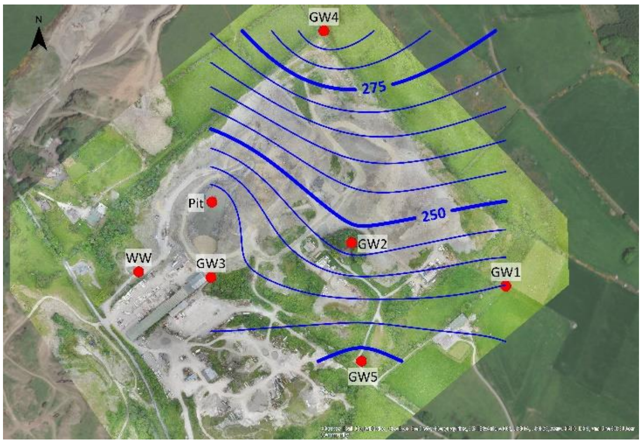
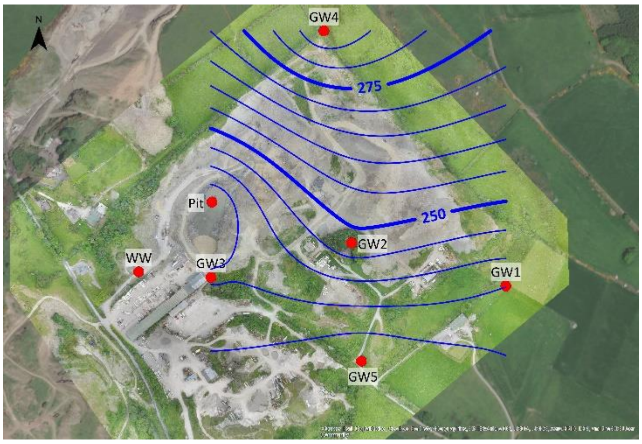


13/12/2019



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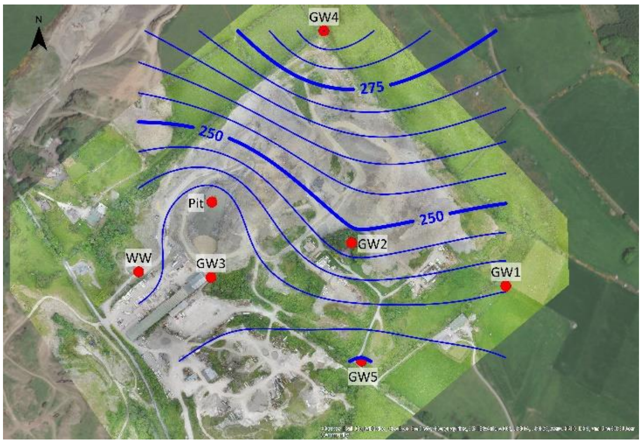

Figure 6-14: Groundwater elevation contour plots Nov-Dec 2019

6.4.3.7 Groundwater Quality

Historical groundwater Monitoring

As part of a previous EIS report for the Site (Byrne Environmental Consulting Ltd, 2007) groundwater samples were collected from three groundwater wells described as *"local to the quarry"*. Samples were collected in February 2006 from the following locations: Factory Supply, On site House supply and Quarry borehole.

Samples were analysed for the following parameters:

- Chemical Oxygen Demand (COD);
- Nitrite;
- Alkalinity (as CaCO3);
- Chloride;
- pH;
- Conductivity;
- Phosphorus;
- Metals (Aluminium, Arsenic, Cadmium, Chromium, Iron, Mercury, Manganese, Nickel, Lead, Tin, Selenium, Titanium, Zinc)

Analytical results were generally found to be less than the limit of detection (LOD). Where an analyte was detected above the LOD, concentrations were found, generally, to be at or below the concentrations reported during the 2019 monitoring (further discussed in the next section) indicating a consistent trend in groundwater quality through the life of the quarry thus far.

2019 Groundwater Monitoring

Groundwater samples were collected from all five of the boreholes installed on the Site on 8th November 2019. Borehole GW4 is considered to be upgradient of the Site, boreholes GW1, GW3 and GW5 are downgradient boreholes and GW2 is situated in a mid-gradient position.

At least three volumes of water were abstracted from each of the boreholes prior to sampling to ensure that water sampled was representative of the surrounding groundwater aquifer.

Each sample was then tested at UKAS accredited Element Materials Technology laboratory for the following parameters:

- Dissolved metals: Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium, Chromium, Copper, Lead, Magnesium, Mercury, Nickel, Potassium, Selenium, Sodium, Vanadium and Zinc;
- Extractable Petroleum hydrocarbons (C8-C40);
- Gasoline Range Organics (GRO C4-C12);
- MTBE. Benzene, Toluene, Ethylbenzene, m/p Xylene, o-Xylene;
- Sulphate;
- Chloride;
- Nitrate as NO3;
- Nitrite as NO2;
- Nitrate as N;
- Nitrite as N;
- Orthophosphate as PO4;
- Orthophosphate as P;

- Total Oxidised Nitrogen;
- Ammoniacal Nitrogen as N;
- Ammoniacal Nitrogen as NH4;
- Hexavalent Chromium;
- Chromium III;
- Total Alkalinity as CaCO3;
- Chemical Oxygen Demand (COD); and,
- Total Suspended Solids (TSS).

The results of the groundwater and surface water quality analysis at the Site are presented below and compared with S.I. No.9 (2010) including S.I. 366 (2016)[1], the European Communities Environmental Objectives (Groundwater) Regulations regarding groundwater status; where a screening value does not exist, the EPA Interim Guideline Values for Groundwater Protection[2] were applied. Full screening results are presented as Appendix 6.2 and a summary of the exceedances are presented in Table 6-5. The laboratory certificates for the results are included in Appendix 6.3.

Table 6-5: Summary of groundwater screening exceedances.

Analyte	Units	Screening Value	LOD	GW1	GW2	GW3	GW4	GW5
Dissolved Arsenic	ug/l	7.5	2.5	<2.5	3.6	<2.5	7.5	<2.5
Dissolved Barium	ug/l	100	3	41	71	28	102	72
Nitrate as NO_3	mg/l	37.5	0.2	13.4	14.6	45	0.4	19.6

Exceeds Screening Value

Arsenic and Barium concentrations at upgradient borehole GW4 were observed to be at or above screening value, although the same elevated levels are not noted in the cross-gradient and downgradient boreholes. Nitrate as NO3 also exceeded the screening value in the sample collected from GW3 this may be attributable to the blasting activities within the on-site pit due to the downgradient location of this borehole. However, it is likely that the source of nitrate arises from agricultural practices in the vicinity of the site.

Trends in groundwater quality cannot be determined from a single dataset and it is recommended that further monitoring is conducted at the Site.

6.5 Hydrological and Hydrogeological Conceptual Model

This section describes the hydrogeological conceptual model for the Site summarising the information contained in Section 6.4 (Existing Environment).

Water enters the Site through direct rainfall precipitation and via the movement of groundwater through the subsurface, which predominantly flows from north to south, coincident with regional topography. In the

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[1] European Communities Environmental Objectives (Groundwater) regulations, SI 9 of 2010 inc. SI 366 of 2016

[2] Towards Setting Guideline Values for the Protection of Groundwater in Ireland- Interim Report, EPA, 2003

excavated areas in the western part of the Site, rainfall will generally runoff and collect at the lowest elevations of the quarry where it will be subject to evaporation or, where possible, provide direct recharge to bedrock. In the other areas of the Site rainfall will predominantly infiltrate to ground where it will be subject to evapotranspiration or become groundwater.

Groundwater is present both within the superficial clayey sand and gravel deposits and bedrock; the superficial deposits and bedrock are considered likely to be in direct hydraulic connectivity. Flow within the bedrock is considered likely to be predominantly confined to fractures and joints in the upper weathered zone, or through isolated zones of increased hydraulic conductivity. Connectivity of fracture sets within the bedrock is expected to be low, with limited lateral connectivity and a decreasing trend of hydraulic conductivity with depth as weathering of the rock reduces. This is consistent with the GSI (2019) bedrock aquifer designations and descriptions of hydraulic properties (see Section 6.4.3.1).

Local surface water features are predominantly fed by rainfall runoff from higher topographical areas which collect in natural gullies and form headwaters for tributaries to larger streams and rivers such as the Goldenhill river. Topography suggests that any runoff from the Site could eventually contribute to the Goldenhill river, although due to the relative distance and current vegetated nature of the area surrounding the Site, it is considered likely that runoff would infiltrate to ground prior to reaching the Goldenhill river. Shallow groundwater may contribute baseflow to local watercourses and it is possible that the thin superficial deposits at the Site are hydraulically connected with the gravels which contribute to waters at the Pollaphuca Reservoir.

6.6 Potential Impacts of the Proposed Quarry Extension

The evaluation of potential and residual impacts on the water environment at and in the vicinity of the Site is based on a methodology similar to that outlined in the ‘Guidelines for the Assessment of Geology, Hydrology and Hydrogeology for National Road Schemes’ published by the National Roads Authority (2009) and ‘Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements’ published by the Institute of Geologists of Ireland (2013).

6.6.1 Sensitive Receptors

Chapter 4.0 of this EIAR (Ecology and Biodiversity) presents a summary of the designated sites located close to the Application area. The following designated Sites and source protection zones for groundwater are located within 5 km of the Site:

- Red Bog, Kildare SAC – also designated as a pNHA (c. 1.5 km south-west of the site);
- Pollaphuca Reservoir SPA – also designated as a pNHA (c.2.5 km south of the site);
- Kilteel Wood pNHA (c. 3.1 km north of the site);
- Slade of Saggart And Crooksling Glen pNHA (c. 4.8 km north-east of the site);
- Kilteel group water scheme (2.5 km to the north of Site); and
- Blessington public supply scheme (3.4 km south of the Site).

The Kitleel group water scheme, Kilteel Wood and Slade of Saggart And Crooksling Glen protected areas are located sufficiently upgradient of the Site to not be considered a sensitive receptor for the Site and have not been considered further in this assessment. Investigations carried out at the Red Bog (John Barnett and Associates Ltd, 2004) indicate that the Red Bog is underlain by impermeable materials and not in hydraulic connectivity with the surrounding water environment and therefore the Red Bog has also not been considered further as a receptor.

Based on the hydrogeological CSM the following have been identified as potential sensitive receptors to impacts on the water environment at the Site and will be considered further in this assessment:

- Pollaphuca Reservoir, which supplies substantial volumes of water to the surrounding areas;
- Residential properties local to the Site (closest residence located within 150 m of pit edge), which are assumed to have private water supplies and use septic tanks;
- The abstraction well at the adjacent Stresslite facility (GW3).

6.6.2 Potential Impacts of Proposed Works

The main activities which will be conducted during further excavation at the Site, and may cause an impact upon surface water or groundwater, are as follows:

- Earthwork activities (e.g. excavation of quarry, movement of material and phased restoration);
- Dewatering of the quarry;
- Dust suppression;
- Blasting of rock using explosives;
- Use and parking of mechanical plant on Site for excavation activities;
- Storage of fuel;
- Use of serviced welfare facilities, including emptying of holding tank; and,
- Post-extraction rebounding of groundwater and flooding of quarry floor.

Without mitigation, the proposed works have the potential to cause the following impacts:

- Increased sediment loading of surface waters caused by the stockpiling of overburden prior to phased restoration (although the potential for runoff from the Site to reach the Goldenhill river, the closest surface water body, is noted to be very low);
- Changes in surface runoff direction and increased runoff and/or sediment loading of surface waters due to changes in topography;
- Pollution of surface water and groundwater from waste generated by on-site welfare facilities;
- Changes in groundwater flow direction at off-site residential septic tank areas;
- Pollution of surface water and groundwater from waste generated by uncontrolled material storage;
- Hydrocarbon contamination of surface water and groundwater caused by leaks from fuel storage tanks;
- Hydrocarbon contamination of surface water or groundwater caused by the unmanaged spillage of fuels or lubricants from Site plant or vehicles used during construction;
- Spread of contamination which may occur in the pit to other areas of the Site via dust suppression systems;
- Reduction in groundwater quantity or quality at local abstraction points;
- Nitrogen loading of groundwater due to blasting activities; and,
- Increased risk of falling / drowning to humans and animals due to the open and flooded quarry pit.

6.6.3 Dewatering Effects and Post Dewatering Water Level

Using the information characterised in Section 6.4, a preliminary estimate of inflows to the pit at the end of the proposed extraction phase (i.e. maximum lateral and vertical extraction from the pit) has been calculated using methodology outlined by Marinelli and Nicolli (2000). Calculations are presented as Appendix 6.4 and estimate a maximum daily inflow to the pit of 202 m^3/day. It should be noted however that the majority of the inflows to the pit are due to direct rainfall capture within the pit, with only 15 m^3/day calculated as groundwater seepage.

The calculated radius of influence using Marinelli and Nicolli estimates a drawdown cone of approximately 188 m from the centre of the pit; this is noted to estimate an influence of only 1 m from the edge of the pit, which is in contradiction to the groundwater level monitoring outlined in Section 6.4.3.6. This could be attributable to the hydraulic conductivity values applied but also it does not consider the cumulative effects of the other abstraction wells in the vicinity of the pit.

Hydraulic conductivity values for the Site are discussed in Section 6.4.3.1. These calculations have conservatively applied the maximum hydraulic conductivity value of $1x10^{-3}$ m/day, which is reported in Driscoll (1986) for well-cemented, lower permeability sandstones such as Greywacke. Maximum reported values for hydraulic conductivity in shale are an order of magnitude lower. Due to the uncertainty that exists with regards to the hydraulic conductivity at the Site and it is recommended that this characterised further by conducting pumping trials within the existing boreholes at the Site.

Post dewatering, it is anticipated that the groundwater level within the pit will rebound and equilibrate to that of the surrounding geology. Given groundwater is observed at approximately 291 m AOD at GW4 and 230 m AOD at the lowest point of the pit, it is anticipated that groundwater will have a static water level of approximately 260 m AOD. This is broadly consistent with that predicted in the 2008 report (BCL, 2008).

6.6.4 Mitigation Measures

6.6.4.1 Consideration of Embedded Design

The following embedded design considerations have been taken when considering the mitigation measures required:

- Dewatering – dewatering will only take place during excavation and only when flooding of the pit occurs. This is anticipated to be required predominantly following rainfall events;
- Soakaway – pumped water from the pit will be discharged to ground via a hydrocarbon interceptor to the holding and settlement area and finally to the soakaway area, thereby providing groundwater recharge and reducing any downgradient impacts on water quantity;
- Runoff – the floor (and faces) of all areas within the extraction area will at all times slope inwards so as to prevent any surface water run-off flowing from the Site;
- Phased restoration – the Site will be subject to phased restoration during the proposed activities. This will reduce the stockpile of raw material and materials will be stabilised once vegetation has been established;
- Restoration materials – only materials which have been stockpiled at the Site during overburden stripping will be used during restoration and there will be no importation of off-site materials;
- Environmental management System (EMS) – an EMS document was produced for the Site in 2007 (Byrne Environmental, 2007), however, the 2007 EMS is not applicable for the current Site as it was produced when the quarry was previously owned and operated by Stresslite Flooring Ltd and incorporated the adjacent Stresslite facility (located outside of the application area). An updated EMS for the Site will be prepared by the new owners, Shillelagh Quarries Ltd, the regulatory guidance and mitigations measures within which will be adhered to;

- Wheelwash – an existing wheelwash is present at the Site. The wheelwash is a contained recycling system and will be maintained appropriately throughout the restoration phase to avoid discharges of wash water; and;
- Welfare facilities – the welfare facilities consist of an inbuilt holding tank will continue to be collected by a suitable disposal contractor on a regular basis so as to avoid discharges of wastewater. The applicant confirms that a current agreement exists for the servicing of the welfare facilities as required.

6.6.4.2 Additional Mitigation Measures Required

Following consideration of the embedded design, the following mitigation measures are recommended to address the potential impacts of the proposed works:

- Interceptor – an interceptor should be installed at the Site and any discharges to ground (e.g. pumped from pit or wheelwash) should be passed through the interceptor prior to discharge. The interceptor should be designed to exceed the maximum predicted dewatering volumes estimated in Section 6.6.3 and further characterisation of the hydraulic conductivity at the Site should be carried out prior to final design.
- Dust suppression – any water used for dust suppression should be obtained after passing through the proposed interceptor, so as to reduce the risk of contamination spreading;
- Decommissioning – proposed decommissioning of the homestead/farm should be completed in such a way that it does not lead to discharges of chemicals such as hydrocarbons or oils (should they be present). If no longer in use and is decommissioned, borehole GW2 should be decommissioned using bentonite grout or pellets, so as to remove any pathway to ground from surface;
- Fuel storage – any fuel products stored on site should be kept in fully bunded tanks with suitable drip trays/nappies used when filling occurs;
- Plant maintenance and refuelling – vehicles and plant on site should be maintained in good condition, vehicle checks should be carried out to assess the condition, fuelling should take place in a designated area of site with appropriate drip trays/nappies in place.
- Fencing and bunding – once extraction has completed, dewatering will cease and the pit will flood with groundwater and rainfall. Fencing should be installed around the pit edge to reduce risk of falling and/or drowning by humans or animals. Additional bunding may be required to ensure there is no runoff of water from the pit along the southern edges.

6.6.4.3 Monitoring Requirements

The following water monitoring is recommended to be carried out at the Site so as to monitor and allow mitigation of any impacts caused by the proposed works:

- Groundwater level – groundwater levels should be monitored at the six monitoring locations (see Figure 6-12) on a minimum monthly basis so as to monitor the effects of dewatering and the extent of the dewatering radius of influence. It is recommended that loggers are used within the active abstraction wells as single point dips may lead to misleading information i.e. GW1, GW2 (if available), GW3 and the wheelwash borehole. GW4 and GW5 are not actively pumped and an electronic dip meter may be used;
- Groundwater quality – groundwater quality should be monitored at a minimum quarterly basis, so as to capture any impacts on water quality. Monitoring should be completed in upgradient borehole GW4 and downgradient boreholes GW2 (if available), GW3, GW5 and the wheelwash borehole. The determinands outlined in Section 6.4.3.7 should be analysed for as a minimum, and;

- Surface water – in line with groundwater quality monitoring, the quality of both the pit water and discharged water (after passing through interceptor) should also be carried out on a quarterly basis for the determinands outlined in Section 6.4.3.7 as a minimum. It is noted that the flooding of the quarry is intermittent and quarterly monitoring may not be possible. Where water is present in the pit, if should be subject to daily visually inspection for signs of hydrocarbon contamination.

The above recommendations should be incorporated into the proposed EMS for the Site.

6.7 Residual Impacts

The residual impacts of the proposed works upon the water environment is assessed in Table 6-6.

Table 6-6: Residual impacts on sensitive water receptors with and without mitigation measures.

Receptor (Importance)	Impact	Magnitude Without Mitigation*	Impact Rating Without Mitigation*	Magnitude Following Mitigation	Impact Rating Following Mitigation
Blessington SAC & Public Water Scheme (Extremely High)	Impact on water quality	Negligible	**Imperceptible**	Negligible	**Imperceptible**
	Impact on water quantity	Negligible	**Imperceptible**	Negligible	**Imperceptible**
GW3, Stresslite Abstraction Well, (Low)	Impact on water quality	Small Adverse	**Imperceptible**	Negligible	**Imperceptible**
	Impact on water quantity	Small Adverse	**Imperceptible**	Negligible	**Imperceptible**
Residential Properties with Boreholes and Septic Tanks (Low)	Impact on water quality	Small Adverse	**Imperceptible**	Negligible	**Imperceptible**
	Impact on water quantity	Small Adverse	**Imperceptible**	Negligible	**Imperceptible**

* Without mitigation, but with consideration of the embedded design.

If works are carried out in line with the embedded design, mitigation measures and monitoring requirements of this Chapter are followed, no residual and deleterious effects on surrounding water bodies or underlying groundwater aquifers are envisaged to be caused by the works.

6.8 Cumulative Impacts

There was potential that the dewatering within the pit could have caused a cumulative impact with regards to groundwater quantity in the area. However, as there are no residual and deleterious effects on surrounding water bodies or underlying groundwater aquifers envisaged, there is no potential for cumulative impacts on surface water or groundwater to occur.

6.9 Major Accidents and Disasters

Environmental impacts assessments are required to address the vulnerability of the proposed projects to major accidents and/or disasters. These unforeseen and unplanned events are to be assessed on the risk of their occurrence (likelihood and consequence).

In the context of water (hydrology and hydrogeology) the following would constitute a major accident or disaster:

- Large oil and fuel spills to ground which enter groundwater or surface water bodies; or
- Loss or irreversible degradation of designated public groundwater supplies.

Given the small volumes of materials stored at the Site and the relatively low rates of dewatering anticipated, the likelihood of a major accident or disaster to occur is very low. This risk is further reduced should the mitigation measures outlined in this this Chapter be adhered to.

6.10 References

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Byrne Environmental Consulting Ltd, 2008. Response to a Request for Further Information from Kildare County Council in Relation to Planning Ref, 07/443, dated February 2008 - Which includes as Appendix V: BCL Consultant Hydrogeologists ltd, 2008. Hempstown Commons Quarry. Assessment of the Potential Impacts of the Continued Development of the Quarry upon the Water Environment.

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APPENDIX 6.1

Technical Specification for Dewatering Pump

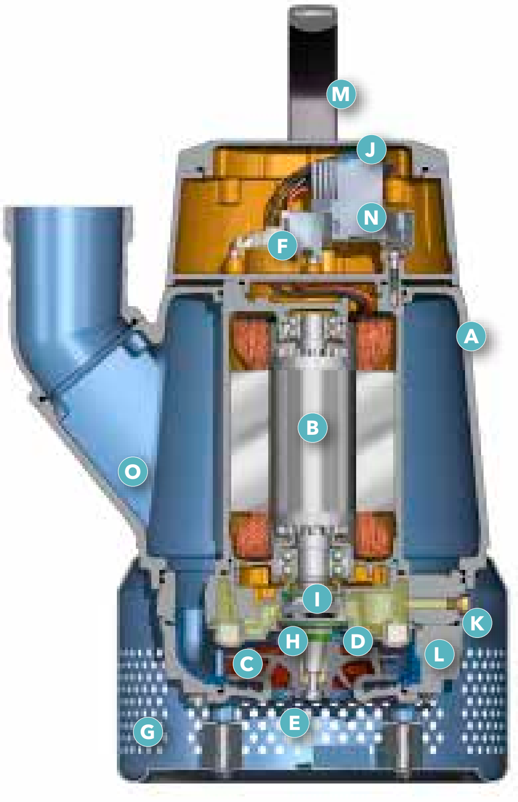
50Hz

Flygt BIBO 2870

SOME THINGS MAKE A LASTING IMPRESSION

For decades whenever a dewatering challenge seemed too tough or too harsh, the answer has been simple, Flygt BIBO. So how do you improve upon a legend? Simple, we created a new one.

It still has the iconic look; a shape that means stability and robustness. We took our proven hydraulic design and merged it with features that once set the standard in dewatering pumping. For mining, quarrying, construction and tunneling, Flygt BIBO, still a choice you never regret.



- **A** **Air valve**
  The cooler the motor, the better the performance.
- **B** **Class H motor**
- **C** **Dura-Spin™**
  The unique closed impeller and the suction cover which reduces wear.
- **D** **Spin-Out™**
  Protects the outer seal from abrasive particles.
- **E** **Hard-Iron™ impeller and suction cover.**
- **F** **Sealed off terminal board**
- **G** **Strainer bottom with shock absorbers**
- **H** **Single impeller-adjustment screw**
- **I** **Plug-in™ seal with aluminum housing**
- **J** **Inspection cover**
- **K** **External inspection and oil plugs**
- **L** **PolyLife™ coated wear parts**
- **M** **Handle with adjustable height**
- **N** **Less risk of cable damage with a protected cable entry**
- **O** **Wide base and low discharge**

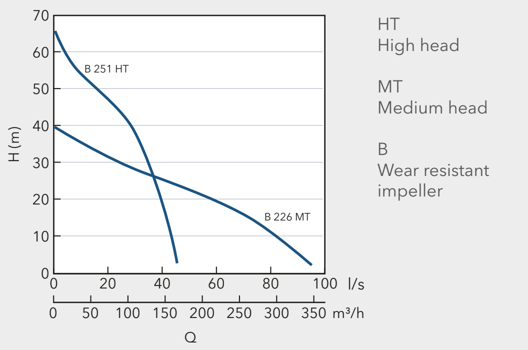
FLYGT
a xylem brand

2870

50Hz

1725 . Flygt Bibo 2870 . 1 . Master . 1 . 20130502

Performance



Rating

18 kW / 3-phase / 2,895 rpm

Voltage V	Rated current A	Starting current A
220 D	58	355
240 D	55	390
380 D	34	239
380 Y	33	203
400 D	33	238
400 Y	32	215
415 D	32	222
440 D	32	238
500 D	26	187
525 D	24	153
550 D	24	162
660 Y	20	138
690 Y	19	137
1000 Y	14	99

Denomination

Product code	2870.180
Installation	Portable
Discharge connection	3″/4″/6″
Impeller characeristics	High head/medium head (HT/MT) Wear resistant impeller (B) with Dura-Spin™

Process data

Liquid temperature	40°C (standard)
Depth of immersion	max 20 m
Liquid density	max 1100 kg/m^3
Strainer hole dimension	ø 12.0 mm
The pH of the pumped liquid	pH 5-8

Motor data

Frequency	50 Hz
Insulation class	H, 180°C
Voltage variation	max ± 10% – continuously running max ± 10% – intermittent running
Voltage imbalance	max 2% - between phases max 30 - No. of starts/hour

Monitoring equipment

Thermal contacts	140°C opening temperature

Cables

SUBCAB®	SUBCAB® Submersible cable

Materials

Outer casing	Aluminium
Impeller	Hard-Iron®
Wear parts	PolyLife/Nitrile rubber/Hard-Iron®
Stator housing	Aluminum
Strainer	Stainless steel
Shaft	Stainless steel
O-rings	Nitrile rubber
Discharge connection	Aluminium

Mechanical face seals

Inner Active Seal™	Tungsten carbide/Tungsten carbide
Outer	Tungsten carbide/Tungsten carbide

Weight and dimensions

Weight (excl. cable)	154 Kg
Height	991 mm
Width	ø 500 mm

Options

Warm liquid version	Warm liquid version max 70°C
Quick couplings	
Starters	
Softstarter	

Accessories

Tandem connections, hose connections. Electrical accessories such as pump controllers, control panels and monitoring relays. Zink anodes.

xylem
Let's Solve Water

XYLEM
Gesällvägen 33
174 87 Sundbyberg, Sweden
Tel +46 8 475 60 00
www.xyleminc.com
www.flygt.com

Environmental Product Declaration
EPD-declared product
EPD®

APPENDIX 6.2

Groundwater Quality Screening Table

Appendix 6.2

Groundwater Quality Screening

Test	Units	SI 9 of 2010, inc. SI 366 of 2016	EPA Interim GW Values	Sample ID	GW1	GW2	GW3	GW4	GW5
				Sampled Date	08/11/2019	08/11/2019	08/11/2019	07/11/2019	07/11/2019
				LOD					
Dissolved Arsenic	ug/l	7.5	-	2.5	<2.5	3.6	<2.5	7.5	<2.5
Dissolved Barium	ug/l	-	100	3	41	71	28	102	72
Dissolved Beryllium	ug/l	-	-	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dissolved Boron	ug/l	750	-	12	<12	14	<12	15	20
Dissolved Cadmium	ug/l	3.75	-	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dissolved Calcium	mg/l	-	200	0.2	47.5	78.3	69.2	49.1	123.5
Total Dissolved Chromium	ug/l	37.5	-	1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Dissolved Copper	ug/l	1500	-	7	<7	16	<7	<7	<7
Dissolved Lead	ug/l	7.5	-	5	<5	<5	<5	<5	<5
Dissolved Magnesium	mg/l	-	50	0.1	7.7	7.1	5.1	26	5.4
Dissolved Mercury	ug/l	0.75	-	1	<1	<1	<1	<1	<1
Dissolved Nickel	ug/l	15	-	2	<2	<2	<2	<2	<2
Dissolved Potassium	mg/l	-	5	0.1	0.7	0.4	0.3	1	1.8
Dissolved Selenium	ug/l	-	-	3	<3	<3	<3	<3	<3
Dissolved Sodium	mg/l	150	150	0.1	9.5	8.8	7.8	19.5	8.7
Dissolved Vanadium	ug/l	-	-	1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Dissolved Zinc	ug/l	75	100	3	19	59	11	7	4
GRO (>C4-C8)	ug/l	-	10	10	<10	<10	<10	<10	<10
GRO (>C8-C12)	ug/l	-	10	10	<10	<10	<10	<10	<10
GRO (>C4-C12)	ug/l	-	10	10	<10	<10	<10	<10	<10
MTBE	ug/l	10	30	5	<5	<5	<5	<5	<5
Benzene	ug/l	0.75	1	5	<5	<5	<5	<5	<5
Toluene	ug/l	525	10	5	<5	<5	<5	<5	<5
Ethylbenzene	ug/l	-	10	5	<5	<5	<5	<5	<5
m/p-Xylene	ug/l	-	10	5	<5	<5	<5	<5	<5
o-Xylene	ug/l	-	10	5	<5	<5	<5	<5	<5
EPH (C8-C40)	ug/l	7.5	10	10	<10	<10	<10	<10	<10
Sulphate as SO4	mg/l	187.5	200	0.5	9.6	16.1	24	12.3	23.2
Chloride	mg/l	187.5	-	0.3	15.1	9.6	9.5	9.6	8.4
Nitrate as NO3	mg/l	37.5	-	0.2	13.4	14.6	45	0.4	19.6
Nitrite as NO2	mg/l	0.375	0.1	0.02	<0.02	<0.02	0.07	0.19	0.02
Ortho Phosphate as PO4	mg/l	-	-	0.06	<0.06	<0.06	<0.06	<0.06	<0.06
Nitrate as N	mg/l	-	-	0.05	3.02	3.3	10.17	0.08	4.43
Nitrite as N	mg/l	-	-	0.006	<0.006	<0.006	0.021	0.059	0.007
Ortho Phosphate as P	mg/l	0.035	0.03	0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Ammoniacal Nitrogen as N	mg/l	-	-	0.03	0.05	<0.03	<0.03	<0.03	0.05
Ammoniacal Nitrogen as NH4	mg/l	0.225	-	0.03	0.07	<0.03	<0.03	<0.03	0.06
Hexavalent Chromium	ug/l	7.5	0.03	6	<6	<6	<6	<6	<6
Total Dissolved Chromium III	ug/l	-	0.03	6	<6	<6	<6	<6	<6
Total Alkalinity as CaCO3	mg/l	-	NAC*	1	142	242	162	282	368
COD (Settled)	mg/l	-	-	7	<7	<7	<7	<7	<7
Total Suspended Solids	mg/l	-	-	10	<10	<10	<10	66	834

Exceeds Screening Value

'NAC' No Abnormal Change

'-' No Screening Value

APPENDIX 6.3

Groundwater Quality Laboratory Report

Element Materials Technology
Unit 3 Deeside Point
Zone 3
Deeside Industrial Park
Deeside
CH5 2UA

P: +44 (0) 1244 833780
F: +44 (0) 1244 833781
W: www.element.com

Golder Associates Ltd
Town Centre House
Dublin Road
Naas
Co Kildare
Ireland

4225

Attention :	Ruth Treacy
Date :	15th November, 2019
Your reference :	19124167
Our reference :	Test Report 19/18452 Batch 1
Location :	Shillelagh
Date samples received :	12th November, 2019
Status :	Final report
Issue :	1

Five samples were received for analysis on 12th November, 2019 of which five were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Authorised By:

Boden

Paul Boden BSc

Senior Project Manager

Client Name:	Golder Associates Ltd	**Report :**	**Liquid**
Reference:	19124167		
Location:	Shillelagh		
Contact:	Ruth Treacy	**Liquids/products:**	V=40ml vial, G=glass bottle, P=plastic bottle
EMT Job No:	19/18452		H=H_2SO_4, Z=ZnAc, N=NaOH, HN=$HN0_3$

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-6	7-12	13-18	19-24	25-30						LOD/LOR	Units	Method No.
Sample ID	GW1	GW2	GW3	GW4	GW5								
Depth													
COC No / misc													
Containers	V H HN P G	V H HN P G	V H HN P G	V H HN P G	V H HN P G								
Sample Date	08/11/2019	08/11/2019	08/11/2019	07/11/2019	07/11/2019								
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water								
Batch Number	1	1	1	1	1								
Date of Receipt	12/11/2019	12/11/2019	12/11/2019	12/11/2019	12/11/2019								
Dissolved Arsenic #	<2.5	3.6	<2.5	7.5	<2.5						<2.5	ug/l	TM30/PM14
Dissolved Barium #	41	71	28	102	72						<3	ug/l	TM30/PM14
Dissolved Beryllium	<0.5	<0.5	<0.5	<0.5	<0.5						<0.5	ug/l	TM30/PM14
Dissolved Boron	<12	14	<12	15	20						<12	ug/l	TM30/PM14
Dissolved Cadmium #	<0.5	<0.5	<0.5	<0.5	<0.5						<0.5	ug/l	TM30/PM14
Dissolved Calcium #	47.5	78.3	69.2	49.1	123.5						<0.2	mg/l	TM30/PM14
Total Dissolved Chromium #	<1.5	<1.5	<1.5	<1.5	<1.5						<1.5	ug/l	TM30/PM14
Dissolved Copper #	<7	16	<7	<7	<7						<7	ug/l	TM30/PM14
Dissolved Lead #	<5	<5	<5	<5	<5						<5	ug/l	TM30/PM14
Dissolved Magnesium #	7.7	7.1	5.1	26.0	5.4						<0.1	mg/l	TM30/PM14
Dissolved Mercury #	<1	<1	<1	<1	<1						<1	ug/l	TM30/PM14
Dissolved Nickel #	<2	<2	<2	<2	<2						<2	ug/l	TM30/PM14
Dissolved Potassium #	0.7	0.4	0.3	1.0	1.8						<0.1	mg/l	TM30/PM14
Dissolved Selenium #	<3	<3	<3	<3	<3						<3	ug/l	TM30/PM14
Dissolved Sodium #	9.5	8.8	7.8	19.5	8.7						<0.1	mg/l	TM30/PM14
Dissolved Vanadium #	<1.5	<1.5	<1.5	<1.5	<1.5						<1.5	ug/l	TM30/PM14
Dissolved Zinc #	19	59	11	7	4						<3	ug/l	TM30/PM14
GRO (>C4-C8) #	<10	<10	<10	<10	<10						<10	ug/l	TM36/PM12
GRO (>C8-C12) #	<10	<10	<10	<10	<10						<10	ug/l	TM36/PM12
GRO (>C4-C12) #	<10	<10	<10	<10	<10						<10	ug/l	TM36/PM12
MTBE #	<5	<5	<5	<5	<5						<5	ug/l	TM31/PM12
Benzene #	<5	<5	<5	<5	<5						<5	ug/l	TM31/PM12
Toluene #	<5	<5	<5	<5	<5						<5	ug/l	TM31/PM12
Ethylbenzene #	<5	<5	<5	<5	<5						<5	ug/l	TM31/PM12
m/p-Xylene #	<5	<5	<5	<5	<5						<5	ug/l	TM31/PM12
o-Xylene #	<5	<5	<5	<5	<5						<5	ug/l	TM31/PM12
EPH (C8-C40) #	<10	<10	<10	<10	<10						<10	ug/l	TM5/PM30
Sulphate as SO4 #	9.6	16.1	24.0	12.3	23.2						<0.5	mg/l	TM38/PM0
Chloride #	15.1	9.6	9.5	9.6	8.4						<0.3	mg/l	TM38/PM0
Nitrate as NO3 #	13.4	14.6	45.0	0.4	19.6						<0.2	mg/l	TM38/PM0
Nitrite as NO2 #	<0.02	<0.02	0.07	0.19	0.02						<0.02	mg/l	TM38/PM0
Ortho Phosphate as PO4 #	<0.06	<0.06	<0.06	<0.06	<0.06						<0.06	mg/l	TM38/PM0
Nitrate as N #	3.02	3.30	10.17	0.08	4.43						<0.05	mg/l	TM38/PM0
Nitrite as N #	<0.006	<0.006	0.021	0.059	0.007						<0.006	mg/l	TM38/PM0
Ortho Phosphate as P #	<0.03	<0.03	<0.03	<0.03	<0.03						<0.03	mg/l	TM38/PM0
Ammoniacal Nitrogen as N #	0.05	<0.03	<0.03	<0.03	0.05						<0.03	mg/l	TM38/PM0
Ammoniacal Nitrogen as NH4 #	0.07	<0.03	<0.03	<0.03	0.06						<0.03	mg/l	TM38/PM0
Hexavalent Chromium	<6	<6	<6	<6	<6						<6	ug/l	TM38/PM0
Total Dissolved Chromium III	<6	<6	<6	<6	<6						<6	ug/l	TM0/PM0

Client Name:	Golder Associates Ltd
Reference:	19124167
Location:	Shillelagh
Contact:	Ruth Treacy
EMT Job No:	19/18452

Report : **Liquid**

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
H=H_2SO_4, Z=ZnAc, N=NaOH, HN=$HN0_3$

EMT Sample No.	1-6	7-12	13-18	19-24	25-30								
Sample ID	GW1	GW2	GW3	GW4	GW5								
Depth													
COC No / misc													
Containers	V H HN P G	V H HN P G	V H HN P G	V H HN P G	V H HN P G								
Sample Date	08/11/2019	08/11/2019	08/11/2019	07/11/2019	07/11/2019								
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water								
Batch Number	1	1	1	1	1						LOD/LOR	Units	Method No.
Date of Receipt	12/11/2019	12/11/2019	12/11/2019	12/11/2019	12/11/2019								
Total Alkalinity as CaCO3 #	142	242	162	282	368						<1	mg/l	TM75/PM0
COD (Settled) #	<7	<7	<7	<7	<7						<7	mg/l	TM57/PM0
Total Suspended Solids #	<10	<10	<10	66	834						<10	mg/l	TM37/PM0

Please see attached notes for all abbreviations and acronyms

Client Name: Golder Associates Ltd
Reference: 19124167
Location: Shillelagh
Contact: Ruth Treacy

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
No deviating sample report results for job 19/18452						

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.

Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 19/18452

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.

Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher, this result is not accredited.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

EMT Job No: 19/18452

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM0	Not available	PM0	No preparation is required.				
TM5	Modified 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM14	Analysis of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for dissolved metals and acidified if required.				
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM14	Analysis of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for dissolved metals and acidified if required.	Yes			
TM31	Modified USEPA 8015B. Determination of Methyltertbutylether, Benzene, Toluene, Ethylbenzene and Xylene by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM36	Modified US EPA method 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results can be confirmed using GCMS.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM37	Modified methods USEPA 160.2, EN872:2005 and SMWW 2540D. Gravimetric determination of Total Suspended Solids. Sample is filtered through a 1.5um pore size glass fibre filter and the resulting residue is dried and weighed.	PM0	No preparation is required.	Yes			
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods 325.2 (Chloride), 375.4 (Sulphate), 365.2 (o-Phosphate), 353.1 (TON), 354.1 (Nitrite), 350.1 (NH_4+) comparable to BS ISO 15923-1, 7196A (Hex Cr)	PM0	No preparation is required.				
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods 325.2 (Chloride), 375.4 (Sulphate), 365.2 (o-Phosphate), 353.1 (TON), 354.1 (Nitrite), 350.1 (NH_4+) comparable to BS ISO 15923-1, 7196A (Hex Cr)	PM0	No preparation is required.	Yes			
TM57	Modified US EPA Method 410.4. Comparable with ISO 15705:2002. Chemical Oxygen Demand is determined by hot digestion with Potassium Dichromate and measured spectrophotometerically.	PM0	No preparation is required.	Yes			

EMT Job No: 19/18452

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM75	Modified US EPA method 310.1. Determination of Alkalinity by Metrohm automated titration analyser.	PM0	No preparation is required.	Yes			

APPENDIX 6.4

Seepage Calculations

			Future Scenario	
Notation	**Parameter**	**Units**	**Value**	**Comments**
Ap	Pit surface area	m^2	68900	*Calculated from Site survey Data (6.89 ha)*
P	Precipitation	m/year	0.994	*Based on average annual precipitation of 994 mm (Met Eireann, 2019)*
h_p	Current saturated thickness above base of pit (seepage face height)	m	61.00	*Calculated from base of quarry (230 m) and maximum recorded water level at GW4 (291 m)*
W	Recharge flux	m/s	3.17E-09	*Based on groundwater recharge rate of 100 mm/year (GSI, 2019)*
K_{h1}	Horizontal hydraulic conductivity Zone 1	m/s	1.16E-08	*Driscoll (1986) value for well cemented sandstone formations*
K_{h2}	Horizontal hydraulic conductivity Zone 2	m/s	1.16E-08	*Driscoll (1986) value for well cemented sandstone formations*
K_{v2}	Vertical Hydraulic Conduictivity Zone 2	m/s	1.16E-09	*Anisotropy assumed; Kv assumed to be an order of magnitude lower than Kh*
r_p	Radius of pit	m	187	*Estimated maximum radius from Site survey data*
r_o	Radius of influence	m	188	*Trial number for calculation*
h_o	Pre-mining saturated thickness above base of pit	m	61.00	*Calculated (reference Marinelli and Niccoli, 2000)*
h_u	Recorded pre-mining saturated thickness above pit base	m	61.00	*Calculated from Site survey Data*
z_p	Depth of quarry	m	67.00	*Calculated from Site survey data (297 mAOD) and proposed quarry floor (230 mAOD)*
d	Depth of pit lake	m	0.00	*Quarry floor assumed to be kept dry*
Note:	***All heads are in m above quarry floor***		-	
Q_1	Rate of inflow to pit through face	m^3/day	0.323	*Calculated (reference Marinelli and Niccoli, 2000)*
		m^3/s	0.000	
Q_2	Rate of inflow to pit through floor	m^3/day	1.45E+01	*Calculated (reference Marinelli and Niccoli, 2000)*
		m^3/s	1.67E-04	
Q_T	Total inflow to pit from strata	m^3/day	14.784	*Calculated (reference Marinelli and Niccoli, 2000)*
		m^3/s	0.000	
Qv	Total volume to be pumped (inflow plus rainfall)	m^3/day	202.419	*Calculated (inflow + rainfall)*
		m^3/hr	8.434	
		m^3/s	0.002	
		l/s	2.3	

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W: www.element.com

Golder Associates Ltd
Town Centre House
Dublin Road
Naas
Co Kildare
Ireland

4225

Attention : Ruth Treacy

Date : 7th January, 2022

Your reference : 19124167

Our reference : Test Report 21/20160 Batch 1

Location : Shillelagh

Date samples received : 16th December, 2021

Status : Final Report

Issue : 1

Six samples were received for analysis on 16th December, 2021 of which six were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Authorised By:

Paul Boden BSc

Senior Project Manager

Client Name:	Golder Associates Ltd	**Report :**	**Liquid**
Reference:	19124167		
Location:	Shillelagh		
Contact:	Ruth Treacy	**Liquids/products:**	V=40ml vial, G=glass bottle, P=plastic bottle
EMT Job No:	21/20160		$H=H_2SO_4$, Z=ZnAc, N=NaOH, $HN=HN0_3$

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-6	7-11	12-17	18-23	24-29	30-35							
Sample ID	GW01	GW01D	GW02	GW03	GW04	GW05							
Depth													
COC No / misc													
Containers	V H HN P G	V H HN P	V H HN P G	V H HN P G	V H HN P G	V H HN P G							
Sample Date	13/12/2021	13/12/2021	13/12/2021	13/12/2021	13/12/2021	13/12/2021							
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water							
Batch Number	1	1	1	1	1	1					LOD/LOR	Units	Method No.
Date of Receipt	16/12/2021	16/12/2021	16/12/2021	16/12/2021	16/12/2021	16/12/2021							
Dissolved Arsenic#	<2.5	<2.5	2.6	<2.5	6.8	<2.5					<2.5	ug/l	TM30/PM14
Dissolved Barium#	36	35	67	15	146	71					<3	ug/l	TM30/PM14
Dissolved Beryllium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5					<0.5	ug/l	TM30/PM14
Dissolved Boron	<12	<12	<12	<12	22	14					<12	ug/l	TM30/PM14
Dissolved Cadmium#	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5					<0.5	ug/l	TM30/PM14
Dissolved Calcium#	51.4	51.0	69.0	72.0	36.1	95.8					<0.2	mg/l	TM30/PM14
Total Dissolved Chromium#	<1.5	<1.5	<1.5	1.9	<1.5	<1.5					<1.5	ug/l	TM30/PM14
Dissolved Copper#	<7	<7	14	15	<7	<7					<7	ug/l	TM30/PM14
Dissolved Lead#	<5	<5	<5	<5	<5	<5					<5	ug/l	TM30/PM14
Dissolved Magnesium#	6.9	6.8	7.1	5.9	19.6	4.6					<0.1	mg/l	TM30/PM14
Dissolved Mercury#	<1	<1	<1	<1	<1	<1					<1	ug/l	TM30/PM14
Dissolved Nickel#	<2	<2	<2	<2	<2	<2					<2	ug/l	TM30/PM14
Dissolved Potassium#	0.4	0.4	0.4	0.3	6.2	2.4					<0.1	mg/l	TM30/PM14
Dissolved Selenium#	<3	<3	<3	<3	<3	<3					<3	ug/l	TM30/PM14
Dissolved Sodium#	7.9	7.9	8.4	9.4	17.7	8.6					<0.1	mg/l	TM30/PM14
Dissolved Vanadium#	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5					<1.5	ug/l	TM30/PM14
Dissolved Zinc#	5	4	40	28	<3	<3					<3	ug/l	TM30/PM14
GRO (>C4-C8)#	<10	<10	<10	<10	<10	<10					<10	ug/l	TM36/PM12
GRO (>C8-C12)#	<10	<10	<10	<10	<10	<10					<10	ug/l	TM36/PM12
GRO (>C4-C12)#	<10	<10	<10	<10	<10	<10					<10	ug/l	TM36/PM12
MTBE#	<5	<5	<5	<5	<5	<5					<5	ug/l	TM36/PM12
Benzene#	<5	<5	<5	<5	<5	<5					<5	ug/l	TM36/PM12
Toluene#	<5	<5	<5	<5	<5	<5					<5	ug/l	TM36/PM12
Ethylbenzene#	<5	<5	<5	<5	<5	<5					<5	ug/l	TM36/PM12
m/p-Xylene#	<5	<5	<5	<5	<5	<5					<5	ug/l	TM36/PM12
o-Xylene#	<5	<5	<5	<5	<5	<5					<5	ug/l	TM36/PM12
EPH (C8-C40)#	<10	<10	<10	<10	<10	<10					<10	ug/l	TM5/PM30
Sulphate as SO4#	9.8	9.6	21.7	20.2	13.2	27.6					<0.5	mg/l	TM38/PM0
Chloride#	11.6	11.8	9.7	14.0	8.9	13.1					<0.3	mg/l	TM38/PM0
Nitrate as NO3#	14.2	14.1	18.0	25.2	1.9	34.4					<0.2	mg/l	TM38/PM0
Nitrite as NO2#	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02					<0.02	mg/l	TM38/PM0
Ortho Phosphate as PO4#	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06					<0.06	mg/l	TM38/PM0
Nitrate as N#	3.21	3.19	4.07	5.69	0.42	7.77					<0.05	mg/l	TM38/PM0
Nitrite as N#	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006					<0.006	mg/l	TM38/PM0
Ortho Phosphate as P#	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03					<0.03	mg/l	TM38/PM0
Total Oxidised Nitrogen as N#	3.2	3.2	4.1	5.7	0.4	7.8					<0.2	mg/l	TM38/PM0
Ammoniacal Nitrogen as N#	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03					<0.03	mg/l	TM38/PM0
Ammoniacal Nitrogen as NH4#	<0.03	<0.03	<0.03	<0.03	0.03	<0.03					<0.03	mg/l	TM38/PM0
Hexavalent Chromium	<6	<6	<6	<6	<6	<6					<6	ug/l	TM38/PM0
Total Dissolved Chromium III	<6	<6	<6	<6	<6	<6					<6	ug/l	TM0/PM0

Client Name: Golder Associates Ltd
Reference: 19124167
Location: Shillelagh
Contact: Ruth Treacy
EMT Job No: 21/20160

Report : **Liquid**

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
H=H_2SO_4, Z=ZnAc, N=NaOH, HN=$HN0_3$

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-6	7-11	12-17	18-23	24-29	30-35							
Sample ID	GW01	GW01D	GW02	GW03	GW04	GW05							
Depth													
COC No / misc													
Containers	V H HN P G	V H HN P	V H HN P G	V H HN P G	V H HN P G	V H HN P G							
Sample Date	13/12/2021	13/12/2021	13/12/2021	13/12/2021	13/12/2021	13/12/2021							
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water							
Batch Number	1	1	1	1	1	1					LOD/LOR	Units	Method No.
Date of Receipt	16/12/2021	16/12/2021	16/12/2021	16/12/2021	16/12/2021	16/12/2021							
Total Alkalinity as CaCO3 #	162	172	212	182	244	262					<1	mg/l	TM75/PM0
COD (Settled) #	<7	<7	<7	<7	<7	<7					<7	mg/l	TM57/PM0
Electrical Conductivity @25C #	328	351	417	406	427	528					<2	uS/cm	TM76/PM0
pH #	7.25	7.27	7.67	8.13	8.14	7.72					<0.01	pH units	TM73/PM0
Total Suspended Solids #	<10	<10	<10	<10	37	38					<10	mg/l	TM37/PM0

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

Notification of Deviating Samples

Client Name: Golder Associates Ltd
Reference: 19124167
Location: Shillelagh
Contact: Ruth Treacy

Matrix : Liquid

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
21/20160	1	GW01D		7-11	EPH	Sample received in inappropriate container

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.

Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 21/20160

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

HWOL ACRONYMS AND OPERATORS USED

HS	Headspace Analysis.
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent.
CU	Clean-up - e.g. by florisil, silica gel.
1D	GC - Single coil gas chromatography.
Total	Aliphatics & Aromatics.
AL	Aliphatics only.
AR	Aromatics only.
2D	GC-GC - Double coil gas chromatography.
#1	EH_Total but with humics mathematically subtracted
#2	EU_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +).
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total
MS	Mass Spectrometry.

EMT Job No: 21/20160

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM0	Not available	PM0	No preparation is required.				
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM14	Preparation of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for Dissolved metals, and remain unfiltered for Total metals then acidified				
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM14	Preparation of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for Dissolved metals, and remain unfiltered for Total metals then acidified	Yes			
TM36	Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested.	PM12	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM37	Modified methods - TSS: USEPA 160.2 (1983), EN872:2005 and APHA SMEWW 2540D:1999 22nd Edition; VSS: USEPA 1684 (Jan 2001), USEPA 160.4 (1971) and SMEWW 2540E:1999 22nd Edition. Gravimetric determination of Total Suspended Solids (TSS) and Volatile Suspended Solids (VSS). Sample is filtered through a 1.5um pore size glass fibre filter and the resulting residue is dried and weighed at 105°C for TSS and 550°C for VSS.	PM0	No preparation is required.	Yes			
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l	PM0	No preparation is required.				
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l	PM0	No preparation is required.	Yes			
TM57	Modified US EPA Method 410.4. (Rev. 2.0 1993) Comparable with ISO 15705:2002. Chemical Oxygen Demand is determined by hot digestion with Potassium Dichromate and measured spectrophotometerically.	PM0	No preparation is required.	Yes			
TM73	Modified US EPA methods 150.1 (1982) and 9045D Rev. 4 - 2004) and BS1377-3:1990. Determination of pH by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			

EMT Job No: 21/20160

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM75	Modified US EPA method 310.1 (1978). Determination of Alkalinity by Metrohm automated titration analyser.	PM0	No preparation is required.	Yes			
TM76	Modified US EPA method 120.1 (1982). Determination of Specific Conductance by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			

element

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ilac-MRA

UKAS
TESTING
4225

Attention :	Ruth Treacy
Date :	17th May, 2022
Your reference :	19124167
Our reference :	Test Report 22/7391 Batch 1
Location :	Shillelagh
Date samples received :	6th May, 2022
Status :	Final Report
Issue :	1

Five samples were received for analysis on 6th May, 2022 of which five were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Authorised By:

Boden

Paul Boden BSc
Senior Project Manager

Client Name: Golder Associates Ltd
Reference: 19124167
Location: Shillelagh
Contact: Ruth Treacy
EMT Job No: 22/7391

Report : **Liquid**

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
H=H_2SO_4, Z=ZnAc, N=NaOH, HN=$HN0_3$

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-6	7-12	13-18	19-24	25-30								
Sample ID	GW1	GW2	GW3	GW4	GW5								
Depth													
COC No / misc													
Containers	V H HN P G	V H HN P G	V H HN P G	V H HN P G	V H HN P G								
Sample Date	28/04/2022	28/04/2022	28/04/2022	28/04/2022	28/04/2022								
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water								
Batch Number	1	1	1	1	1						LOD/LOR	Units	Method No.
Date of Receipt	06/05/2022	06/05/2022	06/05/2022	06/05/2022	06/05/2022								
Dissolved Arsenic #	<2.5	<2.5	<2.5	7.4	<2.5						<2.5	ug/l	TM30/PM14
Dissolved Barium #	33	63	13	148	45						<3	ug/l	TM30/PM14
Dissolved Beryllium	<0.5	<0.5	<0.5	<0.5	<0.5						<0.5	ug/l	TM30/PM14
Dissolved Boron	<12	<12	<12	<12	<12						<12	ug/l	TM30/PM14
Dissolved Cadmium #	<0.5	<0.5	<0.5	<0.5	<0.5						<0.5	ug/l	TM30/PM14
Dissolved Calcium #	51.7	70.9	74.0	48.5	75.9						<0.2	mg/l	TM30/PM14
Total Dissolved Chromium #	<1.5	<1.5	<1.5	<1.5	<1.5						<1.5	ug/l	TM30/PM14
Dissolved Copper #	<7	18	8	<7	<7						<7	ug/l	TM30/PM14
Dissolved Lead #	<5	<5	<5	<5	25						<5	ug/l	TM30/PM14
Dissolved Magnesium #	6.9	7.4	6.1	28.2	4.2						<0.1	mg/l	TM30/PM14
Dissolved Mercury #	<1	<1	<1	<1	<1						<1	ug/l	TM30/PM14
Dissolved Nickel #	<2	<2	<2	<2	<2						<2	ug/l	TM30/PM14
Dissolved Potassium #	0.4	0.4	0.4	0.6	1.8						<0.1	mg/l	TM30/PM14
Dissolved Selenium #	<3	<3	<3	<3	<3						<3	ug/l	TM30/PM14
Dissolved Sodium #	8.7	9.2	9.5	12.4	9.1						<0.1	mg/l	TM30/PM14
Dissolved Vanadium #	<1.5	<1.5	<1.5	<1.5	<1.5						<1.5	ug/l	TM30/PM14
Dissolved Zinc #	3	39	13	<3	18						<3	ug/l	TM30/PM14
GRO (>C4-C8) #	<10	<10	<10	<10	<10						<10	ug/l	TM36/PM12
GRO (>C8-C12) #	<10	<10	<10	<10	<10						<10	ug/l	TM36/PM12
GRO (>C4-C12) #	<10	<10	<10	<10	<10						<10	ug/l	TM36/PM12
MTBE #	<5	<5	<5	<5	<5						<5	ug/l	TM36/PM12
Benzene #	<5	<5	<5	<5	<5						<5	ug/l	TM36/PM12
Toluene #	<5	<5	<5	<5	<5						<5	ug/l	TM36/PM12
Ethylbenzene #	<5	<5	<5	<5	<5						<5	ug/l	TM36/PM12
m/p-Xylene #	<5	<5	<5	<5	<5						<5	ug/l	TM36/PM12
o-Xylene #	<5	<5	<5	<5	<5						<5	ug/l	TM36/PM12
EPH (C8-C40) #	<10	<10	<10	<10	<10						<10	ug/l	TM5/PM30
Sulphate as SO4 #	10.5	22.7	18.1	12.7	33.4						<0.5	mg/l	TM38/PM0
Chloride #	12.7	10.3	15.8	9.8	11.1						<0.3	mg/l	TM38/PM0
Nitrate as NO3 #	14.7	17.5	23.7	<0.2	25.3						<0.2	mg/l	TM38/PM0
Nitrite as NO2 #	<0.02	<0.02	<0.02	<0.02	0.10						<0.02	mg/l	TM38/PM0
Ortho Phosphate as PO4 #	<0.06	<0.06	<0.06	<0.06	<0.06						<0.06	mg/l	TM38/PM0
Nitrate as N #	3.32	3.95	5.36	<0.05	5.72						<0.05	mg/l	TM38/PM0
Nitrite as N #	<0.006	<0.006	<0.006	<0.006	0.030						<0.006	mg/l	TM38/PM0
Ortho Phosphate as P #	<0.03	<0.03	<0.03	<0.03	<0.03						<0.03	mg/l	TM38/PM0
Total Oxidised Nitrogen as N #	3.3	3.9	5.4	<0.2	5.7						<0.2	mg/l	TM38/PM0
Ammoniacal Nitrogen as N #	<0.03	<0.03	<0.03	<0.03	0.12						<0.03	mg/l	TM38/PM0
Ammoniacal Nitrogen as NH4 #	<0.03	<0.03	<0.03	0.03	0.16						<0.03	mg/l	TM38/PM0
Hexavalent Chromium	<6	<6	<6	<6	<6						<6	ug/l	TM38/PM0
Total Dissolved Chromium III	<6	<6	<6	<6	<6						<6	ug/l	TM0/PM0

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name: Golder Associates Ltd
Reference: 19124167
Location: Shillelagh
Contact: Ruth Treacy
EMT Job No: 22/7391

Report : **Liquid**

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
H=H_2SO_4, Z=ZnAc, N=NaOH, HN=$HN0_3$

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-6	7-12	13-18	19-24	25-30						LOD/LOR	Units	Method No.
Sample ID	GW1	GW2	GW3	GW4	GW5								
Depth													
COC No / misc													
Containers	V H HN P G	V H HN P G	V H HN P G	V H HN P G	V H HN P G								
Sample Date	28/04/2022	28/04/2022	28/04/2022	28/04/2022	28/04/2022								
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water								
Batch Number	1	1	1	1	1								
Date of Receipt	06/05/2022	06/05/2022	06/05/2022	06/05/2022	06/05/2022								
Total Alkalinity as CaCO3 $^{\#}$	156	212	188	264	184						<1	mg/l	TM75/PM0
COD (Settled) $^{\#}$	<7	<7	<7	<7	11						<7	mg/l	TM57/PM0
Electrical Conductivity @25C $^{\#}$	341	437	442	475	444						<2	uS/cm	TM76/PM0
pH $^{\#}$	7.08	7.64	7.58	8.16	7.82						<0.01	pH units	TM73/PM0
Total Suspended Solids $^{\#}$	<10	<10	<10	808	196						<10	mg/l	TM37/PM0

Client Name: Golder Associates Ltd
Reference: 19124167
Location: Shillelagh
Contact: Ruth Treacy

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
No deviating sample report results for job 22/7391						

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.

Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 22/7391

SOILS and ASH

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. Asbestos samples are retained for 6 months.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C. Ash samples are dried at 37°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

STACK EMISSIONS

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation for Dioxins and Furans and Dioxin like PCBs has been performed on XAD-2 Resin, only samples which use this resin will be within our MCERTS scope.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.
Laboratory records are kept for a period of no less than 6 years.

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

Customer Provided Information

Sample ID and depth is information provided by the customer.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

HWOL ACRONYMS AND OPERATORS USED

HS	Headspace Analysis.
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent.
CU	Clean-up - e.g. by florisil, silica gel.
1D	GC - Single coil gas chromatography.
Total	Aliphatics & Aromatics.
AL	Aliphatics only.
AR	Aromatics only.
2D	GC-GC - Double coil gas chromatography.
#1	EH_Total but with humics mathematically subtracted
#2	EU_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +).
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total
MS	Mass Spectrometry.

EMT Job No: 22/7391

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM0	Not available	PM0	No preparation is required.				
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM14	Preparation of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for Dissolved metals, and remain unfiltered for Total metals then acidified				
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM14	Preparation of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for Dissolved metals, and remain unfiltered for Total metals then acidified	Yes			
TM36	Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested.	PM12	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM37	Modified methods - TSS: USEPA 160.2 (1983), EN872:2005 and APHA SMEWW 2540D:1999 22nd Edition; VSS: USEPA 1684 (Jan 2001), USEPA 160.4 (1971) and SMEWW 2540E:1999 22nd Edition. Gravimetric determination of Total Suspended Solids (TSS) and Volatile Suspended Solids (VSS). Sample is filtered through a 1.5um pore size glass fibre filter and the resulting residue is dried and weighed at 105°C for TSS and 550°C for VSS	PM0	No preparation is required.	Yes			
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l	PM0	No preparation is required.				
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l	PM0	No preparation is required.	Yes			
TM57	Modified US EPA Method 410.4. (Rev. 2.0 1993) Comparable with ISO 15705:2002. Chemical Oxygen Demand is determined by hot digestion with Potassium Dichromate and measured spectrophotometerically.	PM0	No preparation is required.	Yes			
TM73	Modified US EPA methods 150.1 (1982) and 9045D Rev. 4 - 2004) and BS1377-3:1990. Determination of pH by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			

EMT Job No: 22/7391

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM75	Modified US EPA method 310.1 (1978). Determination of Alkalinity by Metrohm automated titration analyser.	PM0	No preparation is required.	Yes			
TM76	Modified US EPA method 120.1 (1982). Determination of Specific Conductance by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			

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Golder Associates Ltd
Town Centre House
Dublin Road
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Co Kildare
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4225

Attention : Ruth Treacy

Date : 28th October, 2022

Your reference :

Our reference : Test Report 22/16636 Batch 1

Location : Shillelagh

Date samples received : 12th October, 2022

Status : Final Report

Issue : 1

Four samples were received for analysis on 12th October, 2022 of which four were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Authorised By:

Simon Gomery BSc

Project Manager

Please include all sections of this report if it is reproduced

Client Name: Golder Associates Ltd
Reference:
Location: Shillelagh
Contact: Ruth Treacy
EMT Job No: 22/16636

Report : **Liquid**

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
H=H_2SO_4, Z=ZnAc, N=NaOH, HN=$HN0_3$

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-6	7-12	13-18	19-24									
Sample ID	GW1	GW2	GW3	GW4									
Depth													
COC No / misc													
Containers	V H HN P G	V H HN P G	V H HN P G	V H HN P G									
Sample Date	10/10/2022	10/10/2022	10/10/2022	10/10/2022									
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water									
Batch Number	1	1	1	1							LOD/LOR	Units	Method No.
Date of Receipt	12/10/2022	12/10/2022	12/10/2022	12/10/2022									
Dissolved Arsenic#	<2.5	<2.5	<2.5	7.8							<2.5	ug/l	TM30/PM14
Dissolved Barium#	37	70	13	104							<3	ug/l	TM30/PM14
Dissolved Beryllium	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM30/PM14
Dissolved Boron	<12	<12	<12	<12							<12	ug/l	TM30/PM14
Dissolved Cadmium#	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM30/PM14
Dissolved Calcium#	54.0	70.9	70.7	49.8							<0.2	mg/l	TM30/PM14
Total Dissolved Chromium#	<1.5	<1.5	<1.5	<1.5							<1.5	ug/l	TM30/PM14
Dissolved Copper#	<7	12	<7	<7							<7	ug/l	TM30/PM14
Dissolved Lead#	<5	<5	<5	<5							<5	ug/l	TM30/PM14
Dissolved Magnesium#	7.0	7.4	6.0	27.7							<0.1	mg/l	TM30/PM14
Dissolved Mercury#	<1	<1	<1	<1							<1	ug/l	TM30/PM14
Dissolved Nickel#	<2	<2	<2	<2							<2	ug/l	TM30/PM14
Dissolved Potassium#	0.5	0.4	0.4	0.6							<0.1	mg/l	TM30/PM14
Dissolved Selenium#	<3	<3	<3	<3							<3	ug/l	TM30/PM14
Dissolved Sodium#	9.1	9.1	9.5	12.0							<0.1	mg/l	TM30/PM14
Dissolved Vanadium#	<1.5	<1.5	<1.5	<1.5							<1.5	ug/l	TM30/PM14
Dissolved Zinc#	4	23	5	3							<3	ug/l	TM30/PM14
GRO (>C4-C8)#	<10	<10	<10	<10							<10	ug/l	TM36/PM12
GRO (>C8-C12)#	<10	20	<10	<10							<10	ug/l	TM36/PM12
GRO (>C4-C12)#	<10	20	<10	<10							<10	ug/l	TM36/PM12
MTBE#	<5	<5	<5	<5							<5	ug/l	TM36/PM12
Benzene#	<5	<5	<5	<5							<5	ug/l	TM36/PM12
Toluene#	<5	<5	<5	<5							<5	ug/l	TM36/PM12
Ethylbenzene#	<5	<5	<5	<5							<5	ug/l	TM36/PM12
m/p-Xylene#	<5	<5	<5	<5							<5	ug/l	TM36/PM12
o-Xylene#	<5	<5	<5	<5							<5	ug/l	TM36/PM12
EPH (C8-C40)#	<10	<10	<10^{SV}	<10							<10	ug/l	TM5/PM30
Sulphate as SO4#	11.1	21.2	21.3	13.0							<0.5	mg/l	TM38/PM0
Chloride#	13.3	10.0	17.1	9.8							<0.3	mg/l	TM38/PM0
Nitrate as NO3#	38.3	18.1	24.4	4.0							<0.2	mg/l	TM38/PM0
Nitrite as NO2#	<0.02	<0.02	<0.02	<0.02							<0.02	mg/l	TM38/PM0
Ortho Phosphate as PO4#	<0.06	<0.06	<0.06	<0.06							<0.06	mg/l	TM38/PM0
Nitrate as N#	8.64	4.09	5.52	0.91							<0.05	mg/l	TM38/PM0
Nitrite as N#	<0.006	<0.006	<0.006	<0.006							<0.006	mg/l	TM38/PM0
Ortho Phosphate as P#	<0.03	<0.03	<0.03	<0.03							<0.03	mg/l	TM38/PM0
Total Oxidised Nitrogen as N#	8.6	4.1	5.5	0.9							<0.2	mg/l	TM38/PM0
Ammoniacal Nitrogen as N#	<0.03	<0.03	<0.03	<0.03							<0.03	mg/l	TM38/PM0
Ammoniacal Nitrogen as NH4#	<0.03	<0.03	<0.03	<0.03							<0.03	mg/l	TM38/PM0
Hexavalent Chromium	<6	<6	<6	<6							<6	ug/l	TM38/PM0
Total Dissolved Chromium III	<6	<6	<6	<6							<6	ug/l	TM0/PM0

Client Name: Golder Associates Ltd
Reference:
Location: Shillelagh
Contact: Ruth Treacy
EMT Job No: 22/16636

Report : Liquid

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
H=H_2SO_4, Z=ZnAc, N=NaOH, HN=$HN0_3$

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-6	7-12	13-18	19-24									
Sample ID	GW1	GW2	GW3	GW4									
Depth													
COC No / misc													
Containers	V H HN P G	V H HN P G	V H HN P G	V H HN P G									
Sample Date	10/10/2022	10/10/2022	10/10/2022	10/10/2022									
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water									
Batch Number	1	1	1	1							LOD/LOR	Units	Method No.
Date of Receipt	12/10/2022	12/10/2022	12/10/2022	12/10/2022									
Total Alkalinity as CaCO3 $^{\#}$	128	192	166	252							<1	mg/l	TM75/PM0
COD (Settled) $^{\#}$	8	<7	<7	<7							<7	mg/l	TM57/PM0
Electrical Conductivity @25C $^{\#}$	375	437	442	485							<2	uS/cm	TM76/PM0
pH $^{\#}$	7.00	7.65	7.57	8.12							<0.01	pH units	TM73/PM0
Total Suspended Solids $^{\#}$	<10	<10	<10	906							<10	mg/l	TM37/PM0

Client Name: Golder Associates Ltd
Reference:
Location: Shillelagh
Contact: Ruth Treacy

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
No deviating sample report results for job 22/16636						

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.
Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 22/16636

SOILS and ASH

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. Asbestos samples are retained for 6 months.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C. Ash samples are dried at 37°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

STACK EMISSIONS

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation for Dioxins and Furans and Dioxin like PCBs has been performed on XAD-2 Resin, only samples which use this resin will be within our MCERTS scope.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.
Laboratory records are kept for a period of no less than 6 years.

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

Customer Provided Information

Sample ID and depth is information provided by the customer.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

HWOL ACRONYMS AND OPERATORS USED

HS	Headspace Analysis.
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent.
CU	Clean-up - e.g. by florisil, silica gel.
1D	GC - Single coil gas chromatography.
Total	Aliphatics & Aromatics.
AL	Aliphatics only.
AR	Aromatics only.
2D	GC-GC - Double coil gas chromatography.
#1	EH_Total but with humics mathematically subtracted
#2	EU_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +).
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total
MS	Mass Spectrometry.

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM0	Not available	PM0	No preparation is required.				
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM14	Preparation of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for Dissolved metals, and remain unfiltered for Total metals then acidified				
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM14	Preparation of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for Dissolved metals, and remain unfiltered for Total metals then acidified	Yes			
TM36	Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested.	PM12	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM37	Modified methods - TSS: USEPA 160.2 (1983), EN872:2005 and APHA SMEWW 2540D:1999 22nd Edition; VSS: USEPA 1684 (Jan 2001), USEPA 160.4 (1971) and SMEWW 2540E:1999 22nd Edition. Gravimetric determination of Total Suspended Solids (TSS) and Volatile Suspended Solids (VSS). Sample is filtered through a 1.5um pore size glass fibre filter and the resulting residue is dried and weighed at 105°C for TSS and 550°C for VSS	PM0	No preparation is required.	Yes			
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l	PM0	No preparation is required.				
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l	PM0	No preparation is required.	Yes			
TM57	Modified US EPA Method 410.4. (Rev. 2.0 1993) Comparable with ISO 15705:2002. Chemical Oxygen Demand is determined by hot digestion with Potassium Dichromate and measured spectrophotometerically.	PM0	No preparation is required.	Yes			
TM73	Modified US EPA methods 150.1 (1982) and 9045D Rev. 4 - 2004) and BS1377-3:1990. Determination of pH by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			

EMT Job No: 22/16636

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM75	Modified US EPA method 310.1 (1978). Determination of Alkalinity by Metrohm automated titration analyser.	PM0	No preparation is required.	Yes			
TM76	Modified US EPA method 120.1 (1982). Determination of Specific Conductance by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			

Appendix 6E

SEEPAGE CALCULATIONS

Notation	Parameter	Units	Latest Value	Comments
Ap	Pit surface area	m^2	56000	*Calculated from 2023 Site survey Data (5.6 ha)*
P	Precipitation	m/year	1.015	*Based on average annual precipitation of 1015 mm over the review period*
h_p	Current saturated thickness above base of pit (seepage face height)	m	83.00	*Calculated from base of quarry (208 m) and maximum recorded water level at GW4 (291 m)*
W	Recharge flux	m/s	3.17E-09	*Based on groundwater recharge rate of 100 mm/year (GSI, 2019)*
K_{h1}	Horizontal hydraulic conductivity Zone 1	m/s	1.16E-08	*Driscoll (1986) value for well cemented sandstone formations*
K_{h2}	Horizontal hydraulic conductivity Zone 2	m/s	1.16E-08	*Driscoll (1986) value for well cemented sandstone formations*
K_{v2}	Vertical Hydraulic Conduictivity Zone 2	m/s	1.16E-09	*Anisotropy assumed; Kv assumed to be an order of magnitude lower than Kh*
r_p	Radius of pit	m	140	*Estimated maximum radius from 2023 Site survey data*
r_o	Radius of influence	m	141	*Trial number for calculation*
h_o	Pre-mining saturated thickness above base of pit	m	83.00	*Calculated (reference Marinelli and Niccoli, 2000)*
h_u	Recorded pre-mining saturated thickness above pit base	m	61.00	*Calculated from Site survey Data*
z_p	Depth of quarry	m	89.00	*Calculated from 20023 Site survey data (297 mAOD) and latest quarry floor (208 mAOD)*
d	Depth of pit lake	m	0.00	*Quarry floor assumed to be kept dry*
Note:	***All heads are in m above quarry floor***		-	
Q_1	Rate of inflow to pit through face	m^3/day	0.242	*Calculated (reference Marinelli and Niccoli, 2000)*
		m^3/s	0.000	
Q_2	Rate of inflow to pit through floor	m^3/day	1.47E+01	*Calculated (reference Marinelli and Niccoli, 2000)*
		m^3/s	1.71E-04	
Q_T	Total inflow to pit from strata	m^3/day	14.973	*Calculated (reference Marinelli and Niccoli, 2000)*
		m^3/s	0.000	
Qv	Total volume to be pumped (inflow plus rainfall)	m^3/day	170.699	*Calculated (inflow + rainfall)*
		m^3/hr	7.112	
		m^3/s	0.002	
		l/s	2.0	