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Note: there are 145 no. additional Figures within **Appendix 7-A**: Rathcore Quarry - Hydrogeological Investigation (2022).

APPENDICES

INTRODUCTION

Background

7.1 This Chapter of the Environmental Impact Assessment Report (EIAR) provides a description of the existing surface and groundwater conditions within the application site and the surrounding area.

7.2 The baseline surface water and groundwater conditions are identified and described, and the potential effects of the proposed development on surface and groundwater are assessed, and if required, mitigation measures are proposed.

7.3 The assessment presented in this chapter is based on the publicly available desktop environmental information for the site, the ongoing water related monitoring by Kilsaran in relation to the existing planning permission and discharge licence, and a report on a hydrogeological investigation completed between 2019 and 2022.

7.4 Kilsaran previously applied for planning permission to deepen the existing quarry in 2017. An Bord Pleanála refused permission in 2018.

7.5 One of the main reasons for refusal was the Board's view that the applicant's planning application contained a limited investigation and understanding of the complex hydrogeological conditions on site and in the area. As a result, the Board was not satisfied that the proposed development would not give rise to an adverse impact on water supplies in the vicinity of the site or have an adverse effect on St Gorman's Well and its ecology.

7.6 Kilsaran carefully examined the Board's reasons for refusal. Kilsaran asked David Ball (an independent hydrogeologist) to assess the Board's decision. He agreed with the Board that the complex hydrogeology was not sufficiently understood. He was asked by Kilsaran to carry out an investigation of the hydrogeology in late 2018, with particular reference to the quarry, the existing water supplies and St Gorman's Well. Mr Ball carried out an investigation, analysis and interpretation of data and report compilation over the next three years, ending in February 2022. Mr Ball pulled together a large body of existing information and obtained a further large amount of new information from his drilling, pumping tests, and water level monitoring field work. He also, with considerable assistance from the Geological Survey of Ireland (GSI), applied a new methodology for processing recently acquired airborne electrical conductivity data along 48 sections crossing the area obtained by the GSI's Tellus airborne geophysical survey programme. He correlated the data with past and recent borehole logs to obtain a detailed revelation of the hitherto hidden complex geology, structural geology and karst development in the area.

7.7 The resulting Hydrogeological Investigation Report is a significant body of work and presents a very detailed assessment. The total document is 448 pages long. It includes 145 no. full page illustrations, graphs, maps, and cross-sections, and the graphical representation of the logs of 55 boreholes drilled during the investigation. Chapter 5 which assesses in detail all the existing and new information on the spring and from the boreholes at the St Gorman's Well site, and also analyses the recent changes in rainfall in the area, is over 150 pages long.

7.8 Where necessary, the Investigation is referred to throughout this EIAR Chapter. However, due to the detailed nature of the report, the conclusions and points presented here represent a summary of the comprehensive assessment undertaken by Mr Ball and relayed in full in the Rathcore Quarry - Hydrogeological Investigation Report (2022). The full Hydrogeological Investigation Report is attached as **Appendix 7-A**, including the additional 145 no. figures.

Proposed Development

7.9 The existing quarry is located approximately 1km south west of Rathcore village, Co. Meath; refer to **Figure 1-1** in this EIAR. The site of the existing quarry is located on the side of a small low hill which is elevated in comparison to the lower lying ground located to the south and west of the site.

7.10 The proposed development includes the continued use of the permitted development within an overall application area of 31.0 hectares (ha), and all for a period of 22 years, and it will comprise the following:

- Permission for continued use of the previously permitted developments under P. Reg. Ref. No's. 01/1018 (PL17.127391), 95/1416 (PL17.099325) and 91/970 (PL17.089787) to include the existing quarry, drilling, blasting, crushing and screening of rock and related ancillary buildings and facilities;
- Permission for continued use of the previously permitted developments under P. Reg. Ref. No. TA/120923 consisting of a discharge water treatment facility comprising two lagoons (30m x 13m), an oil interceptor, a reed bed (27m x 10m) and a concrete canal with "V" notch weir.
- Permission for a small lateral extension of c.0.9 hectares from the existing quarry area of c.9.7 hectares as permitted under P. Ref. 01/1018 (PL17.127391) to give an overall extraction footprint of c.10.6 hectares;
- Permission for the deepening of the overall extraction area (c.10.6 hectares) by 2 no. 15m benches to a final depth of c.45m AOD from the current quarry floor level of c.75m AOD as permitted under P. Ref. P. Ref. 01/1018 (PL17.127391);
- Permission for a proposed new rock milling plant to be enclosed within a steel-clad building (c.575m² with roof height of 22.5m and exhaust stack height of 28.2m);
- Replacement of existing septic tank with a new wastewater treatment system and constructed percolation area;
- Restoration of the site to a beneficial ecological after-use; and
- All associated site works within an overall application area of 31.1 hectares. The proposed operational period is for 20 years plus 2 years to complete restoration (total duration sought 22 years).

Existing and Proposed Water Management

7.11 The existing quarry at Rathcore is worked to just below the winter groundwater level in the bedrock. Groundwater is managed and discharged from the site to create dry working conditions on the floor of the quarry. The existing site layout and water management infrastructure is shown in Figure 7-1.

7.12 Surface water and groundwater at the site is managed, treated and discharged off-site to a nearby field drain under an existing Discharge Licence (Ref. No. 13/02). Rainfall infiltrates to ground across the majority of the quarry site. Rainfall run off on roadways, hard standing and roof areas either infiltrates to ground or is directed to the quarry floor. Surface run off and infiltrated rainfall seeps through the zone of shattered rock on the quarry floor to the lowest point on the site, a sump on the quarry floor along the western quarry face.

7.13 From here, the water is pumped up to ground level outside the quarry excavation over a distance of c.150m westwards to a settlement pond. The water passes through this settlement pond (c. 30m x 13m) which has been constructed in accordance with discharge licence requirements. From here the water flows through a hydrocarbon interceptor and to an adjacent constructed reed bed (c. 27m x 10m) before being discharged off site via a buried pipe to a local surface water drainage channel which flows in a northwest direction away from the site. Several kilometres further downstream, this drainage channel discharges into a tributary of the Blackwater River. This water management system was granted permission in October 2012, under planning reference no. TA120923. The discharge of the treated clean water from the site is carried out under Discharge Licence (Ref. No. 13/02), granted by Meath County Council in May 2013. Meath County Council also agreed to a variation of the discharge rate under Discharge Licence 13/02 in July 2020 in order to carry out the long pumping tests during the hydrogeological investigation. The permitted discharge rate was increased to 6,000 m^3/day (or 6 million litres per day). As the quarry deepens with the proposed development, it is proposed to construct a second settlement pond adjacent to the existing pond to cater for any increase in the volumes of water (associated with dewatering of the deeper quarry void) requiring attenuation and treatment.

7.14 Other components of the existing water management system at the site are detailed below:

- Water for dust suppression on the processing plant is sourced from a borehole located beside the plant;
- The existing wastewater treatment system at the site comprises a septic tank and percolation area. This treatment system will be removed and a new proprietary treatment system and constructed percolation area will be installed as part of the proposed development;
- General water supply (potable water) for the quarry washroom and small canteen facilities is from the site borehole supply source; and,
- There is bunded fuel storage at the site with a hardstand refuelling area.

7.15 At full production there are 14 persons directly employed at the existing quarry. It is not anticipated that this number will increase as a result of the proposed development.

Process Water

7.16 Water is required for a number of different existing operations at the site. There will be no change in the requirement of water associated with the proposed lateral extension and deepening of the quarry. Water is currently sourced from the existing supply boreholes at the site which will continue to supply the following operations:

- Aggregate Processing Plant;
- Dust suppression and wheel wash; and,
- Site welfare facilities.

7.17 The estimated volumes of water required for each of the processes is outlined in **Table 7-1** below.

Table 7-1
Estimated daily on site water requirement at the site from supply wells

Operation	Requirement (m^3/day)	Requirement (m^3/hr)
Aggregate Processing Plant (dust suppression only)	50	6.25
Site Welfare Facilities*	0.66	0.08
Wheel Wash (bath type)	Top up only	Top up only
Dust suppression	Intermittent	Intermittent
Total Requirement	50.6	6.3

'* based on 14 persons working at the quarry

7.18 Dust suppression is required for aggregate production (crushing and screening) and general site dust suppression at the site. Dust control measures are outlined in Chapter 2.

7.19 A tractor and bowser with a spray bar will carry out dust suppression on the site access road and internal haul roads during periods of dry weather. The tractor and bowser will be mobilised to site as required. Water used for dust suppression is sourced from the supply well (PW1), and it either evaporates after a short time or infiltrates naturally to the ground.

7.20 Potable drinking water for the canteen and welfare facilities at the site will continue to be sourced from the existing supply well (PW2).

7.21 There are no food preparation facilities at the site and therefore it is estimated that daily water usage for welfare and making drinks is ~40 l/per person/day for full time employees and 10 l/per driver.

Wastewater Management

7.22 There is an existing septic tank effluent treatment system with percolation area at the site entrance. As outlined in Chapter 2, it is proposed to decommission the existing wastewater treatment system and replace it with a new proprietary wastewater treatment system and a new constructed percolation area. The existing septic tank will be decommissioned and the contents of the tank will be taken off site for appropriate treatment by a licenced contractor.

7.23 For the purpose of the effluent waste water treatment system it was assumed that there are 14 full time employees at c. 40l/day and ten drivers at c. 10l/day to provide a daily wastewater volume of 660l/day (EPA, 1999, Table 3), and this is equivalent to a PE (Population Equivalent) of 3.3.

7.24 Details of the new wastewater treatment system are included in **Appendix 7-B**. The new treatment system will be installed in the location of the existing septic tank and will be plumbed into the existing foul pipework. proposed wastewater treatment system will comprise of a septic tank and filter system with treated effluent discharged to ground through a percolation area, see **Appendix 7-B**.

Fuel/Chemical Storage

7.25 As outlined in Chapter 2, fuels are stored in bunded tanks at three locations at the site, beside the workshop, beside the generator for the processing plant, and beside the generator for the pump for dewatering. Fuel will continue to be stored at these locations in the future for vehicles and power generation.

7.26 A mobile tanker is used on site to refuel the operating plant and machinery on the quarry floor and the fuel for the pump generator.

7.27 Oil and lubricants for plant and machinery are stored on spill pallets in the designated storage area within the workshop building located within the quarry yard area of the permitted planning area. Spill Kits and spill training has been provided. All new employees are given an induction which includes spill kit training and how to respond to a fuel spill.

7.28 No additional fuel storage is required for the proposed development.

Scope of Work / EIA Scoping

7.29 This EIAR chapter is based on a desk study and site investigation works in order to collect all relevant hydrological, hydrogeological and meteorological data for the proposed development site and the receiving water environment.

Consultations / Consultees

7.30 An Bord Pleanála previously refused permission to deepen Kilsaran’s quarry at Rathcore (planning ref: 161227, ABP Ref: PL17.249132). The refusal was based on the Boards opinion that sufficient attention had not been pain to the potential effects that the deepening of the quarry may have on the local hydrogeological regime, and in particular the effect on St. Gorman’s Well (a local spring of significant hydrogeological importance). Following this refusal, Kilsaran commissioned hydrogeologist David Ball to complete a detailed hydrogeological investigation to determine whether there is a link between the quarry and the spring. This chapter and the impact assessment draws conclusions from the Hydrogeological Investigation Report 2022 which is attached (in full) as **Appendix 7-A**.

7.31 A formal pre-planning consultation (ref. P.P. 8123) was held via Teams between planning, environment and transport staff of Meath County Council and representatives of Kilsaran, SLR Consulting and Hydro-Environmental Services on 15th September 2023.

7.32 Consultation was held with the Geological Survey of Ireland (GSI) in respect of St. Gorman's Well, a County Geological Heritage site. Details of the consultation and response are provided in **Appendix 6-A** of EIAR Chapter 6 Land, Soils and Geology.

Contributors / Author(s)

7.33 This chapter of the EIAR was prepared by Michael Gill and Conor McGettigan of Hydro-Environmental Services. Hydro-Environmental Services (HES) are a specialist geological, hydrological, hydrogeological and environmental practice which delivers a range of water and environmental management consultancy services to the private and public sectors across Ireland and Northern Ireland. HES was established in 2005, and our office is located in Dungarvan, County Waterford. Our core areas of expertise and experience include hydrology and hydrogeology. We routinely complete environmental impact assessments for hydrology and hydrogeology for a large variety of project types including sand and gravel pits and bedrock quarries.

7.34 Michael Gill (BA, BAI, Dip Geol., MSc, MIEI) is an Environmental Engineer, Hydrologist and Hydrogeologist with 22 years' environmental consultancy experience in Ireland. Michael has a degree in Civil and Environmental Engineering, a MSc in Engineering hydrology from TCD and a MSc in Applied Hydrogeology from Newcastle University. Michael has completed numerous (60+) hydrological and hydrogeological assessments relating to bedrock quarries and sand and gravel pits. Recent examples include Ardfert quarry in County Kerry, Middleton Quarry in County Cork and Clonard Quarry in County Kildare.

7.35 Conor McGettigan (BSc, MSc) is an Environmental Scientist with 3 years' experience in the environmental sector. Conor holds an MSc in Applied Environmental Science and a BSc in Geology. Conor routinely completes hydrological and hydrogeological impact assessments for a variety of proposed developments including wind farms, residential and industrial developments, bedrock quarries and sand and gravel pits.

Limitations / Difficulties Encountered

7.36 No limitations or difficulties were encountered during the preparation of this EIAR chapter.

REGULATORY BACKGROUND

Legislation

7.37 This EIAR is prepared in accordance with the requirements of European Union Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (the 'EIA Directive') as amended by Directive 2014/52/EU.

7.38 In addition, the requirements of the following legislation is complied with:

- S.I. No. 349/1989: European Communities (Environmental Impact Assessment) Regulations, and subsequent Amendments (S.I. No. 84/1994, S.I. No. 101/1996;
- S.I. No. 351/1998, S.I. No. 93/1999, S.I. No. 450/2000 and S.I. No. 538/2001;
- S.I. No. 134/2013 and the Minerals Development Act 2017), the Planning and Development Act, and S.I. No. 600/2001 Planning and Development Regulations and subsequent Amendments. These instruments implement EU Directive 85/337/EEC and subsequent amendments, on the assessment of the effects of certain public and private projects on the environment;
- Directives 2011/92/EU and 2014/52/EU on the assessment of the effects of certain public and private projects on the environment, including Circular Letter PL 1/2017: Implementation of Directive 2014/52/EU on the effects of certain public and private projects on the environment (EIA Directive);
- Planning and Development Acts, 2000 (as amended);
- Planning and Development Regulations, 2001 (as amended);
- S.I. No 296/2018: European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 which transposes the provisions of the EIA Directive as amended by the Directive 2014/52/EU into Irish Law;
- S.I. No. 94/1997: European Communities (Natural Habitats) Regulations, resulting from EU Directives 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive) and 79/409/EEC on the conservation of wild birds (the Birds Directive);
- S.I. No. 293/1988: Quality of Salmon Water Regulations;
- S.I. No. 272/2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009, as amended, and S.I. No. 722/2003 European Communities (Water Policy) Regulations, as amended, which implement EU Water Framework Directive (2000/60/EC) and provide for the implementation of 'daughter' Groundwater Directive (2006/118/EC). . Since 2000 water management in the EU has been directed by the Water Framework Directive (2000/60/EC) (as amended by Decision No. 2455/2011/EC; Directive 2008/32/EC; Directive 2008/105/EC; Directive 2009/31/EC; Directive 2013/39/EU; Council Directive 2013/64/EU; and Commission Directive 2014/101/EU ("WFD"). The WFD was given legal effect in Ireland by the European Communities (Water Policy) Regulations 2003 (S.I. No. 722/2003);
- S.I. No: 122/2010: European Communities (Assessment and Management of Flood Risks) Regulations, resulting from EU Directive 2007/60/EC;
- S.I. No. 684/2007: Waste Water Discharge (Authorisation) Regulations, resulting from EU Directive 80/68/EEC on the protection of groundwater against pollution caused by certain dangerous substances (the Groundwater Directive);
- S.I. No. 9/2010: European Communities Environmental Objectives (Groundwater) Regulations 2010, as amended; and,
- S.I. No. 296/2009: European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009, as amended.

Planning Policy and Development Control

7.39 The Planning Policy and Development Control relating to water at the site in this EIAR is set out in the:

- Meath County Development Plan 2021-2027.

7.40 The county development plan sets out conservation objectives in relation to the hydrological and hydrogeological environment.

Guidelines and Technical Standards

7.41 This chapter of the EIAR is carried out in accordance with the guidance contained in the following:

- Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended by 2014/52/EU);
- Environmental Protection Agency (EPA) (May 2022): Guidelines on the Information to be Contained in Environmental Impact Assessment Reports;
- Institute of Geologists Ireland (IGI) (2013): Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements;
- National Roads Authority (NRA) (2008): Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;
- Inland Fisheries Ireland (IFI) (2016): Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters;
- PPG1 - General Guide to Prevention of Pollution (UK Guidance Note);
- PPG5 – Works or Maintenance in or Near Watercourses (UK Guidance Note);
- CIRIA (Construction Industry Research and Information Association) (2006): Guidance on 'Control of Water Pollution from Linear Construction Projects' (CIRIA Report No. C648, 2006);
- CIRIA 2006: Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors (CIRIA C532, 2006);
- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (DoHPLG, 2018);
- Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended by 2014/52/EU), (European Union, 2017);
- Department of the Environment, Heritage and Local Government; Quarries and Ancillary Activities – Guidance for Authorities (April, 2014);
- Environmental Protection Agency (EPA) (2006): Environmental Management in the Extractive Industry (Non-Scheduled Minerals); and,
- Environmental Protection Agency (EPA) (1999): Wastewater Treatment Manuals – Treatment Systems for Small Communities, Business, Leisure Centres and Hotels.

Significant Risks

7.42 The proposed development is a conventional quarry project providing for continued use of the previously permitted developments, a small lateral extension and the deepening of a quarry. The nature and extent of the works involved, when managed in accordance with best practice and subject to appropriate regulatory oversight, do not present any risk of a major accident or disaster which would give rise to uncontrolled emissions of dangerous substances to air, land or water which could, in turn, give rise to significant adverse impacts on the health of the local population or the surrounding natural environment. Sensitive water receptors have been identified, including St Gorman's spring and local private wells. The potential effects of the proposed development on St. Gorman's Spring are addressed in the Rathcore Quarry - Hydrogeological Investigation (2022) (**Appendix 7-A**), the results of which are summarised where relevant in this chapter. Please note the report is referred to as Hydrogeological Investigation Report (2022) throughout this chapter. The potential risk to local private wells are also assessed in this chapter.

7.43 Any potential risks, including significant risks, in relation to surface water and groundwater arising from the proposed continued use, small lateral extension and deepening which may impact on water quality in the area are identified and addressed by this EIAR Chapter.

RECEIVING ENVIRONMENT

Study Area

7.44 The potential for the proposed development to affect the water environment is limited within surface water catchment and groundwater bodies within which the site is located.

7.45 In terms of the hydrological environment (*i.e.* surface water), the water study area is limited within the Blackwater River catchment and the catchment of the River Boyne downstream of the site.

7.46 In terms of the hydrogeological environment (*i.e*. groundwater), the water study area comprises the application site the surrounding area up to 2km radius around the site boundary and is increased to 5km reflect the sensitivity of the subsurface, for example where karst systems are present. This is in line with the Institute of Geologists of Ireland's (IGI) guidelines (2013).

Baseline Study Methodology

7.47 A comprehensive geological, hydrological and hydrogeological dataset has been collected as part of this EIAR study.

Desk Study

7.48 A desk study of the site and the surrounding lands was completed in order to gather all relevant geological, hydrological, hydrogeological and meteorological data for the study area: This desk study included consultation with the following sources of information:

- Environmental Protection Agency Databases (www.epa.ie);
- Geological Survey of Ireland – Groundwater Databases (www.gsi.ie);
- Met Eireann Meteorological Databases (www.met.ie);
- National Parks & Wildlife Services Public Map Viewer (www.npws.ie);
- Water Framework Directive Map Viewer (www.catchments.ie);
- Teagasc/GSI soil and subsoil mapping (www.gsi.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 13. Geological Survey of Ireland (GSI, 1999 and 2001);
- 3rd Cycle Boyne Catchment Report (EPA, 2021);
- Meath County Development Plan 2021 – 2027;
- Geological Survey of Ireland - Groundwater Body Characterisation Reports; and,
- OPW Flood Mapping (www.floodinfo.ie).

Site Investigations

7.49 In addition to the above desk study of publicly available data, HES drew upon the Hydrogeological Investigation Report 2022, which is attached in **Appendix 7-A**. As stated previously, this report is comprehensive and presents data from a wide range of historic and recent site investigations. The site investigations referred to as part of the assessment are wide ranging and included information gathered over the past 160 years during which 30 geoscientists studied the subsurface of the local area for different purposes. The locations of the historic and recent site investigations at Rathcore Quarry are shown in Figure 7-2, while Figure 7-3 presents the site investigation locations of works completed at St. Gorman's Well and in the surrounding lands. The works referred to in the Hydrogeological Investigation Report include:

- Geological mapping of the area in the 1850s and observations at St Gorman's Well in 1855 and 1859;
- Field monitoring measurements of the flow and water temperature of St Gorman's Well between 1981 and 1983 by Stephen Peel of Minerex;
- 2 no. boreholes (BHs) drilled by the GSI and Minerex adjacent to St. Gorman's Well in 1983;
- 7 no. BHs drilled by Hydro-Research adjacent St. Gorman's Well in the mid-1980s;
- An exploration borehole drilling programme in the area by K. T. Cullen for a new water supply for Longwood village for Meath County Council;
- A PhD study completed by Frank Murphy which included deep drilling of Borehole SG 8 adjacent to St. Gorman's Well. This thesis was published in 1989;
- Bedrock Geology mapping by Chevron and published by the GSI in 1992;
- 4 no. deep mineral exploration boreholes and airborne geophysical surveys and mapping completed in the local area by BHP in the 1990s;
- Tracey Enterprises drilled 6 no. rotary coreholes at Rathcore quarry in 2001;
- Borehole logs and pumping test water level and temperature data for two production boreholes for the Longwood water supply in 2001 and 2011.
- Site investigation borehole logs, pumping test data, water level data from a detailed geology/hydrogeology investigation by Eugene Daly & Associates (EDA) in 2001-2002 and 2006 for a planning application (later withdrawn) by Roadstone for a new quarry on Ballinakill hill adjacent to the spring and boreholes at the St Gorman's Well site;
- Site visits and measurements by Ecoserve at St Gorman's Well in 2003;
- A site visit and measurements by Tobins and Robbie Meehan to St Gorman's Well and the adjacent borehole SG4 in 2009;
- A Site visit and measurements by Richard Langford for GSI to St Gorman's Well and the adjacent boreholes and drains in 2011;
- A PhD Study of the water levels, electrical conductivity and temperature in Borehole SG4 adjacent to St Gorman's Well by Sarah Blake between 2013 and 2015, and supplementary water level and temperature monitoring by Sarah Blake in 2018/19. Sarah's study also included a magneto-telluric ground geophysical survey to investigate deep structures;
- Numerous papers published in scientific journals by Sarah Blake and other authors on the temperature and water levels in Borehole SG4 and geophysics;

- More recently (2019-2022) David Ball completed inspections of the bedrock exposed in the quarry walls and floor at Rathcore with John Paul (JP) Moore, a structural geologist carrying out research in UCD under iCRAG;
- 52 no. exploratory BHs were drilled at Rathcore under the direction of David Ball and J. P. Moore to explore structural geology targets identified from a structural analysis of the features identified in the quarry by MK Drilling Ltd (2019);
- 3 no. wide diameter BHs were drilled on targets identified during the exploration drilling in Rathcore Quarry under the direction of David Ball by Patrick Briody and Sons (2019);
- Several long and shorter high rate pumping tests were carried out in 2020-2021 using these 3 no. wide diameter BHs to investigate the quantity of water that could be withdrawn from the karst conduit system under the quarry, and the potential effect that abstraction of water from the quarry may have on the local groundwater levels;
- Concurrent water level monitoring (before during and after the pumping tests) to determine the effects that abstraction of water from the quarry may have on local groundwater levels and resources;
- Tellus Airborne conductivity survey data from 48 flight lines flown 200 metres apart across the area, with measurements taken every six metres along the flight path, was specially re-processed by the GSI as a research project. The re-processed data were used to create 48 graphically consistent, cross sections down to roughly 30 metres below sea level. The data also was compiled from the sections into five depth slice maps down to 75metres below ground level. The sections and maps were correlated with the geology recorded in the logs of boreholes. There was a good correlation. The sections and maps were then used for a geology/structural geology/karst weathering interpretation of the subsurface that is currently hidden below the overburden; and,
- A down-the-hole video survey of boreholes SG4 and SG7 carried out by the GSI in 2021.

7.50 Furthermore, HES obtained all hydrological and hydrogeological monitoring data completed by Kilsaran in accordance with the existing discharge licence and permissions. The data obtained and included in the assessment is as follows:

- Surface water discharge volumes between January 2023- and August 2023;
- 42 no. discharge water quality laboratory results taken between January 2020 and August 2023 (note that no samples were obtained in April 2020 and September 2021); and,
- Groundwater level monitoring – Monthly monitoring of 4 no. on-site BHs since 2008 and monitoring of 14 no. private wells in the lands surrounding the quarry since 2006.

7.51 In addition, Kilsaran completed groundwater quality monitoring at 2 no. wells in March 2021 and surface water quality monitoring was completed on the Blackwater River on 2 no. occasions in November 2023.

Existing Discharge Licence

7.52 The existing operations at Rathcore Quarry are below the local groundwater table and require a surface water discharge. Water is discharged to a nearby drain which flows to the northwest before discharging into a small tributary of the Blackwater River.

7.53 An existing Discharge Licence is in place for the ongoing operations. The Licence reference is 13/02, and it was issued by Meath County Council on 27th June 2013. Meath County Council agreed to a variation of the discharge rate under Discharge Licence 13/02 in July 2020 in order to carry out the long pumping tests during the hydrogeological investigation. The permitted discharge rate was increased to 6 million litres per day (6,000 m^3/day).

7.54 The discharge licence requires that all effluent generated by the dewatering operations is directed through a treatment system comprising of a settlement pond, hydrocarbon interceptor and a reed bed. This treatment system is being operated and maintained in accordance with the discharge licence.

7.55 Several maximum limit values are outlined in the Discharge Licence with respect to effluent water quality and discharge volumes.

7.56 Monitoring of surface water flow volumes and discharge water quality is currently being undertaken by Kilsaran in accordance with the existing discharge licence. The results of the recent monitoring and compliance are discussed below in relation to discharge quality and flow volumes (Para 7.89 to 7.92).

Topography, Physical Features, and Land-use

7.57 Rathcore quarry is an excavation into the centre of Rathcore Hill, a small low hill in an otherwise gently undulating landscape. Elevated ground associated with Rathcore Hill extends to the east and northeast of the site, while to the west there is a low hill in the townland of Ballinakill. The natural topography ranges between c. 80m AOD (metres above Ordnance Datum) in the low lying ground to the west of the site to c. 115m AOD along the eastern boundary of the site and c. 120m AOD at the western edge of the site where the tree line is located. The existing quarry floor level is at c. 75m AOD.

7.58 The site drains to the west to the Blackwater River which is a tributary of the River Boyne.

7.59 Land use at the site comprises of the quarry area, with existing extraction and processing operations. The surrounding land is largely agricultural, used primarily for grazing and tillage. There is a scattering of domestic houses, farm houses and farm buildings along the local roads in the lands surrounding the site.

Rainfall and Climate

7.60 The nearest rainfall gauging station for which long term rainfall data is available is located at Ballivor, ~12km northwest of the site. The Long Term Average (LTA) annual rainfall recorded at Ballivor weather station is 897mm/yr for the period 1981-2010 (Met Eireann, 2021). The LTA monthly rainfall for the period 1981-2010 are shown in **Table 7-2** below.

Table 7-2:
Long Term Average Monthly Rainfall (mm) for Ballivor (Met Eireann, 2020)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
85	61	69	62	61	72	71	81	71	94	84	86

7.61 Met Eireann also provide a grid of average annual rainfall for the entire country for the period of 1991 to 2020. Based on these more site-specific modelled rainfall values, the average annual rainfall at the site is taken to be 867mm/yr (this is considered to be the most accurate estimate of average rainfall from the available sources).

7.62 The closest synoptic station where average potential evapotranspiration (PE) is recorded is at Casement Aerodrome, located ~31km southeast of the site. The long-term average PE for this station is 510mm/yr. This value is used as a best estimate of the PE at the site. Actual Evapotranspiration (AE) is estimated as 484.5mm/yr (0.95 x PE).

7.63 The effective rainfall represents the water available for runoff and groundwater recharge and is calculated as:

$$\text{Effective Rainfall} = \text{LTA} - \text{AE}$$

$$= 867 - 484.5$$

$$= 382.5\text{mm/year}$$

7.64 Based on recharge coefficient estimates from the GSI, groundwater recharge at the site ranges from 60% to 85%. An estimate of 85% recharge is taken for the overall site as much of the soil and subsoil has already been removed from the site due to previous extraction activities and bedrock is now exposed at the surface across much of the site. Therefore, annual recharge and runoff rates at the site are estimated to be 325mm/yr and 57.5mm/yr respectively.

7.65 Climate change projections for Ireland are provided by Regional Climate Models (RCM's) downscaled from larger Global Climate Models (GCM's). Projections for the period 2041-2060 (mid-century) are available from Met Eireann (www.met.ie). The data indicates a projected decrease in summer rainfall from 0 to 13% under the medium-low emission range scenario and an increase in the frequency of heavy precipitation events of ~20%. In total the projected annual reduction in rainfall near the site is modelled as ~8% under the medium-low emission scenario and ~6% under the high emissions scenario. As stated above the local average long term rainfall data for the site is estimated to be 867mm/yr. Under the medium-low emissions scenario this may reduce to ~798mm/yr, while under the high emissions scenario this figure may reduce to 815mm/yr.

Soils and Geology

7.66 Soils and geology are discussed in detail in Chapter 6 of this EIAR.

Soils and Subsoils

7.67 The Teagasc soils map for the local area, available at www.gsi.ie, shows that the site is predominantly underlain by basic shallow well drained mineral soils (BminSW). These soils are classified in the Rendzina and Lithosols soil group. Areas in the south and east of the site are mapped as basic deep well drained mineral soils (BminDW) which are classified as grey, brown Podzolics.

7.68 Other soils in the lands surrounding the site include basic mineral poorly drained soils (BminPD) and lacustrine type soils. The closest mapped lacustrine soils are ~200m to the northwest and ~700m to the southwest of the site. Mineral alluvium is also mapped along many of the local watercourses in the surrounding lands, with the closest alluvium deposits mapped ~550m to the southeast.

7.69 The GSI map subsoils at the site as comprising of till derived from limestones (TLs) and areas of bedrock outcrop or subcrop (Rck) (www.gsi.ie).

7.70 Other subsoils in the lands surrounding the site include gravels derived from limestones (GLs), lacustrine sediments and alluvium deposits.

7.71 The soils and subsoils in the existing quarry area have already been removed. The soils and subsoils in the proposed lateral quarry extension area (c. 0.9ha) will be removed as part of the proposed development.

Bedrock Geology

7.72 The GSI online map viewer (www.gsi.ie) shows that the northwest of the site is mapped as being underlain by Waulsortian Limestones. These comprise of massive, bedded, pale grey, fossiliferous fine grained limestones which are composed of fine lime muds. Meanwhile, the southeast of the site is mapped as being underlain by the Lucan Formation which comprises of dark limestone and shale.

7.73 Site investigations detailed in the Hydrogeological Investigation Report 2022 show that the local geology at Rathcore and in the surrounding lands is a lot more complex than is indicated on the GSI bedrock geology map (1:100,000). This is discussed in more detail in subsequent sections (7.125 to 7.133) of this EIAR chapter and in Chapter 6 (Land Soils and Geology).

Surface Water – Hydrology

7.74 The site is located in the Boyne regional surface water catchment and within Hydrometric Area 7 of the Eastern River Basin District. The Boyne catchment has a total area of 2,694km^2 (EPA, 2021) and includes all areas drained by the River Boyne and all streams entering the tidal water between The Haven and Mornington Point, Co. Meath. This is the Water Framework Directive (WFD) Water Management Unit Catchment and is the highest-level catchment unit in Ireland. A regional and local hydrology map is included as Figure 7-4.

7.75 More locally, the site is mapped in the Boyne_SC_020 WFD sub-catchment and 3 no. WFD river sub-basin. The site drains to the Blackwater River which in turn discharges into the River Boyne ~7.5km to the northwest.

- The south of the site is located in the Blackwater (Longwood)_030 WFD river sub-basin. Within this area, the Blackwater River flows to the northwest ~2.5km southwest of the site.
- The centre and west of the site are located in the Blackwater (Longwood)_050 WFD river sub-basin. The closest mapped watercourse to the site is a small 1st order stream, located ~950m to the northwest. This stream flows to the northwest before discharging into a 2nd order stream. This stream flows to the west and discharges into the Blackwater River ~3.4km northwest of the site. These streams are locally unnamed but have been assigned names by the EPA. The small 1st order stream is referred to as the Clonguiffin stream while the 2nd order stream is referred to as Connellstown stream.
- The east of the site is located in the Rathcore Stream_010 WFD river sub-basin. The closest watercourse to the site is a 2nd order stream, referred to by the EPA as the Jordanstown Stream. This stream is mapped ~1.25km northeast of the site. This stream flows to the northeast and discharges into the Rathcore Stream ~750m northwest of Rathcore village. The Rathcore Stream flows to the northwest and discharges into the Blackwater River ~4.2km northwest of the site.

7.76 Site walkover surveys and drainage mapping have revealed that there are no surface water features at the site of the existing quarry. The closest surface watercourse is ~150m to the west of the site. This is an open ditch which drains to the northwest and discharges into the Clonguiffin stream (EPA Name) The existing surface water discharge from the site is to this open drainage channel. The existing outfall location and associated drain is included in Figure 7-4.

Surface Water Flow

Regional and Local Flow Volumes

7.77 There is an OPW hydrometric gauge and recorder on the River Blackwater at Castlerickard Bridge (Station. No: 07003), downstream of the site (refer to Figure 7-4).

7.78 The recording station at Castlerickard has been operational since August 1953 and data is available for the period August 1953 to December 2010. The catchment at the gauging station is 190km^2. Based on the recorded flow data the Blackwater at Castlerickard station has a 50%ile flow of 1.64m^3/s and a 95%ile flow of 0.43m^3/s. Dry weather flow is estimated to be 0.247m^3/s.

7.79 The EPA's hydrotool, available on www.catchments.ie, was consulted in order to estimate the baseline flow volumes in the local area. The Hydrotool dataset contains estimated of naturalise river flow duration percentiles. Several nodes were consulted downstream of the site and downstream of the existing surface water outfall from the site.

7.80 A 95%ile flow relates to the flow which will be exceeded within the river 95% of the time. **Chart 7-1** below presents a flow duration curve for several of the Hydrotool nodes downstream of the site as follows:

- Node 07_948, located on the Connellstown stream;
- Node 07_231 located on the Blackwater River upstream of the Connellstown stream;
- Node 07_949 located on the Blackwater River downstream of the Connellstown stream and upstream of the Rathcore stream;
- Node 07_956 located on the Blackwater River upstream of its confluence with the Boyne;
- Node 07_257 located on the Boyne downstream of its confluence with the Blackwater River;
- Node 07_385 located on the Rathcore stream; and,
- Node 07_245 located on the Boyne at Trim.

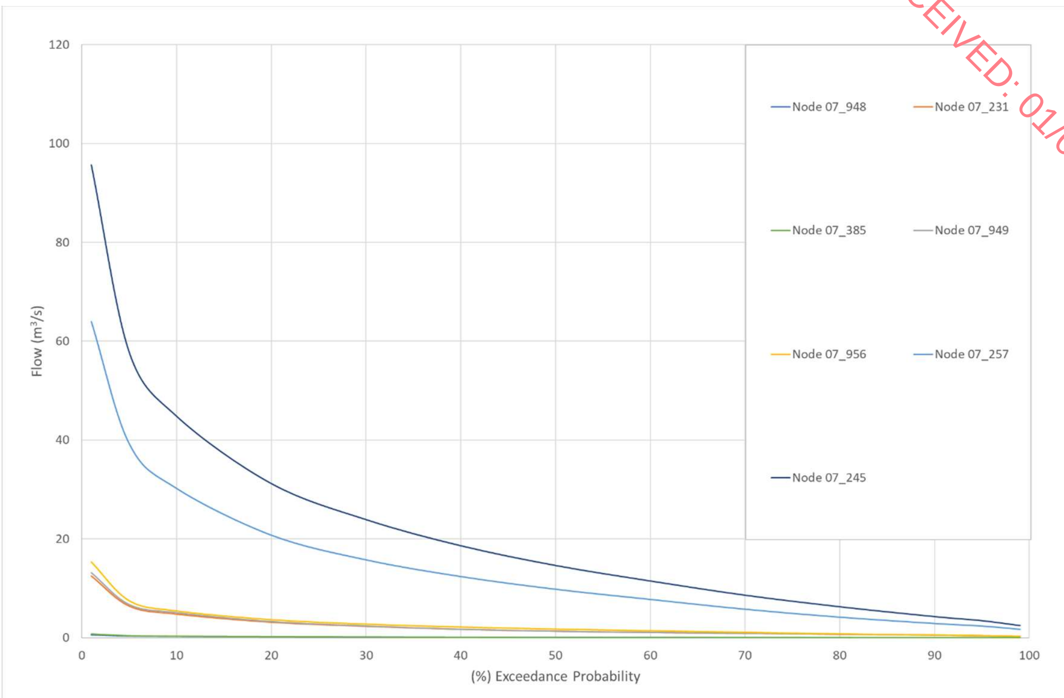
7.81 EPA Hydrotool Node 07_948 is the closest node to the site and is located on the Connellstown stream downgradient of the existing outfall. The 50%ile flow in this watercourse is estimated to be 0.083m^3/s (7,171m^3/day) while the 95%ile flow is estimated to be 0.015m^3/s (1,296m^3/day). The modelled flow data for this node is presented in **Table 7-3** below.

7.82 Due to the increasing catchment site, the estimated flow volumes at the nodes along the Blackwater River and along the Boyne River downstream of the site are larger. For example at Node 07_956 on the Blackwater River the 95%ile flow is estimated to be 0.43m^3/s (37,152m^3/day). Further downstream, at Node 07_257 on the Boyne River the 95%ile flow is estimated to be 2.406m^3/s (207,878m^3/day). The progressively increasing flow volumes are associated with the increased upstream catchment areas of the respective watercourses, with the flow volumes in the Boyne River representing a large regional watercourse.

Table 7-3:
Estimated Flow Duration Percentiles for the Tributary of the River Blackwater

Flows equalled or exceeded for the given percentage of time (m^3/sec)										
5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	95%
0.35	0.273	0.187	0.143	0.109	0.083	0.062	0.045	0.031	0.019	0.015

Chart 7-1
EPA Hydrotool Node: Flow Duration Curves



Discharge Licence – Flow Volume Monitoring

7.83 Rathcore Quarry discharges to a small open drainage channel to the northwest of the site which in turn discharges into a small 1st order stream, referred to by the EPA as the Clonguiffin stream. Further downstream this watercourse discharges into the Connellstown Stream (2nd order stream) which is a tributary of the Blackwater River.

7.84 Condition 2.2 (Ref. No. 13/02) of the existing discharge licence states that: "The total volume of effluent to be discharged shall not exceed 30m^3/hr and a maximum volume of 724m^3/day."

7.85 The surface water discharge is currently automated based on a float level on the groundwater sump in the floor of the quarry. The discharge volume from the site is via a v-notch weir and the flow is recorded on a 15 minute basis; continuous monitoring has been undertaken at the site and recorded since March 2014.

7.86 Summary details of the discharge from January 2023 to present are shown in **Table 7-4** below. The daily discharge volumes generally exceed the existing discharge licence limit. A discharge licence review application will be completed for the proposed development to cater for the increased discharge volumes.

Table 7-4
Summary of Daily Discharge Results by Month (Jan 2023 to Present)

Monitoring Period	Average Daily Discharge (m^3/day)
Jan-23	2005.4
Feb-23	1121.2
Mar-23	1224.9
Apr-23	1375.9

May-23	909.7
Jun-23	503.2
Jul-23	742.4
Aug-23	892.0

Surface Water Quality

EPA Biological Q-Rating Monitoring

7.87 Biological Q-rating data for EPA monitoring points are available on the Blackwater and Boyne rivers in the vicinity and downstream of the site and are presented in **Table 7-5** below. The Q-rating is a water quality rating system based on both the habitat and the invertebrate community assessment and is divided into status categories ranging from Q1 (Bad) to Q4-5 (High). No Q-rating data is available for the tributaries of the Blackwater River which are located downstream of the site.

7.88 Q-rating data from 2020 is available on the Blackwater River upstream of its confluence with the small tributary into which the quarry discharges (i.e. Connellstown stream). At a bridge southeast of Longwood (EPA Station Code: RS07B020300) the Blackwater River achieved a Q-rating of Q3-4 i.e. moderate status. Upstream of its confluence with the Boyne River (EPA Station Code: RS07B020600), the Blackwater also achieved a Q3-4 rating in 2020. Meanwhile, the Boyne River achieved a Q4 rating i.e. Good status at Scariff bridge (EPA Station Code: RS07B040900). The locations of these EPA monitoring stations are shown in Figure 7-5.

Table 7-5
Latest EPA Water Quality Monitoring Q-Values (2020)

Watercourse	Station ID	Easting	Northing	Q-Rating
Blackwater	RS07B020300	272156	245230	Q3-4
Blackwater	RS07B020600	271290	250085	Q3-4
Boyne	RS07B040900	273392	252679	Q4

Discharge Licence – Water Quality Monitoring

7.89 Kilsaran have been conducting monitoring of emissions to water from the quarry from 2013 to the present as set out in the discharge licence (DL) for Rathcore (Ref. No. 13/02).

7.90 As previously noted, the consented discharge water from the site is treated through a settlement lagoon, a hydrocarbon interceptor and reed bed system to treat for nitrate and BOD before it is discharged to the receiving waters. As the quarry develops and should the need arise, a second settlement pond will be installed adjacent to the existing pond. A larger pump sump will also be provided on the floor of the quarry to cater for increasing volumes of water which will require attenuation and treatment as the quarry deepening progresses.

7.91 A total of 42 no. grab samples have been taken and sent to an accredited laboratory for analysis between January 2020 and August 2023. The laboratory results and existing emission limits are summarised in **Table 7-6** below. 7 no. exceedances of the emission limits have been recorded during this time period with 4 no. exceedances being recorded for BOD. In addition, 1 no. exceedance has been recorded for suspended solids, ortho-phosphate and ammonia.

7.92 In general, the discharge has largely been compliant in terms of effluent water quality. The laboratory results for these 42 no. grab samples are attached as **Appendix 7-C**.

Table 7-6
Kilsaran Water Quality Monitoring (Jan 2020 – August 2023)

Parameter	DL Limit	No. Samples	Range	Exceedances	% Compliant
BOD_5 (mg/l)	2.5	42	<0.1 – 3	4	91%
COD (mg/l)	50	42	<5 - <50	0	100%
Suspended Solids (mg/l)	20	42	<2 – 23	1	98%
pH (mg/l)	6.0 – 9.0	42	7.41 – 7.98	0	100%
Ortho-phosphate (mg/l)	0.065	42	<0.0014 - 0.29	1	98%
Nitrates (as N)	12	42	1.2 – 11	0	100%
Ammonium (as N)	0.1	42	<0.01 – 0.68	1	98%
TPH (µg/l)	50	42	<0.01 - <10	0	100%
BTEX Compounds (µg/l)	10	42	0 - <1	0	100%

Recent Kilsaran Sampling

7.93 Kilsaran completed 2 no. rounds of sampling on the River Blackwater in the vicinity of the site on the 20th and 21st November 2023. The location of sampling corresponds to the EPA Monitoring Station: RS07B020300 shown on Figure 7-5. The results of the laboratory analysis are shown alongside relevant water quality regulations in **Table 7-7** below.

7.94 Suspended solids concentrations ranged from <2 to 9mg/l and were below the S.I. 293 (of 1988) threshold of 25mg/l in both samples. BOD concentrations ranged from 1.4 to 1.5mg/l and were found to be of Good to High status with respect to the thresholds detailed in S.I. 272 of 2009. Ammonia concentrations were below the High status threshold of ≤0.04mg/l in both samples. The full results are included as **Appendix 7-D**.

Table 7-7
Kilsaran Water Quality Monitoring on River Blackwater (November 2023)

Sampling Date	Suspended Solids (mg/l)	BOD (mg/l)	Nitrite (mg/l as N)	Nitrate (mg/l NO_3)	Ammonia (mg/l)	Total Phosphorus (mg/l)
EQS	≤25[1]	≤ 1.3 to ≤ 1.5[2]		-	-≤0.065 to ≤ 0.04[2]	
20/11/2023	9	1.4	0.017	2.47	0.04	0.12
21/11/2023	<2	1.5	0.015	3.27	0.03	0.2

[1] *S.I. No. 293 of 1988: European Communities (Quality of Salmonid Waters) Regulations*

[2] S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended by S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy).

Water Framework Directive

7.95 Local Surface Water Body (SWB) Water Framework Directive (WFD) information is available for review at www.catchments.ie and further details are provided in the 3rd Cycle Boyne Catchment Report (EPA, 2021). Summary WFD information for the SWBs draining the proposed development site is presented in **Table 7-8** below.

7.96 The SWBs in the vicinity and downstream of the site, including the Blackwater River, generally achieved 'Moderate' status in the latest WFD cycle (2016-2021). Meanwhile, the Rathcore Stream_010 SWB, which receives no discharge from the quarry, to the north of the site achieved 'Poor' status. Further downstream, the Boyne_060 SWB is of 'Good' status.

7.97 In terms of risk status, all sections of the Blackwater River in the vicinity and downstream of the site have been deemed to be 'at risk' of failing to meet their respective WFD objectives. The risk status of the Rathcore Stream_010 SWB is currently under review. Meanwhile, the Boyne_060 SWB has been deemed to be 'not at risk'.

7.98 The 3rd Cycle Boyne Catchment Report (EPA, 2021) states that excess nutrients remain the most prevalent issue in the Boyne Catchment. Agriculture is listed as a significant pressure on several SWBs in the vicinity and downstream of the site. In addition, hydromorphology is listed as a pressure in the Blackwater (Longwood)_050 and Boyne_060 SWBs. An unknown anthropogenic pressure is impacting the Blackwater (Longwood)_040 SWB. Peat drainage and peat extraction is also identified as a pressure on this SWB. This pressure has resulted in increased sediment loads in rivers and fluctuations in ammonia concentrations. However, Bord na Móna ceased commercial peat extraction in summer 2020 on all of its bogs within the Boyne catchment.

7.99 The Boyne River downstream of the site is a salmonid protected river under the WFD. However, the Blackwater River and its tributaries are not listed as salmonid protected waters.

7.100 A full WFD Compliance Assessment report for the proposed development is included as **Appendix 7-E**.

Table 7-8
Summary WFD Information for Surface Water Bodies

River Waterbody	Status 2010-2015	Status 2013-2018	Status 2016-2021	3rd Cycle Risk Status	Pressures
Blackwater (Longwood)_030	Unassigned	Moderate	Moderate	At risk	Agriculture
Blackwater (Longwood)_040	Moderate	Moderate	Moderate	At risk	Peat & Other
Blackwater (Longwood)_050	Moderate	Moderate	Moderate	At risk	Agriculture & Hydromorphology
Rathcore Stream_010	Unassigned	Moderate	Poor	Under Review	None
Boyne_060	Moderate	Good	Good	Not at risk	Agriculture & Hydromorphology

Flooding

7.101 To identify those areas as being at risk of flooding, the OPW's Past Flood Events Maps, the National Indicative Fluvial Mapping, CFRAM River Flood Extents, historical mapping (i.e. 6" and 25" base maps) and the GSI Groundwater Flood Maps were consulted. These flood maps are available to view at www.floodinfo.ie.

7.102 Identifiable text on local available historical 6" or 25" mapping does not identify any land which are liable to flood in the vicinity of the site.

7.103 The OPW Past Flood Events Maps have no records of recurring or historic flood instances within the site. The closest mapped recurring flood event (Flood ID: 1204) is located ~820m northeast of the site. In relation to this flood event the local area engineers report states that inadequate surface water drainage causes a road to flood. There are no other mapped flood events in close proximity to the site.

7.104 The GSI Winter 2015/2016 Surface Water Flood Map shows surface water flood extents for this winter flood event. This flood event is recognised as being the largest flood event on record in many areas. This flood map does not show any historic flood zones within the site. A small areas of flooding is recorded ~2.5km east of the site.

7.105 No CFRAM mapping has been completed for the area of the site. The closest mapped CFRAM fluvial flood zones are located along the Blackwater River, ~3.5km to the southeast.

7.106 The National Indicative Fluvial Flood Map for the Present Day Scenario does not record any flood zones in the area of the site. The closest mapped flood zones are located ~2.3km northwest of the site along the tributary of the Blackwater River (Connellstown stream) and ~1.2km north of the site along the Rathcore stream. The modelled flood zones for the Mid-Range and High-End future scenarios associated with climate change do not differ significantly from the Present Day Scenario.

7.107 Furthermore, there are no historic or modelled groundwater flood zones in the site or in the surrounding lands.

7.108 The site is considered to be at low risk of flooding.

Receiving Water Channel Capacity

7.109 There is an existing discharge of treated surface water and groundwater from the site. The discharge licence (Ref. No. 13/02) was issued in May 2013 and allows for a discharge volume of 724m^3/day. Meath County Council agreed to a variation of the discharge rate under Discharge Licence 13/02 in July 2020 in order to carry out the long pumping tests during the hydrogeological investigation. The permitted discharge rate was increased to 6,000 m^3/day. The maximum discharge from the quarry during the winter pumping test in March 2021 was 3,700 m^3/day. There were no reports or observations of flooding in the Clonguiffin Stream during this period of high discharge from the quarry.

7.110 The discharge associated with the proposed development will continue at the existing outfall location.

7.111 The River Blackwater, the locally unnamed tributary (Connellstown and Clonguiffin streams) and the existing field drain have all been excavated out in the past (deepened and straightened) for arterial drainage purposes; none of the channels are existing natural channels.

7.112 The existing field drain and the Clonguiffin stream channel have been surveyed to determine the maximum (bank full) channel capacity. The channel cross section survey locations and the channel bank full calculations are shown in **Appendix 7-F**. The channel bank full discharges (*i.e.* maximum in channel flow volumes) are summarised in **Table 7-9** below.

Table 7-9
Channel Bank Full Discharge Capacity

Channel Cross Section	Location	Channel Capacity (Bank Full Discharge)	
		m^3/s	m^3/d
CS03	Existing field drain	9.5	820,926
CS04	Existing field drain	4.8	421,148
CS05	Existing field drain	4.7	413,562
CS06	Existing field drain	3.0	263,292
CS07	Existing field drain	2.3	205,050
CS08	Existing field drain	1.1	99,466
CS09	Unnamed tributary	2.6	224,469

7.113 The channel cross section surveys indicate that the channel bank capacity is decreasing in the downstream direction, CS01 to CS08, until CS09 which is on the tributary (*i.e.* Clonguiffin stream), where there is an increase in the channel bank full capacity.

7.114 In a natural channel there would be an expected increase in channel bank full capacity in the downstream direction, however the excavation (deepening and straightening) of the channel for arterial drainage has modified the channel and it is now considered to be an artificial channel.

7.115 From the channel bank full discharges shown above in **Table 7-9**, there is sufficient capacity in the receiving field drain and unnamed tributary to accommodate the maximum discharge from the quarry.

7.116 An assessment of the assimilative capacity of the River Blackwater was carried out in November 2023 and is presented in **Appendix 7-G**. The assimilative capacity was completed for a maximum discharge of 6,000m^3/day and found that under the 95%ile flow conditions, there is no assimilative capacity for BOD (due to elevated background concentrations in the River Blackwater) while there was found to be sufficient available capacity for the other parameters.

Groundwater – Hydrogeology

Desk Study Hydrogeological Data

7.117 According to the GSI bedrock mapping in 1999 (www.gsi.ie) the northwest of the site is mapped as being underlain by Dinantian Pure Unbedded Limestones, associated with the mapped extent of the Waulsortian Limestones. Meanwhile, the southeast of the site is mapped as being underlain by Dinantian Upper Limestones, associated with the Lucan Formation.

7.118 Currently, the bedrock aquifer in the northwestern part of the site is classified as being a Locally Important Aquifer which is moderately productive in local zones (Ll). Meanwhile, the southeastern part of the site is underlain by a Locally Important Aquifer which is moderately productive (Lm) (www.gsi.ie).

7.119 However, as described in Chapter 6 and in paragraphs 7.125 to 7.133, the bedrock geology at the site is more complex than is indicated on the 1999 GSI mapping. Based on site-specific, latest geology and hydrogeological information, the Hydrogeological Investigation Report 2022 suggests that the bedrock aquifer underlying the site should be reclassified as a Regionally Important Karst Aquifer (conduit).

Longwood Groundwater Body

7.120 The bedrock aquifer underlying the northwestern part of the site is part of the larger Longwood Groundwater Body (GWB) described by the GSI in 2003, based on information from the 1980s and 1990s, as follows:

7.120.1 This GWB is located in southwest Co. Meath around the village of Longwood. The area is low-lying with elevations ranging from 70 to 100mOD. The GWB is composed primarily of low permeability rocks, although localised zones of enhanced permeability do occur. The area of Waulsortian around Longwood defines the extent of the GWB. Recharge occurs diffusely through the subsoils and via outcrops. It takes place mainly in the upland areas where subsoils are thinner or more permeable. The aquifers within the GWB are generally unconfined, but may become locally confined where the subsoil is thicker and/or lower permeability.

7.120.2 Most flow in this aquifer will occur near the surface. In general, the majority of groundwater flow will occur in the upper 10m, comprising a weathered zone of a few metres and a connected fractured zone below this. However, deepwater strikes in more isolated faults/ fractures can be encountered at 50-70 mbgl. Flow path lengths are relatively short, and in general are between 30 and 300m. The regional groundwater flow direction is to the northwest although on a local scale groundwater will follow the local hydraulic gradient towards rivers in the area.

7.120.3 Although very little water-well information is available for this area, drilling information from mining companies suggests that the limestones at Longwood are weathered and karstified (Cullen 1985). Drilling at Rathcore suggests the Waulsortian is less permeable, and a number of wells drilled there recorded very low yields and dry wells in some instances, with clay filled fissures (Cullen 1992). There is very limited evidence of dolomitisation and karstification within the Waulsortian of Co. Meath, other than the warm springs. Two warm springs in particular are located in the south near Longwood: St Gorman's Spring and Ardanew Spring.

7.120.4 As part of the Geothermal Project (Minerex 1983) two boreholes were drilled adjacent to St. Gorman's Spring to a depth of 13m. The first borehole, 2m from the spring encountered very broken Waulsortian limestone and a cavity, which was connected to the spring. The second borehole, 12m from the spring, also encountered fractured limestone. Both boreholes responded rapidly to the abstraction of water from the spring and to fluctuations in the pumping rate (1,300-1,800m^3/d). The temperature ranged from 20.9-21.3°C and the conductivity from 570-585 µS/cm. The well records indicate seven "good" wells (100-400m^3/d), all located around the Longwood and Summerhill areas. Specific capacities range from 5-140 m^3/d/m and transmissivities from 30 to 40 m^2/d (Woods 1998).

7.121 Please note that the understanding of the hydrogeology of the Longwood GWB has advanced significantly by the contemporary data and studies referenced in the Hydrogeological Investigation Report 2022 (**Appendix 7-A**).

Trim Groundwater Body

7.122 The bedrock aquifer underlying the southeastern part of the Rathcore quarry site is part of the Trim Groundwater Body. Both point and diffuse recharge occur over the area of this GWB. Point recharge is known to occur at the contact between the non-calcareous rocks and the limestones. This form of recharge is most likely to occur over the more clean and fractured limestones. Diffuse recharge is a more widespread process occurring over the entire area of the GWB. This will be the main recharge process in the large lowland areas of this GWB. Groundwater flow will be from local areas of high recharge, e.g. areas of thin subsoils in the uplands, to the main surface water bodies overlying the aquifer, such as the Boyne. Where overlying quaternary deposits consist of thick limestone tills, they can act as a confining layer, thus producing artesian supplies. This occurs, for example at Kilmoon, Dunshaughlin and Longwood public water supplies in County Meath.

7.123 Discharge from the aquifer is also varied. Water will leave the aquifer in a diffuse nature as baseflow along riverbeds and also as point source at springs. The development of a karstic groundwater system has a key influence on the transportation of pollutants to receptors. Groundwater flow will be faster and more concentrated along karstic conduits.

7.124 Again, please note that the understanding of the hydrogeology and boundary location of the Trim GWB has advanced significantly by the contemporary data and studies referenced in the Hydrogeological Investigation Report 2022 (**Appendix 7-A**). The Trim GWB is comprised largely of Calp Limestones and the recent geological investigations show that the boundary of the Lucan formation, which comprises of Calp limestones, and defines the western edge of the Trim GWB is no longer underlying the Rathcore site. Therefore, the site is not within and probably not significantly contributing to the Trim GWB.

Hydrogeological Investigation Report: Summary of Site Geological Data

7.125 Volume 1 Chapter 2 of the Hydrogeological Investigation Report 2022 provides a comprehensive and detailed study of overburden and bedrock Geology at Rathcore Quarry and the surrounding area. This detailed hydrogeological study is attached in full in **Appendix 7-A** and the key findings of this assessment are summarised below.

7.126 According to the GSI's bedrock geology map for the local area in 1999, the site is underlain by the Waulsortian limestones in the northwest and the Lucan Formation to the southeast. However, the Hydrogeological Investigation Report 2022 describes how the eastward excavation of the quarry has crossed the line, drawn on the GSI map, dividing the Waulsortian and the Lucan formations, and that it is evident that the quarry site is not underlain in the east by the Lucan formation. The recent airborne geophysical data from the GSI's Tellus project shows that the Lucan formation lies to the east of the quarry site outside the area of the proposed excavation.

7.127 Since 1999, there have been numerous site investigations at Rathcore and in the surrounding lands. Intensive site investigations have been completed due to the complexity of the bedrock geology and the presence of a seasonal spring, referred to as St. Gorman's Well. Many of these site investigations postdate the publication of the GSI's bedrock geology map and the results from these site investigations show that the geology and structural geology of the area is much more complex than that presented on the GSI's map.

7.128 The geological data obtained across multiple phases of geological investigations both at Rathcore and in the wider area has been collated, assessed and interpreted in the Hydrogeology Investigation Report 2022. These site investigations include historical site investigations dating as far back as the 1980s and the recent site investigations at Rathcore. These investigations comprised the drilling of bedrock boreholes, site walkover surveys, geophysical investigations and detailed logging and investigation of the exposures at Rathcore Quarry.

7.129 The current understanding of the geology of the local area has been updated based on data obtained from these investigations. The Hydrogeological Investigation Report 2022 states that the bedrock geology of the local area is "*divided into irregular blocks. The geophysics and the drilling data all show that the GSI's depiction of the Waulsortian bedrock geology is an understandable simplification. Instead the bedrock consists of upward, downward and sideways juxtaposed blocks of different limestones separated by Carboniferous and Cenozoic age faults*."

7.130 The findings of the Hydrogeological Investigation Report 2022 with respect to regional geology are summarised below and are presented in full in **Appendix 7-A**:

- The regional geology contains areas underlain by fault-bounded blocks of massive Waulsortian Limestone, heavily weathered Waulsortian Limestone, the Lucan Formation (dark limestones and shales) and weathered versions of the Lucan Formation.

- The updated bedrock geology map (Figures 2.47 and 2.50 in **Appendix 7-A**) shows that the large block of Waulsortian limestone in the GSI's 1999 map is divided by numerous faults, of different ages, into smaller blocks, and with a block of Lucan formation in the middle to the northwest of the quarry. The report has named a large block of Waulsortian north of this Lucan block as the Cullentry block. Rathcore Quarry lies towards the southern tip of a narrow northeast to southwest oriented fault-bounded block of Waulsortian Limestone named the Rathcore block. The Rathcore block is separated, by the block of the Lucan formation to the west, from two smaller blocks of Waulsortian limestone named the Ballinakill block and the Clonguiffin block. The important boreholes and spring at the St Gorman's site are on the western edge of the Ballinakill block.
- These four blocks of massive limestones are separated by fault-bounded blocks of heavily weathered limestones which are visible as topographic lows in today's landscape.
- A Carboniferous age northwest to southeast orientated fault lies to the south of these blocks, with the Lucan Formation located to the south of the fault.

7.131 The findings of the Hydrogeological Investigation Report 2022 with respect to more local geology within Rathcore Quarry are summarised below:

- Extensive gravel deposits are present in the Rathcore area, and those are much more extensive than indicated on the Teagasc / GSI soil map. We note that Rathcore Quarry was initially a sand and gravel pit on the side of Rathcore Hill.
- The quarry faces in Rathcore are composed of karstified Waulsortian Limestone.
- Significant zones of dolomitised limestone have been recorded in the Rathcore Quarry and in the numerous boreholes drilled in 2019.
- Karst solution weathering is ubiquitous but also heterogenous in the Waulsortian Limestone.
- Drilling and pumping tests at the quarry revealed the presence of an open underground karst conduit system. The conduits are not present everywhere. In some areas they are well connected but in other areas they appear to be poorly connected.
- The rock between these conduits is solid and will not store or transmit groundwater.
- Karst depressions seen in the quarry walls and conduits encountered during drilling have been either partially or wholly clogged with yellow clay and other solution weathering debris. Some of the conduits allow little water flow, whilst others have greater water flows.
- The structural geology interpretation of the quarry revealed that there are two main fault/fracture orientations. There are normal fault structural features dating from the Carboniferous period, associated with the Variscan orogeny, that have a general east-west orientation, whilst much more recent and hydrogeologically more important Cenozoic strike slip fault structures have a northwest to southeast or northeast to southwest alignment.
- Correlation of the drilling logs with new geophysical conductivity sections, provided by the GSI from the Tellus airborne survey data, have revealed an excellent correlation, and have shown that the Waulsortian Limestone is karstified both at Rathcore and in the wider area.
- Research in the past decade in Ireland by J.P. Moore and the UCD Fault Analysis Group has shown that the older Carboniferous faults are likely to be closed by compression. Whereas the younger Cenozoic faults have been found to be more likely to be open. Therefore, the younger faults are likely to provide the potential for development of shallow and deep conduits, while the older Carboniferous faults have been squeezed closed and are less likely to be karstified or solutionally enlarged, except where they are intersected by the younger Cenozoic faults. Most

of the karst conduits were encountered in the north of the quarry, with the rock in the south noted to be less karstified, with tightly closed faults.

7.132 With respect to hydrogeology, the fabric of the solid Waulsortian Limestones does not contain open pore spaces which can store and transmit groundwater. Instead, water in this karst system flows through cracks, faults and fissures which form breaks in the limestone rock. Therefore, whilst the rock itself may not be considered an aquifer, the occurrence of an anisotropic network of solutionally enlarged conduits and passageways in the rock allows for the movement of significant volumes of water. Therefore, in this area it is the characteristics of the passageways which control the movement of water. The size, shape and interconnection of the passageways as well as the amount of clay within them, determines the ease with which groundwater can flow through the rock mass.

7.133 Based on these findings, the Hydrogeological Investigation Report 2022 states that, on the basis of the recent information, it is likely that the "*Waulsortian Limestone in this area will be reclassified as, at least, a Locally Important Karstified bedrock aquifer, if not a Regionally Important Karstified bedrock aquifer*."

Groundwater Vulnerability

7.134 Groundwater Vulnerability is a term used to represent the natural ground characteristics that determine the ease with which groundwater may be contaminated by human activities (www.gsi.ie). More scientifically, groundwater vulnerability embodies the characteristics of the intrinsic geological and hydrogeological features at a site that determine the ease of contamination of groundwater.

7.135 According to the GSI online groundwater vulnerability maps (www.gsi.ie) the quarry site and proposed extraction area is located in an area of Extreme-X to High groundwater vulnerability status with rock and karst at the ground surface. The more recent geological investigations around Rathcore provide further understanding of groundwater vulnerability in the area. For example, in the lower lying areas around the site the groundwater vulnerability is classified as High and Moderate. However, the overburden in the lower lying areas appears to be composed of a shallow sand and gravel aquifer separated from the groundwater in the underlying bedrock by a layer of boulder clay and yellow clay. Whilst the shallow aquifer vulnerability may be high or moderate, the vulnerability of the bedrock groundwater system below the clay is probably low.

Groundwater Recharge Mechanisms

7.136 Superficial deposits are noted at thicknesses ranging 0.8m to 18m onsite. Where the limestone is exposed within the excavated area of the quarry, it is assumed that any incidental rainfall directly infiltrates into the aquifer system. The limestones strata outcrops to the north and north east of site where there are areas of higher elevation.

7.137 The average annual precipitation for the area is 867mm. Adjusted to include average annual evapotranspiration rates for the area, the effective rainfall for the area is ~383mm. Recharge at the quarry will be much higher than this however as the vegetation and soils have been stripped from the quarry void.

Karst Features

7.138 Karst features are mapped by the GSI and available through the GSI online viewer (www.gsi.ie). A map of known karst features is included as Figure 7-6. Karst features within 5km of the site have been identified as follows:

- The closest mapped karst feature to the site is St. Gorman's well located ~1.6km to the west of the quarry boundary (~2km to the center of the quarry). This feature is described by the GSI as a warm spring;

- Karst spring emerging in field, 4km to the north east;
- Karst spring with pumphouse at outflow, 4.3km south east; and,
- Kilbrook thermal spring, 5.3km south east.

7.139 A number of karst features have been identified from the surface at Rathcore Quarry that indicates that the Waulsortian Limestones have in part developed solutionally enhanced conduits. A relatively large cavity system exists in the northern part of the site and there is evidence of infilled karst depressions in the northeastern and southwestern walls of the quarry void.

7.140 A vertical karst cavity was discovered about twenty years ago in the northern part of the site next to the processing plant. Groundwater was evident in its base. It has since been filled in.

7.141 The drilling and pumping tests during the Hydrogeology Investigation in 2019-2022 discovered that a hidden network of open and connected karst conduits exist below Rathcore Quarry. However, drilling and water level monitoring in the east and south of the quarry found fewer and smaller, poorly connected fractures and conduits in the more massive, less broken limestones.

Long-Term Groundwater Level Monitoring

7.142 There is a long record of groundwater level monitoring at Rathcore quarry. Water level monitoring at Rathcore has not solely been completed in order to meet the requirements of planning conditions (Conditions No. 9 and No. 10 of the existing planning permission (PL 17.127391)) but principally to discover whether the quarry dewatering operations are impacting on local groundwater levels and well supplies. Groundwater levels have been manually dipped every two weeks in the onsite boreholes located on Kilsaran's land. In addition, monthly manual dip measurements have also been made in the wells and boreholes located in 14 adjoining properties. Monitoring of groundwater levels is ongoing.

Groundwater Levels (Onsite)

7.143 Groundwater level monitoring has been completed by Kilsaran for 4 no. onsite boreholes (D1 to D4). Monitoring in these wells has been ongoing since 2006. The location of these onsite BHs are shown in Figure 7-2.

- D1 is located in agricultural pastures, ~150m south of the existing quarry void. The hydrograph shows water level fluctuations of about 3m between the winter highs and the summer lows. Long term monitoring has revealed a slight decline of ~0.5m over the last 17 years. The minimum water levels are ~3m above the quarry floor (75mOD). The hydrogeological Investigation Report 2022 states that the hydrograph is similar to nearby shallow dug wells and this water level may represent the water level of the sandy tills and not the bedrock.
- D2 was originally located in pastures but as the quarry extended southwards, access to this borehole was lost in September 2020.
- D3 is located to the northwest of the quarry excavation and is noted to have a water level similar to that of D2. The annual end of summer recession water levels appear to have declined by about 2 metres over the past 17 years, with no appreciable change after the onset of quarry dewatering in 2013. Water levels were manually dipped in D3 up until July 2020. A Diver pressure transducer logger was installed taking readings at 20 minute intervals in 2019. Over 130,000 water level measurements have been made in this borehole since the instrument was installed. The graphs and analysis of the data are described in detail in Chapter 4 of the Hydrogeology Investigation Report 2022.
- D4 is located at the road entrance into the quarry. There has been no decline in the water levels in this BH over the 15-year study period. The water levels have been noted to fluctuate within a

range of ~4m. Similarly to D2 and D3, the water level in D4 does not appear to have been lowered by the onset of pumping in 2013. There may have been a slight rise in water levels due to recharge from the nearby settlement pond. The water levels in D4 are likely to represent the water level in the perched overburden aquifer and not the water level in the underlying bedrock.

7.144 The onsite weekly groundwater monitoring data for BHs D1 and D4 are presented in **Table 7-10**. The monthly data from 2006 to 2023 has been summarised within **Table 7-11**. Hydrographs for the wells are included in Chapter 4 of the Hydrogeology Investigation Report 2022, along with a detailed analysis of the data up to 2022. The table below updates the information in Chapter 4 (of **Appendix 7-A**).

Table 7-10
Weekly Groundwater Level Monitoring Onsite 2023

Groundwater Levels (mOD)		
Date	D1 (Perched WL in Overburden)	D4 (Perched WL in Overburden)
Top of Casing (mAOD)	86.431	86.398
04/01/2023	79.780	79.650
12/01/2023	79.880	79.830
18/01/2023	80.150	80.050
26/01/2023	80.630	80.070
01/02/2023	80.430	80.000
08/02/2023	80.330	80.000
14/02/2023	80.230	80.050
23/02/2023	80.130	80.050
02/03/2023	80.230	79.850
08/03/2023	80.180	79.700
14/03/2023	80.130	79.700
21/03/2023	80.230	79.700
29/03/2023	80.130	80.000
05/04/2023	80.330	79.700
12/04/2023	80.430	80.250
18/04/2023	80.430	80.400
25/04/2023	80.580	80.320
03/05/2023	80.500	80.300
09/05/2023	80.380	80.180
16/05/2023	80.210	80.100
24/05/2023	80.130	79.950
30/05/2022	80.030	79.880
07/06/2023	79.930	79.800
14/06/2023	79.830	79.700
21/06/2023	79.730	79.580
28/06/2023	79.530	79.480

05/07/2023	79.480	79.500
12/07/2022	79.530	79.400
19/07/2023	79.630	79.450
26/07/2023	79.430	79.500
02/08/2023	79.480	79.450
09/08/2023	79.530	79.450
15/08/2023	79.580	79.500
22/08/2023	79.530	79.450
28/08/2023	79.530	79.430
06/09/2023	79.430	79.350

7.145 A review of the long term groundwater monitoring data (2006 –2023) indicates that water levels in the onsite BHs have average water levels ranging from 78.89 to 79.99m AOD. Seasonal variations of up to 10.5m are recorded with maximum ranges over the monitoring period of between approximately 4.93 to 10.55m, see **Table 7-11** below.

7.146 The current quarry floor bench at c. 75mOD was established in 2006. Between this time and 2013 a limited amount of water was pumped internally from one part of the quarry to another in order to lower water levels locally on the lowest bench. Quarry dewatering only commenced in 2013 once the discharge licence was granted. The collection of historical groundwater level monitoring data preceded the commencement of dewatering at the site. The water levels before the start of dewatering shows a trend in the end of summer lowest water levels. The trend is a small gradual decline (see Figures 4.10 and 4.11 in the Hydrogeology Investigation Report). This trend appears to have continued after the start of existing quarry dewatering. The routine dewatering regime appears to have not disturbed the trend in groundwater levels in the monitored wells inside the site. However, Borehole D3 did respond rapidly to pumping from the boreholes used during the long pumping tests in 2020 and 2021.

Table 7-11
Summary of Monthly Onsite Groundwater Level Monitoring (2008 - 2023)

Borehole ID	Groundwater Levels (mOD)					
	Count	Min	Mean	Max	Range (m)	Distance from Sump(m)
D1	480	77.31	79.99	82.83	5.52	200 SW
D2	445	73.50	79.79	84.05	10.55	236 S
D3	443	75.59	78.92	85.96	10.37	539 N
D4	480	78.45	79.89	83.08	4.93	176.7 W

Groundwater Levels (Offsite)

7.147 Monthly groundwater level monitoring has also been carried out by Kilsaran in 14 no. private wells and boreholes in the lands surrounding the quarry. Monitoring in these wells commenced in 2006 and is ongoing. The location of these offsite BHs are also shown in Figure 7-2.

7.148 The groundwater levels in the local private wells are shown in **Table 7-12** and discussed at length in Chapter 4 of the Hydrogeological Investigation Report 2022. This chapter also includes hydrographs for each (shallow) dug well and (deeper) borehole, i.e. deep wells sourced from the limestone bedrock and shallower wells which source water from the local sand and gravel aquifer. Most of the local private wells and boreholes are pumped and the water used to meet domestic and farm demands for water. Therefore, some of the monthly spot water level measurements are dynamic pumping water levels and not natural rest water levels. The average variation in groundwater levels ranged from 2m to 12.47m (refer to **Table 7-12**).

7.149 The hydrographs show variations in water levels in response to winter highs and summer recessions associated with rainfall recharge and pumping. The seasonal variations are greater in the deeper limestone boreholes than in the shallow overburden wells, due to the greater capacity of the overburden to receive and store recharge. Since monitoring began there has been a gradual decline in groundwater levels. This decline predates 2013 and therefore cannot be attributed to the existing quarry dewatering regime at Rathcore. The Hydrogeological Investigation Report (2022) (**Appendix 7-A**) presents a detailed discussion with regard to this long term decline in water levels with respect of climate change (decreased rainfall) and groundwater abstractions in the local area.

7.150 The Hydrogeological Investigation Report 2022 concluded that quarry dewatering and the pumping tests had not affected the water level in the shallow dug wells drawing water from the sands and gravels in the overburden aquifer perched above the bedrock groundwater system. It was also observed that quarry dewatering and the pumping tests had no effect in some deep bedrock boreholes, but in others there may have been a drawdown of about 2metres during the pumping tests in 2020. It is difficult discriminate between the effect of the pumping in the quarry and the effects of pumping in the private borehole at the time the monthly monitoring measurement was made.

7.151 Presently, the average resting water level within these boreholes is approximately 81m AOD and 1.2m above that of the average groundwater level recorded within boreholes situated within the site.

Table 7-12:
Summary of Monthly Offsite Groundwater Level Monitoring (2006 - 2023)

Borehole ID	Groundwater Levels (mOD)					
	Count	Min	Max	Mean	Range (m)	Distance from Sump(m)
W2	126	76.38	88.85	79.96	12.47	519 N
W3	189	86.85	90.88	89.36	4.03	484 N
W4	189	71.46	80.34	77.45	8.88	365 W
W5	188	78.98	82.54	80.86	3.56	260 SW
W6	148	78.97	82.47	80.67	3.50	277 SW
W7	114	78.24	82.13	80.17	3.89	298 SW
W8	188	78.55	80.71	80.07	2.16	383 SW
W9	189	78.83	82.35	80.87	3.52	405 SW
W10	188	70.97	82.87	78.65	11.90	471 SW
W11	132	75.16	81.62	79.77	6.46	450 SW
W12	189	75.87	85.57	81.06	9.70	322 S
W13	189	76.76	88.30	81.29	11.54	356 S
W17	187	75.88	85.37	82.75	9.49	700 SSE
W21	92	78.55	80.55	79.92	2.00	351 SW

Summary

7.152 Groundwater monitoring has been completed in a variety of structures, *i.e*. deep bedrock boreholes and shallow dug wells in the overburden deposits, over a 17-year period.

7.153 Groundwater levels appear to have been slightly and slowly decreasing since the water level monitoring began in 2006.

7.154 A gradual fall in water levels can be observed in both overburden wells and bedrock boreholes.

7.155 The trend in the shallow wells is small, ~1m, while the trend in the bedrock boreholes is larger and more variable with a decline of ~4-6m. Groundwater levels were falling before the onset of quarry dewatering and had fallen ~2-3m between 2006 and 2013. The onset of dewatering the quarry in 2013 and the ongoing pumping does not appear to have changed the rate of decline.

7.156 Given that this decline is present in both the overburden and bedrock, it appears reasonable to interpret this as a natural change, or a change that reflects a general increase in groundwater use elsewhere in the catchment, that a natural change which has taken place over the monitoring period. This change may be a decrease in rainfall recharge. The difference in the rates of decline between the water level in the overburden and the bedrock is expected due to the greater ability of the overburden to accommodate rainfall recharge (i.e. pore spaces in the subsoil matrix).

Hydrogeological Investigation Report 2022: 2020/2021 Groundwater Pumping Tests

7.157 The Hydrogeological Investigation Report (2022) provides a very detailed study of hydrogeology and hydrogeological characteristics of the bedrock at Rathcore Quarry and the surrounding area. This detailed study is attached in full in **Appendix 7-A**. A conceptual site model of Rathcore Quarry based on the data presented in the Hydrogeological Investigation Report is included as Figure 7-7.

7.158 Following the drilling of 52 no. exploratory BHs at Rathcore in 2019, 3 no. wider diameter BHs were drilled in November and December 2019 in order to provide the infrastructure to carry out pumping tests with the aim of being able to determine the potential groundwater drawdown associated with the proposed deepening of the quarry at Rathcore. These BHs are located in the centre-north of the quarry because the 52 exploration boreholes did not encounter any open karst conduits at depth, with potential high yields, in the south of the quarry. Pumps were installed at a depth of ~30m below the existing quarry floor in the three pumping boreholes (i.e., at a level equivalent to the proposed final quarry floor depth).

7.159 It was recognised during the drilling that high flow rates could be obtained from some of the karst conduits in the bedrock. Therefore, rather than carrying out short pumping tests (for example a 3 day test) at modest pumping rates, the objective of the pumping test was to pump at high rates for a long period, to put a significant stress on the groundwater system, and to observe the groundwater response to this stress, both within the quarry and in the surrounding lands. This was done in order to determine the degree of connectivity between the conduits below the quarry and those under the surrounding lands and to determine if the proposed dewatering would affect St. Gorman's Well.

7.160 During the drilling several zones of fracturing and cavities were noted at a range of depths. The drilling at BH1 ceased at 36mbg due to unstable clay and large volumes of water, with water and drill cuttings being blown out of nearby exploratory boreholes. Meanwhile, drilling ceased at BH2 and BH3 at depths of 56.5 and 62mbgl respectively. During drilling the estimated yields of the boreholes ranged from 25m^3/day at BH1 to 7,000m^3/day at BH2. (However, the observations at BH2 were misleading because water was re-circulating back into the borehole via the deep zone of shattered rock forming the quarry floor)

7.161 A long high rate pumping test was carried out on these wide-diameter BHs between 15th July 2020 and early December 2020. Shorter tests were carried out to prepare the quarry for heavy rain over the Christmas period in 2020 and to drain the quarry in the New Year. A subsequent long winter test was completed in February and March 2021.

7.162 During the pumping test water levels were monitored to determine the effect that the pumping was having on local groundwater levels inside and outside the quarry. A total of 29 no. wells were being monitored during the pumping tests (14 no. local private wells, 14 no. onsite boreholes and exploratory boreholes and 1 no. well at St. Gorman's Well). The location and nature of the monitored wells were variable ranging from deep bedrock boreholes within the quarry and the surrounding lands to shallow overburden wells to a borehole at St. Gorman's Well, ~1.6km to the west of the quarry boundary (and ~2km to the center of the quarry site).

7.163 The pumping test was found to lower water levels in some of the onsite non-pumping exploration boreholes by ~4m and in some nearby private wells by ~2m. The greatest drawdown of ~4m was recorded in the onsite exploratory boreholes adjacent to the borehole within which the pumping tests were being conducted.

7.164 Pumping did not appear to have any effect on the private shallow dug wells in the local area which are sourced from the sand and gravel aquifer which is perched above the bedrock. The lack of response of water levels in the shallow wells indicates the presence of a low permeability layer (likely to be boulder clay) which separates the shallow overburden aquifer from the underlying limestone aquifer. A drawdown of ~2m was recorded in several local wells sourced from the bedrock aquifer. There was also no response recorded at well W17, located to the south of the quarry, and within the Lucan Formation. This indicates that the groundwater systems in the Lucan Formation and the Waulsortian Limestones are separate, and that the fault to the south of the quarry is closed and acts as a barrier to flow rather than a conduit.

7.165 The pumping test showed that water levels could be held down in the northern area of the quarry which is underlain by numerous highly productive karst conduits. The long period of pumping could not have been sustained if there was no connectivity of these conduits to ones outside of the quarry. The conduits in the area sustained a flow of over 2,000 to 3,000m^3/day for almost five months. This flow rate indicates that the water bearing conduits below the existing quarry are connected to a karst conduit groundwater flow system that extends beyond the area of the quarry. The pumping tests supports the interpretation in Chapter 2 (of the Hydrogeological Investigation Report 2022) of the latest geological information, and appears to confirm that there is a complex, extensive interconnected system of karst conduits within the Waulsortian Limestone at Rathcore.

Groundwater Quality

7.166 The GSI's Initial Characterisation Report for the Longwood Groundwater Body (GWB) in 2004 states that the water will have a calcium bicarbonate signature and typically has electrical conductivity values of around 700µS/cm. Similarly the Trim GWB Characterisation Report states that the water in this GWB also has a calcium bicarbonate signature with conductivities ranging between 150 to 350mg/l.

7.167 The groundwater quality at the site is not monitored directly at the onsite groundwater wells or in the quarry sump. The groundwater from the quarry sump is sampled at the discharge point (SW1), although it has gone through the sediment settlement lagoon, hydrocarbon separator and the polishing reed bed.

7.168 Groundwater quality sampling was completed at 2 no. locations (Borehole W1 and Borehole W4) on 10th March 2021. Borehole W1 is a household domestic water supply borehole. Borehole W4 is a water supply down gradient of a farm where the yard often contains parked trucks and some farm sheds are used for metal fabrication. These groundwater samples were sent to an accredited laboratory for independent analysis. Laboratory results are shown alongside relevant water quality regulations in **Table 7-133**. Full results from the accredited laboratory are attached as **Appendix 7-H**.

7.169 Ammonia was below the limit of detection (0.2mg/l) of the laboratory in both samples. Nitrate concentrations were well below the threshold values outlined in the Groundwater Regulations (S.I. 9/2010) and the Drinking Water Regulations (S.I. 122/2014). The nitrite concentration ranged from <0.05mg/l at W4 to 0.11mg/l at W1. Ortho-phosphate concentrations were below the limit of detection of the laboratory (0.01mg/l).

7.170 The concentration of several metals (Cadmium, Lead and Nickel) were above the threshold values outlined in the Groundwater Regulations.

7.171 The E.coli concentrations were below the limit of detection of the laboratory in both samples. Total coliforms ranged from 11MPN/100ml at W1 to <10MPN/100ml at W4.

7.172 Total petroleum hydrocarbon concentrations ranged from <0.1mg/l at W1 to 0.036mg/l at W4.

Table 7-13
Groundwater Quality Results (2021)

Parameter	Units	GW Regs	DW Regs	EPA IGVs	W1	W4
Ammonia as N	mg/l	0.065-0.175	-	0.15	<0.2	<0.2
Chloride	mg/l	24 - 187.5	250	30	34	37
Nitrate	mg/l	37.5	50	25	27.7	14.4
Nitrite	mg/l	-	-	0.1	0.11	<0.05
Potassium	mg/l	-	-	5	1.3	0.5
pH	pH Units	≥6.5 & ≤9.5	≥6.5 & ≤9.5	≥6.5 & ≤9.5	7.4	7.29
Phosphate (Ortho as P)	mg/l	-	0.03	0.03	<0.01	<0.01
Cadmium	mg/l	0.00375	0.005	0.005	0.02	0.03
Copper	mg/l	1.5	2	0.03	0.11	0.27
Iron	mg/l	-	0.2	0.2	39	111
Lead	mg/l	0.018	0.01	0.01	0.2	0.011
Nickel	mg/l	0.015	0.02	0.02	0.23	0.71
Magnesium	mg/l	-	50	50	31	59
Manganese	mg/l	-	0.05	0.05	2.8	6.4
Zinc	mg/l	-	5	0.1	0.35	0.92
E. Coli	MPN/100ml	-	0	0	ND	<10
Coliforms	MPN/100ml	-	0	0	11	<10
TPH	mg/l	-	0.01	0.01	<0.01	0.036

Groundwater Flow and Type

7.173 It is not possible to produce a detailed bedrock 'water table' map from the water level data recorded in the on-site and privately owned boreholes. This is typical of limestone aquifer systems where groundwater flow is within a network of fissures and fractures which may be poorly inter-connected from borehole to borehole.

7.174 Within local hydrogeological reports produced by GSI for the Longwood and Trim GWBs (GSI, 2004) it is suggested that primary groundwater flow within the Waulsortian Limestones is within the uppermost 3m as a result weathering and the formation of epikarst. Within this zone groundwater flow will be rapid through a dense network of interconnected solution features in the epikarst. Beneath this, flow will be much less and will be confined to isolated fractures, joints and fissures. These fissures will decrease with depth and are typically not found below 50m below ground level.

7.175 However, the site specific data obtained during the Hydrogeology Investigations between 2019-2022 shows that the GSI's assumptions about the majority of flow being in the shallow epikarst and less flow at depth is not supported, and that the Waulsortian Limestones at Rathcore contain a network of solutionally enlarged conduits and passageways near the top of the bedrock and at various and considerable depths which allow for the flow of potentially significant volumes of groundwater.

7.176 The Hydrogeology Investigation Report found that there is a bedrock groundwater flow system in the karst that is separated from an overlying perched shallow sand and gravel overburden aquifer. For example, the water level in dug well W3 is 12 metres above the water level in the bedrock seen in monitoring hole D3. It is assumed that the flow direction in the overburden reflects the slope of the topography and surface drainage.

Water Framework Directive

7.177 Local Groundwater Body WFD information is available for view from www.catchments.ie and is summarised in **Table 7-14** below.

7.178 The Longwood and Trim GWBs underlying the site (based on the GSI's 1999 bedrock map) both achieved 'Good' status in all 3 no. WFD cycles. However, it should be noted that the recent geological investigations show that the boundary of the Lucan formation that defines the western edge of the Trim GWB is no longer underlying the site, and therefore the site is not within and probably not significantly contributing to the Trim GWB.

7.179 The Longwood GWB has been deemed to be 'not at risk' while the Trim GWB is 'at risk' of failing to meet its WFD objectives.

7.180 The 3rd Cycle Boyne Catchment Report states that the Trim GWB is under significant pressure from domestic wastewater, agriculture and an unknown anthropogenic pressure.

Table 7-14
Summary WFD Information for Groundwater Bodies

GWB	Status 2010-2015	Status 2013-2018	Status 2016-2021	3rd Cycle Risk Status	Pressures
Longwood	Good	Good	Good	Not at risk	None
Trim	Good	Good	Good	At risk	Agriculture, Domestic Wastewater & Other

Water Resources

Surface Water

7.181 The Draft 3rd Cycle Boyne Catchment Report (EPA, 2021) states that there are 12 no. SWBs in the catchment identified as Drinking Water Protected Areas (DWPA). The closest DWPA downstream of the site is the Boyne River downstream of Trim (Boyne_100 SWB). This SWB is located ~13.6km northeast of the site (as the crow flies).

Groundwater

7.182 The GSI do not map the presence of any National Federation registered Group Water Schemes (GWS) or Public Water Schemes (PWS) or an associated Source Protection Area (SPA) within the site, or in the adjacent lands (www.gsi.ie).

7.183 The closest mapped PWS is the Longwood PWS. The SPA associated with this PWS is located ~2.5km northwest of the site. The EPA published a report on the establishment of Source Protection Zones for the Longwood Water Supply Scheme in September 2010 based on the one borehole on the site at the time. This borehole is a moderate yielding borehole that abstracts from a 5m thick sand and gravel deposit overlying pure unbedded limestones. The Hydrogeology Investigation Report (2022) describes a second borehole drilled 45 metres away in 2011. This borehole draws upon groundwater from the Waulsortian Limestone bedrock. Both boreholes are artesian or free flowing when they are not being pumped. The SPA has not been revised since 2010.

7.184 The Enfield PWS is located ~3.8km south of the site with the outer SPA located ~2km from the site boundaries. The EPA published a report on the establishment of the Source Protection Zones for the Enfield Water Supply Scheme in May 2010. This is a moderately yielding borehole that abstracts from a weathered, fractured, impure bedded limestone (EPA, 2010).

7.185 The GSI national well database (www.gsi.ie) records the presence of several wells in the lands surrounding the site, corresponding to many of the local private wells which are currently being monitored by Kilsaran.

7.186 Residences in the vicinity of the site area are on groundwater well supplies. A groundwater well survey was undertaken previously by SLR Consulting in February 2017 and identified a total of 21 private wells within the vicinity of the quarry, shown in **Figure 7-2**. The groundwater levels in the private wells have been monitored, when accessible, by Kilsaran on a monthly basis since November 2006. The private supply wells are pumped wells and therefore the groundwater level will vary with abstraction rates for the households and this is reflected in the monitoring results. Several local wells are shallow dug wells, sourced from the overburden aquifer, whilst others are deeper, sourced from the bedrock aquifer.

7.187 There are two Groundwater supply wells at the site, PW1 and PW2, which provide for site uses only. PW1 is located close to the fixed aggregate processing plant and PW2 is located close to the site canteen / welfare facilities. As detailed in **Table 7-1**, the total combined volume requirements from these wells is 50.6m^3/day.

Protected Areas

7.188 Within the Republic of Ireland, designated sites include Natural Heritage Areas (NHAs), proposed Natural Heritage Areas (pNHAs), Special Areas of Conservation (SACs), candidate Special Areas of Conservation (cSAC) and Special Protection Areas (SPAs).

7.189 The site is not located within a designated site of national (Natural Heritage Area (NHA) / Proposed Natural Heritage Area (pNHA)) or European importance (Special Area of Conservation (SAC) / Special Protection Area (SPA).

7.190 However, as detailed in there are several designated sites in the surrounding lands and downstream of the site. A map of designated sites is included as Figure 7-8.

Table 7-15:
Protected Areas

Protected Area	Location in relation to the site	Comment on Hydrological / Connectivity
Ballina Bog pNHA (000390)	4.8km southwest	Royal Canal and the Blackwater River act as hydrological barriers between this pNHA and the site
Rathmoylan Esker pNHA (000557)	4.8km northeast	No hydrological connection to this pNHA The Rathcore Stream and its tributaries act as a hydrological barrier.
Royal Canal pNHA (002103)	2.6km south	No hydrological connection to this pNHA
River Boyne and River Blackwater SAC (002299)	5.6km north (as the crow flies) 9.3km via the existing hydrological pathways to the northwest	The site is hydrologically connected to this SAC via the River Blackwater and its tributaries. The Blackwater River discharges into this SAC downstream of the site.
River Boyne and River Blackwater SPA (004232)	6.5km west (as crow flies) 9.3km via the existing hydrological pathways	The site is hydrologically connected to this SPA via the River Blackwater and its tributaries. The Blackwater River discharges into this SAC downstream of the site.
Molerick Bog NHA (001582)	8.5km northwest	Royal Canal and the Blackwater River act as hydrological barriers between this pNHA and the site
Trim pNHA (001357)	13.5km northeast	Situated along the River Boyne and hydrologically connected to the site
Boyne Woods pNHA (001529)	30km northeast	Situated along the River Boyne and hydrologically connected to the site
Rossnaree River Bank pNHA (001589)	31km northeast	Situated along the River Boyne and hydrologically connected to the site
King Williams Glen (001804)	41.8km northeast	Situated along the River Boyne and hydrologically connected to the site
Slane Riverbank (001591)	35.4km northeast	Situated along the River Boyne and hydrologically connected to the site
Crewbane Marsh pNHA (000553)	36.1km northeast	Situated along the River Boyne and hydrologically connected to the site
Dowth Wetland pNHA (001861)	40.5km northeast	Situated along the River Boyne and hydrologically connected to the site
Boyne River Islands pNHA (001862)	42.6km northeast	Situated along the River Boyne and hydrologically connected to the site
Boyne Coast and Estuary SAC and pNHA (001957)	45km northeast	Situated along the River Boyne and hydrologically connected to the site
Boyne Estuary SPA (004080)	45km northeast	Situated along the River Boyne and hydrologically connected to the site

St. Gorman's Well

7.191 The location of St. Gorman's Well with respect to Rathcore Quarry is shown in Figure 7-6**.** St Gorman's Well is physically a shallow, small depression in the ground. The vegetation in the depression is grass, that is currently mowed. The depression sometimes contains water, and if and when the level is high enough, the water flows from the depression across the ground to a nearby drain. It is located ~2km from the center of the excavation at Rathcore Quarry. It is not a perennial spring. There is no natural stream or drainage channel incised in the ground by a flow of water from the spring to the drain. Next to the depression there is an attractive pond. Water remains in this pond because it has been landscaped with an artificial pond liner.

7.192 There is a recorded observation in May 1855 of the Well 'giving out a body of water sufficient to turn a small mill', and the water temperature being 23 degrees (presumably Fahrenheit) above the air temperature. But 4 years later, the important geologist George V. Du Noyer, surveying the area for the Geological Survey, described it as follows; "*This spring was not the least warm when I visited it on the 21st July 1859, and to me, it appeared in every respect a delusion*.", "*It scarcely deserves the name of "a spring*", *as it presented the appearance of a stagnant pool covered in duckweed.*" These two descriptions of St Gorman's, over 160 years ago, provide an insight into the enigma that is called St Gorman's Well.

7.193 St Gorman's Well has a reputation as a warm but unpredictable spring. Sometimes, it does not flow for more than about two weeks in winter. Sometimes, in the past, it has been found to flow from the autumn to early summer. There has been only one systematic study of the spring. It was carried out by Minerex over forty years ago. Weekly or bi-weekly manual measurements were made of flow and temperature between late 1981 and early 1983. The Minerex survey found that when there was copious flow, the temperature was often 21-22°C, but at lesser flows the temperature decreased to 17°C. There was effectively no flow for 6 months in the summer of 1981 and for three months in the autumn of 1982.

7.194 Since the Minerex survey in the 1980s there appear to have been only five measurements of the temperature of water flowing out of the depression in the ground. These were spot measurements, rather than multiple measurements over a period of time. E.D.A. measured a temperature of 21.1°C on 4th April 2001. Ecoserve measured a temperature of 12°C in the spring of 2003. Tobin Consulting Engineers measured a temperature of 14.4°C on 21st September 2009. Richard Langford measured a temperature of 10.5°C on 21st April 2011. Kilsaran measured a temperature of 10.6°C in the bottom of the pool on 5th February 2021. Part of the reason for the sparsity of temperature measurements of flowing water from the spring is that the spring is often not found to be flowing. Unfortunately, there have been measurements made when the spring is not flowing, the shallow water in the depression is stagnant, and the water temperature of the small volume of water in the shallow pool is affected by the ambient air temperature and direct sunlight. The most misleading measurement of the stagnant water temperature was a reading of 25°C. This was made by an ecologist for Ecoserve at the edge of the shallow pool in the middle of summer in 2003. This one measurement entered official literature and has been taken by other official desk studies as being representative of the high temperature of fresh flowing groundwater emanating from the spring. The misleading measurement of 25°C of stagnant water on a summer's day has enhanced the reputation of St Gorman's Well as perhaps the warmest spring in Ireland.

7.195 Within this context a document entitled the "Geology of County Meath" was prepared by Matthew Parkes and Sarah Gatley of the GSI in 2007. This report contained a County Geological Site Report for St Gorman's Well. It stated that St. Gorman's Spring should be a County Geological Heritage Site. The authors did not visit the site. They relied on existing information and in particular on information from Ecoserve in 2003. They quoted the two Ecoserve measurements of 12°C and 25°C and described it thus:- "*This spring is a very important example of the warm spring province of the Kildare-Meath border area in northwest Leinster. As it is one of the highest temperature warm springs, well studied* *and the least disturbed in the Leinster province, and probably in the whole of Ireland, it is to be proposed as an NHA. It should also be listed as a County Geological Site in Meath."*

7.196 There is a second official data-base entry and designation for St Gorman's Well that was based on the Geology of County Meath Heritage Site report, which in turn had been based on the Ecoserve data from 2003. This is the National Parks and Wildlife on-line '*Map of Irish Wetlands*', where the site position was originally 500 metres from its actual position (since corrected in November 2021).

Hydrogeological Investigation Report 2022: St. Gorman's Well

7.197 Volume 3 Chapter 5 of the Hydrogeological Investigation Report 2022 is a very detailed study of the St. Gorman's Well site and the potential effects that the proposed development may have on the groundwater regime which supplies this warm spring. Chapter 5 in the report is 96 pages long, including 58 full-page illustrations, maps and multi parameter graphs. The report is attached in full in **Appendix 7-A**. The site investigation locations in the immediate vicinity of St. Gorman's Well are shown on Figure 7-9 alongside nearby surface hydrological features. The conceptual site model of St. Gorman's Well based on the data presented in the Hydrogeological Investigation Report is shown as Figure 7-10.

7.198 The key findings of Hydrogeological Investigation Report 2022 with regards to St. Gorman's Well are summarised as follows:

- The St Gorman's Well site consists of two important features; the Well or spring, and the deep boreholes drilled in the mid-1980s by Hydro-Research. The spring depression flows or contains water infrequently. Therefore, as there is no water to be seen in it most of the time, it is not possible to use it to monitor groundwater conditions at, or under, the site. However, two of the 1980s boreholes provide an invaluable piece of infrastructure to monitor and assess the changes in the groundwater levels/pressures and changes in water temperature throughout the year. Therefore, the scientific value of the site lies mostly in the information that has, and can be, obtained from the boreholes. Borehole SG4 has been continuously monitored for water pressure/levels and temperature since 2013 with the exception of a gap from September 2015 to August 2018.
- There has been confusion in the past in reports and papers where data appears to be ascribed to 'St Gorman's Well', whereas it is actually data from a borehole on the site close to St Gorman's Well. In Chapter 5, the small natural depression that sometimes contains water is referred to as St Gorman's Well. The boreholes are referred to by their individual names.
- Water flows from St. Gorman's Well when the local groundwater table is sufficiently high. In recent years the well has only flowed for two months or less in winter. The last significant flow was in February 2021, when at the same time a long high rate pumping test was being carried out at the quarry.
- The analysis of information from the detailed water level and temperature monitoring in borehole SG4 has shown that groundwater levels and temperatures below the site are influenced and controlled by 'Earth tides' (the local distortion of the earth's shape by the gravitational pull of the moon and the sun) and the interplay of three groundwater flow systems present under the St. Gorman's Well site:
    - A shallow, overburden-upper epikarst system that responds principally to local rainfall recharge;
    - A deeper, confined/pressurised, more regional, major conduit karst system at depths of 30 - 100m in the Waulsortian Limestones. This system is confined over much of the general area by clays and clayey decomposed limestones which separate the deep karst groundwater system from the shallow perched water table in the overburden; and,

  - A very deep, probably 'U-shaped' conduit system (50-1000m) which brings water from the greater depths towards the surface.

- The interplay of these three systems, rainfall the response or lack of response to pumping tests in the quarry, and the tidal rise and fall of water pressures and temperatures are illustrated in graphs such as Figures 5.19 to 5.37 in Chapter 5. A schematic section showing the relative depths and elevations of boreholes, the topography and drainage adjacent is shown in Figure 5.38.
- The warm water flowing from St. Gorman's Well originates from the 'U' shaped conduit which is probably along a deep Cenozoic aged fault system which brings the water to sufficient depths to be warmed to about 20°C. Water flows down and along the 'U-shaped' conduit when rainfall recharge sufficiently raises the water table at the inlet. If the water level at the inlet is higher than the water levels at the St. Gorman's Well site then there is the potential for warm water to rise up in the boreholes and the natural spring depression.
- Since E.D.A's measurement of temperature in the flowing spring of 21.1°C in April 2001, there has been no similar high warm temperature recorded in the spring. However, the data from Borehole SG4 shows that when water levels in the borehole rise to about 74.5m AOD warm water starts to come into a large cave at 90+ metres depth in the borehole and rise by convection up inside the borehole. Eventually if the water level or water pressure in Borehole SG4 rises above the collar at the top of the borehole (76.2mAOD) an artesian flow takes place and the water is warm, though currently not as warm as the temperatures in the flowing spring in the 1980s. The Well will also be full at this time and may flow, but the water temperature (based on the few recorded measurements) is usually cool, seemingly around 10-11°C. This is because the water temperature in the spring depression is dominated by cool shallow groundwater recharged by the previous recent rainfall.
- The exact source or location of the inlet to this deep conduit is unknown. The Hydrogeology Investigation Report 2022 suggests that it may be related to one of several northeast-southwest orientated strike-slip fault which run through the bedrock under Ballinakill Hill from a relatively elevated area of gravels overlying the Cullentry Waulsortian limestone block on the northern side of the shallow valley running roughly east west from Rathcore (see Figures 2.47 and 2.51 for the alignment of these faults). Rainfall, recharges the gravel aquifer and raises the water level above the deep conduit karst system. The 'U-shaped' deep conduit system brings this water, to great depths. When there is sufficient pressure or hydraulic head at the inlet, the water is driven up into the large conduits seen in borehole SG4 and SG7 below St. Gorman's Well.
- The possibility that the inlet of the warm water system is the Rathcore Quarry area is highly unlikely. The natural groundwater levels at the quarry are only slightly elevated with respect those at St. Gorman's Well. The GPS survey in 2021 showed that the elevation of the base of the Well depression well is 75.34mOD (see Figure 5.3 and 5.38). The elevation of the base of the Well depression is almost exactly the same as the current floor level of the quarry. Therefore, water levels at the quarry floor level would not create a sufficient hydraulic head to drive the water down to a great depth and to then push it back to the surface at the St. Gorman's Well site. The pumping test in the winter of 2021 showed that when the water levels at the quarry were lowered to roughly 20m below the water levels at the St. Gorman's Well site, the artesian flow from the boreholes and water level in the well depression was unaffected. This indicates that there is no link between the lowering of the water levels at the quarry and the groundwater system which drives warm water to the surface at St. Gorman's Well.
- However, a long pumping test, carried out in the summer, autumn and early winter of 2020, showed that the pumping from the quarry started to lower groundwater levels in borehole SG4 within two days (see graphs and analysis in Chapters 4 and 5 of the Hydrogeology Investigation Report 2022). The effect of pumping from the quarry boreholes lowered the pressure in the

limestone conduit system. Continued pumping and the natural fall of groundwater levels lowered the water level in borehole SG4 by about 2.4m over the next two and a half months. However, at the beginning of October 2020 water levels in SG4 started to rise in response to the late summer and autumn rain/recharge. Even though the pumping rate from the boreholes in the quarry increased from 2,500 cubic metres per day (m^3/day) to 2,900m^3/day over the next two months, it was not possible to hold down the water levels in borehole SG4 at the St Gorman's Well site. The water levels in this borehole (i.e. the water levels below the spring) rose by 2.5metres in spite of the constant pumping from the quarry. Therefore, the water levels below the St Gorman's Well site were higher before the pumps were turned off at the end of the long pumping test, than natural water level before the pumps started. The pumping tests showed that in summer, when there is less effective rainfall recharge entering the groundwater system, high rate pumping from the quarry will lower the water pressure in the confined karst conduits criss-crossing the area, but this pressure effect is over-ridden by effective rainfall recharge into the system and a local recharge raising water levels in the shallow overburden sand and gravel aquifer.

- Therefore, pumping at the quarry had an effect on groundwater levels at St. Gorman's Well when the water levels were low but did not have an effect when groundwater levels were high and groundwater was flowing from the well.
- Based on the results of the pumping tests, designed to simulate the effects of the long term quarry dewatering, the following conditions arise:
  - In winter conditions when there is enough recharge, St. Gorman's Well will continue to flow even if future groundwater dewatering at the quarry is implemented.
  - In summer conditions, when there is limited recharge, water levels are low and St. Gorman's Well is naturally dry, there is potential for future quarry dewatering to slightly lower groundwater levels, as measured in the boreholes at the St. Gorman's Well site. The St. Gorman's Well spring depression can still fill and overflow when there is sufficient local rainfall recharge.

Receptor Sensitivity and Importance

7.199 This section discusses the sensitivity of the receiving hydrological and hydrogeological environment in terms of the proposed development and identifies those receptors which will be carried forward into the impact assessment.

7.200 Due to the local hydrogeological regime with high rates of groundwater recharge (associated with permeable soils and exposed limestone bedrock) and karst bedrock, and the nature of the proposed development (lateral expansion and deepening of an existing quarry) groundwater will be the main sensitive receptor.

7.201 In terms of groundwater, the following receptors are identified for impact assessment:

- The Locally Important bedrock aquifers underlying the site (note that the Hydrogeological Investigation Report 2022 states that the bedrock aquifer in this area should be reclassified as, at least, a Locally Important Karstified bedrock aquifer, if not a Regionally Important Karstified bedrock aquifer);
- The WFD status of the GWBs underlying the site (i.e. the Longwood and Trim GWBs) (note that the geological and hydrogeological data obtained as part of the Hydrogeological Investigation Report (2022) shows that the site is not underlain by the calp limestones of the Trim GWB. Nevertheless, for the purpose of completeness, it will be included in the assessment);
- Local private and domestic groundwater abstractions;

- Local public groundwater abstractions including the Enfield PWS and the Longwood PWS; and,
- St. Gorman's Well.

7.202 In relation to surface waters, downstream surface waters have the potential to be impacted by the proposed quarry discharge which will continue at the site. The quantification of flow volumes indicates that the watercourses in the immediate vicinity of the site will be most susceptible to potential effects. Further downstream, the watercourses will be less susceptible to potential effects due to increasing flow volumes (as the contributing catchments get larger). Downstream of the site, no effects associated with the development will occur on the River Boyne downstream of EPA Node 07_245. Here at Trim, the Boyne has a total catchment of ~1,360km^2 and there will be no potential for effects to occur due to the large flows.

7.203 In terms of surface water, the following surface water receptors are identified for impact assessment:

- The local surface watercourses downstream of the site, including the Blackwater River and its tributaries and the River Boyne (as far as Trim);
- The WFD status of the SWBs in the vicinity and downstream of the site; and,
- The salmonid waters of the River Boyne, downstream as far as the Trim.

7.204 In terms of designated sites, only those designated sites which are hydrologically/hydrogeologically connected with the proposed development will be included in the impact assessment. Designated sites located downstream of Trim will be omitted from the assessment due to the large volumes of water within the Boyne and the associated dilution effect which this provides. The following designated sites are included in the impact assessment:

- St. Gorman's Well; and
- River Boyne and River Blackwater SAC and SPA.

7.205 For each identified receptor, the significance and sensitivity of the receptor is assessed in **Table 7-16** below and a rating (High / Medium / Low / Negligible) applied, based on the methodology outlined in existing guidance and reproduced in **Appendix 7-I**.

Table 7-16
Existing Environment – Significance and Sensitivity / Importance

No.	Existing Environment	Significance	Sensitivity	Existing Environment Significance / Sensitivity Rating (H/M/L/N)
1	St Gorman's Spring	A natural warm water spring located ~2km west in the Waulsortian limestones.	St Gorman's Spring is a pNHA and a County Geological Site.	High – Attribute has a high quality or value on a local scale.

No.	Existing Environment	Significance	Sensitivity	Existing Environment Significance / Sensitivity Rating (H/M/L/N)
2	Locally important bedrock aquifers (likely to be updated to a Regionally Important Karst Aquifer).	The site is mapped by the GSI as being underlain by the Longwood and Trim GWBs. Note that the site investigation data indicates that the calp limestones of the Trim GWB lie to the south of the site. A number of karst features have been identified at Rathcore Quarry and karst features are also located in the wider area.	Reduction in groundwater volumes and quality.	High – Attribute has a high quality or value on a local scale.
3	Domestic Water Supply Wells.	Local deep groundwater supply wells in the local limestone bedrock aquifer. Local shallow groundwater supply wells in the overburden aquifer.	The groundwater in the bedrock and overburden aquifers is used for water supplies. Reduction in groundwater volumes and quality.	Medium – Attribute has a medium quality or value on a local scale
4	Public water Supplies.	Enfield and Longwood PWS.	The groundwater in the bedrock aquifer is used for water supplies. Reduction in groundwater volumes and quality.	High – Attribute has a high quality or value on a local scale.
4	Tributary of River Blackwater.	The River Blackwater tributary is located 150m west of the site, and has a moderate status in the area.	Reduction in surface water quality due to quarry discharge.	Medium – Attribute has a medium quality or value on a local scale
5	River Boyne.	The River Boyne lies downstream of the proposed development site and is an SPA and SAC.	Reduction in surface water quality. Alteration of surface water flow volumes.	Medium – Attribute has a medium quality or value on a local scale
6	River Boyne and River Blackwater SAC and SPA.	The site is hydrologically linked to these designated sites.	Reduction in surface water quality. Alteration of surface water flow volumes.	High – Attribute has a high quality or value on a local scale.

Site Baseline Summary

7.206 The proposed development consists of permission for continued use of the previously permitted developments including the existing quarry, stone extraction and processing and related ancillary buildings and facilities, permission for 2 no. 15m benches to a final depth of 45m AOD from the current quarry floor level of c.75m AOD and permission for a small lateral extension of 0.9hectares. The existing quarry has been worked dry to a current level of c. 75mOD, and groundwater has been pumped and discharged from the site to maintain dry working conditions since 2013.

7.207 There are no surface water features at the site of the existing quarry. The closest surface watercourse is a tributary of the River Blackwater, ~150m to the west of the site. The site is located in the River Blackwater catchment which is a sub-catchment of the River Boyne.

7.208 There is an existing discharge of treated surface water and groundwater from the site to a drainage ditch to the west of the site (DL 13/02). The discharge is automated based on a float level on the groundwater sump. Water is treated via a suitably sized settlement pond, a hydrocarbon interceptor and a constructed reed bed prior to discharge. Monitoring of the effluent discharge quality has revealed that to date the discharge from the site has largely been compliant with the existing discharge licence conditions and emission limit values. Monitoring of discharge flow volumes have revealed that the discharge rates exceed the discharge limit and a review of the existing discharge licence is required.

7.209 Downstream of the outfall location, the drainage ditch flows to the northwest and discharges into a small 1st order stream (Clonguiffin stream), which in turn flows into a 2nd order stream (Connellstown stream). This 2nd order stream flows to the west and discharges into the Blackwater River.

7.210 The Hydrogeology Investigation Report 2022 has demonstrated that the bedrock geology of the site is more complex than that indicated on the available 1:100,000 GSI map of the local area. Based on comprehensive new data, combined with geological investigations in the wider area over the past 160 years, the geology of the local area has been found to comprise of a series of fault bounded blocks of Waulsortian Limestones, the Lucan Formation and weathered versions of each formation.

7.211 Site investigations at Rathore have found that the site is underlain by Waulsortian Limestones. Contrary to the GSI map, the Lucan Formation is not present at Rathcore Quarry. The Waulsortian Limestones encountered at Rathcore have been subject to karstification along fault zones which has resulted in a network of solutionally enlarged cavities over varying dimensions, partly filled with clay. The solid limestone between the cavities does not store or transmit groundwater. Drilling investigations indicates that these cavities are largely concentrated towards the north of the site.

7.212 Long high-rate pumping tests were completed at Rathcore from July 2020 to March 2021 to simulate the effects of the proposed quarry dewatering on local groundwater levels. The pumping tests revealed that the conduits underlying the site sustained a flow of over 2,000m^3/day for almost five months. This indicates that the water bearing conduits below the existing quarry are connected to a karst groundwater flow system that extends beyond the area of the quarry. The pumping tests correlates with the geological data and suggests that there is a complex but extensive and interconnected system of karst conduits within the Waulsortian Limestones.

7.213 Based on the site investigations, the Hydrogeological Investigation Report 2022 suggests that the aquifer classification of the Waulsortian Limestones at the site will be upgraded to a Regionally Important Karst Aquifer (conduit) from its current classification as a Locally Important Aquifer.

7.214 The site is located in close proximity to 2 no. public groundwater abstractions (*i.e*. Enfield and Longwood PWS). Residences in the vicinity of the site area are also served by private groundwater well supplies. Local shallow wells are sourced from the overburden aquifer whilst deeper wells are sourced from the karst bedrock aquifer.

7.215 Extensive groundwater monitoring has been completed in both on-site boreholes and nearby private wells since 2008 and 2006 respectively. This long-term monitoring has shown a gradual decline in local groundwater levels. The decline in groundwater levels predates the commencement of pumped discharges from the quarry in 2013. Furthermore, the rate of groundwater level decline does not appear to have been altered by the existing quarry dewatering regime.

7.216 The River Boyne and River Blackwater SAC and SPA are located downstream of the site. The site is hydrologically linked with this designated site via the tributaries of the Blackwater River into which the site discharges treated water.

7.217 Upwelling of groundwater is highlighted by the presence of St. Gorman's Spring, a natural but intermittent spring located approximately 2km west of the center of the excavation in Rathcore Quarry. St Gorman's Spring has been proposed as an NHA principally on ecological grounds that are no longer valid, and a County Geological Site based in part on unrepresentative data collected 20 years ago. Comprehensive site investigations and monitoring have been completed in order to determine the potential effect that the proposed development may have on the groundwater regime which feeds this spring. As discussed in paragraph 7.198, the Hydrogeological Assessment Report 2022 concludes that the future dewatering of the quarry would not affect the functionality of the spring. During long term high-rate pumping tests it was found that during winter conditions, when the spring is in flow, pumping will have no effect of groundwater levels at the site of St. Gorman's Well.

7.218 In summary, comprehensive and detailed hydrogeological investigations and monitoring have been completed at the Rathcore site and its surrounds. These comprise of quarry discharge quality and flow monitoring, groundwater level monitoring in both onsite wells and nearby private wells since 2006, extensive borehole drilling onsite (52 no. BHs), unprecedented long-term pumping tests (7-month long tests in total) and monitoring of the water levels at St. Gorman's Well. These site investigations have provided a detailed and comprehensive dataset on the local hydrogeological and hydrological regime at the site and due to the quantity of data obtained results in a high degree of confidence in the conclusions presented above and in the subsequent impact assessment.

IMPACT ASSESSMENT

Evaluation Methodology

7.219 The potential direct and indirect effects to surface water and groundwater associated with the proposed development are discussed below.

7.220 The methodology applied here is a qualitative risk assessment methodology in which the nature of the potential effects are described in terms of the character, magnitude, duration, probability and consequence of the impact, see **Appendix 7-J.**

7.221 The potential effect is then screened against the sensitivity of the receiving environment to establish the overall significance of the potential effect (without mitigation). Appropriate mitigation measures for the potential effects identified are discussed, and the identified potential effects reassessed assuming the identified mitigation measures in place.

Construction Phase Potential Effects (No Mitigation)

7.222 The potential direct and indirect effects to surface water and groundwater during the construction phase are discussed below.

7.223 In the context of the proposed development, the construction phase is considered to be the preparation of the small lateral quarry extension area of ~0.9ha. The quarry preparation works involve the removal of soils and subsoils from the proposed extension area and the storage of these materials elsewhere within the site. In addition the construction phase will include the construction of the new rock milling plant.

7.224 The soil and subsoil, where present, will be stripped from the lateral quarry extension area using earth moving machinery. The topsoil and any overburden material will be stored in temporary overburden storage berms, ready to be used in the restoration of the site. Similar topsoil and subsoil stripping works have been completed at the site in the past.

7.225 The construction phase will be approximately six-months in duration and will be carried out in tandem with ongoing operational phase works.

7.226 During the construction phase, the site will continue to operate in accordance with the existing discharge licence. Surface water runoff and groundwater inflows will be gathered in the quarry sump before being pumped to a settlement pond and passed through a hydrocarbon interceptor and a reed bed prior to discharge.

7.227 The potential for groundwater quality effects are not significant during the construction phase as quarry dewatering will be ongoing in order to maintain a dry quarry floor. Therefore, the quarry will be a sink for groundwater flow, with groundwater being pumped from the sump in the quarry floor to the existing settlement pond. As stated above, this water will be treated prior to discharge as surface water.

7.228 The significance of the potential direct and indirect effects during the construction phase are described below and are summarised in **Table 7-18**.

Direct Effects

Change in Groundwater Vulnerability Rating

7.229 The removal of soil/subsoil from the proposed lateral extension to the bedrock quarry, will increase the groundwater vulnerability rating of the underlying bedrock aquifer in this area (0.9ha). However, the groundwater vulnerability rating of the bedrock aquifer in this area is already currently Extreme to Extreme-X. With the removal of the soil/subsoil from this area the rating will across the lateral extension area to Extreme-X with bedrock exposed at the surface.

7.230 The pre-mitigation potential effect is considered to be a direct, negative, slight, permanent and likely effect on the local groundwater vulnerability rating.

Indirect Effects

Accidental Release of Hydrocarbons

7.231 Soil/subsoil stripping and the construction of the new milling plant will be completed using earth-moving machinery. Such machinery are powered by diesel engines and operate using hydraulics. Unless carefully managed such plant and machinery have the potential to leak hydraulic oils or cause fuel leaks. The accidental release of these compounds into the environment have the potential to negatively impact water quality in the underlying bedrock aquifer and the downstream surface watercourse which are linked to the proposed extraction area via groundwater flowpaths. However, as stated above, there is limited potential for effects given the existing quarry dewatering and water treatment systems in place at Rathcore, with all discharge passing through a hydrocarbon interceptor.

7.232 The pre-mitigation potential effect is considered to be an indirect, negative, imperceptible, temporary, unlikely effect given the existing water treatment process in operation at the site.

Potential Entrainment of Suspended Solids

7.233 There is the potential for the generation of suspended sediment in surface water runoff during the construction phase. Earthworks, the construction of the new milling plant, the stripping of soil/subsoil and the stockpiling of such material which will be a potential source of sediment laden water. Such activities can result in the release of suspended solids to surface waters which could affect the water quality of downstream receptors. However, due to the bowl-shaped nature of the site and the local hydrogeological regime, all runoff from the construction areas will gather in the sump on the quarry floor and will be treated prior to release. Therefore, the local hydrological regime and the existing discharge licence limit the potential for any effects.

7.234 The pre-mitigation potential effect is considered to be an indirect, negative, imperceptible, temporary, unlikely effect given the existing water treatment process in operation at the site.

Potential Effects on Local Groundwater Wells

7.235 There is limited potential for groundwater quality in local wells to be impacted as a result of suspended solids entering groundwater or the accidental spillage of fuels and lubricants. Groundwater will be drawn towards the quarry sump and then pass through the existing water treatment process before being discharged as surface waters.

7.236 The increase in quarry dewatering will only be minor during this phase of the proposed development. The maximum discharge rates of 5,000 to 6,000m^3/day will not be required until the quarry is operating at the lowest bench (during the later stages of the operational phase). The Hydrogeological Investigation Report 2022 concluded that at these maximum operational phase pumping rates, there will be no significant effect on local wells. Therefore, during the construction phase, when the pumping rates are similar to the existing discharge rates, there is limited potential for any effects on groundwater levels and quantity in local wells. The pre-mitigation potential effect is considered to be an indirect, negative, imperceptible, temporary, unlikely effect on local groundwater wells.

Potential Effects on WFD Status

7.237 The EU Water Framework Directive (2000/60/EC) requires that all member states protect and improve water quality in all waters, with the aim of achieving good status by 2027 at the latest. Any new development must ensure that this fundamental requirement of the Directive is not compromised. In the vicinity of the site the Blackwater River is of “Moderate” status while the Boyne River further downstream is of “Poor” status. In terms of GWBs, the Trim and Longwood GWBs are of “Good” status. The proposed development must not prevent these waterbodies from achieving “Good” in the future.

7.238 Potential effects on surface and groundwater quality as a result of the construction phase have the potential to negatively affect the status of these waterbodies. However, given the nature and short timeframe for the construction phase works, combined with the existing water treatment processes in operation at Rathcore Quarry no effects on the status of downstream SWBs will occur. In relation to GWBs, there is no potential for the status of underlying GWBs to be effected given that there will be no discharge to ground and all groundwater will flow into the quarry void as per the existing baseline conditions.

7.239 Potential effects on surface and groundwater quantity are not anticipated. There will be no significant increase in the discharge rates or rates of dewatering during the construction phase. Therefore, there is little potential to change the quantitative status of downstream SWBs or underlying GWBs.

7.240 The potential for effects on the WFD status of waterbodies is negligible.

7.241 A full WFD Compliance Assessment is included as Appendix 7-D.

Operation Phase Potential Effects (No Mitigation)

7.242 The operation phase is taken to comprise of the deepening of the quarry by 2 no. 15m benches to a final depth of 45mAOD from the current quarry floor level of 75mAOD. The reduction in floor level in the quarry will require continued and increased pumping from the sump in the quarry floor to maintain dry working conditions on the quarry floor.

7.243 During this phase, the quarry will continue to discharge treated effluent at the existing outfall location. The volume of effluent will increase, associated with the increased pumping rate. This increased discharge rate will be subject to a review application of the discharge licence.

7.244 The operation phase will be ~20 years in duration.

7.245 The local and downstream surface water receptors will continue to be sensitive receptors during this phase of the proposed development. Any changes in discharge quality or quantity could affect local downstream surface water receptors.

7.246 Groundwater quality will not be particularly susceptible during this phase of the development as the quarry void will act as a groundwater sink. Groundwater will flow into the quarry and there will be no discharge to ground.

7.247 However, the increased pumping rate will have an effect on local groundwater levels and groundwater quantity, potentially drawing groundwater levels down locally.

7.248 The significance of the potential direct and indirect effects resulting from the operational phase are described below and are summarised in **Table 7-18**.

Direct Effects

Potential Effects of Quarry Dewatering on Groundwater Levels (Increased Drawdown)

7.249 With the deepening of the quarry void, the pumping rate will be increased to ensure that the floor of the quarry remains dry and workable. The increased pumping rate, at a maximum of 5,000 to 6,000m^3/day when the lowest bench of the quarry is being worked to 45mOD will result in a lowering of groundwater levels at the quarry. This reduction of groundwater levels also has the potential to effect groundwater levels in nearby private wells and boreholes.

7.250 The potential effect of drawdown on groundwater levels and in local wells was assessed in the Hydrogeological Investigation Report 2022; refer to **Appendix 7-A**). During recent site investigations, groundwater levels in on-site and offsite boreholes were recorded during the long, high-rate pumping tests which aimed to simulate the potential effects associated with the proposed quarry dewatering during a variety of meteorological conditions. The report concluded that:

- During the pumping tests the water levels fell by ~4m in the onsite (quarry) boreholes and ~2m in some local private deep boreholes. The karst conduit system in the Waulsortian and the bedding and fracture system in the Lucan formation are heterogeneous and anisotropic. Therefore, there will not be a uniform change in water levels or any effect akin to a 'cone of drawdown' as might be found in a porous media aquifer.
- 5 no. of the monitored wells are shallow dug wells which draw water from the local sand and gravel aquifer. No water level effects were recorded in these shallow wells during the pumping tests. The lack of water level response in these shallow wells indicates that the local sand and gravel aquifer is separated from the underlying Waulsortian Limestones by a low permeability layer. This layer is likely to comprise of boulder clay which was noted to overlie the bedrock at

the edge of the quarry. Therefore, they have no potential to be impacted by the proposed additional quarry dewatering which will be solely located in the bedrock aquifer.

- 10 no. of the monitored local wells are deep boreholes which draw water from the bedrock aquifer, i.e. karstified Waulsortian limestones. Water level impacts in the magnitude of ~2m were recorded in many of these local private wells during the pumping tests. During the proposed quarry dewatering a similar drawdown of water levels will occur in these deep bedrock boreholes. However, these bedrock boreholes are deep and the arising water is sourced from a network of deep fractures and karst conduits, i.e. water inflows at several levels in the bedrock penetrated by the borehole. A drawdown of ~2m will not impact flow into these boreholes from the deeper conduits, which will remain open and continue to provide sufficient flow into the borehole. Therefore, there is limited potential for the proposed dewatering to impact on the yield of these local bedrock boreholes.
- Therefore, given the groundwater level responses of the individual local wells to the pumping tests and the potential for the proposed dewatering to impact the water supplies are summarised in **Table 7-17** below. Given the results of the recent pumping test (which was purposefully intended to simulate extended/deepened quarry dewatering) and the monitored groundwater levels, the pre-mitigation potential effect is considered to be a direct, negative, slight, long-term, likely effect on local groundwater levels in deep boreholes (groundwater wells).

Table 7-17
Potential Impact of Quarry Dewatering on Local Private Wells

Well ID	Shallow / Deep	Potential Water Level (WL) Effect	Potential Effect to Overall Well Supply
W1	Deep bedrock borehole	No recorded WL response during pumping test	No effect likely – the water level drawdown of ~2m will not affect the supply volume from deeper conduits
W2	Deep bedrock borehole	No monitoring during pumping tests as BH was not accessible. Monitoring ceased in 2017	No effect likely – the water level drawdown of ~2m will not affect the supply volume from deeper conduits
W3	Shallow well in overburden	No recorded WL response during pumping tests	No effect – supply is hosted in the overburden aquifer which is perched above the limestone bedrock aquifer
W4	Deep bedrock borehole	~0.5m drawdown recorded during pumping tests	No effect likely – the water level drawdown of ~0.5m will not affect the supply volume from deeper conduits
W5	Shallow well in overburden	No recorded WL response during pumping tests	No effect – supply is hosted in the overburden aquifer which is perched above the limestone bedrock aquifer
W6	Shallow well in overburden	No recorded WL response during pumping tests	No effect – supply is hosted in the overburden aquifer which is perched above the limestone bedrock aquifer
W7	Deep bedrock borehole	No monitoring during pumping tests as BH was not accessible. Monitoring ceased in 2017	No effect likely – the water level drawdown of ~2m will not affect the supply volume from deeper conduits

W8	Shallow well in overburden	No recorded WL response during pumping tests	No effect – supply is hosted in the overburden aquifer which is perched above the limestone bedrock aquifer
W9	Shallow well in overburden	No recorded WL response during pumping tests	No effect – supply is hosted in the overburden aquifer which is perched above the limestone bedrock aquifer
W10	Deep bedrock borehole	~2m drawdown recorded during pumping tests	No effect likely – the water level drawdown of ~2m will not affect the supply volume from deeper conduits
W11	Deep bedrock borehole	No monitoring during pumping tests as BH has been covered and sealed	No effect likely – the water level drawdown of ~2m will not affect the supply volume from deeper conduits
W12	Deep bedrock borehole	~2.2m drawdown recorded during pumping tests	No effect likely – the water level drawdown of ~2.2m will not affect the supply volume from deeper conduits
W13	Deep bedrock borehole	~2m drawdown recorded during pumping tests	No effect likely – the water level drawdown of ~2m will not affect the supply volume from deeper conduits
W17	Deep bedrock borehole	No recorded WL response during pumping tests	No effect likely – the water level drawdown of ~2m will not affect the supply volume from deeper conduits
W21	Deep bedrock borehole	No monitoring since 2014 due to the presence of dogs	No effect likely – the water level drawdown of ~2m will not affect the supply volume from deeper conduits

Potential Effects on Downstream Surface Water Flow Volumes

7.251 The proposed deepening and extension of the existing extraction area has the potential to increase volumes of surface water being discharged. This will be a consequence of the increased volumes of surface and groundwater being generated within the extended and deepened quarry void. This will potentially reduce baseflow slightly to the Clonguiffin stream, but this reduction is offset by the increased volumetric discharge from the quarry, i.e. there is no net loss of flow as the water is pumped to the stream.

7.252 Surface water discharges from Rathcore Quarry currently operate under DL 13/02 and associated conditions and a discharge licence review application will need to be completed for the increases in discharge volume associated with the proposed development. Any unmitigated and uncontrolled increases in discharge has the potential to adversely impact local hydromorphology, water quality and increase the flood risk downstream of the site.

7.253 Based on the volumes of water encountered during the long pumping test (maximum pumping rate of 3,500m^3/day), the estimated volume of water to be discharged will increase to 5,000 to 6,000m^3/day (maximum combined rainfall and groundwater volume). Studies have shown that these maximum discharge volumes will only be achieved upon extraction of the proposed second bench down to 45mOD. Therefore there will be a gradual increase in discharge volumes throughout the operational phase, and the receiving drainage ditch (which is maintained by the OPW) has the capacity to receive and transmit this additional flow. Channel capacity assessments have shown that the lowest capacity of the drainage ditch is 99,466m^3/day which is significantly greater than the proposed discharge volumes. We also note that this drainage channel and all downstream watercourses coped with similar flow volumes during the long pumping test completed from July 2020 to December 2020, therefore this assessment is not simulated or calculated, it has been tested and proven. We also note that Meath Co. Council allowed permission for increased discharges through an amended discharge licence for the duration of the long duration pumping tests.

7.254 The pre-mitigation potential effect is considered to be a direct, negative, moderate, long-term, likely effect on surface water flows.

Potential Effect on Downstream Surface Water Quality

7.255 During the operational phase, runoff from the extraction area and pumped groundwater will be directed to a sump in the quarry floor. En route to the sump, surface water will increase in turbidity due to the collection of sediment particles. Waters may also be contaminated with any leaked hydrocarbons on the quarry floor. Any release of untreated water has the potential to effect water quality in the local downstream receiving waters (*i.e.* Blackwater River and its tributaries and the River Boyne). Discharge from the quarry currently operates under a discharge licence which sets out several emission discharge limits with respect to water quality.

7.256 Furthermore, based on recent site investigations at Rathcore, the initial flows from the karst conduits beneath the quarry will contain a large amount of suspended sediment. The concentrations of suspended sediment will decrease with time and pumping tests found that near sediment free water can be obtained constant pumping conditions.

7.257 Monitoring of discharge water quality in accordance with the discharge licence has shown that the site is compliant with the existing discharge emission limits in terms of water quality. An assimilation capacity has been completed for the proposed development and the maximum estimated discharge rate of 6,000m^3/day and has shown that there is limited potential for effects (**Appendix 7-F**).

7.258 The pre-mitigation potential effect is considered to be a direct, negative, moderate, long-term, likely effect on downstream surface water quality.

Potential Effect on Water Quality Due to Contamination with Wastewaters

7.259 The release of effluent from wastewater treatment systems has the potential to effect groundwater and surface water quality.

7.260 The pre-mitigation potential effect is considered to be a direct, negative, significant, long-term, unlikely effect on surface water quality and a direct, negative, slight, long-term, unlikely effect on local groundwater.

Indirect Effects

Potential Effects on Karst Features (St. Gorman's Well)

7.261 In karstified aquifers there is a close interaction between the groundwater and surface water. Hence, any potential effects described above could indirectly effect local karst features. The karst features mapped by the GSI in the local area comprise of springs, the closest of which is St. Gorman's Well, located 2km to the west of the quarry excavation. The proposed deepening of the quarry and the associated lowering of groundwater levels has the potential to effect groundwater levels in the Limestone bedrock. This could have an indirect effect on groundwater levels and spring flows at St. Gorman's Well.

7.262 The potential effect of drawdown on groundwater levels and flow at St. Gorman's Well was investigated and assessed in the Hydrogeological Investigation Report 2022 (**Appendix 7-B**). During the long-term (7-month total), high-rate pumping tests, designed to simulate the effects associated with further dewatering, groundwater levels in boreholes adjacent to St. Gorman's Well were monitored. Key findings of Hydrogeological Investigation Report 2022 with regards to the characterisation and assessment of potential impacts on St. Gorman's Well are summarised in Section 7.198, and concluded the following:

- Analysis of groundwater level and temperature data from borehole SG4 has shown that water levels and temperatures at the site are influenced and controlled by 'Earth tides' and the interplay of three groundwater flow systems present under the St. Gorman's Well site:
- A shallow, overburden-upper epikarst system that responds principally to local rainfall recharge;
- A deeper, confined/pressurised, more regional, major conduit karst system at depths of 30-100m in the Waulsortian Limestones. This system is confined over much of the general area by clays and clayey decomposed limestones which separate the deep karst groundwater system from the shallow perched water table in the overburden; and,
- A very deep, probably 'U-shaped' conduit system (50-1000m) which brings water from the greater depths towards the surface.
- The warm water flowing from St. Gorman's Well originates from the 'U' shaped conduit which is probably along a deep Cenozoic aged fault system which brings the water to sufficient depths to be warmed to about 20°C. Water flows down and along the 'U-shaped' conduit when rainfall recharge sufficiently raises the water table at the inlet. The exact source or location of the inlet to this deep conduit is unknown.
- Long, high rate pumping tests was completed at Rathcore Quarry to simulate the dewatering of the deepened quarry. Monitoring was undertaken at St. Goman's well during that pumping test to understand the potential effects of the future quarry dewatering. The water level monitoring results showed that pumping at the quarry had an effect on groundwater levels at St. Gorman's Well when the water levels were low but did not have an effect when groundwater levels were high and groundwater was flowing from the well.
- Based on the results of the pumping tests, designed to simulate the effects of the long term quarry dewatering, the following conditions arise:
- In winter conditions when there is enough recharge, St. Gorman's Well will continue to flow even if future groundwater dewatering at the quarry is implemented.
- In summer conditions, when there is limited recharge, water levels are low and St. Gorman's Well is naturally dry, there is potential for future quarry dewatering to slightly lower groundwater levels, as measured in the boreholes at the St. Gorman's Well site. The St. Gorman's Well spring depression can still fill and overflow when there is sufficient local rainfall recharge.
- Therefore, the pre-mitigation potential effect is considered to be direct, negative, imperceptible, long-term, unlikely effect on St. Gorman's Well.

Potential Effects on Designated Sites

7.263 The River Boyne and River Blackwater SAC and SPA are located downstream of the site and are hydrologically connected to the site via the tributary of the Blackwater River and the drainage channel into which the quarry discharges. The hydrological pathway (along the drainage channels) between the site and these designated sites is 9.3km.

7.264 Any changes in the quantity or quality of the surface water discharge has the potential to affect the qualifying interests of these downstream designated sites.

7.265 The pre-mitigation potential effect is considered to be indirect, negative, moderate, long-term, likely effect on the River Boyne and River Blackwater SAC and SPA.

Potential Effects on WFD Status

7.266 The potential surface water and groundwater effects are greater in the operational phase than in the construction phase described above. Therefore, the potential for the operational phase to effect the WFD status of the SWBs downstream of the site and the underlying GWBs is increased.

7.267 During the operational phase, increased dewatering will be required. This has the potential to negatively affect local groundwater levels and can impact the quantitative status of the underlying GWBs. In addition, the WFD status of the SWBs downstream of the site may be affected by the increased discharge volumes from the site.

7.268 Therefore, the pre-mitigation potential effect is considered to be an indirect, negative, moderate, long-term likely effect on the WFD status of the underlying GWBs and downstream SWBs.

7.269 A full WFD Compliance Assessment is included as **Appendix 7-D**.

Post – Operational Phase Effects (No Mitigation)

7.270 On cessation of the quarrying activities, pumping of water from the quarry void will cease and the quarry will be allowed to flood and become a natural habitat. All chemicals, petroleum-based products will be removed from the site prior to its closure to eliminate potential sources of contamination. Site security will be maintained post-closure to discourage unauthorized dumping or any other activities which have the potential to contaminate the water environment. A restoration scheme has been prepared for the quarry and will be implemented following permanent cessation of quarrying activities, refer to Chapter 2 of the EIAR for details.

Direct Effects

7.271 No direct post-operational effects on the water environment have been identified.

Indirect Effects

7.272 No indirect post-operational phase impacts on the water environment have been identified.

Significance of Potential Effects (Unmitigated)

7.273 The significance of the identified potential impacts, in the absence of mitigation, are assessed here and is shown in **Table 7-18** below. The significance of the impact is determined according to the table in **Appendix 7-I**.

Table 7-18
Summary of Pre-Mitigation Potential Effects

No.	Identified Potential Effect	Description of Effect (No Mitigation)	Magnitude of Effect (No Mitigation)
Construction Phase			
1	Change in Groundwater Vulnerability Rating.	Removal of soil/subsoil from proposed lateral quarry extension area will increase the groundwater vulnerability rating in these areas. However, the vulnerability rating is already 'Extreme-E', therefore there will only be a small change in the groundwater vulnerability rating to Extreme-X over an area of 0.9Ha, and this change is consistent with emerging trends in the area of the existing quarry.	Direct, negative, slight, permanent, likely effect.
2	Accidental Release of Hydrocarbons.	Reduction in surface or groundwater quality due to accidental spill or leaks of hydrocarbons. Groundwater is not particularly susceptible as pumping and dewatering will continue in this phase. Local groundwater will be drawn towards the quarry sump and discharged as surface water. The existing water treatment processes including hydrocarbon interceptor will be in use and there will be no untreated discharge to surface waters.	Indirect, negative, imperceptible, temporary, unlikely effect.
3	Potential Entrainment of Suspended Solids.	Reduction in surface or groundwater quality. Groundwater is not particularly susceptible as groundwater will flow into the quarry sump and be discharged as surface water following treatment. All water will be treated via a settlement pond prior to release as per the existing discharge water treatment processes.	Indirect, negative, imperceptible, temporary, unlikely effect.
4	Potential Effect on Local Groundwater Wells.	Reduction in local groundwater quality. The potential is very limited due to the nature of the hydrogeological regime, with local groundwater flow being directed to the quarry void. Due to the ongoing pumping regime, the quarry void will act as a sink for groundwater flow rather than a source. No groundwater will leave the area of the quarry during the construction phase. There will be no change in groundwater levels as pumping is already ongoing.	Direct, negative, imperceptible, temporary, unlikely effect.
5	Potential Effect on WFD Status.	Effect on the overall status of the underlying GWBs are unlikely due to the nature of this phase of the development. There will be limited change in the baseline hydrogeological	No potential for effect

No.	Identified Potential Effect	Description of Effect (No Mitigation)	Magnitude of Effect (No Mitigation)
		environment as pumping is already ongoing. Similarly there will be limited potential to effect the status of downstream SWBs as the quarry is already discharging treated effluent, and monitoring of existing discharge water quality demonstrates that discharge limits are achieved 91 to 100% of the time.	
Operation Phase			
6	Potential Effects of Quarry Dewatering on Groundwater Levels.	Deepening of the quarry void will lower local groundwater levels. Long-term groundwater level monitoring indicates that the current dewatering regime has not impacted local wells. Furthermore, recent groundwater level monitoring completed during pumping testes designed to simulate the predicted dewatering (of the extended and deepened quarry) showed a groundwater level fall of ~2m in nearby local wells. The study concluded that the shallow wells, sourced from the overburden aquifer will not be affected by the proposed development as the overburden aquifer is perched above the underlying bedrock aquifer. Deep bedrock boreholes will experience a groundwater drawdown of ~2m. However, these wells have the capacity to cope with such a fall in water level as they are sourced from a network of deep fractures and conduits which will continue to provide an adequate water supply. The proposed development will not impact the yield of these wells.	Direct, negative, slight, long-term, likely effect.
7	Potential Effects on Downstream Flow Volumes.	Increase in flow volumes associated with greater pumping rates. Discharge volumes will increase gradually throughout the operational phase as the quarry void is extended and deepened. A channel capacity assessment has shown that the drainage ditch has the capacity for the estimated flow. The drainage ditch and downstream watercourses coped with similar flow during a long high-rate pumping test.	Direct, negative, moderate, long-term, likely effect.
8	Potential Effects on Downstream Surface Water Quality.	Increased volumes of discharge may have the potential to overwhelm the existing water treatment system and result in downstream surface water quality effect.	Direct, negative, moderate, long-term, likely effect.
9	Potential Effect on Water Quality due to Contamination with Wastewaters.	The release of effluent from wastewater treatment systems has the potential to impact local surface and groundwater quality. Groundwater quality is less susceptible due to the local hydrogeological regime and groundwater pumping.	Direct, negative, slight, long-term, unlikely effect.

No.	Identified Potential Effect	Description of Effect (No Mitigation)	Magnitude of Effect (No Mitigation)
10	Potential Effects on Karst Features (St. Gorman' Well).	Potential water level effects associated with quarry dewatering and the groundwater system which feeds this warm spring at St. Gorman's Well. Pumping tests designated to simulate the future quarry dewatering, have shown that the spring will continue to flow during winter despite the proposed quarry dewatering.	Direct, negative, imperceptible, long-term, unlikely effect.
11	Potential Effects on Designated Sites.	River Boyne and River Blackwater SAC and SPA are located downstream of the site. Any changes in discharge quality or quantity may affect these designated sites.	Indirect, negative, moderate, long-term, likely effect
12	Potential Effects on WFD Status.	Groundwater level effects associated with dewatering and increased drawdown may affect the status of the underlying GWBs. Any changes in discharge quality or quantity may affect downstream SWBs.	Indirect, negative, moderate, long-term likely effect

Unplanned Events

7.274 Potential effects on surface water or groundwater could occur (in the worst case scenario, with no monitoring or management) from accidental spillages, uncontrolled discharges and or downstream flooding.

7.275 Spillages of fuels or chemical during quarrying activities could happen in the absence of proper controls, maintenance and supervision. Surface water discharges could potentially breach water quality limits without monitoring and water treatment. Pump failure in the quarry could result in the ingress of groundwater and the flooding of the quarry floor. Furthermore, uncontrolled discharge could lead to flooding downstream of the site on the Blackwater River and its tributary.

7.276 However, appropriate mitigation measures and monitoring are proposed below to ensure that there are no potential effects on the water environment as a result of unplanned events at the site.

‘Do-nothing Scenario’

7.277 If the proposed lateral extension and deepening of the quarry is not permitted, the extension area will remain undeveloped. Furthermore, the wider quarry void will be allowed to fill with water and the site will be restored to a variety of ecological after uses.

Cumulative Effects

7.278 There are no other quarries or pits in the immediate vicinity of the site. The existing quarry at the site is currently operational.

7.279 The closest bedrock quarries to the site are at Trammon, located ~5.7km to the northeast near Rathmolyon. According to the GSI bedrock geology map these two quarries are hosted in the Waulsortian Limestones. These quarries are located a sufficient distance away from the site to ensure that there will be no cumulative groundwater related effects. In relation to potential cumulative surface water effects, the two Trammon Quarries discharges into a small tributary of the Boyne River. These quarries operate in accordance with an existing discharge licences (14/01 and 04/02). Given the significant volumes of water within the River Boyne, the separation distance between the 3 no. quarries and the existing discharge licence emission limits, there will be no cumulative effects on the hydrological environment.

7.280 Detailed mitigation measures are outlined below to ensure the protection of surface water and groundwater quality during all phases of the proposed development. This will ensure that there is no potential for any significant cumulative effects to arise as a result of the proposed development.

MITIGATION MEASURES

7.281 Mitigation measures required to reduce the significance of potential effects associated with the proposed development are detailed below.

7.282 Mitigation measures are already in place at the existing quarry to prevent any reduction in the quality of the local hydrological and hydrogeological environment. These measures will remain in place during the construction phase and may be altered for the operational phase to cater for increasing volumes of water.

7.283 The mitigation measures will be implemented at the site during the proposed deepening of quarry to reduce the potential negative effects on the receiving environment which have been identified and outlined above in this assessment.

Construction Phase

Change in Groundwater Vulnerability Rating

7.284 There will be an increase in groundwater vulnerability rating due to the removal of overburden, however this will only occur in the small lateral extension to the quarry (0.9ha). The removal of this overburden is seen as an acceptable consequence of the proposed development and is in line with trends in the surrounding environment *i.e.* the proposed extension is adjacent to the existing quarry.

7.285 The main mitigation with respect to groundwater quality will be through the employment of best practice mitigation measures with respect to oil usage and refuelling of plant and machinery.

Accidental Release of Hydrocarbons

7.286 The following mitigation measures will be employed with respect to hydrocarbons:

- All plant and machinery will be serviced before being mobilised to site;
- Refuelling will be completed in a controlled manner using drip trays (bunded container trays) at all times;
- Only designated trained operators will be authorised to refuel plant on site;
- Procedures and contingency plans will be set up to deal with emergency accidents or spills; and,
- All water pumped from the quarry will pass through a hydrocarbon interceptor prior to discharge.

Potential Entrainment of Suspended Solids

7.287 No specific mitigation measures are required. Due to the bowl shaped nature of the site, all run-off will gather in the floor of the existing quarry and will be treated as per the existing water treatment train prior to discharge. There will be no discharge of untreated waters.

Potential Effects on Local Groundwater Wells

7.288 No specific mitigation measures in relation to nearby private wells are required. During the construction phase, dewatering of the existing quarry void will continue at similar rates to the existing pumping rates. This pumping from the sump directs local groundwater flow towards the quarry. Therefore, there is no potential for any groundwater quality effects in nearby local wells. Furthermore, there is no discharge of untreated water and therefore any local shallow wells in the perched sand and gravel aquifer will not be impacted by the surface water discharge. No groundwater quantity or quality effects have been reported to date in nearby wells.

Potential Effects on WFD Status

7.289 The mitigation measures detailed above for the protection of surface and groundwater during the construction phase of the proposed development will ensure that there is no change in the WFD status of any waterbody.

Operation Phase

Potential Effects of Quarry Dewatering on Groundwater Levels (Increased Drawdown)

7.290 The proposed deepening of the quarry will extend to 45mOD, therefore limiting the extent of local groundwater drawdown.

7.291 A detailed Hydrogeological Investigation Report 2022 has been completed at Rathcore Quarry and that study included long, high-rate pumping tests designed to simulate the effects of the proposed dewatering on groundwater levels. This assessment found that there is not likely to be any significant effects on nearby deep private wells due to the limited drawdown (~2m). This limited drawdown effect is proven, and is not an estimate and as a result there will be no significant effects on the yield of the bedrock wells. Furthermore, there will be no effect on local shallow wells as these are sourced from the overburden aquifer which is perched above and separated from the limestone bedrock by a layer of boulder clay.

7.292 Kilsaran will continue to monitor groundwater levels in both on-site boreholes and local private wells throughout the operation phase to identify any further potential effects. In the event that a significant effect is identified, Kilsaran will either deepen the well or provide an alternative water supply to the property.

7.293 No additional mitigation measures are required.

Potential Effects on Downstream Surface Water Flow Volumes

7.294 A water management system is already in place at Rathcore Quarry whereby a combination of groundwater and surface water is treated and attenuated within the site prior to discharge in accordance with the existing discharge licence.

7.295 The existing water management system will be upgraded as required to deal with the increasing volumes of water. The following mitigation measures will be implemented with respect to surface water discharge volumes:

- An expanded temporary sump on the quarry floor will provide attenuation of water;
- Water will be pumped to the existing settlement pond which will provide additional attenuation;
- An additional settlement pond (equivalent to the existing pond) will be installed if sampling results for suspended solids indicates that additional treatment is required;
- Kilsaran will apply to Meath County Council for a review of the existing discharge licence at the site. This licence will set out a new discharge volume limit and Kilsaran will comply with the conditions in any revised discharge licence and will put in place the necessary measures to achieve this; and,
- The volume of water to be discharged will increase gradually throughout the operational phase as the quarry void is extended and deepened. Site investigations have shown that the bedrock in the north of the quarry contains a higher concentration of water bearing fractures and conduits in comparison to the southern area. A key mitigation during the operational phase will be to work the benches from south to north, thereby reducing the periods when maximum discharge volumes will be required.

Potential Effects on Downstream Surface Water Quality

7.296 The proposed development will utilise the existing water treatment system designed to prevent contamination of local surface waters.

7.297 During the initial period of pumping, the pumped groundwater may contain a higher concentration of suspended solids (they may be fully flushed already) as the clay in the karst conduits is disturbed. Initial “dirty” water was encountered during the initial period of the long pumping tests. In the event that groundwater contains high concentrations of suspended solids, this “dirty” water will be released onto the floor of the quarry, where suspended solids will settle out naturally. A sump will be located at a low point on the quarry floor and water will be directed to this sump. The sump will promote additional settling of solids. Water from the sump will then be pumped to a settlement pond and will undergo the same treatment as for the standard operational phase (discussed below) which will require less treatment as the groundwater will contain significantly lower concentrations of suspended solids. To date pumping from an open sump at Rathcore has not displayed any high concentrations of suspended solids, with the sump on the quarry floor comprising of clean groundwater. It is unlikely that the same disturbance to clay in cavities will occur whilst pumping from an open sump in comparison to pumping from a confined borehole (i.e. the long pumping tests).

7.298 The following mitigation measures will be in place for the operational phase once the initial dirty water has been treated:

- The water will be directed to the quarry sump through channels on the quarry floor and will then be pumped up to the discharge treatment area be treated through the settlement lagoon(s), hydrocarbon interceptor and a constructed reed bed prior to discharge as surface water;
- An additional settlement pond will be installed if sampling results for suspended solids indicates that additional treatment is required. The settlement pond and the sump on the quarry floor will be sized to ensure there is adequate retention time for the settling of solids;
- Additional treatment capacity for hydrocarbons, in the form of hydrocarbon separator(s), will be added as required with the increase in discharge from the site;
- Kilsaran will apply to Meath County Council for a review of the existing discharge licence at the site. Kilsaran will comply with the conditions in any revised discharge licence and will put in place the necessary measures to achieve this;
- Fuel will be stored in the designated bunded tanks at the site with 110% of the tank capacity, and in a double skinned tank for the pump generator;
- Surface water from bunds will be pumped out through a suitable oil interceptor or will be taken off site by a licenced contractor for disposal;
- All chemicals and lubricating/hydraulic oils will be stored on spill trays under cover in the existing workshop;
- Waste oils will be stored under cover in the workshop on spill pallets and will be collected and disposed of by a licenced contractor;
- All plant will be regularly maintained and inspected daily for leaks of fuels, lubricating oil or other contaminating liquids/liquors;
- Maintenance of plant and machinery will be undertaken within existing site maintenance sheds / workshop or on the hard stand area in front of the workshop, as appropriate, in order to minimise the risk of uncontrolled release of polluting liquids;
- The refuelling of vehicles will be undertaken on the surfaced area adjacent from the fuel tank beside the workshop, in order to minimise the risk of uncontrolled release of polluting liquids / liquors reaching the receiving environment;

- The refuelling of plant and machinery on the quarry floor will only be undertaken using a mobile double skinned fuel bowser, in order to minimise the risk of uncontrolled release of polluting liquids/liquors which may arise from an accident; and,
- A spill kit is kept on site to stop the migration of any accidental spillages, should they occur.

Potential Effects on Water Quality Due to Contamination with Wastewater

7.299 Wastewater at the site will be treated in a new proprietary treatment system which will comprise of a septic tank and filter system. The treated effluent will be released through a percolation area.

7.300 No additional mitigation measures are required.

Potential Effects on Karst Features (St. Gorman's Well)

7.301 A detailed Hydrogeological Investigation has been completed for Rathcore Quarry and this included an assessment of the potential effects of the dewatering on groundwater levels at St. Gorman's Well and flows from the spring. The investigations (which are included in full in **Appendix 7-B**) concluded that there is no link between lowering of the water levels at the quarry and the groundwater system which drives warm water to the surface at St. Gorman's Well.

7.302 Therefore, no specific mitigation measures are required. Furthermore, no monitoring will be required at St. Gorman's Well with respect to potential effects arising from the proposed development. Intermediate groundwater level monitoring will be completed in the private wells adjacent to the quarry and this monitoring will detect any increased drawdown signal.

Potential Effects on Designated Sites

7.303 The proposed development is located upstream of the River Boyne and the River Blackwater SAC and SPA. The surface water connections from the site could transfer poor quality surface water that may affect these designated sites. However, with the implementation of the mitigation measures detailed above (for discharge water treatment), there will be no effect on these downstream designated sites.

Potential Effects on WFD Status

7.304 Strict mitigation measures in relation to the protection of surface and groundwaters are detailed above. The implementation of these measures will ensure that the qualitative and quantitative status of the receiving waterbodies will not be altered by the proposed development.

7.305 There will be no change in status of the underlying GWBs or downstream SWBs resulting from the proposed development. As such the proposed development is compliant with the requirements of the Water Framework Directive.

RESIDUAL IMPACT ASSESSMENT

Construction Phase (Post-Mitigation)

7.306 No significant residual effects on the water environment will occur in the construction phase due to the short-term and temporary nature of the works. The post-mitigation residual effects are summarised in **Table 7-19**.

7.307 Due to the local hydrogeological regime, coupled with the implementation of the proposed mitigation measures for the protection of groundwater and downstream surface waters, we consider that there will be no residual effect on the WFD status of surface or groundwater bodies in the vicinity of Rathcore Quarry.

Operational Phase (Post Mitigation)

Potential Effects of Quarry Dewatering on Groundwater Levels (Increased Drawdown)

7.308 Due to the nature of the bedrock geology at the site and the proposed mitigation measures we consider that the residual effect to be a direct, negative, slight, long-term, likely effect on local groundwater levels.

Potential Effects on Downstream Surface Water Flow Volumes

7.309 With the implementation of the mitigation measures outlined above, the existing water attenuation facilities at Rathcore Quarry and the ongoing discharge monitoring, we consider the residual effect to be a direct, negative, imperceptible, long-term, unlikely effect on downstream surface water flow volumes.

Potential Effects on Downstream Surface Water Quality

7.310 With the implementation of the mitigation measures outlined above, the existing and proposed water treatment systems and the ongoing discharge monitoring, we consider the residual effect to be a direct, negative, imperceptible, long-term, unlikely effect.

Potential Effects on Water Quality Due to Contamination with Wastewater

7.311 With the implementation of the new proposed wastewater treatment system at the site, we consider the residual effect to be a direct, negative, imperceptible, long-term, unlikely effect.

Potential Effects on Karst Features (St. Gorman's Well)

7.312 Due to the separation distances involved, the site specific geological and hydrogeological knowledge of the local area and groundwater levels, and with the knowledge of how the proposed pumping will impact groundwater levels in the area of St. Gorman's Spring we can conclude that the residual effect is a direct, negative, imperceptible, long-term, unlikely effect.

Potential Effects on Designated Sites

7.313 With the implementation of the mitigation measures targeted at surface and groundwater quality, we consider the residual effect to be indirect, negative, imperceptible, long-term, unlikely.

Potential Effects on WFD Status

7.314 With the implementation of the mitigation measures outlined above there will be no change in the GWB or SWB status in the underlying GWBs or downstream SWBs resulting from the proposed development. The proposed development will not result in the deterioration in the WFD status of any surface or groundwater body nor will it jeopardise the attainment of good status in the future.

Post – Operational Phase (Post Mitigation)

7.315 No residual effects will occur on the hydrological and hydrogeological environment during the post-operational phase.

7.316 A summary of the post mitigation potential effects is presented in **Table 7-19**.

Table 7-19:
Post-Mitigation Potential Residual Effects

No.	Identified Potential Effect	Post-Mitigation Potential Effects	Magnitude of Effect
Construction Phase			
1	Change in Groundwater Vulnerability Rating.	The application of best practice methods with regard to oils and fuels will ensure that there are no significant effects on groundwater quality.	Direct, negative, imperceptible, permanent, likely effect.
2	Accidental Release of Hydrocarbons.	All operations during the construction phase will continue in accordance with best practice procedures with respect to hydrocarbons. The existing water treatment process includes the provision of a hydrocarbon interceptor. There will be no discharge of untreated water.	Indirect, negative, imperceptible, temporary, unlikely effect.
3	Potential Entrainment of Suspended Solids.	All operations during the construction phase will continue in accordance with best practice procedures with respect to suspended solids. The existing water treatment process includes the use of a hydrocarbon interceptor, a settlement pond, and a constructed reed bed. There will be no discharge of untreated water.	Indirect, negative, imperceptible, temporary, unlikely effect.
4	Potential Effect on Local Groundwater Wells.	There will be no effects on groundwater quantity as there will be no increase in dewatering/pumping rates during this phase. The application of best practice procedures with respect to hydrocarbons will ensure the protection of groundwater quality.	Direct, negative, imperceptible, temporary, unlikely effect.
5	Potential Effect on WFD Status.	Due to the minor and small-scale nature of the works there is no potential for the status downstream SWBs or underlying GWBs to be impacted during the construction phase.	No potential for effect
Operation Phase			
6	Potential Effects of Quarry Dewatering on Groundwater Levels.	Recent groundwater level monitoring completed during pumping tests designed to simulate the predicted dewatering showed a groundwater level fall of 2-4m in nearby local wells. The study concluded that shallow wells will not be affected as these source water from the overlying perched water table. Groundwater supplies in the deep bedrock	Direct, negative, slight, long-term, likely effect.

No.	Identified Potential Effect	Post-Mitigation Potential Effects	Magnitude of Effect
		boreholes will not be impacted as many strike deep cavities which will not be affected by the proposed development.	
7	Potential Effects on Downstream Flow Volumes.	The drainage ditch and downstream watercourses coped with similar flow during a long high-rate pumping test. A discharge licence review is recommended as the existing discharge rates exceed the permitted emission limits.	Direct, negative, imperceptible, long-term, likely effect.
8	Potential Effects on Downstream Surface Water Quality.	All operations will be in accordance with best practice procedures with respect to hydrocarbons. Detailed mitigation measures are proposed including the provision of additional hydrocarbon interceptors and additional settlement ponds as required to cater for the increased volumes of water requiring treatment.	Direct, negative, imperceptible, long-term, likely effect.
9	Potential Effect on Water Quality due to Contamination with Wastewaters.	A new proprietary wastewater treatment system is proposed and there will be no untreated discharge of wastewaters at the site.	Direct, negative, imperceptible, long-term, unlikely effect.
10	Potential Effects on Karst Features (St. Gorman' Well).	A detailed Hydrogeological Investigation Report has concluded that there is no link between lower groundwater levels at the site and the groundwater system which feeds warm water to the spring.	Direct, negative, imperceptible, long-term, unlikely effect.
11	Potential Effects on Designated Sites.	With the implementation of the proposed mitigation measures and upgrades to the existing water treatment process, there will be no effects on downstream designated sites.	Indirect, negative, imperceptible, long-term, likely effect
12	Potential Effects on WFD Status.	With the implementation of the proposed mitigation measures there will be no change in the WFD status of any waterbody as a result of the proposed development.	Indirect, negative, moderate, long-term likely effect

MONITORING

7.317 Surface water and groundwater monitoring is currently undertaken at the site in compliance with existing planning conditions and the existing discharge licence as set out below. The existing monitoring regime at the site will continue or as revised by conditions in a reviewed discharge licence.

Surface Water Monitoring

7.318 Discharge quality and volume is monitored as per the conditions in the existing discharge licence (Ref. No. 13/02) for the site. Monitoring will continue during the proposed works.

7.319 Discharge water quality is monitored on a monthly basis for the following parameters:

- BOD (mg/l);
- COD (mg/l);
- Suspended Solids (mg/l);
- pH;
- Orthophosphate (mg/l);
- Nitrates (N) (mg/l);
- Ammonium (N) (mg/l);
- TPH (µg/l);
- BTEX (µg/l);

7.320 Discharge volume is monitored on a continuous basis using the existing weir and an automatic flow level logger.

Groundwater Monitoring

7.321 Groundwater levels will continue to be recorded on a weekly basis for the onsite wells and on a monthly basis for nearby residences. No monitoring is required at St. Gorman's Well as the intermediate monitoring to be completed onsite and at nearby residences will detect any increased groundwater drawdown.

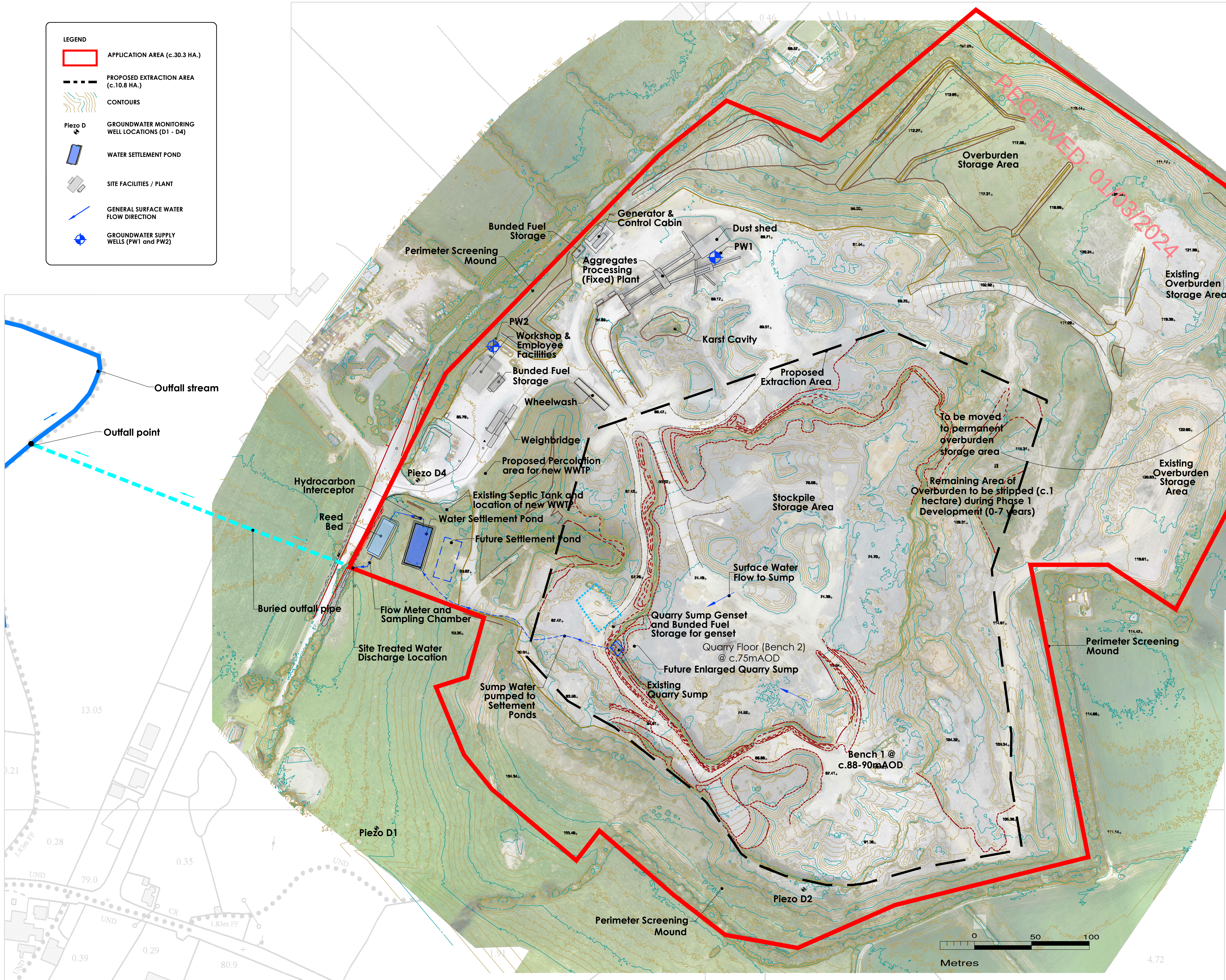
7.322 Groundwater sampling and testing will be undertaken on an annual basis at the site potable supply well (PW2) and at the groundwater monitoring wells (D1-D4). Groundwater samples will be tested for a range of physical and chemical parameters in order to assess water quality. The parameters to be tested for are:

- Conductivity;
- pH value;
- Total Coliforms CFU/100mls;
- Ammonia mg/l NH_3-N;
- Nitrate mg/l NO_3;
- Nitrite mg/l;
- Ortho Phosphate / Ortho Phosphate mg/l as P;

- TPH mg/l;
- PRO mg/l; and
- DRO mg/l.

7.323 No monitoring will be required at St. Gorman's Well with respect to potential impacts arising from the Proposed Development. As described above, there will be no residual effect on St. Gorman's Well. However, in order to advance the hydrogeological understanding at St. Gorman's well Kilsaran propose to continue to monitor groundwater levels in a borehole adjacent to the spring. A continuous water level datalogger will be installed and will be downloaded at quarterly intervals (permission has been granted by the landowner of Hotwell House for this activity). In the future this data can be used to further our understanding of Irish geothermal springs and will be made available to the GSI.

FIGURES



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Date	Description	Chkd	Signed

Revisions

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Client: Kilsaran Concrete

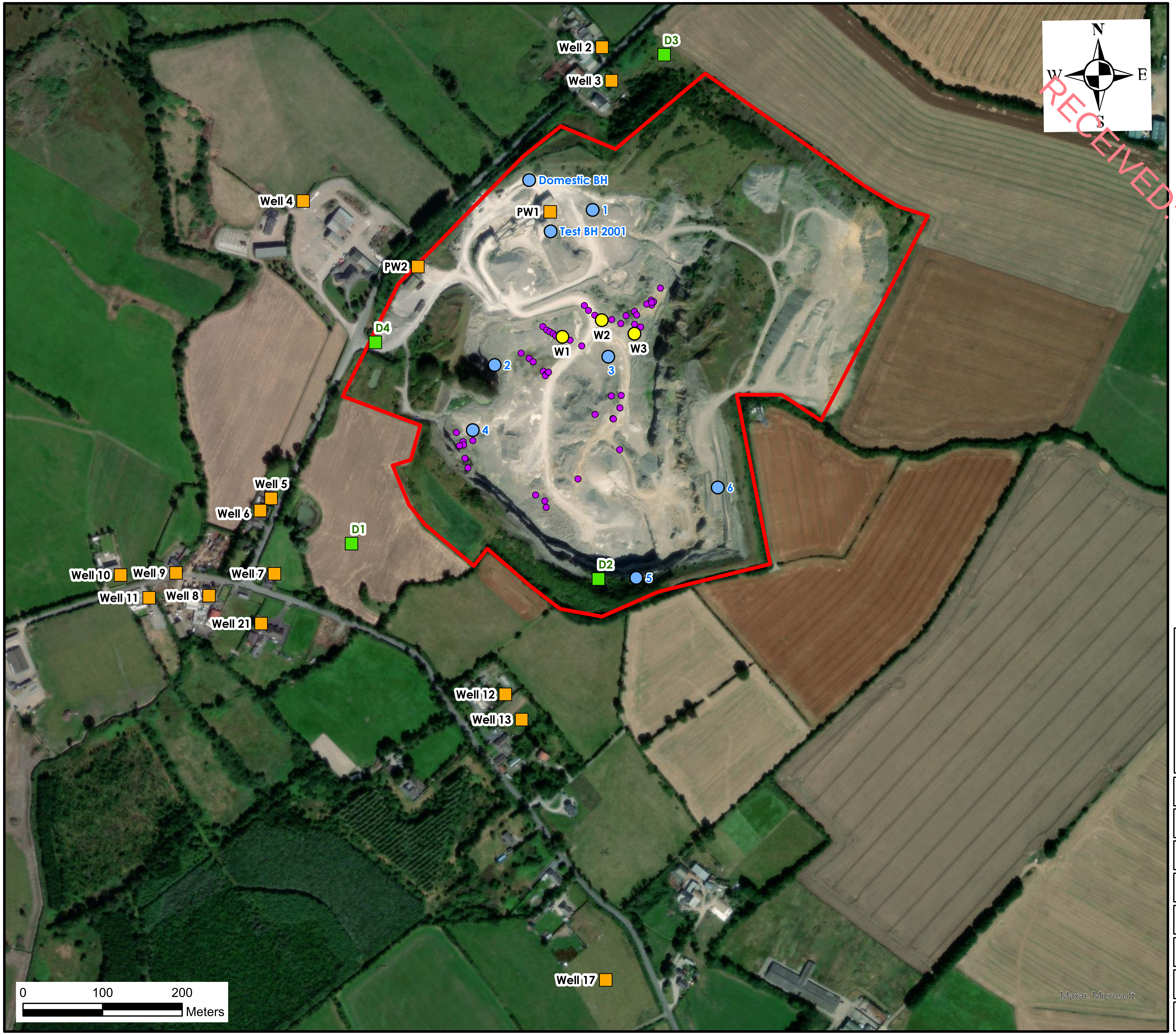
Job: Rathcore Quarry, Co. Meath

Title: Existing Site Layout and Water Management System

Figure No: 7-1

Drawing No: P1642-0-0124-A3-701-00A

Sheet Size: A3	Project No.: P1642-0
Scale: 1:2,500 (A3)	Drawn By: GA
Date: 11/01/2024	Checked By: MG



Legend

- Site Boundary
- 2001 Coreholes and Boreholes
- 2019 Test Wells
- Domestic Monitoring Wells
- Monitoring Wells/Core Holes
- 52 no. 2019 Exploratory Boreholes

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Client: Kilsaran Concrete	
Job: Rathcore Quarry, Co. Meath	
Title: Site Investigation Locations at Rathcore Quarry	
Figure No: 7-2	
Drawing No: P1642-0-0124-A4-702-00A	
Sheet Size: A3	Project No: P1642-0
Scale: 1:4,500	Drawn By: GA
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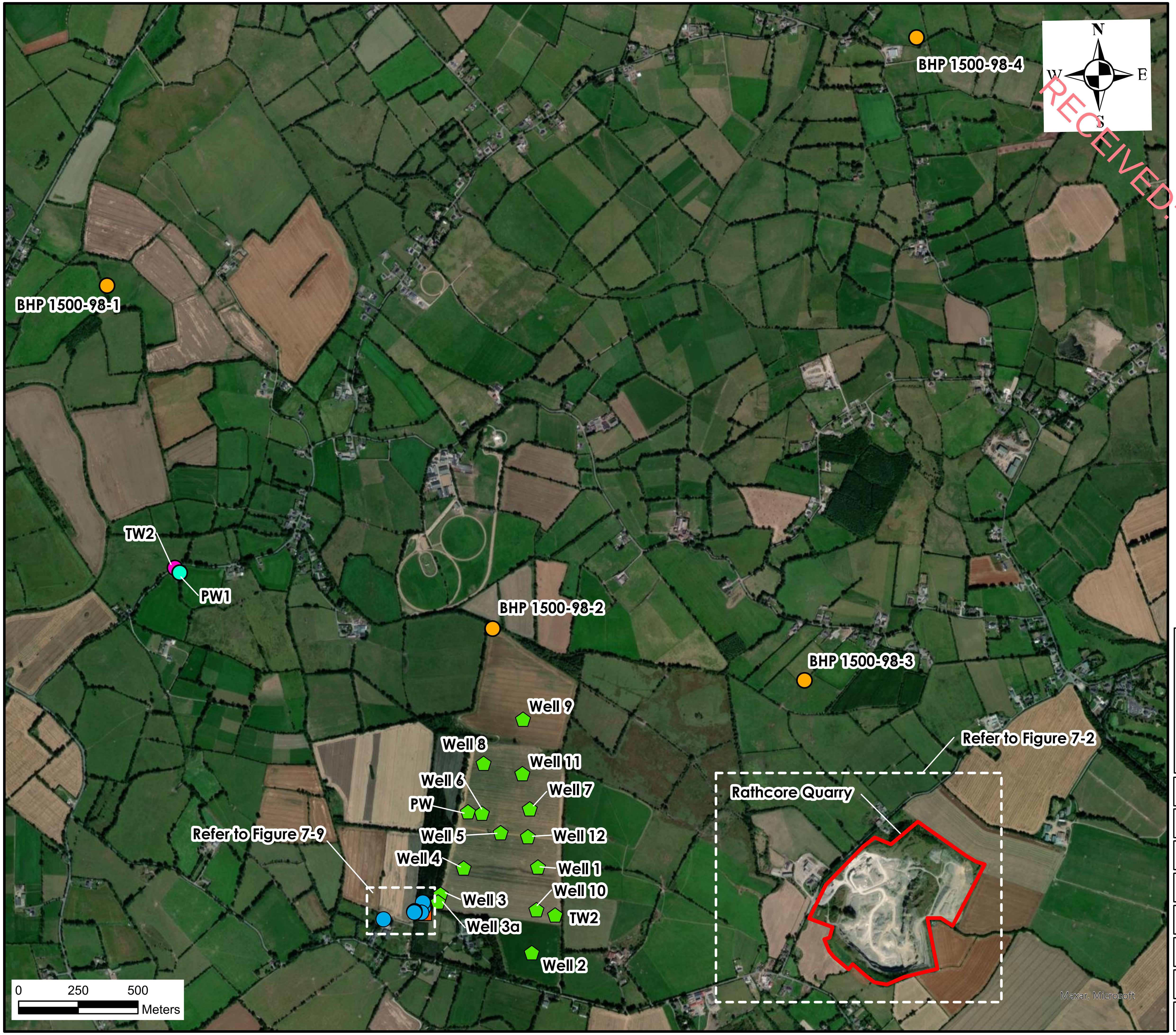

Legend

- Site Boundary
- St. Gorman's Well
- BHP Exploration Wells (1998)
- EDA Ballinakill Boreholes (2001-2006)
- Hydro Research and F.Murphy Boreholes (1980s)
- Longwood Exploratory Borehole (1985)
- Longwood Water Supply Borehole (2001)

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Client: Kilsaran Concrete	
Job: Rathcore Quarry, Co. Meath	
Title: Site Investigation Locations near St. Gorman's Well	
Figure No: 7-3	
Drawing No: P1642-0-0124-A4-703-00A	
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