6 WATER

6.1 INTRODUCTION

This Chapter of the Environmental Impact Assessment Report (EIAR) provides an assessment of the hydrological (surface water) and hydrogeological (groundwater) aspects of the Shillelagh Hempstown Quarry (the 'Site'), in support of an application under Section 37L of the Planning and Development Act, as amended, for the continuation and extension of quarrying activities at the Site. This Chapter characterises the pre-extension baseline conditions and gives consideration to any potential impacts on the surface and groundwater resulting from extension and restoration at the Site.

It is noted that activity at the Site will continue to involve the extraction of rock (greywacke and shale) utilising blasting and mechanical excavation 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 PROJECT BACKGROUND AND OVERVIEW

The existing quarry at the Site has been operational since pre-1964. The site has been operated by Shillelagh Quarries Ltd since 2018 and they subsequently purchased the site from Stresslite Precast Ltd in June 2019.

The further development of the quarry is proposed over areas directly adjacent to the existing extractive quarry area, as well as within the existing quarry for the purpose of recovering the economic reserve that remains in the existing void.

Under the current programme of the Proposed Development, the extraction will continue at an average of ca. 115,650 tonnes of rock (2020-2024 rate). The Proposed Development totals a remaining volume of ca. 703,000 m3 (1,757,500 tonnes) of greywacke and shale rock. This includes an estimated volume of 226,000 m^3 from within the existing quarry area and 477,000 m^3 from the extension area. Scope of assessment

The technical scope of this assessment is to consider the potential impacts and effects that extension of the quarry and post-operational restoration at the Site (as detailed in Chapter 2, Project Description) may have on the water environment. This assessment considers the potential sources of change resulting from potential future 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.

This assessment also identifies potential effects of secondary changes in the water environment on people, ecology (including water dependent habitats or ecological receptors) and infrastructure, which are considered further in the following chapters of the rEIAR:

- Chapter 3 – Populations and Human Health;
- 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 also addressed in this chapter, drawing on the assessment presented in Chapter 5 – Land, Soils and Geology.

6.1.2 LOCATION AND SETTING

The EIAR Site is in the townlands of Hempstown Commons, Co. Kildare centered at ITM coordinates 53°12'27.4"N 6°30'43.6"W.

The lands are located approximately 1.1 km north-west of the N81. The town of Blessington is located ca. 4 km south-west of the Site along the N81. The Site is bound to the north-east by the Kildare / Wicklow border.

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 current 'baseline conditions' of the Site and draws on available historical information. The assessment aims to establish the baseline water environment conditions at the Site and then assesses what impacts the proposed extension of quarrying activities and subsequent restoration will have on the Site and surrounding environment.

The Section 37 Boundary displayed on Figure 6-1 holds the main pit extraction area of the quarry and a proposed northeastern extension. The Section 37L application boundary covers an area of approximately 10 ha in total. The current internal extraction area is approximately 5.1 ha with the proposed northeastern extension approximately 1.89 ha in area.

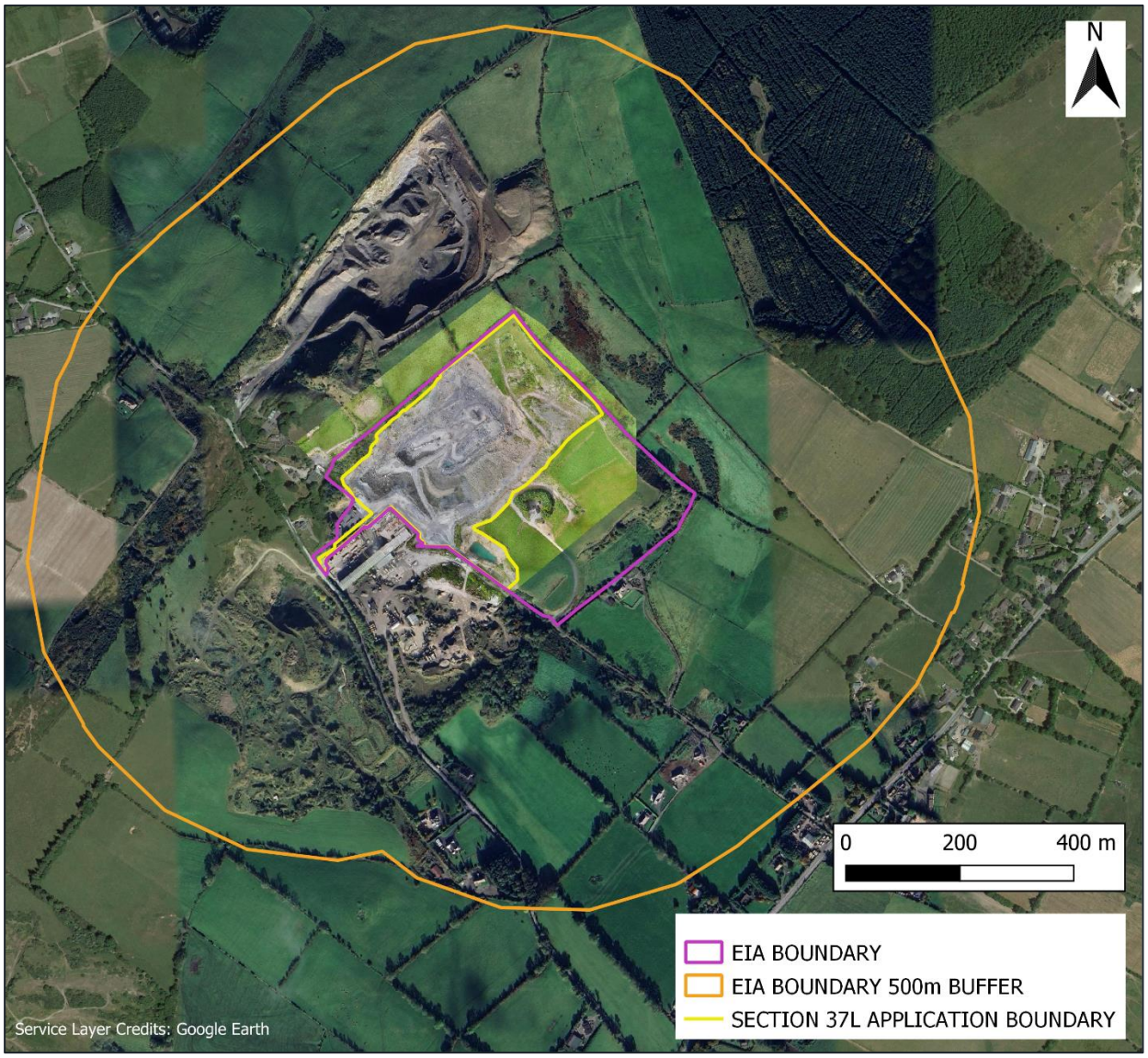

Figure 6-1 - EIA Site Boundary, 500m EIA Buffer and Section 37L Application Boundary

6.1.3 PROJECT DESCRIPTION SUMMARY

A full description of the proposed development is provided in Chapter 2 (Project Description) of this EIAR. A high-level summary of the proposed development is provided below.

The proposed development for further extraction of rock is to be within the existing void area with lateral extension of the void proposed in a north-easterly direction. The estimated total quantity of aggregate resource to be extracted in the life-of-quarry is c. 1,757,500 tonnes. A proposed 12 year life-of-quarry requirement is based on an average production rate of ca. 2,929 tonnes per week for rock. Dry processing of mechanically broken and blast rock onsite will comprise crushing and screening to produce aggregate materials for market.

SQL proposed to relocate the existing office container, wheel wash and water recycling tank, weighbridge to fully within the Application Site to provide space for realignment of the private access lane on SQL lands and to develop dedicated carparking facilities for the quarry operation on SQL owned lands.

The proposed car parking facilities will provide parking for HGVs and private vehicles, including guest parking.

SQL propose to decommission the existing abstraction borehole located off the access road to facilitate the road realignment on their own lands. SQL propose to undertake periodic extraction of groundwater from an abstraction borehole located on Stresslite Precast Ltd to provide water for SQL's closed-loop system wheelwash recycling tank and the mobile bowser.

There will be no direct discharge to surface or groundwater from the quarry operations. Collected waters from the base of the quarry void will continue to be pumped to the primary soakaway (which is connected to an overflow soakaway). It is proposed that the collect waters will pass through a bypass separator prior to discharge to the primary soakaway. It is proposed to extend the existing sump on the quarry floor to provide additional temporary holding capacity for collected waters, if required.

Following end-of-quarry life, a 2 year restoration period is proposed. This is detailed in a Restoration and Habitats Management Plan provided in appendix 2B of Chapter 2 (Project Description) of this EIAR.

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) 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 the Proposed Development and associated activities at the Site on the water environment, 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 of the Site in 2024 and 2025;
- Field monitoring and sampling campaigns carried out over 2024 and 2025;
- Correspondence with the Applicant/Site Owner;
- Desktop reviews of the previous impact assessment by Golder (2019) (Planning Reg. Ref. 07/443 ABP PL09253338);
- 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 – using available recent monitoring data supported by historical monitoring data where available. 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 may occur to each receptor because of Site activities, identify source-pathway receptor linkages, and assign the magnitudes of impact. This stage considers embedded design mitigation, existing and future site practices including good practice in construction, environment management and pollution prevention;

4) Determine the initial effect significance of each potential impact on each sensitive receptor;

5) Consider the need for mitigation measures if it is considered necessary to further reduce the initial magnitude of any impact and associated effect significance.

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 mitigation measures.

Stages 1 and 2 have been completed using published literature, guidance, and available information specific to the Proposed Development, which is presented in Chapter 2 of this EIAR. 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 occur at a receptor has been determined using the understanding of the baseline environment and its properties and consideration of whether there is a feasible linkage between a source of impact and each receptor (i.e. a conceptual site model).

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 occurs as a direct result of the activities on Site and is likely to occur 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 Table 6-3 includes two significance categories, reasoning is provided in the topic chapter if a single significance category is reported. A description of the significance categories used is provided in Table 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.

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

The effects of the Proposed Development are also considered cumulatively, with those that could foreseeably result from other known developments, that have the potential to take place in the study area (see Section 6.10 and Chapter 14 Interactions).

6.4 BASELINE CONDITIONS

This Section presents a summary of the baseline conditions for the water environment (hydrology, hydrogeology, and flooding). Detailed information about land use, soils and geology and ground conditions at the Site is included in Chapter 5, Land, Soils and Geology.

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.

6.4.2 SITE LAYOUT

A detailed description of the Site layout and infrastructure is presented in Chapter 2 (Project Description). Only key information relevant to the water environment is detailed below.

The Site comprises lands which are currently used for quarrying activities. Approximate areas of the quarrying activities have been calculated for the purposes of the assessment in this chapter. These areas occur within the Section 37L application boundary. The current extent of the quarry (including

extraction, plant and ancillary areas) is ca. 5.6 ha (0.056 km^2) in area. The current quarry void (taken in October 2024) covers an area of ca. 5.1 ha (0.051 km^2). The current maximum depth of extraction is 210 m AOD.

The Proposed Development includes northeastern extension (with an internal extraction area of approximately 1.89 ha). The extent of the quarry following the Proposed Development (including extraction, plant, soakaway and ancillary areas) will be ca. 10 ha (0.01 km^2) in area. This area is covered by the Section 37L Application Boundary in Figure 6-1. The final elevation for extraction in the proposed quarry extension is ca. 213 m AOD.

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.

6.4.3 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 is at approximately 207.55 m AOD (September 2023), in the location of the quarry sump.

6.4.4 SITE WATER MANAGEMENT

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 quarry sump is located at the lowest elevation of the excavated pit (approximately 207.55 m AOD September 2023) and is labelled on Figure 6-5.

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.

Figure 6-2 - Eastern Wall Seepages

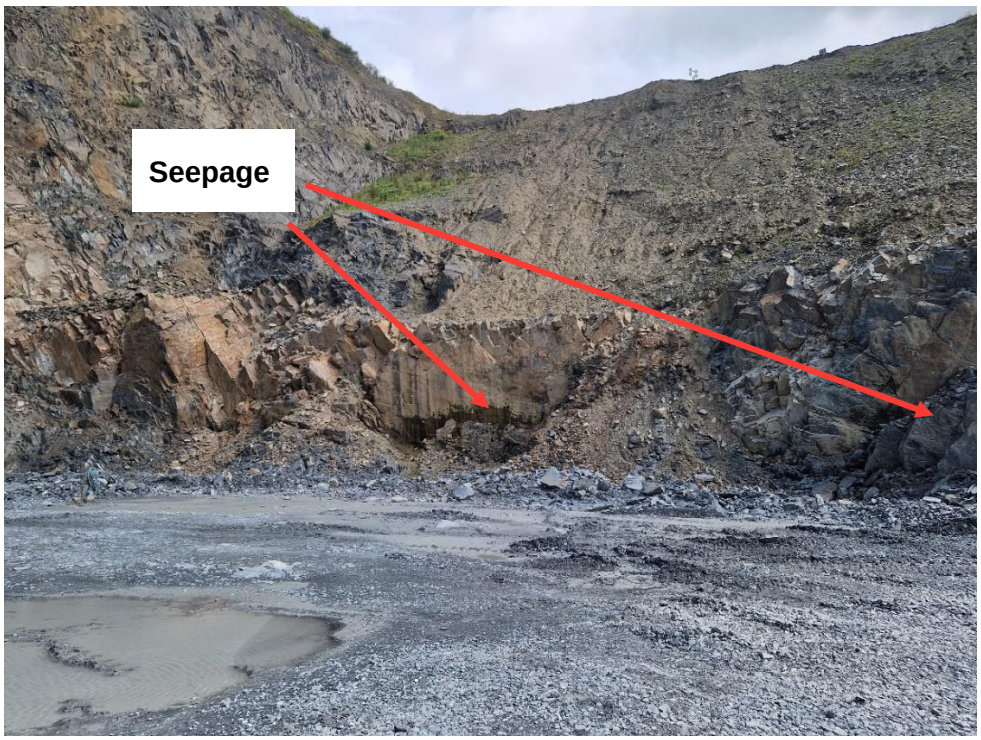

Figure 6-3 – Southern Wall Seepages

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 large soakaway pond to the smaller overflow pond when the level gets too high. Levels are maintained within the soakaways so that flooding of the surrounding land (including access tracks) does not occur.

Both the soakaway pond and the overflow pond are dug down through the sand and gravels into the bedrock (as informed by SQL and determined from borehole geology discussed further in section 6.4.11.2). It is understood that the joining overflow, from the large soakaway pond into the smaller overflow pond is also within the bedrock. Water entering the soakaway ponds is understood to infiltrate back into the groundwater through the brown shale in the upper part of the Pollaphuca Formation bedrock (see section 6.4.5 and 6.4.11.2).

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).

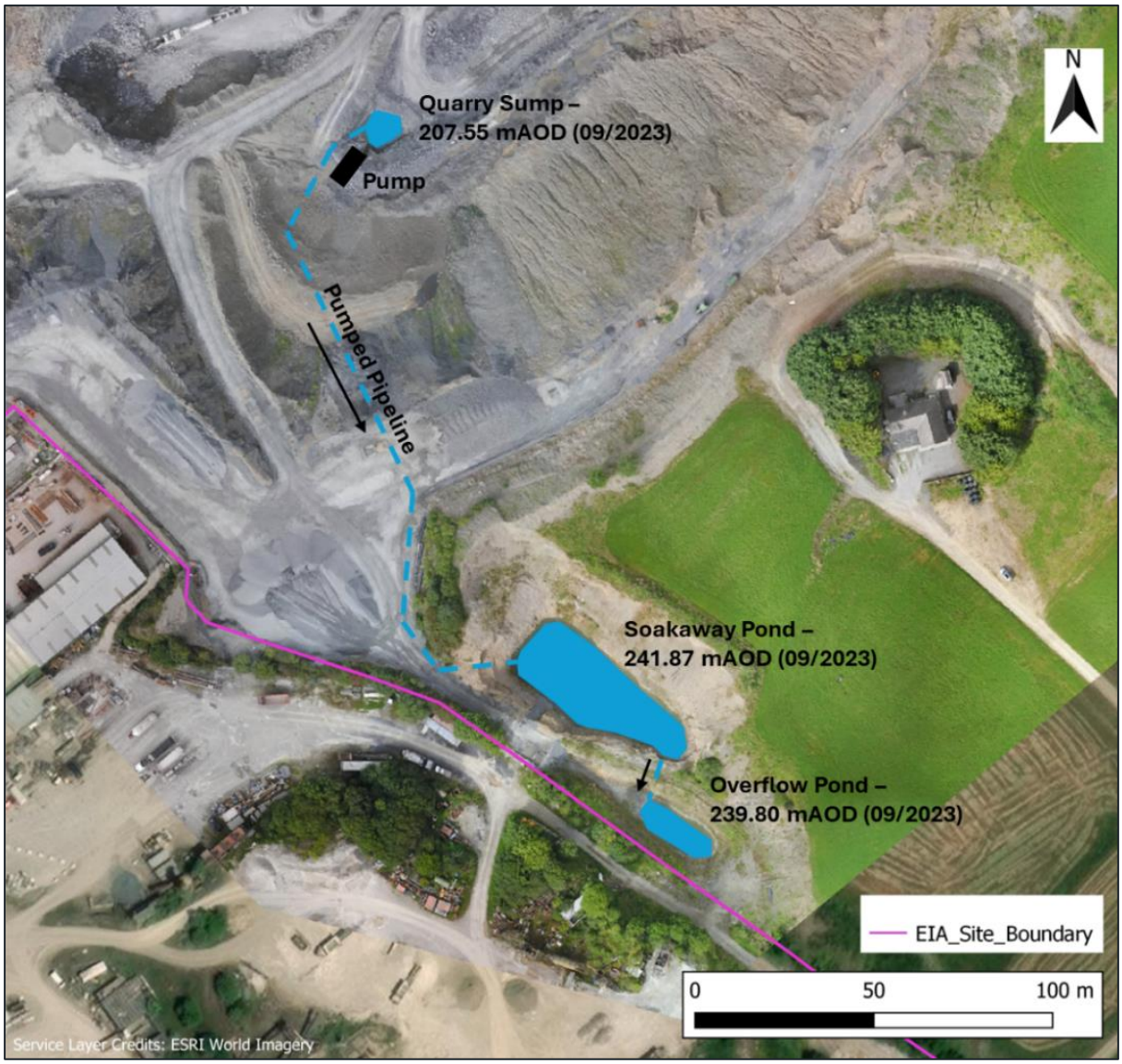

Figure 6-5 - Layout of September 2024 dewatering and discharge system (on September 2023 Aerial)

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 bypass separator has not yet been installed for discharge to the soakaway pond.

6.4.5 GEOLOGY

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

6.4.5.1 Soils

Teagasc have designated the dominant soils underlying the Site as being shallow well drained mineral soils derived from mainly basic parent materials (BminSW). To the south of the quarry void, in the vicinity of the soakaway ponds, the ground elevation is raised by up to ca. 5m with the addition of fill material / made ground. This fill material can be seen in the northern side of the large soakaway pond. The depth is estimated from comparison of historic ground elevation to the latest survey elevation (September 2023).

6.4.5.2 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.

6.4.5.3 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).

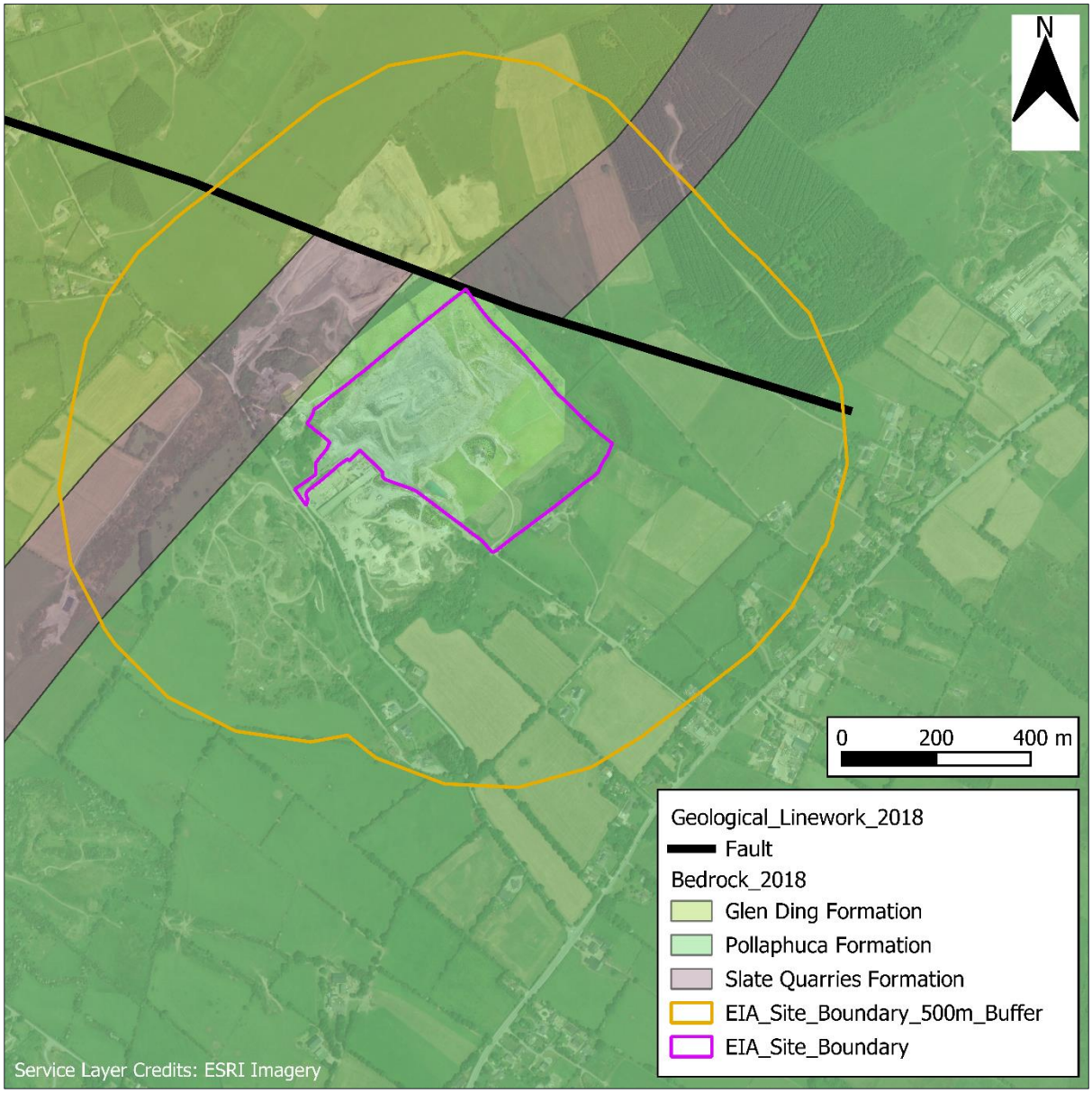

Figure 6-6 - Bedrock Geology Overlay

6.4.6 RAINFALL AND CLIMATE DATA

Table 6-5 below presents annual 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 2005 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 annual data from the period September 2022 to September 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/annum for the area of the quarry void. The total potential evapotranspiration measured at Casement Aerodrome is 591 mm/annum, from 2020 to 2023. This gives an effective rainfall (rainfall minus actual evapotranspiration) of 424 mm/annum for the Site based on a 2020 to 2023 average of 1015 mm/annum.

Table 6-5 - Annual Rainfall Totals

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Rainfall (mm/a)	855	962	1065	1228	1246	888	941	1271	862	1153
Year	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
Rainfall (mm/a)	991	869	908	843	1055	1012	921	924	1203.9	*683.9

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.

6.4.7 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) designation 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 6-7, 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.

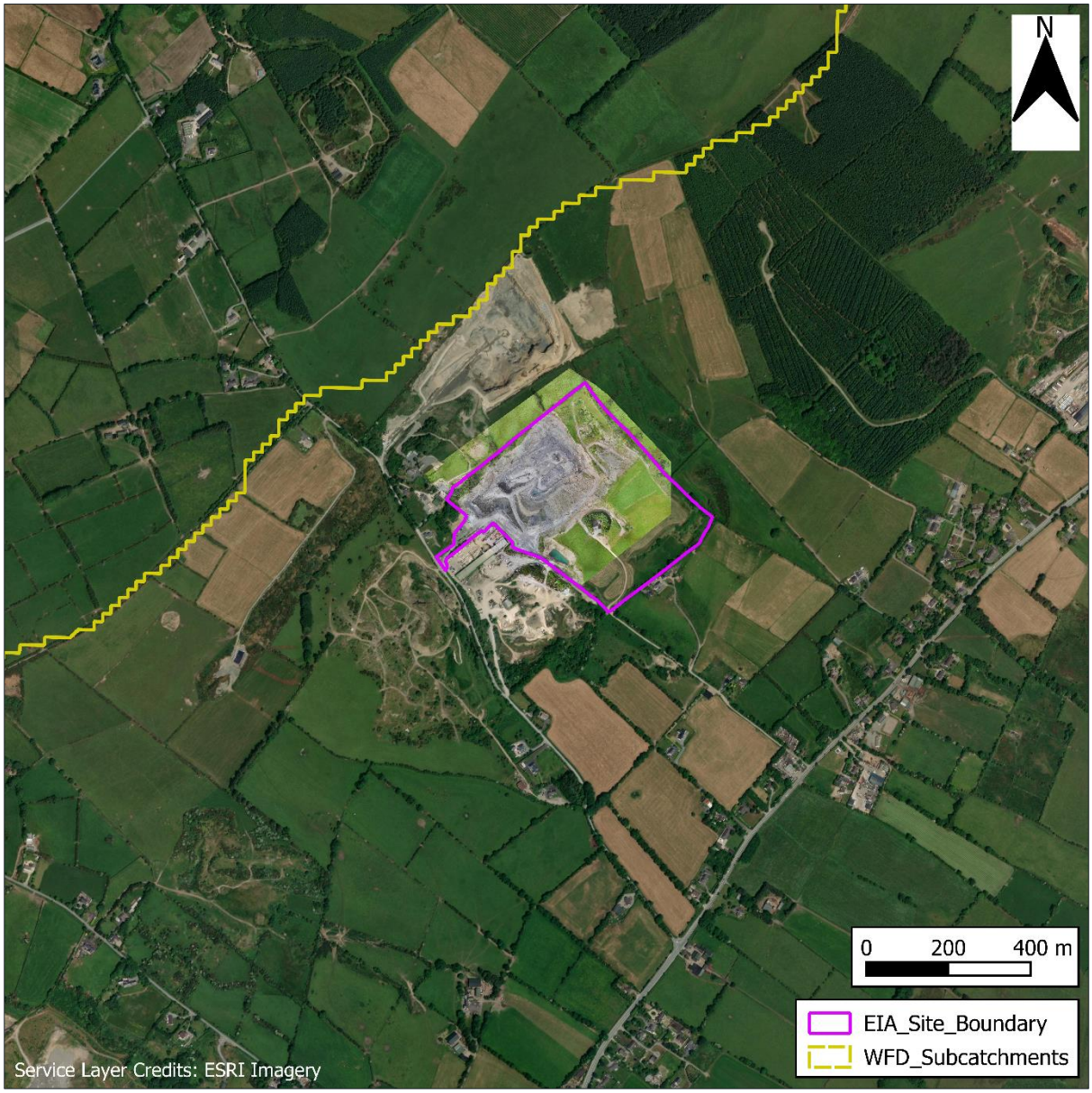

Figure 6-7 - Sub-Basin and Sub-Catchment Divide Across the Site (EPA, 2022)

6.4.7.1 Local Surface Water Features and Flows

The surface water bodies and river network in the area surrounding the Site is shown in Figure 6-8. 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.

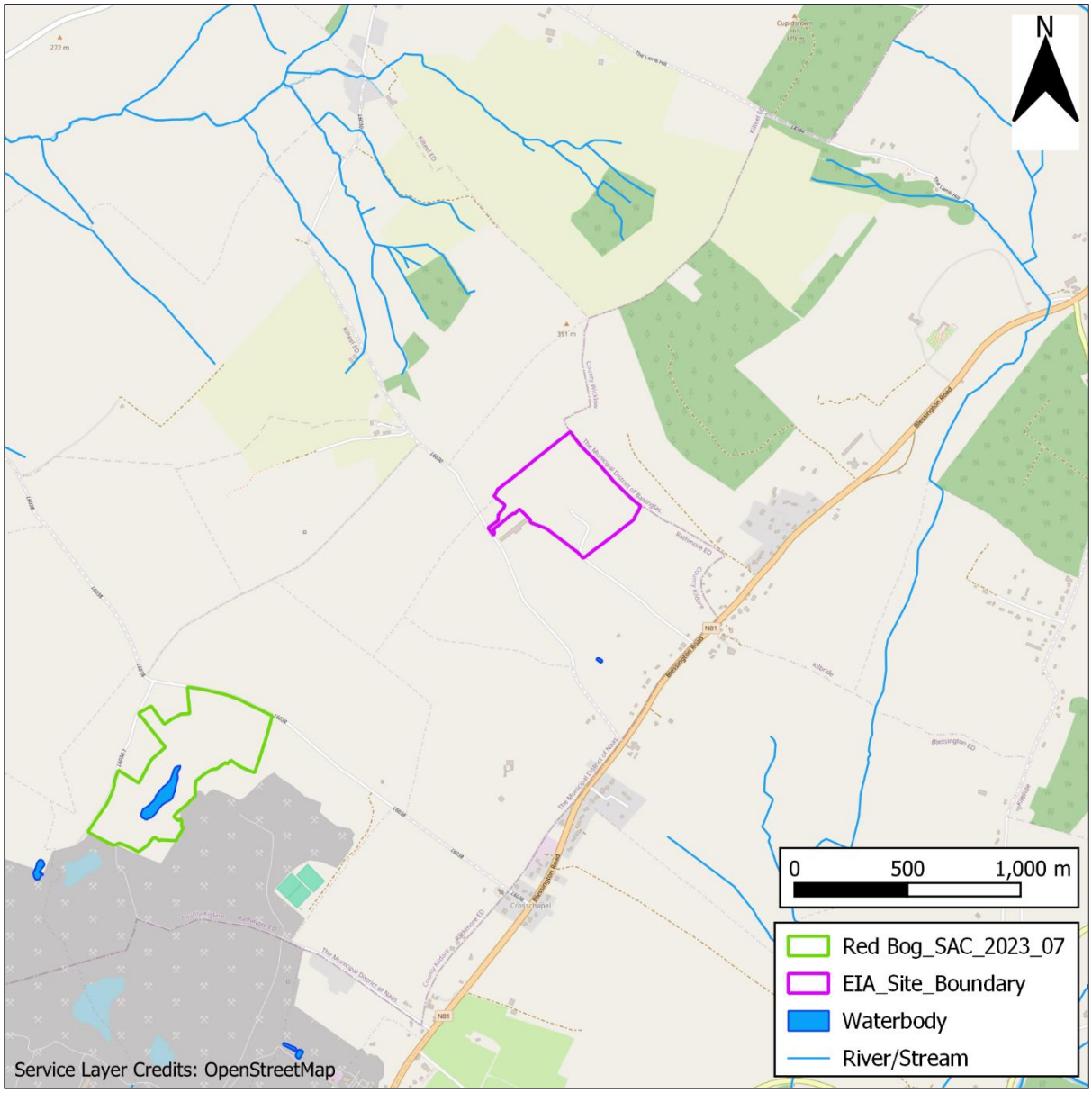

Figure 6-8 - Local Surface Water Bodies and River Network in the Vicinity of the Site

6.4.7.2 Site Surface Water

The latest aerial imagery of the Site from early September 2023 is presented in Figure 6-9. There was significant rainfall in September 2023 (162 mm recorded at Brittas (Glenaraneen) meteorological station), following the survey. There were five dry days preceding the survey indicating that the image was taken with drier conditions at the Site.

By the September 2023 aerial, there is the use of a large soakaway pond and a small overflow pond. The large soakaway measures approximately 60x30 m and up to 20 m deep, as measured from the highest ground surface to the north. The ground surface to the south of the large soakaway is significantly lower, giving an approximate minimum depth of 5 m. The small soakaway pond measures approximately 50x20 m) and approximately 6 m deep (from survey data).

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 and SRTM data.

The Site access road (Figure 6-9) currently has surface run-off leaving the Site entrance following heavy rainfall. Planned works involve lowering the elevation of the access road to divert more of rainfall towards the quarry void along drainage ditches. It is understood that much of this run-off will infiltrate into the bedrock.

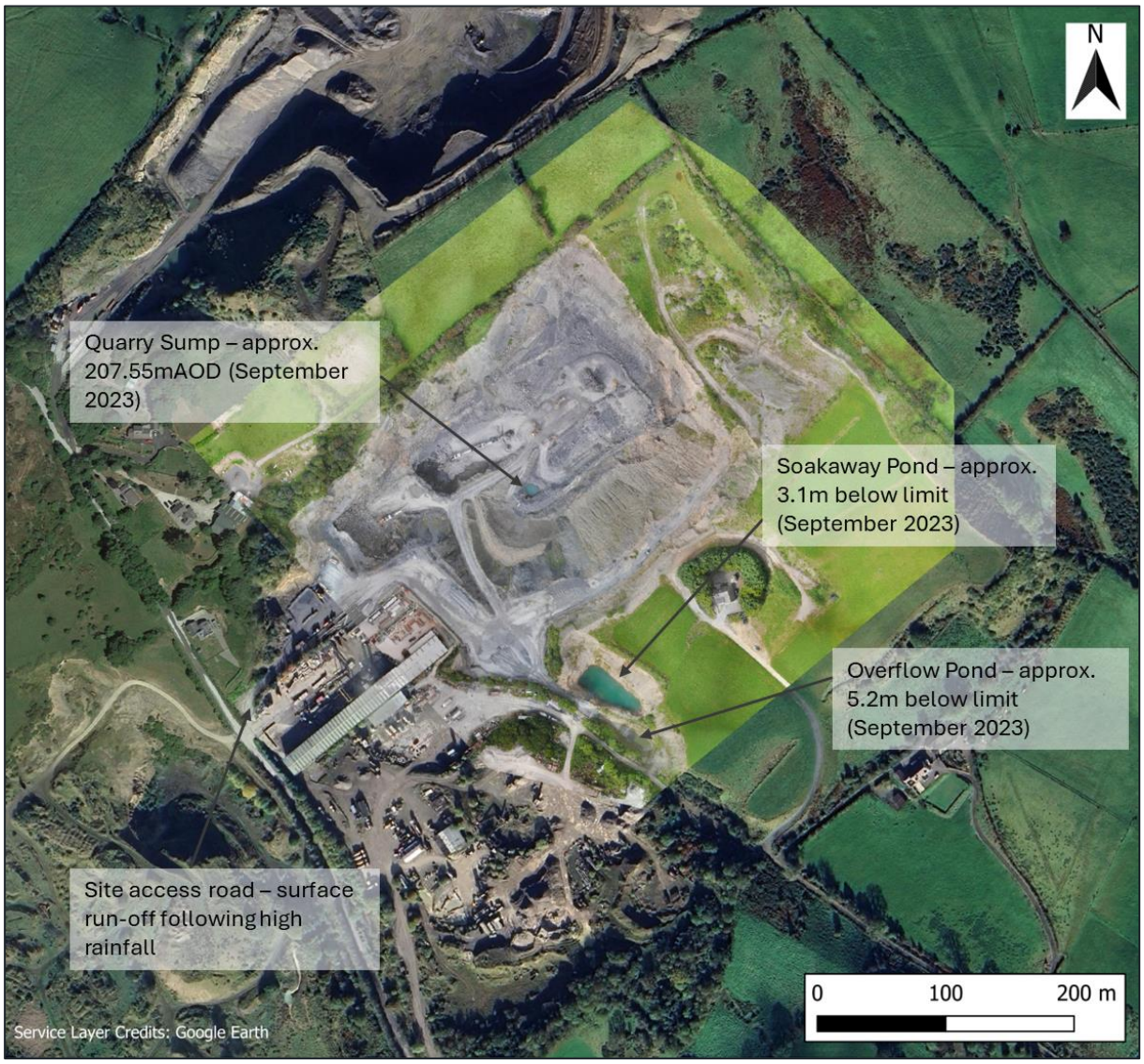

Figure 6-9 - Site Aerial with Surface Water in September 2023 (Images from site survey)

6.4.7.3 Local Surface Water Quality

The current local surface water quality 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 6-10 and summarised in Table 6-6.

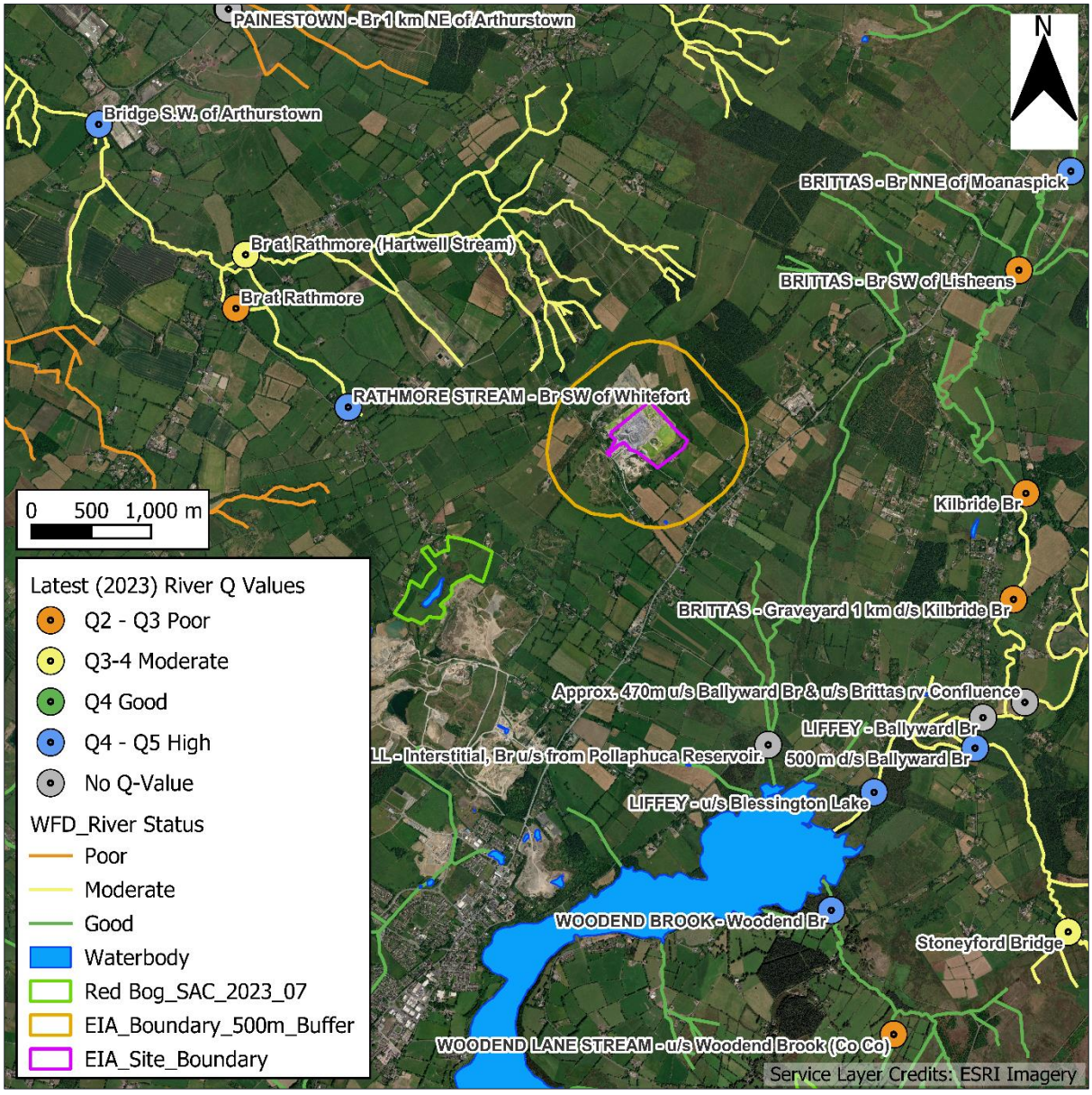

Figure 6-10 - Local River WFD Status (2016-2021), EPA River Quality Values and EPA Monitoring Stations (after EPA, 2023)

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)

River Name	WFD Status (2016-2021)	Station Name	River Q Value (year recorded)
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.

6.4.7.4 Site Surface Water Quality

The water quality in the large soakaway pond (or small overflow) have not been monitored historically. Samples therefore started to be collected and analysed from the large soakaway pond (SW01) in August 2024 with continued sampling in September, October and December 2024, to assist in assessing any trends.

Details of the location of the monitored soakaway pond is given in Table 6-7 and presented on the September 2023 aerial in Figure 6-11.

Table 6-7 – Surface Water Monitoring Location

Surface Water ID	Easting	Northing
SW01	699465.53	718328.21

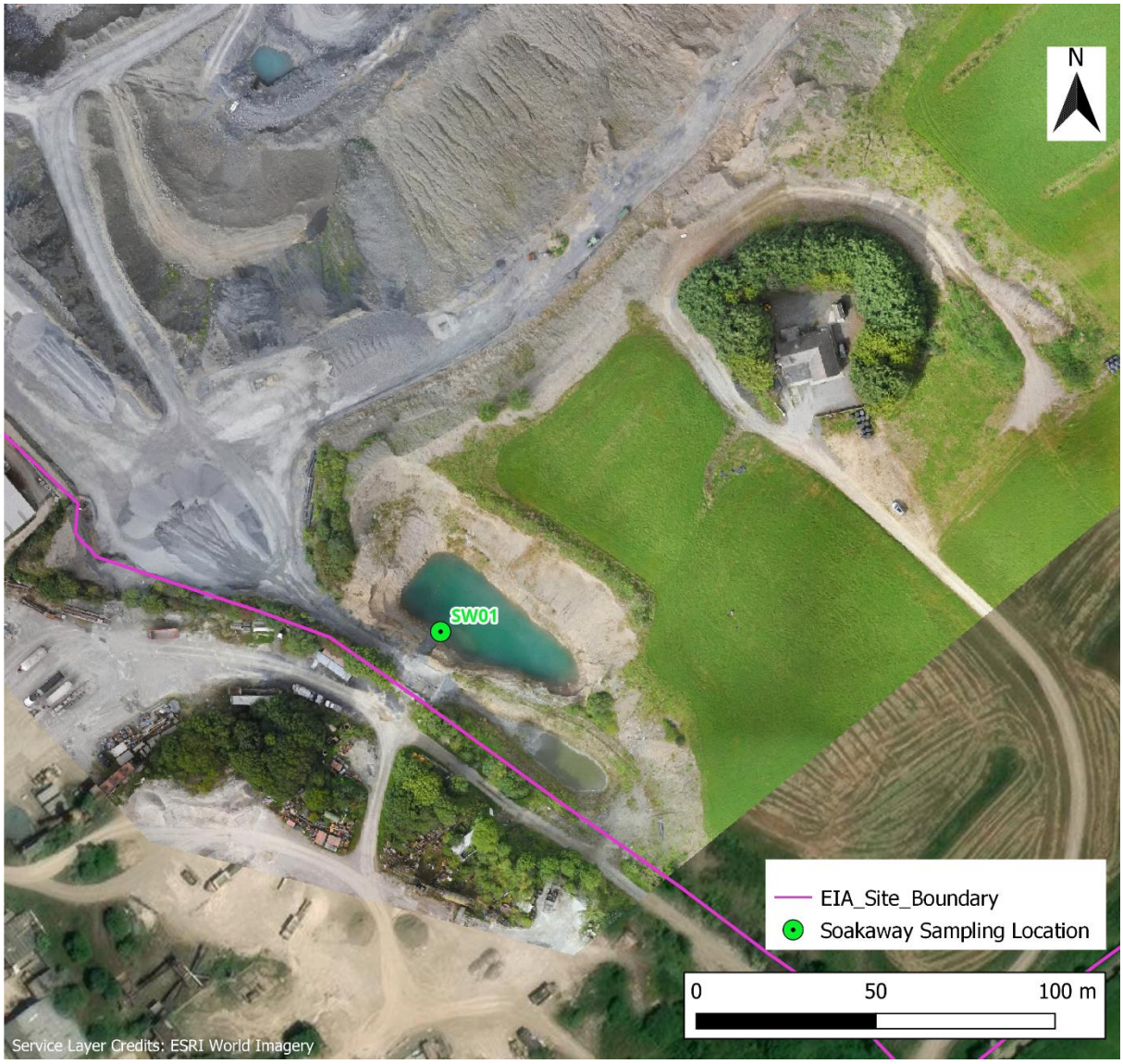

Figure 6-11 - Surface Water Monitoring Location - Soakaway Pond

Laboratory Water Quality

Full laboratory results (for August, September and October 2024) from the soakaway pond are presented in Appendix 6C (Table 6C-1 to Table 6C-4). Table 6C-3 and Table 6C4 includes additional sample rounds for SW01 in October and December 2024. The laboratory certificates for the results are included in Appendix 6D.

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

Nitrate in SW01 exceeds the GTV in August (38.6 mg/l) and December (38.7 mg/l) 2024 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). Nitrite in SW01 exceeds the AA-EQS in December 2024 (0.22 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 aerial in Figure 6-11). The source of the nitrate and nitrite is therefore likely to be from agricultural processes and run-off from the farmed fields. Sulphate as SO4 shows an increasing trend in SW01 as shown in Figure 6C-1 (Appendix 6C) but remains below GTV. The presence of sulphate as SO4 is also linked to the use of fertilisers on neighbouring farmed land.

Arsenic in SW01 exceeds the GTV and AA-EQS in August 2024 (50.2 ug/l), September 2024 (51.9 ug/l), October 2024 (82 ug/l) and December 2024 (62.5 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 4 months in 2024, which water quality was tested at the soakaway pond (SW01). It cannot 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.

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.

6.4.8 GROUNDWATER – HYDROGEOLOGY

Based on a review of borehole logs (Appendix 6B) 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 - Pl. The GSI aquifer designation (GSI, 2023) for the sand and gravel and bedrock aquifers underlying the Site is shown in Figure 6-12 below.

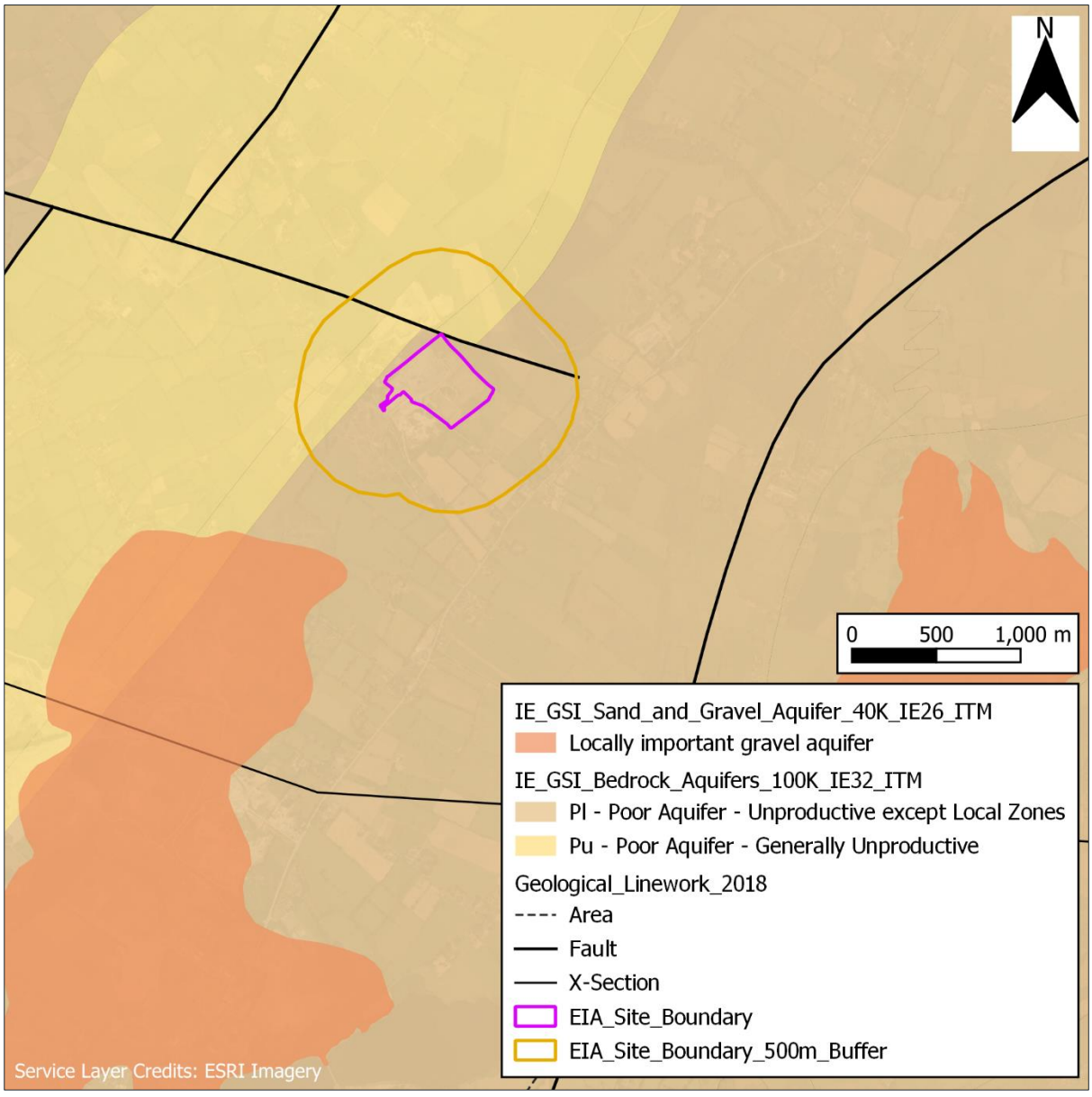

Figure 6-12 - Aquifer Designation Map (GSI, 2023)

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 6-12). The Blessington Gravels are not, however, mapped beneath the Site and are located 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 below 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 6-8 below.

Table 6-8 – 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 6-13). 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 thicken 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).

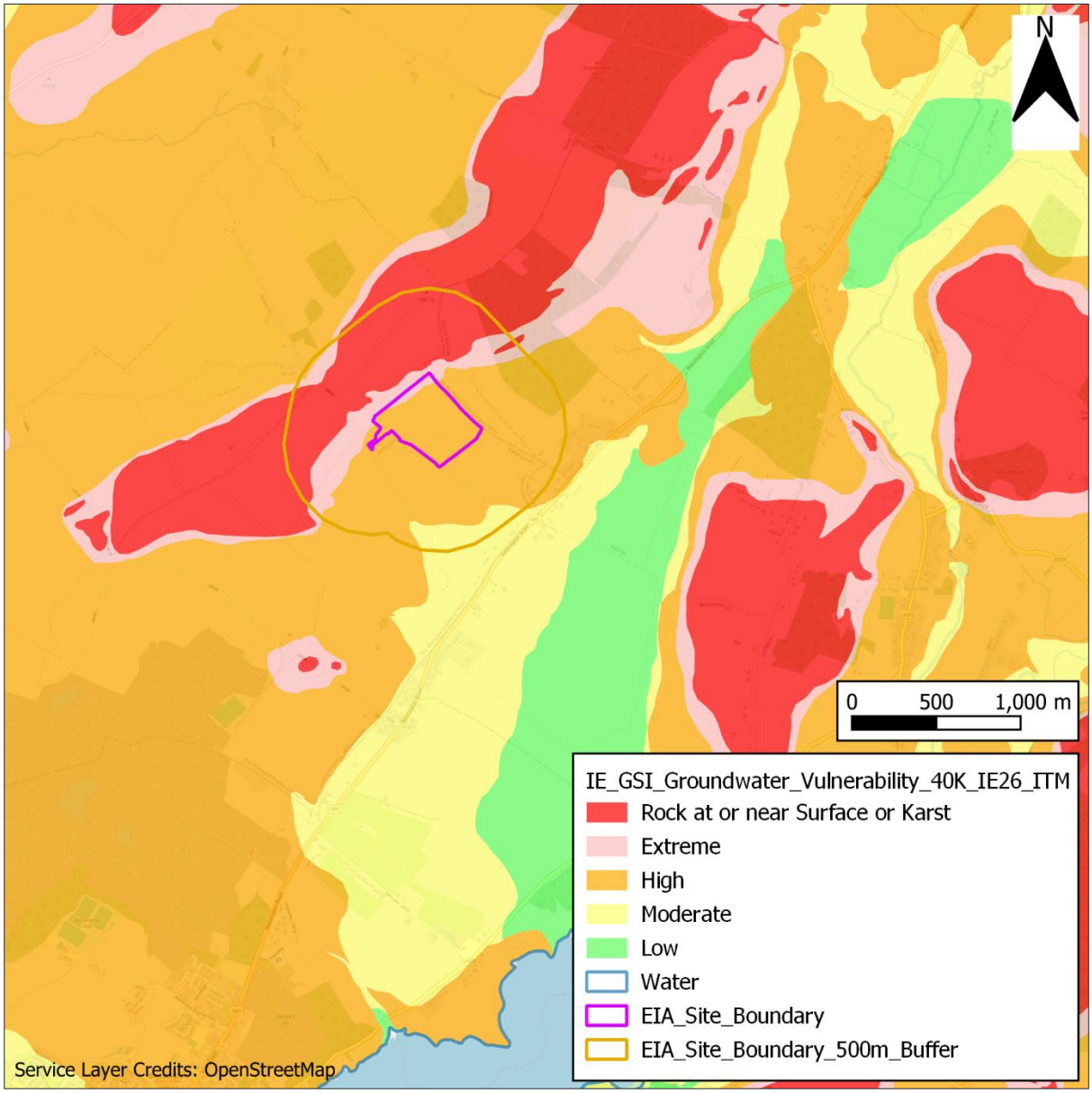

Figure 6-13 - Groundwater Vulnerability Map (GSI, 2023)

Groundwater Recharge

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 Pollaphuca Formation bedrock aquifer to accept all available groundwater recharge is considered to be low. The groundwater recharge map (Figure 6-14) therefore presents a maximum estimated recharge to bedrock of 100 mm/year beneath the Site.

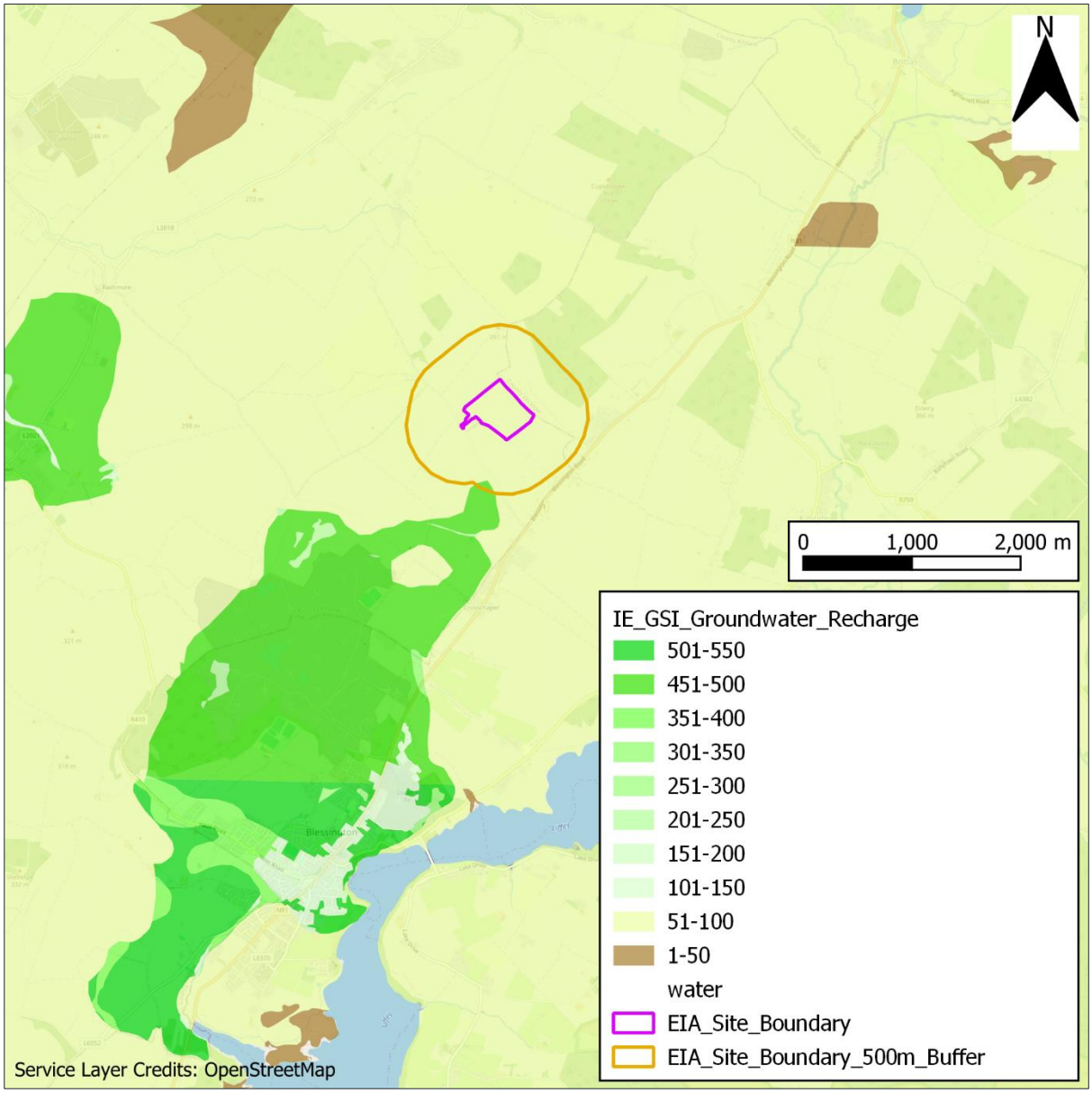

Figure 6-14 - Groundwater Recharge Map (GSI, 2023)

6.4.9 GROUNDWATER ELEVATION INVESTIGATIONS

There have previously been five existing monitoring wells reported (GW1 to GW5). Since then, the 'Wheelwash' borehole was incorporated into the monitoring schedule in 2024, with water levels recorded and water quality samples taken.

The locations of the existing monitoring wells are presented in Figure 6-15 and Table 6-9, with details on construction and lithology are provided in Table 6-10, 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.

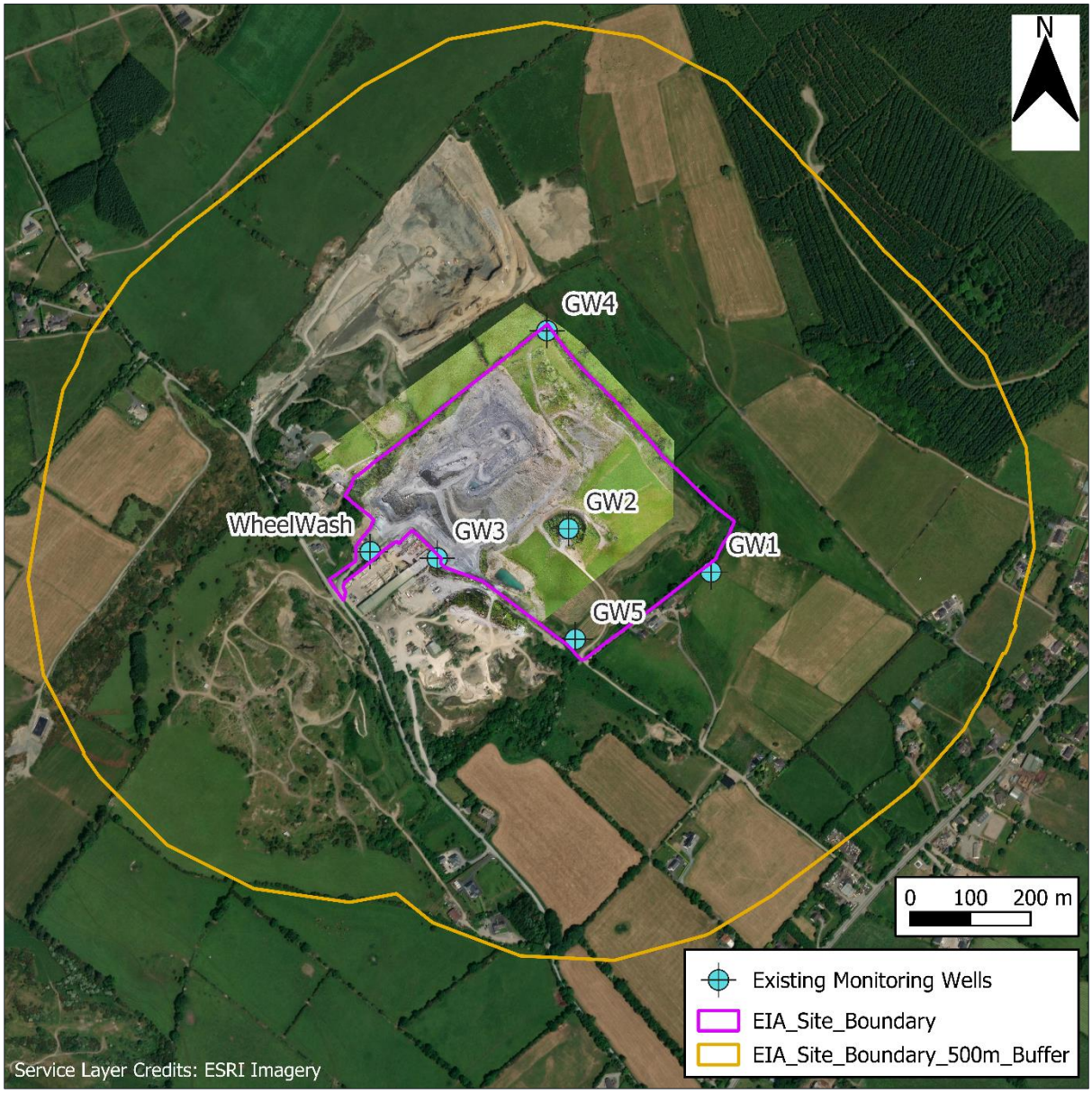

Figure 6-15 - Monitoring Well Locations

Table 6-9 – 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 6-10 – 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

6.4.9.1 Groundwater Elevations

Manual groundwater elevations in Metres Above Ordnance Datum (m AOD) since January 2020 are displayed in Figure 6-16 for the monitoring wells shown in Figure 6-15. 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 have remained relatively stable since 2020, which is reflective of the locally productive and largely 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 (GW4) with direct rainfall recharge to the bedrock aquifer, where it is exposed at surface to the north of GW4. 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 or flowing laterally within the unit or above as surface run-off. It is possible that layers of 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 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 6-10). 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.

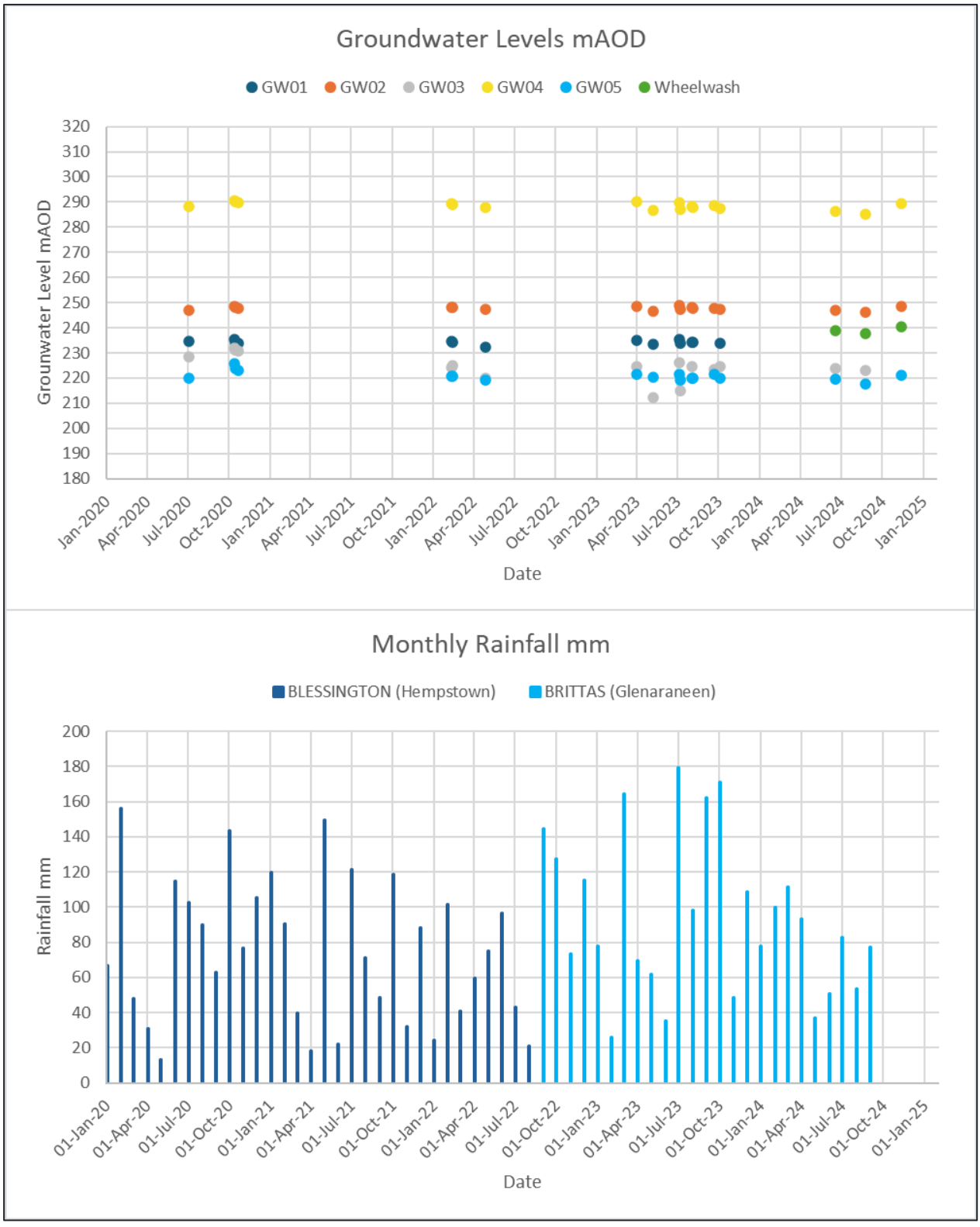

Figure 6-16 - Groundwater Elevations Over Period 2020 to 2024

Groundwater Contours

Groundwater contours generated for October 2023 indicate that groundwater movement is in a southerly direction across the Site (Figure 6-17), 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 6-18 gives a clear representation of the close relationship between the topographical highs and areas of recharge and direction of flow.

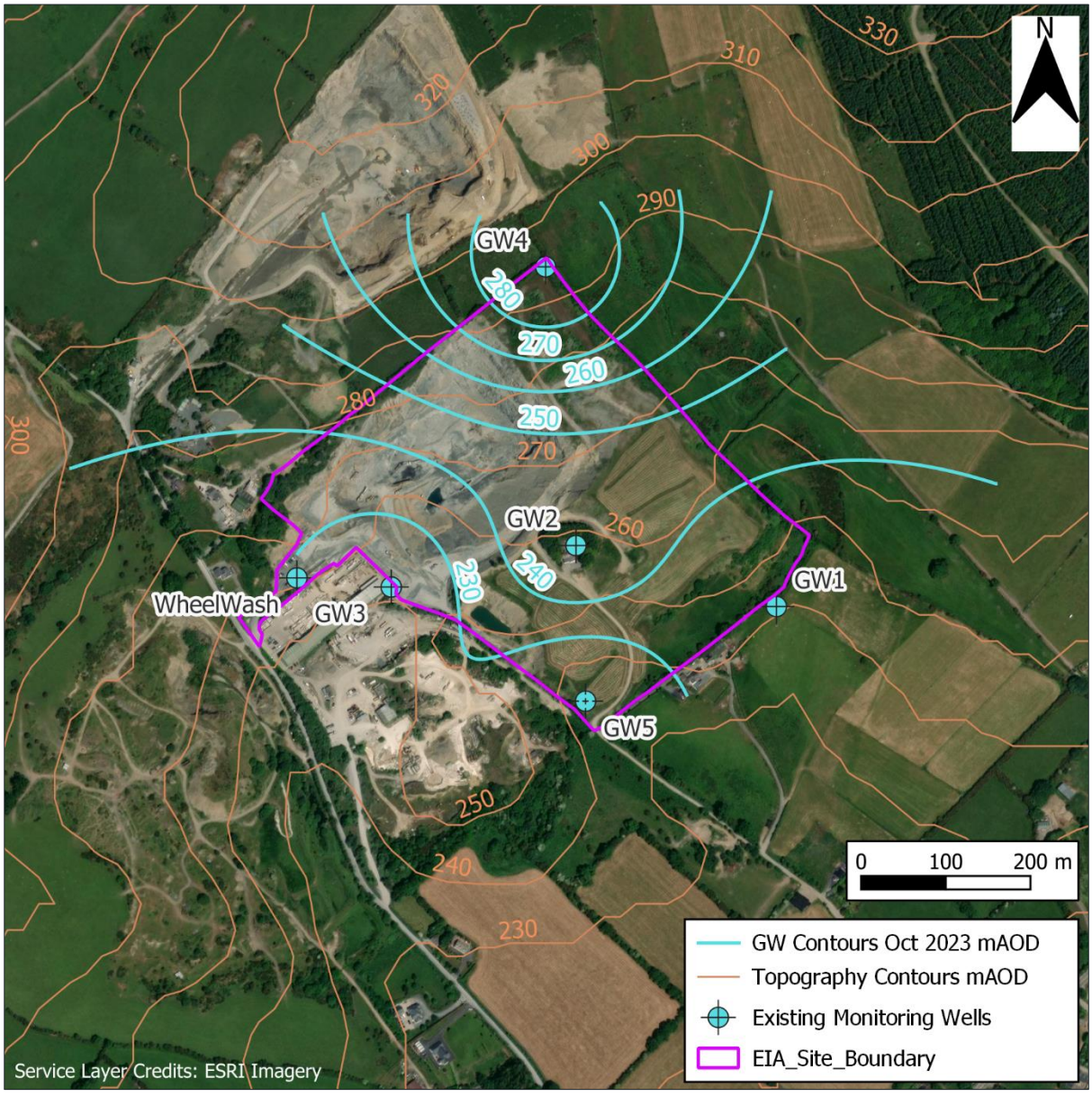

Figure 6-17 - Groundwater Contours October 2023 with aerial and Topography

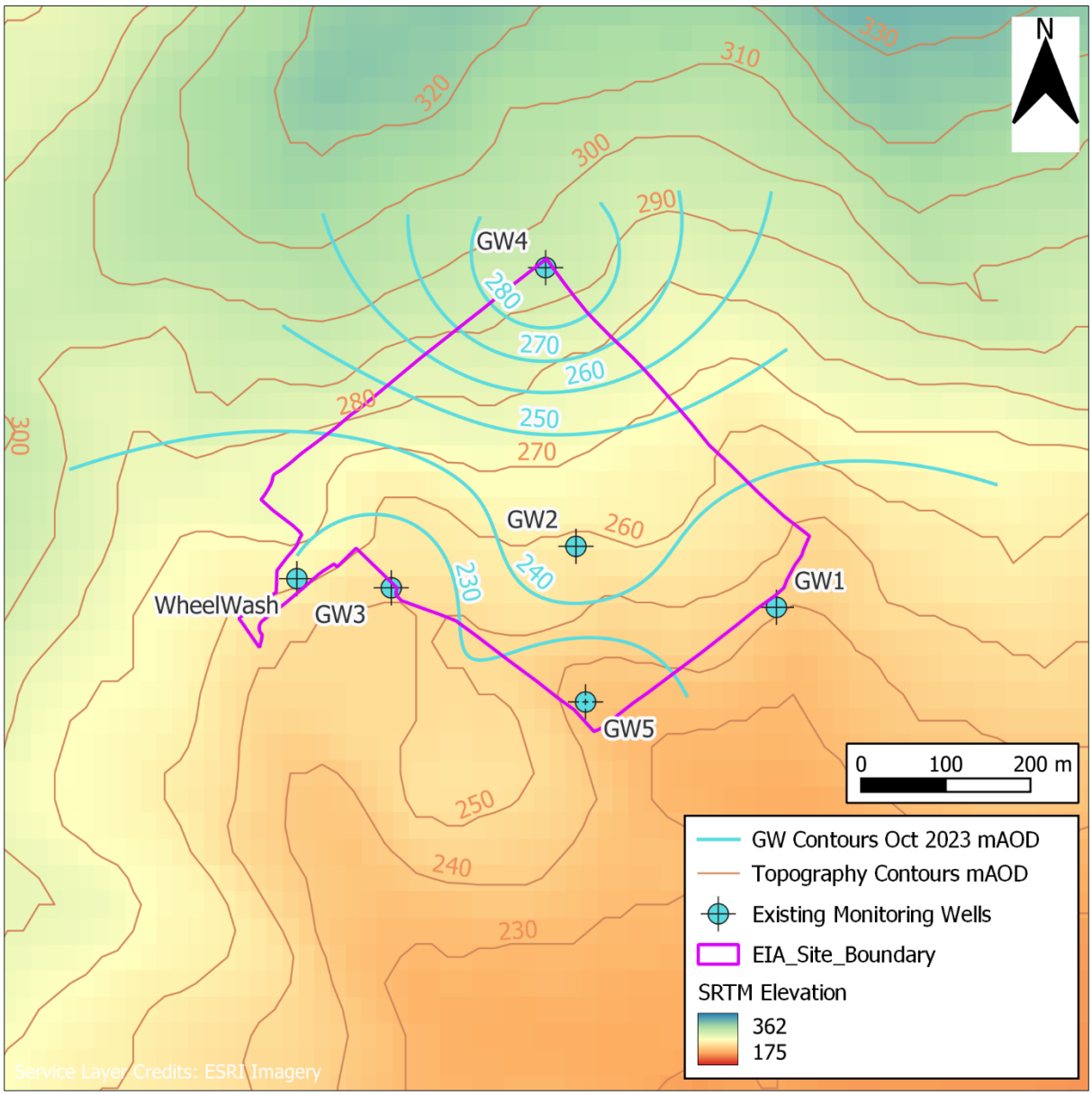

Figure 6-18 - Groundwater Contours October 2023 with Topography

6.4.10 LOCAL GROUNDWATER QUALITY

A total of six groundwater monitoring wells (Figure 6-15) are used to monitor groundwater quality across the Site.

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 (GW5 in August 2024) due to blockages or kinks in the well casing preventing equipment from reaching the water column.

6.4.10.1 Laboratory Water Quality

Laboratory results for 2024 are presented in Appendix 6C from Table 6C-1 to Table 6C-2, with comparison to relevant threshold values. 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. The laboratory results for groundwater were screened against GTV and AA-EQS thresholds. A summary of the screening exceedances is presented below in Table 6-11.

Table 6-11 – Summary of Groundwater Screening Exceedances over 2024

Analyte	Units	GTV	AA-EQS	GW1	GW2	GW4		GW5		Wheelwash	
				Sep-24	Aug-24	Aug-24	Sep-24	Aug-24	Sep-24	Aug-24	Sep-24
Arsenic	µg/l	7.5	50	-	-	7.9	15.2	-	-	9.5	12.6
Barium	µg/l	-	100	-	-	191	208	-	-	126	123
Zinc	µg/l	75	100	83	90	-	-	-	-	-	-
Nitrate as NO_3	mg/l	37.5	50	-	-	-	-	47.8	51.1	-	-

The GTV threshold for arsenic (7.5 µg/l) was exceeded in 2024 in both samples from GW4 (7.9 and 15.2 µg/l) and both samples 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 is linked to 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 in both samples from GW4 (191 and 208 µg/l) and in both samples from Wheelwash (126 and 123 µg/l), in 2024.

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 (Appendix 6C - Figure 6C-1) shows that the long-term trend for most of the monitoring locations is stable. Only GW4 shows the rising trend in barium. GW4 is up hydraulic gradient from the quarry void (see Figure 6-15). Changes in groundwater chemistry in GW4 are therefore most likely to be in response to groundwater inputs north of the Site or changes in meteoric recharge/dilution.

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 GW5 (47.8 mg/l in August 2024) and exceeded the AA-EQS threshold (50 mg/l) in GW5 in September 2024 (51.1 mg/l). Higher nitrate levels are consistently seen in monitoring locations south of the Site, near areas of farmed land. This indicates that elevated nitrate may be caused by off-Site activities, such as applying fertiliser to agricultural land.

6.4.11 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 6-19). 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 6-19 and located approximately 1.3 km to the southwest of the Site.

Figure 6-19 - Source Protection Zones (SPZ) near Site (GSI, 2023) and Red Bog SAC

6.4.11.1 Red Bog

A cross-section is presented in Figure 6-20 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 peat 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 Slate Quarries Formation bedrock exposed at/near surface shown in Figure 6-20, 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.

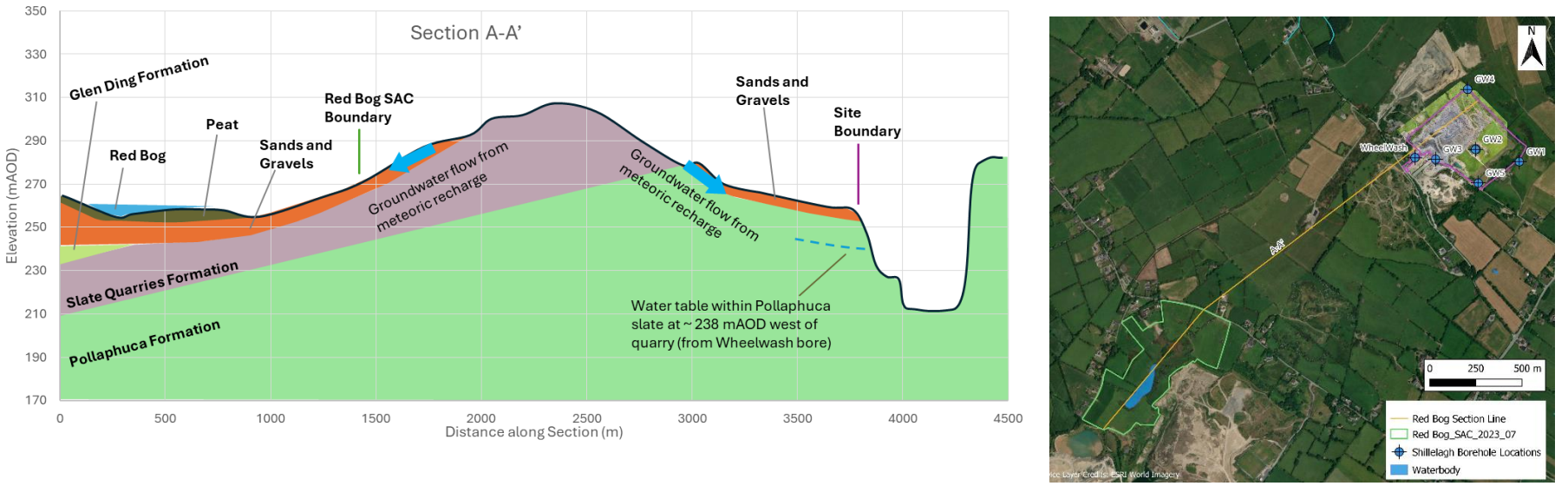

Figure 6-20 - Conceptual Section – Red Bog to Quarry Void

6.4.11.2 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 6-8).

A conceptual section through the Site (centre of quarry void, soakaway and overflow ponds) to the Goldenhill River is presented in Figure 6-21. 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. The conceptual section divides the Pollaphuca Formation into the upper brown shale and the underlying grey shale, based on thicknesses observed in GW4 and GW5 logs.

Based on correspondence with the Site Owner and interpretation 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 Figure 6-21) 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 brown shale 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 (brown shale) 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. Of note is that arsenic levels recorded in the soakaway pond have been highest following dry periods. Over these dry periods, the arsenic concentrates in the quarry sump and soakaway pond due to reduced dilution. There is a lower water level in the soakaway pond and overflow pond, which reduces the potential for drainage through the sands and gravels. Therefore, a hydraulic connection between the soakaway ponds and the Goldenhill River is more likely when the water in the soakaways is more dilute.

Note that the assessment here for the SPA is the same as that for the Poulaphouca Reservoir pNHA in Chapter 4 – Ecology.

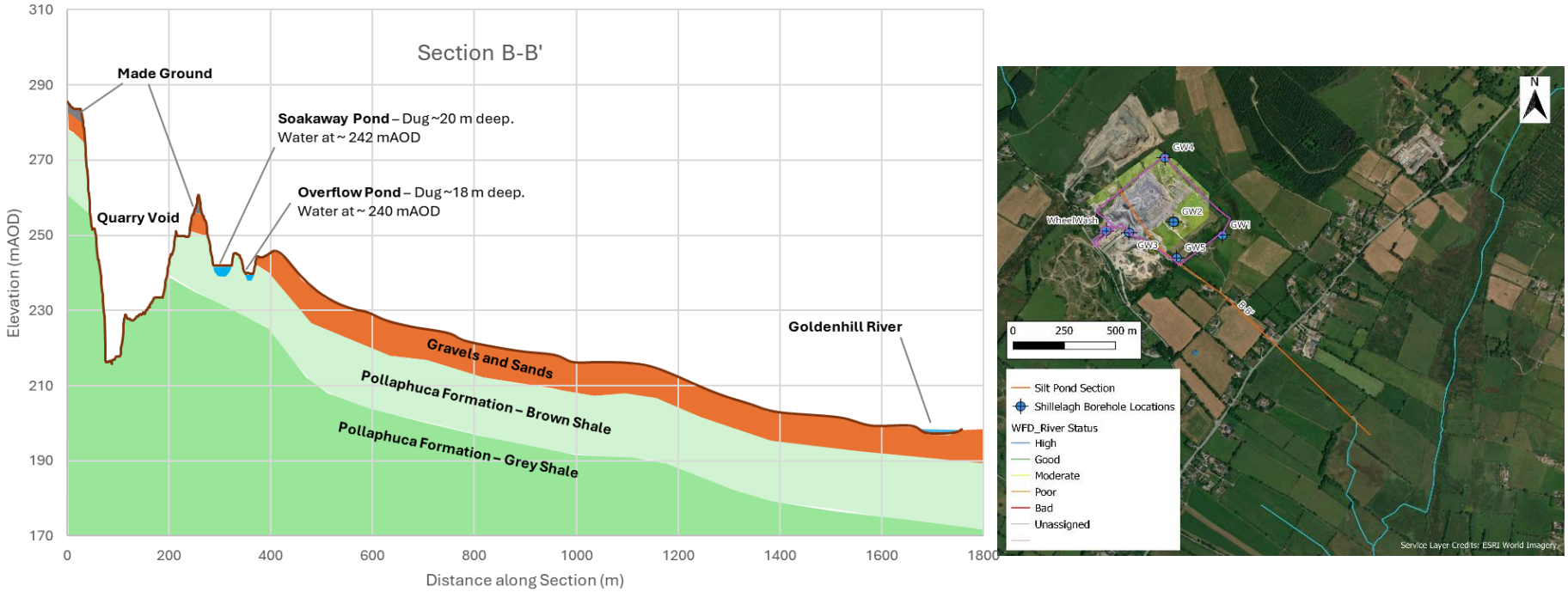

Figure 6-21 - Conceptual Section – Quarry Void to Goldenhill River

6.4.12 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 6-22 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 2024. It is understood that there was no pump assembly noted installed in GW1, GW2 or GW3 over 2024.

The locations of other known private abstraction wells are presented in Figure 6-22 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.

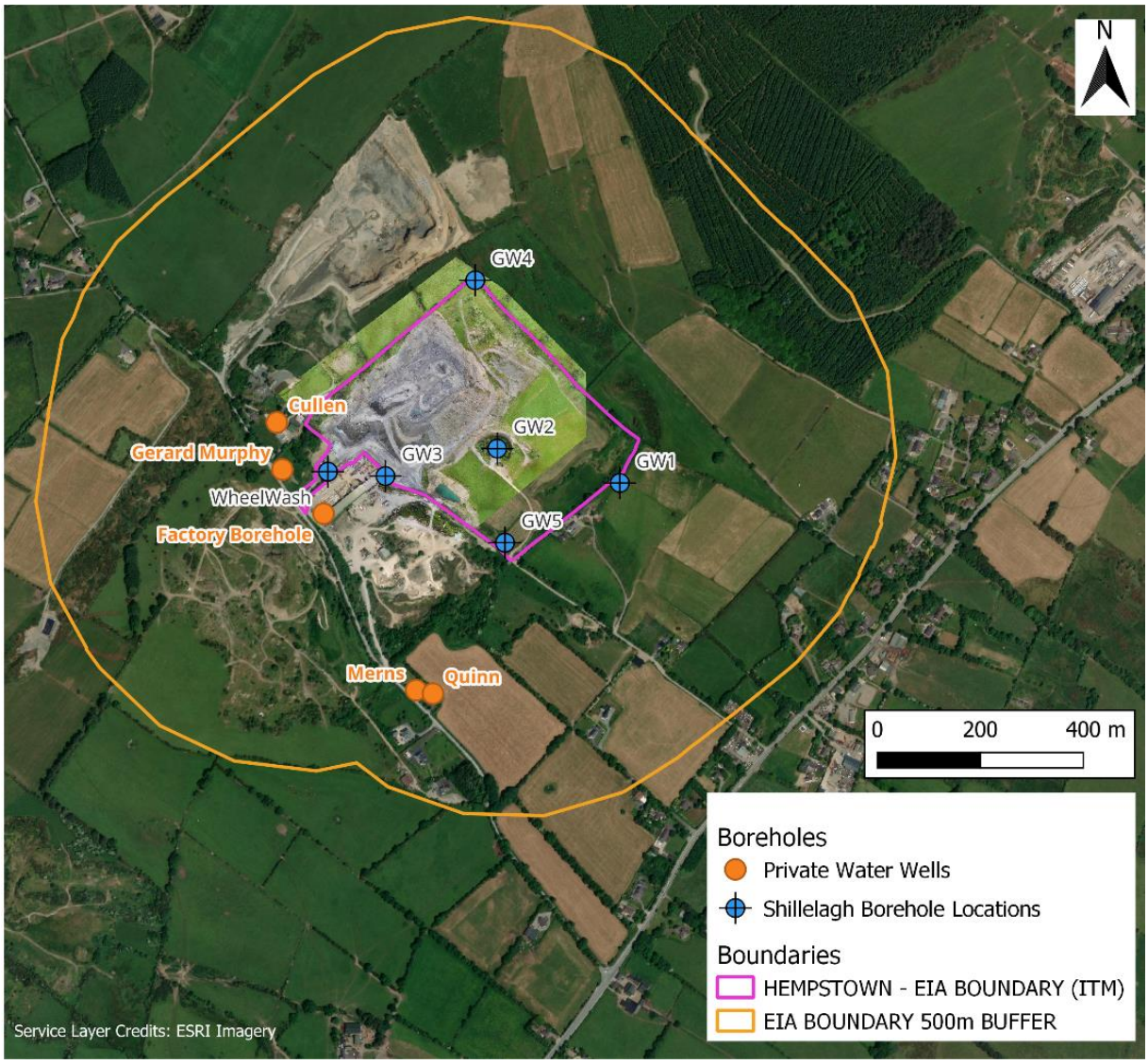

Figure 6-22 - Location of Private Abstraction Boreholes in the Vicinity of the Site

6.4.13 WATER BALANCE

6.4.13.1 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 (detailed below and presented in Table 6-12 and Table 6-13) over a three-year period (2020 to 2023).

As presented below, the annual average rainfall for the Site is 1,015 mm/annum over the three-year period (2020 to 2023). The average rainfall has been taken from January 2020 to December 2023 due to the full 2024 data not being available. The total potential evapotranspiration is 591 mm/annum (Casement Aerodrome), from 2020 to 2023. On an annual basis, ca. 424 mm of rainwater can potentially recharge the aquifer underlying the Site. The extent of the current operational Site area is ca. 5.6 ha (or 56,000 m^2), which includes the quarry, plant and ancillary areas. The recharge to groundwater is taken from Section 6.4.8, as the value of 100 mm/yr.

6.4.13.2 Current Seepage Inflows

Using the information characterised in Section 6.4, a preliminary estimate of current inflows to the pit (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 current groundwater seepage into the pit of 15 m^3/day.

In comparing the seepages to the available daily rainfall in Table 6-12 of 65 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 32,523 m^3 (or 89 m^3/day) (8) assumes that all water entering the pit is pumped to the soakaway ponds from the quarry sump and that this occurs following evaporation losses, without any seepage to bedrock. Note that this has been adapted since the water balance assessment presented in the substitute consent application. The evaporation losses are applied as they follow a more realistic scenario, rather than the highly conservative scenario, where there are no evaporation losses prior to rainfall water collecting in the quarry sump.

6.4.13.3 Current Water Balance Estimate

The current water balance is presented below in Table 6-12 with supporting calculations by Marinelli and Nicolli (2000) presented in Appendix 6E. The estimated average volume of discharge (8) from the quarry sump is 89 m^3/day, which is accounted for by the maximum pumping rates reported in Section 6.4.4 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 (4). A small volume will also re-enter the groundwater through the bedrock (10), estimated as 1,000 mm/annum. 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.

Table 6-12 - 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 Rainfall (m)	1.015 m
(3) Annual Potential Evapotranspiration (m)	0.591 m
(4) Actual Annual Evapotranspiration (m) 90% of (3)	0.532 m
(5) Effective Annual Rainfall (m) (2)-(4)	0.483 m
(6) Available water (m^3) (1) x (5)	27,048 m^3 (74 m^3 daily)

Seepage and Discharge	Annual Average
(7) Current Estimated Annual Volume of Seepage	5,475 m^3 (15 m^3 daily)
(8) Current Estimated Average Annual Volume of Discharge (6) + (7)	32,523 m^3 (89 m^3 daily)
Soakaway Ponds Volume	**Annual Average**
(9) Estimated Area of Ponds (Soakaway + Overflow + surrounding area) (m^2)	6,274 m^2
(10) Recharge to groundwater (m) (GSI, 2023)	0.1 m
(11) Available rainfall to Soakaways (m) (5) – (10)	0.383 m
(12) Volume of rainfall to Soakaway and Overflow Ponds (9) x (11)	2,403 m^3
(13) Annual residual water in Soakaway and Overflow Ponds (8) + (12)	34,926 m^3

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 34,926 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. It might be the case that the upper brown shale (show in Figure 6-21) of the Pollaphuca Formation is more permeable than the underlying grey shale.

6.4.13.4 Proposed Extension Seepage Inflows

The proposed extension will create an operational site area of 93 ha (93,430 m^2), with the additional soakaway area of 6.3 ha (6,274 m^2), as current. The future seepage has been calculated using the methodology outlined by Marinelli and Nicolli (2000). Calculations are presented as Appendix 6E and estimate future groundwater seepage into the pit of 20 m^3/day, with the proposed extension.

6.4.13.5 Proposed Extension Water Balance Estimate

An estimated future water balance with the proposed extension is presented below in Table 6-13 with supporting calculations by Marinelli and Nicolli (2000) presented in Appendix 6E

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

Rainfall Recharge	Annual Average
(1) Estimated Area of Operational Site (m^2)	93,430 m^2
(2) Mean Annual Rainfall (m)	1.015 m
(3) Annual Potential Evapotranspiration (m)	0.591 m
(4) Actual Annual Evapotranspiration (m) 90% of (3)	0.532 m

Rainfall Recharge	Annual Average
(5) Effective Annual Rainfall (m) (2)-(4)	0.483 m
(6) Available water (m^3) (1) x (5)	45,127 m^3 (124 m^3 daily)
Seepage and Discharge	**Annual Average**
(7) Current Estimated Annual Volume of Seepage	7,300 m^3 (20 m^3 daily)
(8) Current Estimated Average Annual Volume of Discharge (6) + (7)	52,427 m^3 (144 m^3 daily)
Soakaway Ponds Volume	**Annual Average**
(9) Estimated Area of Ponds (Soakaway + Overflow + surrounding area) (m^2)	6,274 m^2
(10) Recharge to groundwater (m) (GSI, 2023)	0.1 m
(11) Available rainfall to Soakaways (m) (5) – (10)	0.383 m
(12) Volume of rainfall to Soakaway and Overflow Ponds (9) x (11)	2,403 m^3
(13) Annual residual water in Soakaway and Overflow Ponds (8) + (12)	54,830 m^3

With the increased operational site area there will be 54,830 m^3 of residual water to the soakaways per year. This is an increase of 19,904 m^3 on the current volume. As reported previously, it is likely that the shale bedrock has a higher recharge rate than reported in literature and will account for much of the dewatering volume. Will the increase in dewatering volumes, it is, however, more likely that the soakaway ponds will fill to capacity. At this point the pump in the quarry sump would need to be turned off to prevent flooding around/downstream of the soakaways. This would result in the quarry sump in the base of the pit being allowed to periodically fill.

With higher volumes of water in the soakaway ponds there is increased potential for connection with the shallow sands and gravels, which are potentially exposed near to top of the soakaway ponds (see Figure 6-21).

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 6.4.11.1) 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 6.4.11.2 and the methodology for assessment presented in Section 6.3, the receptors and their assigned sensitivity are presented in

Table 6-14.

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 some 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. 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.	Negligible
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	Negligible

Receptor	Importance and Reasoning	Sensitivity
	dewatering has not resulted in a sustained decline in the groundwater levels in monitoring wells surrounding the quarry void – proving limited connectivity at depth.	
Human Health – 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 bedrock aquifer has been encountered with quarrying, however, there has been no observed deteriorating trend in groundwater level or quality, proving limited connectivity at depth. There is limited knowledge on the status of the off-Site water users' wells.	High

6.6 CHARACTERISTICS OF THE DEVELOPMENT

The characteristics of the Proposed Development with regards to water are previously outlined in Sections 6.4.1 to 6.4.4 and Section 6.4.13 for the water balance.

6.6.1.1 Proposed Development Plans

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

- Operational Phase – lateral extension of the northeastern extraction area,
- Restoration Phase - restoration of the Site in-line with the proposed restoration plan.

The Proposed Development consists of further development of the quarry over the Section 37L application area (ca. 10 ha) that will progress laterally into the bedrock shale in the northeastern extension area, with an area approximately 1.89 ha, in addition to the existing 5.1 ha of quarry void. The proposed areas for extraction are discussed in more detail in Chapter 2 (Project Description) and summarised in Figure 6-23 below.

The bedrock shale is currently worked in the existing quarry to a maximum depth of 210 m AOD. The final elevation for extraction in the proposed quarry extension is ca. 213 m AOD. This depth is elevated in comparison to the maximum depth, in order to maintain the current quarry sump area.

As part of road re-alignment works, the wheel wash borehole will be decommissioned, and water will be temporarily sourced from GW3 located on adjacent Stresslite Precast Ltd lands. This borehole will also provide water for dust suppression activities. With the road re-alignment works, the access road will have a larger section sloping towards the quarry void, which will ensure that a larger volume of rainfall run-off remains within the Site. Drainage channels will be excavated along the access road to assist in diverting the water towards the base of the quarry pit.

In anticipation of increased volumes (with the Proposed Development) of rainfall and seepage collecting in the quarry, the quarry sump is to be extended in order to provide additional capacity.

As part of the mitigation measures discussed in Chapter 6.8, a bypass seperator is to be installed on the pipeline from the quarry sump, prior to discharge into the soakaway pond.

The restoration proposal is detailed in Chapter 2 (Project Description) and is intended to be implemented once extraction proposed is complete. The restoration will be entirely within the EIA boundary and consists of minor rounding of the benches with a pond to be maintained in the base of the void. A combination of native species planting and natural recolonisation of bare ground is proposed in accordance with advice from the ecology team for this EIAR. It is anticipated that progressive restoration will require 24 months for plant and building removal, regrading and planting works and first planting season inspection.

Figure 6-23 - Proposed Extension Area overlain on 2024 aerial

6.6.2 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 are in place, which include:

- 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 6.4.11.2);
- Dust Suppression – water sourced from borehole rather than surface water contained in pit. To switch from use of wheel wash to GW3.
- 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;
- There are no significant quantities of hydrocarbons stored onsite and all plant is re-fueld from a visiting fuel-truck. Minor quantities of lubricating oils and hydraulic fluid is stored in bunded drip trays;
- 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.
- 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); and this EMS is being updated to reflect current site extents and operations.
- 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.

When assessing and evaluating the potential effects of the Proposed Development on the water environment, these embedded mitigation measures are taken into consideration.

6.7 POTENTIAL EFFECTS

The main activities which will be conducted during the future development of the Site, and may cause an impact upon the water environment are as follows:

- Quarrying activities (e.g. blasting of bedrock, excavation of quarry, movement of material);
- Crushing and screening of excavated rock;
- 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;
- Use of welfare facilities, wheel wash and holding tank.

Although there is already embedded mitigation in the Site infrastructure and design, activities at the Site still have potential to cause the following impacts:

- (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 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 Table 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/quantity in the available monitoring wells and soakaway ponds not detecting 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 to date;
- 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; 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 SPA 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 is considered, although it is considered a secondary effect to the Local Abstraction receptor, which has 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 SPA	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 SPA	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 SPA	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 SPA	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 SPA	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
Poulaphouca Reservoir SPA	High	(6) Changes in quality from uncontrolled material storage. *No deterioration in monitored Site surface water quality.*	Negligible	Slight
Poulaphouca Reservoir SPA	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*	Negligible	Imperceptible or slight

Receptor	Sensitivity	Source of Impact/Description of Change	Impact Magnitude	Level of Effect
		low. Arsenic ubiquitous in river sediments		
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 deterioration in monitored Site surface water quality.*	Negligible	Imperceptible or slight
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*	Low	Imperceptible or slight

Receptor	Sensitivity	Source of Impact/Description of Change	Impact Magnitude	Level of Effect
		levels in bedrock with increased dewatering.		
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 the unmanaged spillage of fuels or lubricants from Site plant or vehicles. *No deterioration in monitored Site groundwater quality.*	Negligible	Imperceptible
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

Receptor	Sensitivity	Source of Impact/Description of Change	Impact Magnitude	Level of Effect
Local abstraction	Negligible	(1) Changes in quality due to excavation. *No continued deterioration in monitored Site groundwater quality.*	Negligible	Imperceptible
Local abstraction	Negligible	(2) Changes in quantity due to dewatering. *No obvious long-term declining trend in groundwater levels in bedrock with increased dewatering.*	Negligible	Imperceptible
Local abstraction	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*	Negligible	Imperceptible
Local abstraction	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.*	Negligible (beneficial)	Imperceptible
Human Health	High	(1) Changes in well or reservoir water quality due to excavation. *No continued deterioration in monitored Site groundwater quality.*	Negligible	Slight
Human Health	High	(2) Changes in users' quantity due to dewatering. *No obvious long-term declining trend in groundwater levels in bedrock with increased dewatering.*	Negligible	Slight
Human Health	High	(3) Changes in users' quality from discharges/infiltration from the soakaway to wells or reservoir. *Soakaways into bedrock and not gravels and sands. Groundwater therefore has short pathways or moves within the upper bedrock. Elevated Nitrate/Nitrite likely originating from farming*	Negligible	Slight
Human Health	High	(4) Changes in users' quantity from discharges/infiltration from the soakaway and overflow ponds. *Soakaways into bedrock and not superficial gravels and sands.*	Negligible (beneficial)	Slight

Receptor	Sensitivity	Source of Impact/Description of Change	Impact Magnitude	Level of Effect
		Beneficial in returning groundwater seepage to bedrock aquifer.		

6.8 MITIGATION MEASURES

Additional mitigation and/or management is intended to avoid, prevent, reduce or, if possible, offset any identified significant adverse effects on the environment. The initial assessment of potential effects (considering embedded mitigation) has not identified any significant adverse effects. However, to further mitigate the initial effects associated with the water environment, the following additional mitigation is recommended:

- Bypass separator – a bypass separator should be installed at the Site and any discharges to ground (e.g. pumped from pit or wheelwash) should be passed through the bypass separator prior to discharge to the Soakaway Pond. The bypass separator should be designed to exceed the maximum pump capacity presented in Section 6.4.4.
- 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.
- Extension of the quarry sump for increased capacity. If increase rainfall collection and seepage in the quarry sump (from proposed extension) result in the soakaway and overflow ponds filling to capacity, then pumping should cease to prevent flooding, allowing the periodic filling of the quarry sump.
- Implementation of level monitoring in the soakaway and overflow ponds to better understand the volume changes in response to rainfall and quarrying activities.
- Communication with local water users to determine status (whether they are still in use / abandoned) of private water wells.
- It is recommended that the water quality in the Goldenhill River, both downstream and upstream of the Site be tested in order to assess potential connectivity with the Site and feed into the conceptual model of the Site.

6.9 RESIDUAL EFFECTS

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

Table 6-16.

In all cases the residual level of effect is no greater than *Slight*. Note that mitigation measures only have little effect on the residual impact magnitude, due to many of the receptors currently having an impact magnitude of *Negligible*.

Table 6-16 – Evaluation of Impacts and their Effect Significance

Receptor	Source of Impact - Description of Change	Duration	Impact Magnitude / Level of Effect	Summary of Mitigation (embedded and additional)	Residual Impact Magnitude / Level of Effect
Poulaphouca Reservoir SPA	Changes in quality due to excavation.	Temporary, Reversible	Negligible / Slight	Water quality of monitoring wells. Install of monitoring well downgradient of ponds	Negligible / Slight
Poulaphouca Reservoir SPA	Changes in quantity due to dewatering.	Temporary, Reversible	Negligible / Imperceptible or slight	Water level of monitoring wells. Dewatering to soakaway ponds	Negligible / Imperceptible or Slight
Poulaphouca Reservoir SPA	Changes in quality from discharges/infiltration from the soakaway and overflow ponds.	Temporary, Reversible	Negligible / Slight	Monitoring of water quality within soakaway pond. Install of monitoring well downgradient of ponds	Negligible / Slight
Poulaphouca Reservoir SPA	Changes in quantity from discharges/infiltration from the soakaway and overflow ponds.	Temporary, Reversible	Negligible / Slight	Monitoring of water level within soakaway pond. Install of monitoring well downgradient of ponds	Negligible / Slight
Poulaphouca Reservoir SPA	Changes in quality from wastewater generated by on-Site welfare, holding tank and wheel wash facilities.	Temporary, Reversible	Negligible / Slight	Wheel wash is a closed loop system. No discharges of wastewater on-Site	Negligible / Slight
Poulaphouca Reservoir SPA	Changes in quality from uncontrolled material storage.	Temporary, Reversible	Negligible / Slight	Hydrocarbons will be stored in bunded tanks on an impermeable hardstanding surface	Negligible / Slight
Poulaphouca Reservoir SPA	Changes in quality caused by hydrocarbon leaks from unmanaged spillage of fuels or lubricants from Site plant or vehicles.	Temporary, Reversible	Negligible / Slight	Mobile plant maintenance activities will use a dedicated concrete hardstanding apron. Bypass separator to be installed for discharge to the Soakaway Pond. Emergency spill kit will be available for use.	Negligible / Slight
Goldenhill River (Surface Water)	Changes in quality due to excavation.	Temporary, Reversible	Negligible / Imperceptible or slight	Water quality of monitoring wells.	Negligible / Imperceptible or slight
Goldenhill River (Surface Water)	Changes in quantity due to dewatering.	Temporary, Reversible	Negligible / Imperceptible or slight	Water level of monitoring wells. Dewatering to soakaway ponds	Negligible / Imperceptible or slight

Receptor	Source of Impact - Description of Change	Duration	Impact Magnitude / Level of Effect	Summary of Mitigation (embedded and additional)	Residual Impact Magnitude / Level of Effect
Goldenhill River (Surface Water)	Changes in quality from discharges/infiltration from the soakaway and overflow ponds.	Temporary, Reversible	Negligible / Imperceptible or slight	Monitoring of water quality within soakaway pond. Install of monitoring well downgradient of ponds	Negligible / Imperceptible or slight
Goldenhill River (Surface Water)	Changes in quantity from discharges/infiltration from the soakaway and overflow ponds.	Temporary, Reversible	Negligible / Imperceptible or slight	Monitoring of water level within soakaway pond. Install of monitoring well downgradient of ponds	Negligible / Imperceptible or slight
Goldenhill River (Surface Water)	Changes in quality from wastewater generated by on-Site welfare, holding tank and wheel wash facilities.	Temporary, Reversible	Negligible / Imperceptible or slight	Wheel wash is a closed loop system. No discharges of wastewater on-Site	Negligible / Imperceptible or slight
Goldenhill River (Surface Water)	Changes in quality from uncontrolled material storage.	Temporary, Reversible	Negligible / Imperceptible or slight	Hydrocarbons will be stored in bunded tanks on an impermeable hardstanding surface	Negligible / Imperceptible or slight
Goldenhill River (Surface Water)	Changes in quality caused by hydrocarbon leaks from unmanaged spillage of fuels or lubricants from Site plant or vehicles.	Temporary, Reversible	Negligible / Imperceptible or slight	Mobile plant maintenance activities will use a dedicated concrete hardstanding apron. Bypass separator to be installed for discharge to the Soakaway Pond. Emergency spill kit will be available for use.	Negligible / Imperceptible or slight
Groundwater	Changes in quality due to excavation.	Temporary, Reversible	Low / Imperceptible or slight	Water quality of monitoring wells.	Low / Imperceptible or slight
Groundwater	Changes in quantity due to dewatering.	Temporary, Reversible	Low / Imperceptible or slight	Water level of monitoring wells. Dewatering to soakaway ponds	Low / Imperceptible or slight
Groundwater	Changes in quality from discharges/infiltration from the soakaway and overflow ponds.	Temporary, Reversible	Low / Imperceptible or slight	Monitoring of water quality within soakaway pond. Install of monitoring well downgradient of ponds	Negligible / Imperceptible or slight
Groundwater	Changes in quantity from discharges/infiltration from the soakaway and overflow ponds.	Temporary, Reversible	Medium (beneficial) / Imperceptible or slight	Monitoring of water level within soakaway pond. Install of monitoring well downgradient of ponds	Medium (beneficial) / Imperceptible or slight
Groundwater	Changes in quality from wastewater	Temporary, Reversible	Negligible / Imperceptible	Wheel wash is a closed loop system.	Negligible / Imperceptible

Receptor	Source of Impact - Description of Change	Duration	Impact Magnitude / Level of Effect	Summary of Mitigation (embedded and additional)	Residual Impact Magnitude / Level of Effect
	generated by on-Site welfare, holding tank and wheel wash facilities.			No discharges of wastewater on-Site	
Groundwater	Changes in quality from uncontrolled material storage.	Temporary, Reversible	Negligible / Imperceptible	Hydrocarbons will be stored in bunded tanks on an impermeable hardstanding surface	Negligible / Imperceptible
Groundwater	Changes in quality caused by hydrocarbon leaks from unmanaged spillage of fuels or lubricants from Site plant or vehicles.	Temporary, Reversible	Negligible / Imperceptible	Mobile plant maintenance activities will use a dedicated concrete hardstanding apron. Bypass separator to be installed for discharge to the Soakaway Pond. Emergency spill kit will be available for use.	Negligible / Imperceptible
Flooding	Increased flooding risk to the quarry floor due to elevated rainfall and seepage.	Temporary, Reversible	Low / Slight	Dewatering to soakaway ponds Extend size of quarry sump to allow greater capacity	Low / Slight
Flooding	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.	Temporary, Reversible	Negligible / Imperceptible or slight	Monitor levels in soakaway and overflow Extend size of quarry sump to allow greater capacity To allow quarry sump to fill if soakaways at capacity	Negligible / Imperceptible or slight
Local abstraction	Changes in quality due to excavation.	Temporary, Reversible	Negligible / Imperceptible	Determine status of private water wells. Water quality of monitoring wells	Negligible / Imperceptible
Local abstraction	Changes in quantity due to dewatering.	Temporary, Reversible	Negligible / Imperceptible	Determine status of private water wells. Water level of monitoring wells. Dewatering to soakaway ponds	Negligible / Imperceptible
Local abstraction	Changes in quality from discharges/infiltration from the soakaway and overflow ponds.	Temporary, Reversible	Negligible / Imperceptible	Determine status of private water wells. Monitoring of water quality within soakaway pond. Install of monitoring well downgradient of ponds	Negligible / Imperceptible

Receptor	Source of Impact - Description of Change	Duration	Impact Magnitude / Level of Effect	Summary of Mitigation (embedded and additional)	Residual Impact Magnitude / Level of Effect
Local abstraction	Changes in quantity from discharges/infiltration from the soakaway and overflow ponds.	Temporary, Reversible	Negligible (beneficial) / Imperceptible	Determine status of private water wells. Monitoring of water level within soakaway pond. Install of monitoring well downgradient of ponds	Negligible (beneficial) / Imperceptible
Human Health	Changes in well or reservoir water quality due to excavation.	Temporary, Reversible	Negligible / Slight	Determine status of private water wells. Water quality of monitoring wells	Negligible / Slight
Human Health	Changes in users' quantity due to dewatering.	Temporary, Reversible	Negligible / Slight	Determine status of private water wells. Water level of monitoring wells. Dewatering to soakaway ponds	Negligible / Slight
Human Health	Changes in users' quality from discharges/infiltration from the soakaway or quarry void. Quality of wells and reservoir	Temporary, Reversible	Negligible / Slight	Determine status of private water wells. Monitoring of water quality within soakaway pond. Install of monitoring well downgradient of ponds	Negligible / Slight
Human Health	Changes in users' quantity from discharges/infiltration from the soakaway and overflow ponds.	Temporary, Reversible	Negligible (beneficial) / Slight	Determine status of private water wells. Monitoring of water level within soakaway pond. Install of monitoring well downgradient of ponds	Negligible (beneficial) / Slight

Additional mitigation measures in green

6.10 CUMULATIVE EFFECTS

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

6.11 MONITORING

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

- Groundwater level – groundwater levels should be monitored at the six existing monitoring well locations (Table 6-9) 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 2024; 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 bypass separator is installed, sampling should also take place of the water in the quarry sump, prior to it passing through the bypass separator.
- It is recommended that the water quality in the Goldenhill River, both downstream and upstream of the Site be tested on a bi-annual basis in order to feed into the conceptual model of the Site.

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 19 Pandemic). 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;
- There is no established water level monitoring in the soakaway and overflow ponds, so water levels are interpreted from survey data and observations from site staff; 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 with the Proposed Development.

The main receptors that could be affected by changes to the water environment due to activities undertaken at the Site are identified and potential effects are 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 are groundwater, surface water (Poulaphouca Reservoir SPA and Goldenhill River), flood risk areas and local abstractions. A receptor pathway for the Red Bog SAC is not identified.

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

6.14 REFERENCES

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Appendix 6A

TECHNICAL SPECIFICATION FOR DEWATERING PUMP

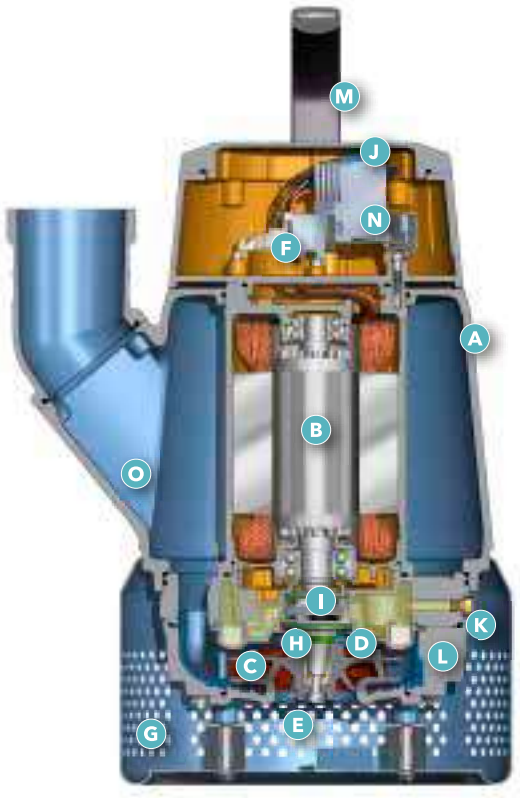
50Hz

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**

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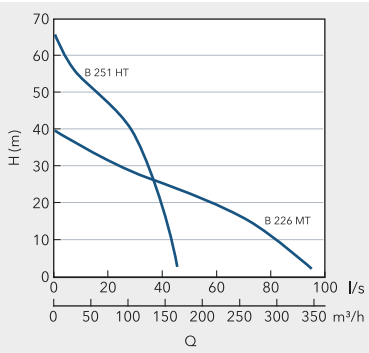
a xylem brand

Performance



HT
High head

MT
Medium head

B
Wear resistant impeller

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/m³
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 acessories 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

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)

SLR Consulting Ireland
7 Dundrum Business Park
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WATER WELL (SURVEY) DATA SHEET

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	SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description
							1.20	MADE GROUND comprising fill. Drill pad installed by site.
							(4.20)	Clay, sand and gravel
							5.40	
							7.00	Gravel / Brown Shale
							(4.00)	Brown Shale
							11.00	
							(8.00)	Blue Shale
							19.00	
							19.70	Brown Shale
▼1							22.40	Blue Shale
							23.20	Brown Shale
							(47.00)	Blue/grey Shale
								White calcite chips at 52 m bGL
							70.20	
							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

WATER/ PROGRESS	INSTALLATION /BACKFILL	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)	Sands and large gravels
							9.00	
							(6.00)	Brown Mudstone / Brown Shale
1							15.00	
								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 - 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-2 - 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-3 - 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)

Table 6C-4 - Laboratory Results – December 2024

Parameter	Units	GTV [1]	EQS 2019 [2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Dissolved Arsenic	ug/l	7.5	50	-	-	-	-	-	62.5	-
Dissolved Barium	ug/l	none	100	-	-	-	-	-	58	-
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	-	-	-	-	-	-	77.4	-
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	-	-	-	-	-	-	12.5	-
Dissolved Mercury	ug/l	0.75	1	-	-	-	-	-	<1	-
Dissolved Nickel	ug/l	none	50	-	-	-	-	-	12	-
Dissolved Potassium	mg/l	none	-	-	-	-	-	-	1.5	-

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	-	-	-	-	-	-	10.3	-
Dissolved Vanadium	ug/l	none	-	-	-	-	-	-	<1.5	-
Dissolved Zinc	ug/l	75	100	-	-	-	-	-	<3	-
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	-

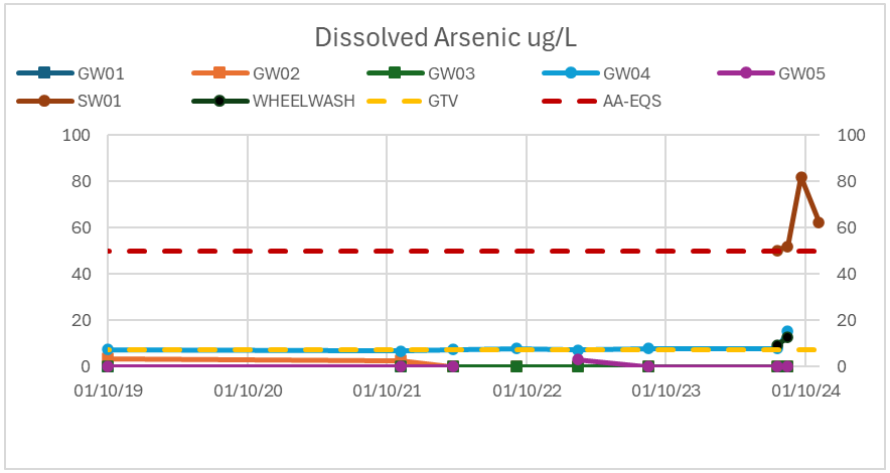
Parameter	Units	GTV [1]	EQS 2019 [2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Sulphate as SO4	mg/l	187.5	200	-	-	-	-	-	64.1	-
Chloride	mg/l	187.5	250	-	-	-	-	-	13.2	-
Nitrate as NO3	mg/l	37.5	50	-	-	-	-	-	38.7	-
Nitrite as NO2	mg/l	0.375	0.2	-	-	-	-	-	0.22	-
Ortho Phosphate as PO4	mg/l	none	-	-	-	-	-	-	0.12	-
Nitrate as N	mg/l	-	-	-	-	-	-	-	8.74	-
Nitrite as N	mg/l	-	-	-	-	-	-	-	0.067	-
Ortho Phosphate as P	mg/l	-	-	-	-	-	-	-	0.04	-
Total Oxidised Nitrogen as N	mg/l	-	-	-	-	-	-	-	8.8	-
Ammoniacal Nitrogen as N	mg/l	none	-	-	-	-	-	-	0.09	-
Ammoniacal Nitrogen as NH4	mg/l	-	-	-	-	-	-	-	0.12	-
Hexavalent Chromium	ug/l	7.5	3.4	-	-	-	-	-	<6	-
Total Dissolved Chromium III	ug/l	-	4.7	-	-	-	-	-	<6	-

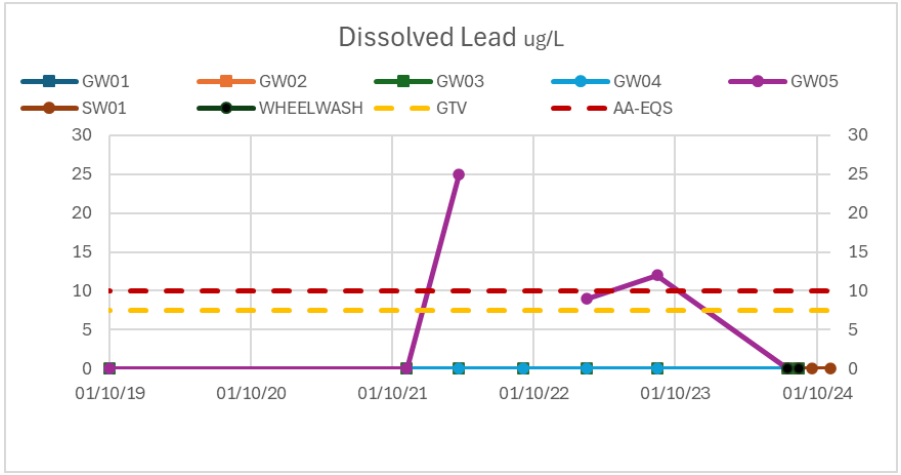
Parameter	Units	GTV [1]	EQS 2019 [2]	GW01	GW02	GW03	GW04	GW05	SW01	WHEEL WASH
Total Alkalinity as CaCO3	mg/l	-	-	-	-	-	-	-	174	-
COD (Settled)	mg/l	none	-	-	-	-	-	-	7	-
Electrical Conductivity @25C	uS/cm	-	-	-	-	-	-	-	580	-
pH	pH units	-	-	-	-	-	-	-	8.17	-
Total Suspended Solids	mg/l	none	-	-	-	-	-	-	<10	-

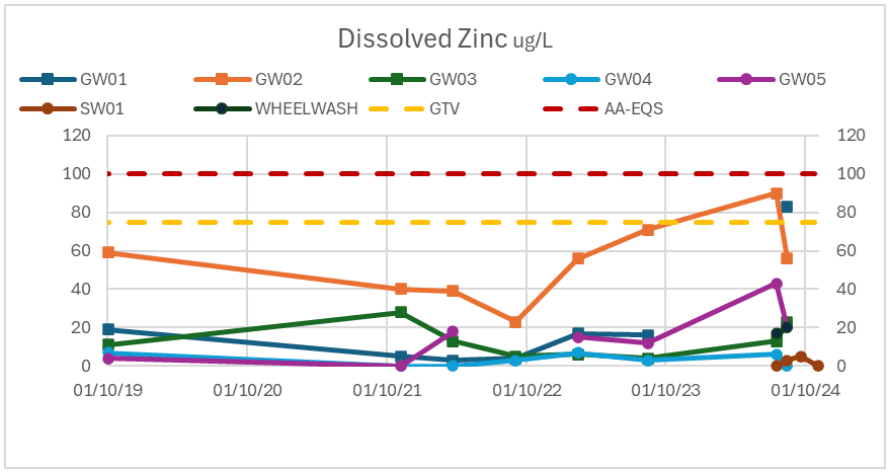
1 Groundwater Regulations 2010 (S.I. No. 9 of 2010) and amendment S.I. No. 366/2016.

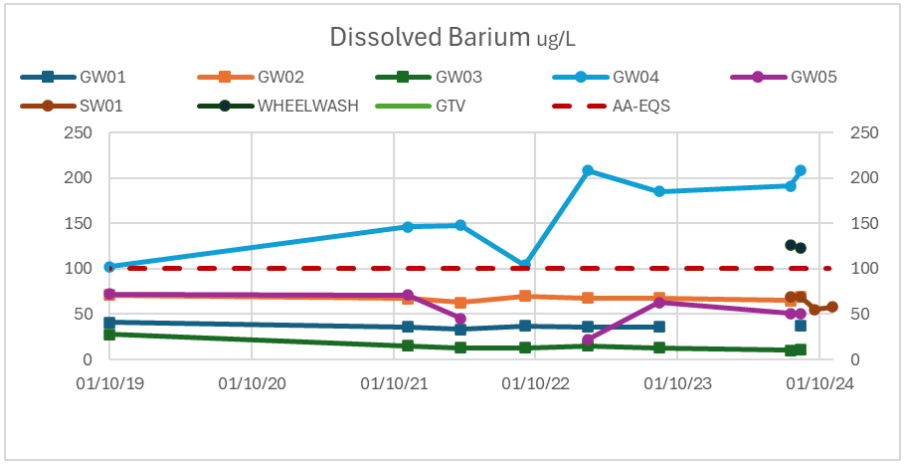
2 AA-EQS - European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. No. 272/2009 including amendments S.I. No. 327/2012, S.I. No. 386/2015 and S.I. No. 77/2019)

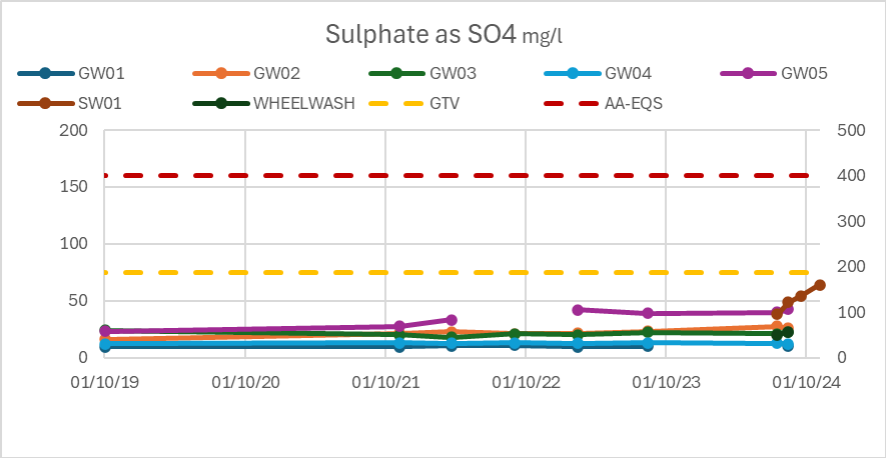
Figure 6C-1 - Time Series Graphs for Sampled Water Quality Parameters Max Values (Nov 2019 to Sep 2024)

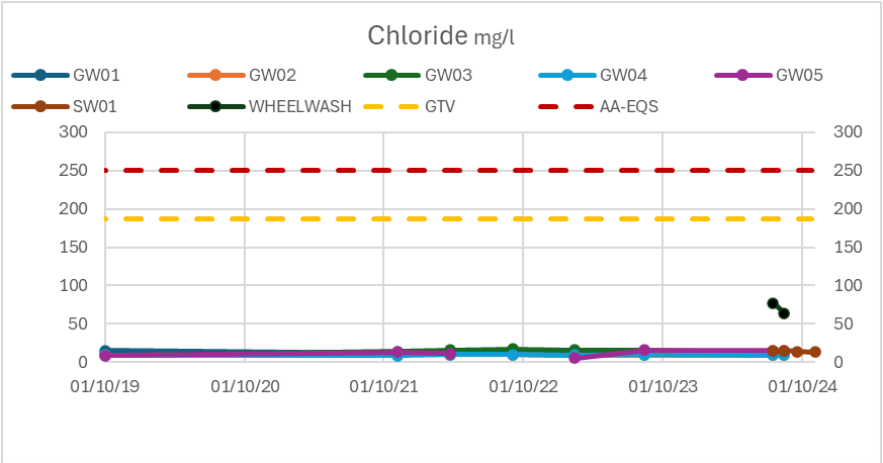


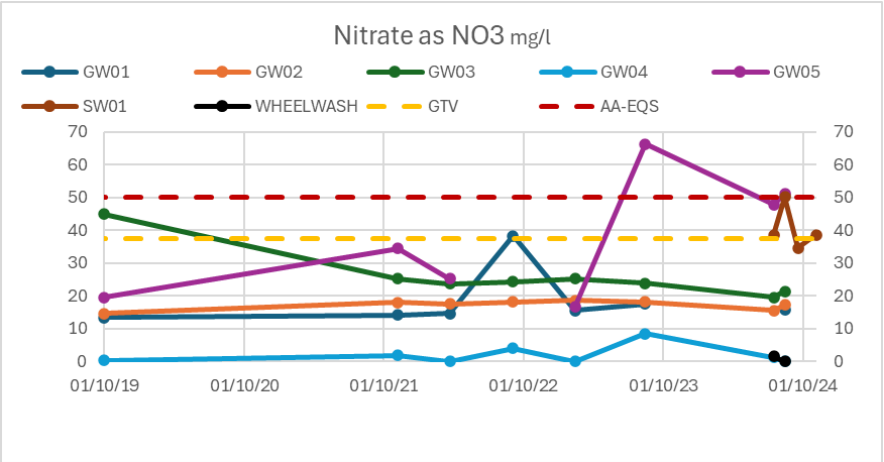


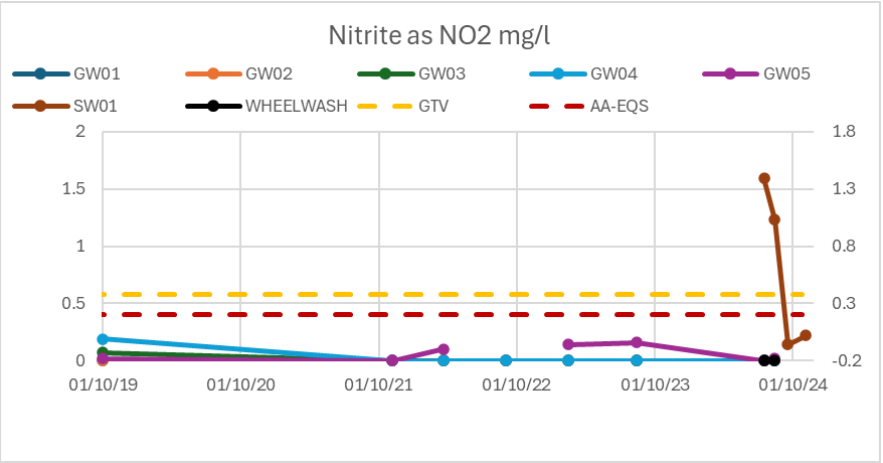





Sulphate as SO4 mg/l
GW01
GW02
GW03
GW04
GW05
SW01
WHEELWASH
GTV
AA-EQS
200
150
100
50
0
500
400
300
200
100
0
01/10/19
01/10/20
01/10/21
01/10/22
01/10/23
01/10/24


Chloride mg/l
GW01
GW02
GW03
GW04
GW05
SW01
WHEELWASH
GTV
AA-EQS
300
250
200
150
100
50
0
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
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

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

WSP Environmental
Town Centre House
Dublin Road
Naas
Co Kildare
Ireland

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					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							
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

Element Materials Technology

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, $HN=HN0_3$

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

Please see attached notes for all abbreviations and acronyms

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

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 (1985), 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: 2013I	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: 2013I	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
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=$HN0_3$

EMT Sample No.	1-6	7-12	13-18	19-24	25-30	31-36	37-42	43-48			LOD/LOR	Units	Method No.
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					
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

Please see attached notes for all abbreviations and acronyms

Element Materials Technology

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, $HN=HN0_3$

EMT Sample No.	1-6	7-12	13-18	19-24	25-30	31-36	37-42	43-48			LOD/LOR	Units	Method No.
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					
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

Please see attached notes for all abbreviations and acronyms

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: 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.

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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.
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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 (1985), 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: 2013I	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: 2013I	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			

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WSP Environmental
Town Centre House
Dublin Road
Naas
Co Kildare
Ireland

Attention :	Zak Bursey
Date :	24th December, 2024
Your reference :	IE0037007
Our reference :	Test Report 24/21405 Batch 1
Location :	Shilleagh Hempstown IE0037007
Date samples received :	13th December, 2024
Status :	Final Report
Issue :	202412240946

Three samples were received for analysis on 13th December, 2024 of which three 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 - 3.475 kg of CO2

Scope 1&2&3 emissions - 8.213 kg of CO2

Authorised By:

Paul Boden BSc
Senior Technical Account Manager

Element Materials Technology

Client Name: WSP Environmental
Reference: IE0037007
Location: Shilleagh Hempstown IE0037007
Contact: Zak Bursey
EMT Job No: 24/21405

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	13-17									
Sample ID	SW01	SW01-DUP01	TRIP BLANK									
Depth										Please see attached notes for all abbreviations and acronyms		
COC No / misc												
Containers	V H HN P G	V H HN P G	V HN P G									
Sample Date	11/12/2024	11/12/2024	11/12/2024									
Sample Type	Liquid	Liquid	Liquid									
Batch Number	1	1	1							LOD/LOR	Units	Method No.
Date of Receipt	13/12/2024	13/12/2024	13/12/2024									
Dissolved Arsenic	62.5	62.9	<2.5							<2.5	ug/l	TM30/PM14
Dissolved Barium	58	58	<3							<3	ug/l	TM30/PM14
Dissolved Beryllium	<0.5	<0.5	<0.5							<0.5	ug/l	TM30/PM14
Dissolved Boron	12	<12	<12							<12	ug/l	TM30/PM14
Dissolved Cadmium	<0.5	<0.5	<0.5							<0.5	ug/l	TM30/PM14
Dissolved Calcium	77.4	77.6	<0.2							<0.2	mg/l	TM30/PM14
Total Dissolved Chromium	<1.5	<1.5	<1.5							<1.5	ug/l	TM30/PM14
Dissolved Copper	<7	<7	<7							<7	ug/l	TM30/PM14
Dissolved Lead	<5	<5	<5							<5	ug/l	TM30/PM14
Dissolved Magnesium	12.5	12.5	<0.1							<0.1	mg/l	TM30/PM14
Dissolved Mercury	<1	<1	<1							<1	ug/l	TM30/PM14
Dissolved Nickel	12	12	<2							<2	ug/l	TM30/PM14
Dissolved Potassium	1.5	1.6	<0.1							<0.1	mg/l	TM30/PM14
Dissolved Selenium	<3	<3	<3							<3	ug/l	TM30/PM14
Dissolved Sodium	10.3	10.4	<0.1							<0.1	mg/l	TM30/PM14
Dissolved Vanadium	<1.5	<1.5	<1.5							<1.5	ug/l	TM30/PM14
Dissolved Zinc	<3	3	<3							<3	ug/l	TM30/PM14
GRO (>C4-C8) (HS_1D_Total)	<10	<10	-							<10	ug/l	TM36/PM12
GRO (>C8-C12) (HS_1D_Total)	<10	<10	-							<10	ug/l	TM36/PM12
GRO (>C4-C12) (HS_1D_Total)	<10	<10	-							<10	ug/l	TM36/PM12
MTBE	<5	<5	-							<5	ug/l	TM36/PM12
Benzene	<5	<5	-							<5	ug/l	TM36/PM12
Toluene	<5	<5	-							<5	ug/l	TM36/PM12
Ethylbenzene	<5	<5	-							<5	ug/l	TM36/PM12
m/p-Xylene	<5	<5	-							<5	ug/l	TM36/PM12
o-Xylene	<5	<5	-							<5	ug/l	TM36/PM12
EPH (C8-C40) (EH_1D_Total)	<10	<10	-							<10	ug/l	TM5/PM30
Sulphate as SO4	64.1	64.5	-							<0.5	mg/l	TM38/PM0
Chloride	13.2	13.3	-							<0.3	mg/l	TM38/PM0
Nitrate as NO3	38.7	39.4	-							<0.2	mg/l	TM38/PM0
Nitrite as NO2	0.22	0.21	-							<0.02	mg/l	TM38/PM0
Ortho Phosphate as PO4	0.12	0.06	-							<0.06	mg/l	TM38/PM0
Nitrate as N	8.74	8.90	-							<0.05	mg/l	TM38/PM0
Nitrite as N	0.067	0.065	-							<0.006	mg/l	TM38/PM0
Ortho Phosphate as P	0.04	<0.03	-							<0.03	mg/l	TM38/PM0
Total Oxidised Nitrogen as N	8.8	9.0	-							<0.2	mg/l	TM38/PM0
Ammoniacal Nitrogen as N	0.09	0.09	-							<0.03	mg/l	TM38/PM0
Ammoniacal Nitrogen as NH4	0.12	0.12	-							<0.03	mg/l	TM38/PM0
Hexavalent Chromium	<6	<6	-							<6	ug/l	TM38/PM0
Total Dissolved Chromium III	<6	<6	-							<6	ug/l	TM0/PM0

Element Materials Technology

Client Name: WSP Environmental
Reference: IE0037007
Location: Shilleagh Hempstown IE0037007
Contact: Zak Bursey
EMT Job No: 24/21405

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	13-17									
Sample ID	SW01	SW01-DUP01	TRIP BLANK									
Depth										Please see attached notes for all abbreviations and acronyms		
COC No / misc												
Containers	V H HN P G	V H HN P G	V HN P G									
Sample Date	11/12/2024	11/12/2024	11/12/2024									
Sample Type	Liquid	Liquid	Liquid									
Batch Number	1	1	1							LOD/LOR	Units	Method No.
Date of Receipt	13/12/2024	13/12/2024	13/12/2024									
Total Alkalinity as CaCO3	174	172	-							<1	mg/l	TM75/PM0
COD (Settled)	7	<7	-							<7	mg/l	TM57/PM0
Electrical Conductivity @25C	580	575	-							<2	uS/cm	TM76/PM0
pH	8.17	7.94	-							<0.01	pH units	TM73/PM0
Total Suspended Solids	<10	<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: IE0037007
Location: Shilleagh Hempstown IE0037007
Contact: Zak Bursey

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
No deviating sample report results for job 24/21405						

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.: 24/21405

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)

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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: 24/21405

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
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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				
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TM37	Modified methods - TSS: USEPA 160.2 (1985), 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.				
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.				
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.				
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.				
TM75	Modified US EPA method 310.1 (1978). Determination of Alkalinity by Metrohm automated titration analyser.	PM0	No preparation is required.				
TM76	Modified US EPA method 120.1 (1982). Determination of Specific Conductance by Metrohm automated probe analyser.	PM0	No preparation is required.				

Appendix 6E

SEEPAGE CALCULATIONS

2020 to 2024

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	0.483	*Based on average annual precipitation of 1015 mm over the review period and evapotranspiration of 591 mm*
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 2023 Site survey data GL (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	89.077	*Calculated (inflow + rainfall)*
		m^3/hr	3.712	
		m^3/s	0.001	
		l/s	1.0	

Future Prediction

Notation	Parameter	Units	Future Scenario Value	Comments
Ap	Pit surface area	m^2	93430	*Future Extraction Area*
P	Precipitation	m/year	0.483	*Based on average annual precipitation of 1015 mm over the review period and evapotranspiration of 591 mm*
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	187	*Estimated maximum radius*
r_o	Radius of influence	m	188	*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 Site survey data GL (297 mAOD) and proposed 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	0.323	*Calculated (reference Marinelli and Niccoli, 2000)*
		m^3/s	0.000	
Q_2	Rate of inflow to pit through floor	m^3/day	1.97E+01	*Calculated (reference Marinelli and Niccoli, 2000)*
		m^3/s	2.28E-04	
Q_T	Total inflow to pit from strata	m^3/day	20.000	*Calculated (reference Marinelli and Niccoli, 2000)*
		m^3/s	0.000	
Qv	Total volume to be pumped (inflow plus rainfall)	m^3/day	143.635	*Calculated (inflow + rainfall)*
		m^3/hr	5.985	
		m^3/s	0.002	
		l/s	1.7	
The following is from Cooper and Jacob (1946) as a comparrison				
r_o =SQRT(2.25Tt)				
T	*Transmisivity (k*average sat thickness)*	*m^2/day*	*7.22E-02*	
t	*Time since start of pumping*	*days*	*30*	
r_o	*Radius of influence*	*m*	*2.21*	