CHAPTER 8

WATER

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QUARRY CONSULTING

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CHAPTER 8: WATER

Statement of Authority

8.1 The evaluation of the Water (hydrological and hydrogeological) environment and the assessment of Effects and Potential Impacts, with Mitigation Measures and Remedial Impacts, was completed by Dr. Pamela Bartley (Hydro-G) who is considered a karst groundwater specialist with quarry, Section 4 Discharge Licencing and Public Water Supply expertise.

8.2 Pamela Bartley's Statement of Expertise is presented as **Appendix 8.1.**

8.3 This Water Chapter and the Lands, Soils & Geology Chapter were created by the same professional civil engineering hydrogeologist, who has soils, geology, hydrological and groundwater competency.

EIAR Structure

8.4 The Road Map for the EIAR was presented in Chapter 2.0 of this EIAR. Chapter 1.0 provided information on the Site location and Context, Chapter 3.0 provided the Description of the Proposed Development and Chapter 16.0 addresses the Interactions of the foregoing. This Chapter of the EIAR assesses the impact of the proposed development on the hydrological and hydrogeological environment.

Overview

8.5 McGraths Limestone Works Ltd. is proposing to further develop the northern part of an existing and permitted limestone quarry at Cregaree, Cong, Co. Mayo. The proposed total footprint of the site (i.e. the existing quarry site and the proposed site extension) will be referred to as "the site" for ease of reference throughout this chapter. The area under consideration in this application is already quarried, with permission, and the proposal is to bring the existing quarry in the north deeper, but to the same elevation as permitted for the southern area of the site.

8.6 The site lies on an 'isthmus', i.e. a land bridge, of limestone between Lough Mask and Lough Corrib. The site is mostly in county Mayo and a small portion of it is in County Galway. It is near the village of Cong.

8.7 The ITM coordinates for central to the overall site are ITM Easting: 514150, ITM Northing 756180.

8.8 The natural land surface elevation of the entire quarry lands before excavations took place there was approximately 26m OD to ~20m OD, approximately. Indeed, the line of Longitude joining Lough Mask, the quarry and Lough Corrib has a land surface elevation of ~20m OD across the entire isthmus between Lough Mask and Lough Corrib. There are a few small dips in the land immediately south of the quarry. There are a few small mounds north and west of the quarry but nothing significant. Land drops steeply south of Cong in the vicinity of the shore of Lough Corrib.

8.9 Whilst the quarry is in County Mayo, the site's licenced Section 4 (W/391/05_R1) discharge point is in County Galway. Refer to **Appendix 8.2** for a copy of the Site's Discharge Licence. Refer to Figure 8.1 for the Site Layout and Discharge Location. Details relating to the Licence is presented in the following section of this Chapter.

8.10 The site lies within the Corrib Catchment (HA30) and Lough Corrib has designation as a European Site (Lough Corrib SAC, 000297; Lough Corrib SPA 004042; proposed NHA 000297) and also has two Statutory Instruments associated: the European Communities Conservation of Wild Birds (Lough

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Corrib Special Protection Area 004042) Regulations 2012 and Lough Corrib Special Area of Conservation 000297 Regulations 2022. Water is a supporting habitat. Therefore, this assessment considers water, ecological receptors and Conservation Objective Sites in an integrated way.

8.11 In addition to connectivity to Conservation Objection Sites, the site's situation in the catchment of Lough Corrib is significant also in the context of Public Water Supply because Lough Corrib is the source of supply to Galway City, Tuam and much of north-east Galway. However, the closest PWS intake is at Luimnagh, which is on the shores of a sheltered inlet on Lough Corrib, and at a distance of c.20km to the south east of the site. The other PWS intake is the Terryland PWS Intake at Galway city is c.34km south of the site. Each of these PWS intakes will be discussed in more detail later.

The Site's Section 4 Discharge Licence

8.12 The site's Section 4 Discharge Licence was originally issued in 2007 but was site initiated 'Reviewed' in 2019 (W/391/05_R1). The Licence is therefore current with legislative requirements.

8.13 The licence was granted, in review, in 2019 to accommodate waters arising over the entire landholding of the site and from the contributing lands. Therefore, the Water Management infrastructure is in place to serve the development currently under proposal. Rainfall arising and running off the quarry floor, in combination with any wall seeps, flows naturally by gravity from north to south to the floor sump at the lowest elevation on the site. The quarry footprint will remain the same under this application i.e. the proposal is for deepening within the permitted quarry footprint with no additional land take proposed. The Water Management System is described after the sections describing the Application Site and Existing Development, below.

8.14 The site is permitted to discharge a maximum of 10,000 m3/d to the Cong Canal, which is the licensed receiver of the site's discharge. Refer to **Figure 8.1 and Appendix 8.2.**

8.15 The Cong Canal flows outside and along the eastern boundary of the quarry's landholding.

8.16 The Cong Canal is the hydrological connector between Lough Mask and Lough Corrib. It is noted that Lough Carra is upstream of Lough Mask and therefore, the Cong Canal's order of low is Lough Carra > Lough Mask > Lough Corrib.

8.17 The Emission Limit Value (ELV) for a volume of 10,000 m3/d is an administrative Emission Limit Value future proofing the site for Climate Change and Extreme Storms that could generate large volumes of water on the quarry floor.

8.18 The site's Section 4 Licence (W/391/05_R1) Emission Limit Values and Conditions were arrived at through detailed consultations with Galway County Council, Inland Fisheries and the EPA in the matter of how to adequately assess the Cong Canal, Lough Corrib and Fisheries interests.

8.19 Fisheries have a particular interest because there is a hatchery between the site and Lough Corrib. Fisheries were included in all aspects of the evaluation of the Reviewed Licence in 2019 and there were no objections to issue.

8.20 Hydro-G consulted with the EPA on how best to assess the potential impact and feasibility of the Discharge in the context of the particular characteristics of the Cong Canal. Consultations and simulation outcomes are detailed in the Hydro-G (2019) report supporting the grant of the site's Section 4 Licence. The Hydro-G (2019) report is presented as **Appendix 8.3.**

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8.21 The Cong Canal is classified as a 'Artificial' channel under Water Framework Directive Classifications (Dr. Jenny Deakin, EPA) and as a known losing stream to groundwater in summer (Dr. Conor Quinlan, EPA).

8.22 In reality, the site's discharge is rainfall response dominated and therefore discharges to a dry Cong Canal do not generally occur. However, the site's discharge was evaluated for both Surface Water and Groundwater compliance feasibility in order to fully account for the potential for the Cong Canal to act as a 'losing' stream.

8.23 The significance of the Groundwater Regulations (2010) was raised following 2019 consultation with Galway County Council and the EPA. Given that the receiving water is the Cong Canal and that this is classified as a 'Artificial' channel under Water Framework Directive Classifications (Dr. Jenny Deakin, EPA) and as a known losing stream to groundwater in summer (Dr. Conor Quinlan, EPA): Dr. Matt Craig's (EPA) suggestion is that streams and rivers that lose to groundwater (and go dry) aren't really adequately captured by solely applying the assimilative capacity approach or direct discharge to groundwater approach. The direct discharge to groundwater guidance suggests that streams which end up in swallow holes (or by inference have significant loss to groundwater) should follow the direct discharge to groundwater approach. Therefore, the information presented to Galway County Council in 2019, which was accepted as a valid description of the systems, demonstrated that there were adequate assimilative capacities in both the surface water and the groundwater systems.

8.24 Direct Discharge to Groundwater and this is permitted under the Groundwater Regulations (2010, as amended): Regulation 8 of the Groundwater Regulations 2010 allows for direct discharge in Clause 8(a)(ii) "for reinjection of pumped groundwater from mines and quarries or associated with the construction or maintenance of civil engineering works"…. "Subject to a requirement for prior authorisation provided such discharges, and the conditions imposed, do not compromise the achievement of the environmental objectives established for the body of groundwater into which the discharge is made".

8.25 The Cong Canal flows to the Cong River. There is an Inland Fisheries hatchery between the quarry and the Cong River. However, the quarry and the Hatchery are not connected because the hatchery takes its incubation and operation waters from the Mill Pool at its site, which is fed by a massive groundwater spring in a deep pond central to the hatchery. The Hatchery has its own discharge licence. LA Reference No W057/78; Licence Holder Name Cong Fish Hatchery; Facility Address Cong, Co Mayo, LA Name Galway County Council. The potential impact of each Licence was evaluated during the 2019 review process.

8.26 The drivers of the site initiated Review of the Section 4 Discharge Licence in 2019 was that the 2007 Licence was not Surface Water Regulation 2009 compliant: the 2007 Licence had not been reviewed when the Surface Water Regulations were enacted and therefore there was no ELV for Ammonia. This was identified as something that left the site vulnerable from an administrative and WFD compliance perspective.

8.27 In the evaluations of the defensible ELVs for the future, assimilation capacity simulations using daily discharge values, monthly monitoring data for the discharge and upstream receptor water quality enabled a conclusion that the maximum permitted daily discharge volume ELV could be increased from the 2007 value of 864 m3/d to a future proofed 10,000 m3/d ELV, which made adequate provision for climate change or encountering groundwater in the future.

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8.28 The ELVs (Emission Limit Values) requested in 2019, which are defensible and regulatory compliant, were already being met by the lagoon systems on site. Readers are referred to Site Monitoring Data section of this Chapter which presents the actual discharge quality, which is equivalent to High Status classification surface water.

8.29 The ELVs for the 2019 revised Section 4 licence (W/391/05_R1) volume of 10,000 m3/d are as follows:

- 20 mg/l Suspended Solids
- 10 mg/l NO3
- 0.03 mg/l MRP-P
- 0.1 mg/l Ammonia
- 0.5 mg/l Total Hydrocarbons
- 20 mg/l COD
- 5 mg/l BOD
- <20oC temperature
- 6 to 9 pH range
- Colour = no change.

8.30 A Galway County Council letter, dated January 2025, demonstrating compliance with the Licence Conditions is presented with a copy of the Licence in Appendix 8.2.

The Application Site

8.31 The site to which the planning application relates (hereafter 'the subject site') is a proposed extension (by deepening) to an existing quarry site operated by McGraths Limestone (Cong) Ltd in the townland of Cregaree, Cong, Co. Mayo.

8.32 The subject site is situated c. 1km north west of the village of Cong in County Mayo. The site is approximately 10km South-west of Ballinrobe, Co. Mayo and 15km north-west of Headford, while Galway is approximately 35km south-east of the site (Figure 1.1).

8.33 The site is located to the north of the R345 from which access is provided via a private access road, approximately 35m in length.

8.34 The application area 'Red Line' boundary and the overall landholding boundary 'Blue Line' are shown in **Plate 8-1**, which is a reproduction, for ease of reference, of the application Drawing Series' Figure 1.2.

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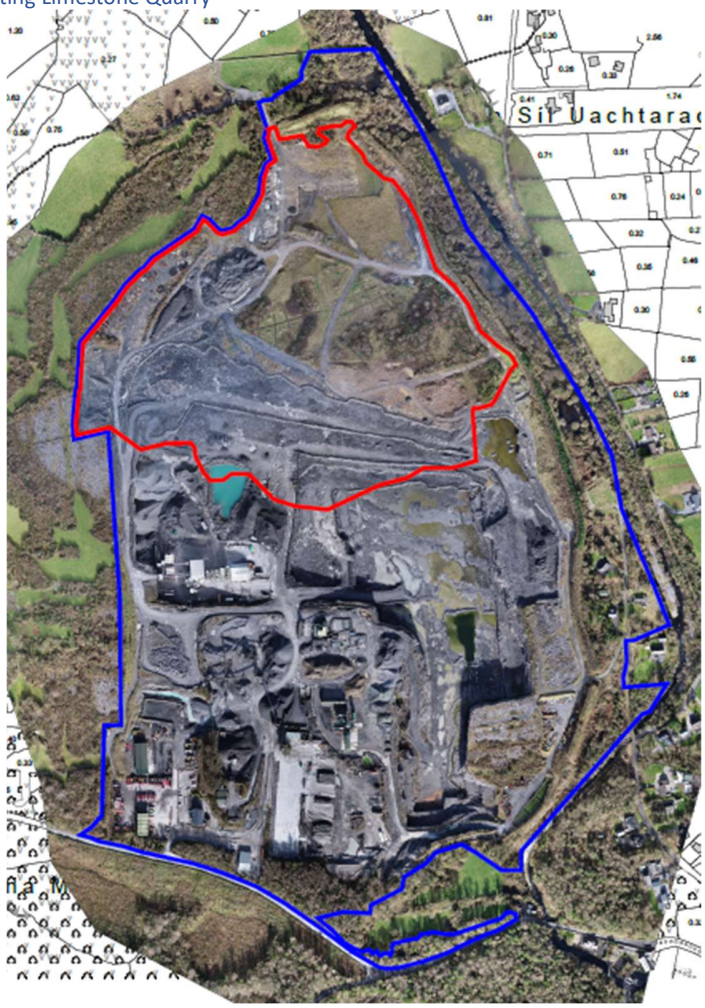

Plate 8-1 McGrath's Cong Overall Site with Red Line Planning Application Area & Blue Line Overall Landholding.

8.35 Beyond the site, the landscape is rural in character, consisting of agricultural land enclosed with stone walls, with interspersed with scrub and large tracts of woodland, most notably Cong Woods, which are situated immediately to the south of the site. Field boundaries in the surrounding area are marked by treelines and hedgerows.

8.36 There are 51 dwellings, approximately, within 500m of the existing quarry. More detail is provided in EIAR Chapter 5.

8.37 Access to and from the quarry is by an established single site entrance off the R345 road. The quarry is screened from view from the R345. Adjoining the entrance to the quarry there is a parking area, office, weighbridge, and wheelwash area from where access to the excavation area is made.

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The Existing Development

8.38 The existing operational limestone quarry extraction covers an area of approximately 62.45 hectares, with details of the site layout shown on the Application's Drawing Series as Figure 1.2.

8.39 The lowest point on the existing permitted quarry floor is -5 mOD, which is in the southern section of the quarry (Pre-63). This area is permitted to -50m OD.

8.40 The existing development involves the extraction of limestone using conventional blasting techniques and processing of rock using static and mobile crushing and screening plant on site to produce limestone aggregates. The processed material is stockpiled prior to transportation to market.

8.41 The rock in the existing quarry is extracted by both blasting and mechanical means, and the extracted material is mainly transported to the area of the quarry dedicated to processing. Blasting under licence occurs at predetermined times. The excavated rock is crushed, screened in mobile crushers, graded, washed and stockpiled for transportation off-site. Processed material is either sold or used to produce ready mix concrete, concrete and crushed lime products. The material is weighed on the weighbridge at the site entrance in the SE section of the quarry, which is also occupied by the site office and fuelling area. There is a large settlement lagoon system located in the SE corner of the existing quarry close to the site boundary with the Cong Canal, and there are smaller ponds located in a more central positions.

8.42 The frequency of the blasting operation on the entire quarry is limited to not more than four production blasts per month, as per Condition 5 of Reference QD 16.QD0009 and Condition 6 of Plan Ref. File No. 20/77/ ABP Ref: ABP-308748-20. Rock breaking is occasionally required (in situations where the blasted rock is too large to enter the crusher).

8.43 The entire quarry can be subdivided into three separate sections as illustrated on Plate 1.1 and described as follows:

- **Area A:** This is the Southern section of the quarry which consists of an area of 43.47 hectares (Plan Ref File No. Q18). This existing working area is authorised by way of a Pre 1963 authorisation and was given planning conditions under Section 261 of the Planning and Development Act. Permission granted for the extraction of material to -12 mOD.
- **Area B:** This section of the quarry consists of an area of 10.58 hectares which has been authorised by way of a substitute consent application (Reference PL 16.SU0132) and a 37L application (Reference QD 16.QD0009) granted by An Bord Pleanála in 2017. Permission granted for the extraction of material to +5 mOD.
- **Area C:** This Section 34 Application (Mayo County Council Plan Ref. File No. 2077/ ABP Ref: ABP-308748-20) area was made in 2019, Granted with Conditions by Mayo County Council in 2020 and Granted by the Board in 2021, and covers an area of 8.4 hectares. Permission granted for the extraction of material to +5 mOD.

Water Management Systems: refer to Figure 1.2

8.44 There are no major springs or groundwater ingress points within the site.

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8.45 There are some ponds of water on the site and these are collection vessels for water arising and used local to their particular part of the site.

8.46 The rainfall runoff, and shallow 'groundwater' contribution, responses are in the epikarst shallow system and the discharge is relatable to catchment area and recent rainfall. This has been expanded upon in mathematical detail in all previous EIAR Water Chapters and the Hydro-G (2019) Discharge Licence Report, which is presented in Appendix 8.3.

8.47 A rainfall and epikarst water response is common in quarries in karst settings and the reason for that is that the circumference of the excavation enables easy escape to any rain that travelled vertically through the soil and subsoil on higher ground in the catchment. Rain is therefore the major player in the drive for water management systems at the site and because of that, in combination with the fall of the permitted floors, all waters arising from and in areas to the north of the site's southern boundary can be managed by gravity flow.

8.48 Rain falls on the fields surrounding the void and on the grounds of the quarry itself. That rain travels through thin soil cover of local lands or rock at surface and finds its natural escape route to the quarry void. This 'interflow' rainfall then enters the upper bedrock zones of weathered limestone bedrock close to the subsoil interface and natural land surface. This rainfall then flows either horizontally or vertically until it reaches a solid impenetrable bedrock platform that is the floor of limestone at the quarry.

8.49 The limestone bedrock at the site is impenetrable and like most long established limestone rock quarries it has no primary porosity. Therefore, rain water runoff travels along the top of the solid limestone until it hits a drop that is caused by a change in floor elevation because of a W-E trending bench. This W-E trending wall is along a line of quarry wall face that approximately marks the northern portion that is the subject of this application.

8.50 There is a W-E trending bench that demarcates a boundary of the original southern portion of the site named Area A ('pre- 63)' and the northern portions of the site that are more commonly referred to as Areas B and C.

8.51 Rain runoff water flows naturally on a gentle slope across the floor of the northern portions of the site and then meets the falloff to the lower elevation exposed limestone quarry floor. The limestones of the floor are solid limestone mass and so, again, the over-ground water continues to move in a southerly direction under gravity towards the quarry's retention sump on the floor in the south western corner of the quarry. This sump is an excavated rock pool that accommodates the submersible pumps.

8.52 All water that enters the void flows by gravity from all worked areas to the sump in the southern portion floor. From there it is pumped up to an engineered concrete tank settlement system.

8.53 The quarry's settlement lagoon system is located at an elevation above the floor sump. The lagoon system is at an elevation close to natural ground level and it is located in the south-east portion of the quarry.

8.54 The water from the quarry is passed through a settlement tank which has the following dimensions (ESP, 2006):

- Total Area = 877.9 m2
- Depth = 2.3 – 2.5 m

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- Total volume = 1,877 m3

8.55 The design flow rate through the settlement systems baffled lagoon system, for the appropriate settlement of suspended solids, is 12.4m3/day for each m2 of area of the lagoons. Therefore, for the plan area of 877.9m2 the settlement lagoon system has the capacity to adequately treat, remove suspended and settleable solids, for a maximum overflow outflow rate, i.e., discharge volume, of 10,866 m3/day.

8.56 The water in the concrete tanks passes through two weirs with baffle boards to prevent any floating materials escaping and has an outlet tank that conveys discharge by pipe to the Cong Canal and one which returns to the quarry. Generally, pumping from the floor sump happens overnight only, unless there are high rainfall events.

Planning History & Historic Assessments

8.57 It is important to note that the current permissions, under which the quarry is currently operating, sanction extraction of rock to an elevation of +5m OD across Area B and Area C and to an elevation of -50mOD in Area A, agreed as part of a compliance submission.

8.58 At the time of the SC and 37L applications in 2016, the proposed development presented to the Board for their consideration was "extraction of c. 6.7million tonnes of limestone rock at the c.10.58ha quarry in two stages over a 50-year time frame, as follows:

- Stage 1 would be to a depth of + 5mOD.
- Stage 2 would be to a depth of -12mOD.

8.59 In the Board's Grant of permission in 2017 (QD16.QD0009), they granted the "Stage 1 to a depth of +5mOD" and advised that should the experience of the extraction concur with the Impact Assessments conclusions of No Potential for Impact, then the "Stage 2 to a depth of -12mOD" could be considered at a later date, subject to the extraction of the first Stage proceeding as per the Impact Assessments presented.

8.60 This is now the later date and it is time to again present the Stage 2 part of the development because the progression to +5mOD progressed without incident. Almost ten years have passed since the commencement of extraction of the current permission. A primary rationale for continuing to deepen the quarry floor is to access deeper limestones reserves, better suited for the production of higher value products. The chemical composition of that deeper rock was presented in detail in the Land, Soils & Geology Chapter and its associated Appendices. It is now time to secure resources for the region for the period 2027 and onwards. It takes time to progress through the planning process understanding that it takes years to progress through the evaluation process.

8.61 The important thing to note is that at the time of the 2017 Grant of planning the information presented to the competent planning authorities included the Site Investigations for the depth of rock excavation through the two Stages and to the elevation of -12m OD. Historic applications have been accompanied by an Environmental Impact Statement (EIS), Natura Impact Statement (NIS) and Further information in relation to European sites.

8.62 Therefore, the historic body of works informing previous Environmental Impact assessments and reporting contains the Site Investigation details and Impact Assessments for the proposal to bring the Floor to the final completion elevation of -12m OD.

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8.63 The Impact Assessment presented here relies on historic intrusive Site Investigations, for drilling, coring, response tests and monitoring, and is updated with site monitoring data collected in the interim.

The Proposed Development

8.64 The proposed development will involve:

- Deepening of 19 ha. of the existing permitted quarry extraction area (Plan File Ref. No. 20/77: ABP-308748-20 & Plan File Ref. No. PL16.SU0132: QD16.QD0009) from an elevation of +5 mOD to a proposed completion elevation of -12 mOD.
- Haulage of material to existing fixed plant within the main quarry for processing.
- All associated ancillary facilities/works.
- Landscaping and restoration of the site.

8.65 Further details on The Proposed Development were provided in Chapter 3.

Assessment Objectives

8.66 Under the European Union's Environmental Impact Assessment (EIA) Directive (2011/92/EU as amended by 2014/52/EU), major building or development projects in the EU must first be assessed for their impact on the environment.

8.67 In Ireland, the EPA (2022) Guidance for Information to be Contained in Environmental Assessment are used to guide assessments and the preparation of an Environmental Impact Assessment Report (EIAR). EPA (2022) has been used in this assessment.

8.68 The objectives of this assessment are, as per the EIA Directive (2014/52/EU) and EPA Guidance (2022), to:

- Provide baseline hydrogeological and hydrological conditions for the site & update previous assessments, which had a strong foundation in drilling and monitoring information.
- Assess the potential impact of the proposed development on the underlying groundwater body, associated surface water bodies and ecosystems.
- Assess the potential for Cumulative Impacts and Transboundary Impacts.
- Upon identification of all potential impacts, provide appropriate mitigation measures for any identified potential impacts, as deemed necessary.
- The proposal, impacts and proposed mitigations will then be reassessed, and residual impacts defined.

Guidance and Legislative Instruments

8.69 This report was prepared with consideration of Industry Guidance documents and ensuring compliance with European Legislation (Directives) and Irish Statutory Instruments and Regulations as listed in **Appendix 8.4**.

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8.70 The author of this assessment hereby confirms that the assessment completed and reported adheres with EU EIA and EIAR Guidance and that the proposed project has been assessed in accordance with EPA (2022) Guidelines for EIA.

8.71 The author of this assessment hereby confirms that the assessment completed and reported has been completed with consideration of Irish Statutory legal instruments enacting the Water Framework Directive (WFD) and the Birds & Habitats Directive.

Data and Maps

8.72 This report was prepared using Desk Study available Data and Maps appropriate to the study site, and wider environment, as listed in **Appendix 8.5**.

Consultations

8.73 Historically, the site's agents have engaged with NPWS in 2015 (Julie Fossitt and Pamela Bartley), Fisheries throughout the site's history (noting that at one stage the Fisheries wished to explore use of the site's "pristine" water for experiments at the Hatchery and also for a Pearl Mussell incubation tank proposal), and with the EPA and Galway County Council during the Review of the Site's Section 4 Licence in 2018 and 2019.

8.74 For this planning application, the applicant retained Quarry Consulting, to prepare a planning application for proposed expansion development at their existing quarry at Cregaree, Cong, Co. Mayo.

8.75 Quarry Consulting managed all pre-planning discussions and scoping as per the provisions of Section 247 of the Planning and Development Acts 2000, as amended.

8.76 Quarry Consulting issued a project description and preliminary findings to a number of statutory consultees. Those respondents of relevance to this Water Assessment include the Geological Survey of Ireland (GSI), NPWS and Uisce Eireann.

8.77 Scoping Responses of relevance to this Water Assessment presented as **Appendix 8.6**, in which Hydro-G responses are also provided.

8.78 The Geological Survey of Ireland (GSI) responded on the 5th of July 2024 (their Ref: 24/217) with a 5 page detailed cross referencing of important considerations and resources available to the applicant. Hydro-G hereby confirms that all resources and consideration requests returned by the GSI have been included in the assessment.

8.79 Uisce Éireann responded on the 1st of July 2024 (their Ref. PN24000005590). Hydro-G has addressed each scoping point in **Appendix 8.6**. In overall summary, the 'Source > Pathway > Model' and EIA Process has been applied and, in combination with the Section 4 Discharge Licence W/391/05_R01 (held by the site since 2007 and reviewed in 2019) enables a conclusion of no residual risk to Lough Corrib as a source of public water supply.

8.80 Readers are again referred to **Appendix 8.2** for a copy of the W/391/05_R01 licence, to **Appendix 8.3** for the Hydro-G (2019) report that supported it, and to Appendix 8.6 for the detailed response by Hydro-G to each item presented by Uisce Eireann.

8.81 The site's continuous record of discharge volume and its quality, as per the licence Conditions, demonstrate the effectiveness of prevention of Risk to Lough Corrib, whether it is considered to be

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a surface water feature of national, European and international significance, or as a Conservation Objective Site or a source of PWS.

8.82 The Impact Tables at the end of this Chapter incorporate all information.

Overall Assessment Methodology

8.83 The methodology adopted for this assessment is as follows:

- Review of current Legislation and Guidance relating to EIA and EIAR, Quarry Assessment Guidance and Water and Habitats related Legislation.
- Review of the 'Subject' development currently under consideration and assessment.
- Review of Responses to Project Scoping documents issued to Statutory Bodies.
- Characterisation of the Receiving Environment (hydrology and hydrogeology).
    - Determination of the Baseline.
    - Evaluation of WFD Reported characterisations for the wider environment.
    - Evaluation of the site's own receiving environment. It is noted that Hydro-G has completed extensive site investigations since 2015 for the entire site's geology, hydrogeology and associated external hydrological systems. Information for the site was presented by Hydro-G in EIAR chapters associated with all previous Planning Determinations for the site [Section 261A substitute consent application (Reference PL 16.SU0132); 37L application (Reference QD 16.QD0009) and Section 34 Application (Plan Ref. File No. 2077/ ABP Ref: ABP-308748-20)] and the Section 4 Discharge Licence Review in 2019, which resulted in the issue of W/391/05_R1.
- Presentation, review and evaluation of Site Investigation Results and Long Term site monitoring data.
- Application of EPA (2022) and IGI (2013) Guidelines on the Assessment of Potential Effects. Identification of Potential Effects, Mitigation Measures, Assessment of Residual Impacts & Other Impacts, as specified in Guidance. (Appendix 8.7).
- Application of the UK Environment Agency's Hydrogeological Impact Appraisal Methodology for Dewatering at Quarries (Appendix 8.8).
- Consideration of PWS Protection Measures & Consideration of SAC Protection Measures, including the conservation objectives of designated Natura 2000 sites.

Desk Study Receiving Environment

Historic Land Use

8.84 Historical land uses were reviewed using maps and aerial photography, which are detailed in Table 8.1.

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Table 8.1 Historical Land-use at the Site and its Surroundings

Ordinance Survey Map Reference & / or dates	On Site	Immediate Surroundings
OS 6 inch colour (1837-1842)	The site is mapped as limestone pavement bare rock outcrop.	There are dwellings in the Cregaree area.
OS 6 inch Cassini (1845)	The site is mapped as limestone pavement bare rock outcrop.	There are dwellings in the Cregaree area. Royal Rock is mapped to the west.
OS 25 inch Historic (1888-1913)	No change from above	
Aerial Imagery 1995	The quarry has been well established in the southern part of the site.	New dwellings have been established around the site.
Aerial Imagery 2001	Perimeter access internal roads built	No obvious change in the vicinity of the site.
Aerial Imagery 2006	Substitute Consent Area Obvious.	No change in the vicinity of the site.
Aerial Imagery 2012 - 2024	Land reclamation to the north, expansion of quarrying activities.	No change in the vicinity of the site.

Conservation Objective Sites

8.85 Conservation Objective Sites/ Designated Areas and the site are presented as Figure 8.2.

8.86 The site lies within the Corrib Catchment (HA30) and Lough Corrib has designation as a European Site (Lough Corrib SAC, 000297; Lough Corrib SPA 004042; proposed NHA 000297) and also has two Statutory Instruments associated: the European Communities Conservation of Wild Birds (Lough Corrib Special Protection Area 004042) Regulations 2012 and Lough Corrib Special Area of Conservation 000297 Regulations 2022. Water is a supporting habitat. Therefore, this assessment considers water, ecological receptors and Conservation Objective Sites in an integrated way.

8.87 Lough Mask is to the north and north west of the site and at its closest the lake is c.2.5km to the north west of the site. Lough Mask is also a Conservation Objective site (Lough Carra/Mask Complex SAC, Site Code 001774; Lough Mask SPA, Site Code 004062; Lough Carra/Mask Complex proposed NHA, Site Code 001774). NPWS Site Synopsis provides as follows: This site is dominated by two large lakes, Lough Mask and Lough Carra, and includes the smaller Cloon Lough. Most of the site is in Co. Mayo, with a small portion in Co. Galway. On the western side, the site is overlooked by the Partry Mountains, while to the east the landscape is largely low-lying agricultural land. The nearest large town is Ballinrobe which is about 4 km east of Lough Mask. The general geological character of the area is Carboniferous limestones, with some shales and sandstones on the western side of Lough Mask. The underlying geology results in a great diversity of habitats, which support many scarce and rare plants and animals. Under WFD and LAWPRO programmes, the Mask Carra Priority Area for Action (PAA) overlaps with 25 protected areas including Special Areas of Conservation (SACs); Special Protected Areas (SPAs); Proposed Natural Heritage Areas (pNHAs); Fresh Water Pearl Mussel (Margaritifera) sensitive areas; Salmonid Waters and Nutrient Sensitive Areas.

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8.88 Ballymaglancy Cave SAC (Site Code 000474) is a linear stream cave which supports a population of Lesser Horseshoe Bat. It is situated approximately 3 km west of Cong in Co. Mayo. The site is a Special Area of Conservation (SAC) selected for the following habitats and/or species listed on Annex I / II of the E.U. Habitats Directive (* = priority; numbers in brackets are Natura 2000 codes):

- [8310] Caves
- [1303] Lesser Horseshoe Bat (Rhinolophus hipposideros)

8.89 Hydro-G offers that this bat cave is highly unlikely to be affected by proposed activity at the quarry site. The caves are sufficiently remote from the site, they are not reliant on water and given that blasting has been ongoing at the quarry for decades and have not affected the caves: the caves are listed and described in a 2018 NPWS (2018) document Conservation objectives supporting document – lesser horseshoe bat (Rhinolophus hipposideros).

8.90 Other potential impacts, aside from the water-related effects, are assessed separately in the biodiversity chapter and the Appropriate Assessment (AA) report that accompany this application.

Public Water Supply (PWS)

8.91 The site's situation in the catchment of Lough Corrib is significant also in the context of Public Water Supply because Lough Corrib is the source of supply to Galway City, Tuam and much of East Galway.

8.92 With respect to Lough Corrib as a source of PWS, as previously stated, there is a PWS intake at Luimnagh, which is on the eastern shore of Lough Corrib in a very sheltered inlet and at a distance of c.20km to the south east of the site. It is entirely reasonable to offer that for magnitude of the PWS abstraction at Luimnagh is not entirely sustained by lake water in such a sheltered recessed inlet. The intake is more probably influenced significantly by groundwater from a spring discharge on the shoreline, with groundwater flow direction coming from north east to south west.

8.93 There is an Uisce Eireann PWS intake at the Terryland PWS Intake at Galway city, which is c.34km south of the site. The Terryland PWS intake is not directly from Lough Corrib but it is on the Corrib_020 river that discharges from the lake.

8.94 No matter what the distances are, at the Desk Study stage, the site is mapped as lying within the Corrib catchment and Uisce Eireann currently assume the entire mapped surface water catchments to be the Source Protection Areas for PWS: in this case the PWS for Galway, Tuam and northeast Galway.

8.95 EPA Envision mapping presents Drinking Water Protection Area (DWPA) information, as shown in Table 8.2.

Table 8.2 Drinking Water Protection Area (DWPA) information (Envision Mapping Source)

Name	Drinking Protection Type	EU Priority Area (PA) Type	EU PA Code	Hydro-G Notes
Mask	Lake	Article 7 Abstraction for Drinking Water	IEPA1_WE_30_665a	Upgradient of application site in terms of water flow direction: **NO Direct Hydro connection from the site to Lough Mask**

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Name	Drinking Protection Type	EU Priority Area (PA) Type	EU PA Code	Hydro-G Notes
				but the Cong Canal leaves Lough Mask and travels in proximity to the site.
Corrib	Lake	Article 7 Abstraction for Drinking Water	IEPA1_WE_30_666b	Downgradient of the application site in terms of water flow direction: **Direct hydro link.**
Cong Robe	Groundwater	Article 7 Abstraction for Drinking Water	IEPA1_WE_G_0019	Site overlies this GWB, which is >500 km^2 area: **Direct hydro link.**
Curraghmore GWS Sub-catchment	NFGWS Group Scheme Source Protection Areas	Not specified but this is a Drinking Water Protection Area	Not specified	On the eastern shores of Lough Mask c.6km Upgradient of application site in terms of water flow direction: **NO hydro connection between the Groundwater under the site and the Groundwater feeding this Scheme.**
Lough Mask Creevagh Sub-catchment	NFGWS Group Scheme Source Protection Areas	Not specified but this is a Drinking Water Protection Area	Not specified	On the eastern shores of Lough Mask c.6km Upgradient of application site in terms of water flow direction: **NO hydro connection between the Groundwater under the site and the Groundwater feeding this Scheme.**
Funshina Cross & Glencorrib Sub-catchment	NFGWS Group Scheme Source Protection Areas	Not specified but this is a Drinking Water Protection Area	Not specified	c.7km to the south east of the site, on the shores of Upper Lough Corrib: **NO hydro connection between the Groundwater under the site and the Groundwater feeding this Scheme.**
KILMAINE PWS	GSI Public Supply Source Protection Areas	Not specified but this is a Drinking Water Protection Area	Not specified	c. 12km to the north east of the site. Regional Groundwater flow is from the NE to the SW. Therefore, there is no possibility of groundwater from the site moving in the direction of this Scheme. **No hydro connection.**
Robeen GWS Subcatchment	NFGWS Group Scheme Source Protection Areas	Not specified but this is a Drinking Water Protection Area	Not specified	c. 13km to the northeast. As above, **No hydro connection due to regional flow direction being NE to SW.**

8.96 On the basis of Desk Study data and evaluation, as presented in Table 8-2, only Lough Mask, Lough Corrib and the Cong Robe GWB DWPAs are brought forward for specific PWS Protection Measure discussion at the end of this chapter of the EIAR. The reason being that there is no connection between the site and any other DWPAs mapped for the wider environment.

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Rainfall & Recharge

8.97 Met Eireann Monthly Rainfall Values for the last number of years as shown in Table 8.3.

Table 8.3 Monthly rainfall values (mm) Claremorris Met Eireann Synoptic Station.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2024	115.9	131.2	124.3	91.5	85	51.4	65.7	180.6	54.1	109.7	111.4	54.6	**1,175.4**
2023	121.9	31.5	164.5	92.6	45.3	60.5	173	109	121.7	136.7	125.5	205.3	**1,387.5**
2022	65.4	150.7	57	58.7	85	101.4	43.1	45.4	93.1	190.9	185.4	112.8	**1,188.9**
2021	139.1	133.9	140.3	29.6	132.6	45.8	73.8	111.8	102.5	167.4	74.6	98.8	**1,250.2**
LTA	**125.6**	**101.1**	**101.4**	**72.4**	**77.5**	**74.4**	**74.3**	**97.8**	**98.2**	**133.7**	**122.7**	**124.5**	1,203.6

8.98 The Long Term Average Annual Rainfall amount reported by Met Eireann, for the Claremorris Station for the 2021 - 2024 period, is c. 1.2m/yr.

8.99 Met Eireann previously reported a 30 year average rainfall value, for the Claremorris Station for the 1971 to 2000 period, as 1.17m/yr. However, the current reporting for the 30 year period to the year 2000 does not report a specific value for the Claremorris Station.

8.100 The Geological Survey of Ireland provides Groundwater Recharge Data and Maps in which Annual Rainfall is reduced to ER [Effective Rainfall, ER = RF-Evapotranspiration Et] and the information Is shown in Table 8.4.

Table 8.4 GSI reported Groundwater Recharge and Effective Rainfall Water Balance Components.

Effective Rainfall (mm/yr)	955.20
Recharge Coefficient (%)	85
Groundwater Recharge Pre Cap (mm/yr)	811.90
Recharge Cap Apply	N
Average Groundwater Recharge Range (mm/yr)	801-900
Hydrogeological Setting Description	Extreme Vulnerability: Areas where rock is at ground surface or karst feature
Vulnerability Category	X
Vulnerability Description	Rock at or near Surface of Karst
Subsoil Type (Quaternary Sediment Code)	KaRck

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Subsoil Description (Quaternary Sediment Description)	Bedrock outcrop and subcrop
Bedrock Aquifer Category & Description	Rkc = Regionally Important Aquifer - Karstified (conduit)
Hydrostratigrahpic Rock Unit Group Name	Dinantian Pure Bedded Limestones

8.101 With reference to Table 8.4, the GSI reports as follows:

- Of the 1.2m/yr Met Eireann average annual rainfall, 955mm is reported as 'Effective'. This means that c.0.25m/yr is lost to the atmosphere by evapotranspiration or evaporation off the bare rock of the quarry.
- The Groundwater Recharge co-efficient applied by the GSI is 85% because the limestone subsoils and bedrock are conceptualised as readily accepting rainfall infiltration.
- No 'Cap' is applied by the GSI and therefore the calculated amount of Groundwater Recharge is 811.90 mm/yr of the 1.2m /yr Met Eireann Rainfall.

Hydrology

8.102 The site lies within the Corrib Catchment (HA30).

8.103 The site is situated between Lough Mask, to the north, and Lough Corrib, to the south.

8.104 The Cong Canal runs from Lough Mask to Lough Corrib and runs close to the eastern boundary of the site. As stated in the earlier pages of this Chapter, the Cong Canal is classified as a 'Artificial' channel under Water Framework Directive Classifications (Dr. Jenny Deakin, EPA) and as a known losing stream to groundwater in summer (Dr. Conor Quinlan, EPA).

8.105 As previously explained, the site holds a discharge licence to discharge to the Cong Canal.

8.106 On a regional scale the application site is located within the Corrib surface water catchment within Hydrometric Area 30 of the Western River Basin District.

8.107 On a local scale the application site exists within the Cong Canal SWB (Code: IE_WE_30C060300).

8.108 Regional Hydrology is presented in Figure 8.3, showing OPW Flow Gauging Stations, and Local Hydrology is shown as Figure 8.4.

8.109 Flowing surface watercourses are sparse in the area, indicative of the underlying karst limestone which allows water to permeate through it via cracks and fissures, connected to Lough Corrib.

8.110 Lough Mask

- Lough Mask is to the north and north west of the site and at its closest the lake is c.2.5km to the north west of the site.
- Lough Mask is a Conservation Objective site (Lough Carra/Mask Complex SAC, Site Code 001774; Lough Mask SPA, Site Code 004062; Lough Carra/Mask Complex proposed NHA, Site Code 001774).
- Lough Carra is to the north east of Lough Mask and they are directly connected.

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- LAWPRO (2018) report that Lough Mask and Lough Carra are important drinking water sources for both regional and local communities. Mask supplies the Lough Mask Regional Water Supply Scheme (RWSS) which serves a population equivalent of 46,500. Carra supplies the Lough Carra and Robeen group water schemes (GWSs) which serve a population equivalent of approximately 1,508 and 687, respectively.
- LAWPRO (2021) reports that Lough Mask is a large (> 8,000 ha) oligotrophic lake that reaches a maximum depth of 58m. The eastern part of the lake is situated on low-lying limestone bedrock while the western side is characterised by mountainous areas on low transmissive rock that flattens toward the lake shore.
- Lough Carra is connected to the north east of Lough Mask, which feeds into Lough Corrib mostly through underground streams that manifest as spring contributions to the Cong River that enters Lough Corrib. Lough Mask is the middle of the three lakes, which empty into the Corrib River, through Galway, into Galway Bay.
- Lough Mask is the sixth largest lake, by area, in Ireland. The eastern half of Lough Mask is shallow and contains many islands. The other half is much deeper, sinking to a long trench with depths in excess of 50 metres.
- Lough Mask has a mean depth of 15m, and a maximum depth of 58m. Its water volume of 1.3 km3 (1,300,000,000 m3) is only surpassed by Lough Neagh's 3.5 km3 in Ireland and Lough Mask is the largest lake, by water volume, in the Republic of Ireland.
- The elevation of land along the southern shores on Lough Mask is ~18.5m OD.
- Lough Mask sits 12 meters higher in altitude than Lough Corrib, whose northern shores have an elevation of ~7m OD.
- A series of subterranean conduits, travelling southwards, link Lough Mask and Lough Corrib.
- These subterranean conduits spout springs of water from the ground in the village of Cong.
- Springs are a term that conventionally describe groundwater's discharge at the land's surface and it is usually perceived to be water that has been in the ground along time. However, the springs at Cong discharge waters that were recently lake waters in Lough Mask. Consequently, the conductivity of the spring waters is relatively low, for karstic groundwater in Ireland, because the water has not been in contact with rock for very long. The waters discharging in this area have a typical electrical conductivity of 250 – 300 uS/cm.
- Between Lough Mask and the 'Cong Springs', the flow directions are to the south and travel times of 250-600 m/hr from Lough Mask's southern boundary swallow holes were measured and reported by Drew and Daly (1993).
- For groundwater to travel this quickly the subterranean conduits would have to be very large indeed and therefore, any intersection in the walls of the McGrath quarry would be obvious.

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- The GSI (2004) cites that "Rapid groundwater flow velocities indicate that a large proportion of groundwater flow takes place in enlarged conduit systems. Groundwater flow in highly permeable karstified limestones is of a regional scale." It is that reference to 'Regional Scale' that places an importance on this work to investigate the Lough Mask/lough Corrib groundwater connectivity.

8.111 Lough Corrib

- Lough Corrib has designations as a European Site (Lough Corrib SAC, 000297; Lough Corrib SPA 004042; proposed NHA 000297) and also has two Statutory Instruments associated:
  - European Communities Conservation of Wild Birds (Lough Corrib Special Protection Area 004042) Regulations 2012, and
  - Lough Corrib Special Area of Conservation 000297 Regulations 2022.
  - Water is considered a supporting habitat. Therefore, this assessment considers water, ecological receptors and Conservation Objective Sites in an integrated way.
- Lough Corrib sits 12 meters lower in altitude than Lough Mask.
- Lough Corrib's northern shores have an elevation of ~7m OD.
- A series of subterranean conduits, travelling southwards, link Lough Mask and Lough Corrib.
- The centre of the quarry is 2km, approximately, north of Lough Corrib.
- Lough Corrib is the second largest lake area in the island of Ireland (after Lough Neagh). It covers 176 km² and lies mostly in County Galway with a small area of its northeast corner in County Mayo.
- Although the Cong Canal is the surface hydrology system's method of connectivity between Lough Mask and Lough Corrib, there is an underground (hydrogeological) connectivity between the two lakes also.

8.112 Cong Canal & Cong River

- As stated, The canal flows outside and along the eastern boundary of the quarry.
- The Cong Canal/Cong River system is generally named the Cong Canal to the north of the Mill Pond in Cong Village and the Cong River downstream of this point, where it is effectively the natural (pre-arterial drainage) section of the channel draining into Lough Corrib.
- The Cong Canal is a historic manmade feature that was originally designed to act a navigation device with added benefit of easement of flood extent on the shores of Lough Mask. However, works were abandoned before the Cong Canal was finished because railways were starting to replace navigation on water and the expected costs of required Lochs were deemed prohibitive.

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Hydrometrics

8.113 Graphs and data available for the OPW hydrometric stations are presented in Appendix 8.9.

8.114 The surface water receiver most directly connected with the site, by virtue of its licensing as the receiver of waters arising at the site, is the Cong Canal, which is often referred to as the 'Dry Canal' in historical records because it 'loses' water in certain seasons and certainly is dry following prolonged periods of dry weather and when the water levels in Lough Mask recede. However, it is not always dry and there are OPW Hydrometric Stations on the Canal upstream and downstream, as follows:

- Station 30017 Carrownagower, upstream of the overall site, and
- Station 30034 Cregaree, immediately upstream of the site's licensed discharge point.

8.115 OPW flow volumes supplied by the OPW for the Carrownagower station on the Cong Canal, up gradient of the quarry, suggest that Total Annual Flows in the Cong Canal can range from ~500,000,000 to >715,000,000 m3/yr. The significance of those volumes are that it would be impossible for the quarry to operate if the quarry were intercepting waters at even a fraction of this hydrological scale. No pump configuration, at any quarry's discharge lagoon system, would be financially able to sustain the average flow that travels outside the quarry's eastern boundary in the adjacent Cong Canal. Therefore, it is reasonable to state that there is no significant ingress of water from the Cong Canal to the quarry.

8.116 The Cong Canal leads from Lough Mask to the north of the site, and through to the Cong River, which feeds into Lough Corrib, to the south of the site. The OPW measure flow in the Cong Canal/Cong River/Cong Weir system.

8.117 The Carrownagower OPW Station is upstream of the site and the Cong Weir is downstream of the site.

8.118 A summary of Historical OPW hydrometric information is summarised in Table 8.5. The entire and current data set is presented graphically and in long term statistics in Appendix 8.9.

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Table 8.5: OPW hydrometric statistics converted from OPW units of m3/s to m3/d for ease of reference with quarry discharge data

	CONG CANAL RECEIVING WATER	
	UPSTREAM OPW DATA	DOWNSTREAM OPW DATA
	Carrownagower (OPW Stn 30017)	Cong Weir (OPW Stn 30031)
MAX Q (m3/s)	58.047	91.242
MAX Q (m3/d)	5,015,261	7,883,309
50%tile (m3/s)	14.143	28.69
50%tile (m3/d)	1,221,955	2,478,816
75%tile (m3/s)	5.548	17.706
75%tile (m3/d)	479,347	1,529,798
95%tile (m3/s)	null*	8.918
95%tile (m3/d)	null*	770,515

8.119 OPW flow volumes supplied for the UPSTREAM Carrownagower station on the Cong Canal, upgradient of the quarry, suggest as follows:

- Daily Minimum flow for the upstream Carrownagower station is Null (zero).
- Daily Maximum flow for the upstream Carrownagower station is c.5 million m3/d
- Hydrometric data for the downstream station is informative because when the upstream Carrownagower OPW Station records 95%tile flow as NULL, the downstream Cong Weir OPW Station has a flow rate of 770,515 m3/d. That latter figure is the volume of groundwater travelling underground in the conduit system and discharging at Cong.

8.120 The reason for the high 95%tile, at 770,515 m3/d, value at the downstream Cong Weir station is because it picks up the three massive Groundwater springs in Cong village and in this way groundwater flow is quantified AND is massive. However, the site's historic daily discharge values and the magnitude of the pump infrastructure do not suggest that massive groundwater is encountered in any way at the site.

8.121 The Cong Canal discharge has a large range of daily flow volumes. This is because the whole hydrological system of the lakes and the karst are driven by the rain falling on the catchments. The discharge from the quarry also has a wide range of flows. At times of high flow in the Cong Canal, the quarry's discharge will be a higher volume. At times of low flow in the Cong canal, so too is the discharge driven from the catchment to the quarry and to the discharge from the settlement lagoons is also low.

8.122 Flow in the Cong River is year-round and is maintained by discharge from two spring fed tributaries and a large spring in the Mill Pond (Hatchery Mill Spring) in Cong village from which flow has been

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measured as 150,000 m3/day while the Cong Canal was dry (Geological Survey of Ireland, 2004). The GIS estimate **total** spring discharge in Cong village to be >3 million m3/d (GSI, 2004).

8.123 Integration of GSI, OPW and Fisheries data suggests that the total combined discharge from Lough Mask in the direction of Lough Corrib approaches 1 billion m3/year. The relevance of the stated volumes and rates of flow is that massive amounts of water flow in this catchment.

8.124 Cong Weir data (Appendix 8.9) suggests that 50%ile is 29.41 m3/s, and so that would mean a value of **at least** 2,541,024m3/yr of water, on average, flowing over the weir at Cong River and feeding directly into Lough Corrib. This is a hydraulic total on the Cong Canal and the springs in Cong as well as other groundwater inflows to the system upgradient of the Cong Weir.

8.125 The significance of the local OPW data value is that IF there were groundwater inflows to the quarry, the business would not be able to deal with the scale of them. The pumps do not exist. The combination of OPW data and operational existence is the proof that there are no groundwater conduits at the site.

8.126 Relative to the OPW value for the 29.41 m3/s flow rate met or exceeded 50% of the time, *i.e.,* 2,541,024 m3/yr (*i.e.*, c. 2.5 million m3/d) of water entering Lough Corrib over the Cong Weir, 89.596 m3/s is reported by the OPW as the 50%tile flow in the River Corrib draining Lough Corrib through Galway city and discharging at Wolf Tone Bridge to Galway Bay. A flow rate of 89.596 m3/s is 7,741,094 m3/d (*i.e.*, c. 8 million m3/d).

Hydrogeology

8.127 The Lands, Soils and Geology Chapter presented detail for the Soils, Subsoils and Bedrock environment at the site and in the surroundings.

8.128 In this chapter, the water related aspects of the geological systems are presented.

8.129 **Groundwater Vulnerability** is mapped by the GSI as 'X' Rock at or near Surface or Karst. The 'X' Groundwater Vulnerability applies to large expanses of the region. Refer to Figure 8.5.

8.130 **Aquifer Classification** is mapped by the GSI as Rkc - Regionally Important Karst Conduit. Refer to Figure 8.6.

8.131 **Karstification** is the process whereby fissures, faults and joints in the purer units of limestone are enlarged by dissolution. Karstification can considerably enhance the permeability of limestone which has essentially no inter-granular permeability. The Region is characterised by numerous karst features such as springs, swallow/sinkholes, sinking streams, turloughs, seasonal lakes and caves as shown in Figure 8.7, which also shows an abundance of GSI tracer lines linking swallow holes on the southern shores of Lough Mask with Springs associated with the Cong River, Cong Springs, and to the south of the quarry.

8.132 The Board's Grant of permission in 2017 (QD16.QD0009) sanctioned "Stage 1 to a depth of +5mOD" and advised that should the experience of the extraction concur with the Impact Assessments conclusions of No Potential for Impact, then the "Stage 2 to a depth of -12mOD" could be considered at a later date, subject to the extraction of the first Stage proceeding as per the Impact Assessments presented. **No conduit Karst has been encountered in the operational excavation of bedrock to the +5mOD in the Stage 1 previously sanctioned.**

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8.133 As previously stated, the shores of Lough Corrib are c.7mOD. Therefore, upon the completion of Stage 1, the site will be below the possible conduits connecting Lough Mask to Lough Corrib.

8.134 **Geology** plays a significant role in the potential for karst formation. As outlined in the Land, Soils and Geology Chapter' Figure 7.4 and In Hydro-G (2020, Appendix 8.3)'s Figure 6 Geological Formations, there is a substantial difference between the Cong Formation (CO) limestone, which underlies the quarry, and the Cong Canal Formation (NL) that holds all the karst features: the swallow holes on the southern shores of Lough mask and the output points are all in the NL formation, rather than in the quarry's CO formation.

8.135 **Karst features** in the local area have previously been described for the applicant in the ESP Report for the site (2006) and the full report is presented as Appendix 8.10. A pictorial representation of Karst features is presented as **Plate 8-2.**

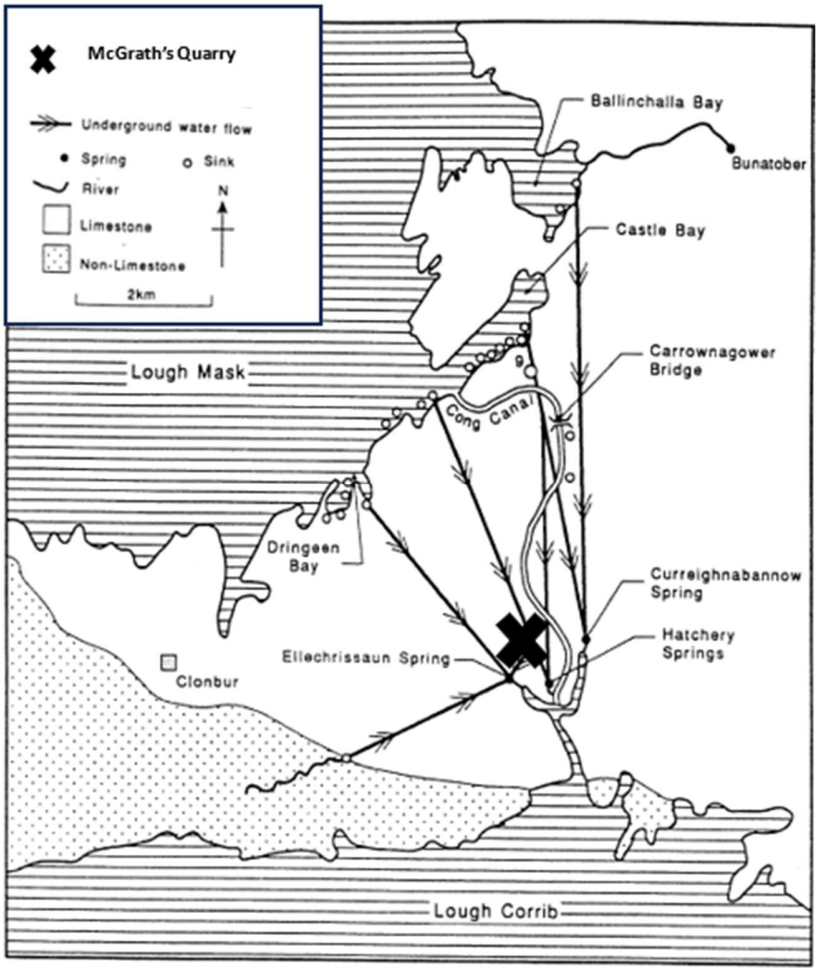

Plate 8-2: Schematic of Karst Features surrounding the site, between Lough Mask and Lough Corrib (ESP, 2006).

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8.136 With reference to the karst features shown in Plate 8-2, ESP (2006) provides descriptions, as follows:

A. Pollyahunipa and other associated ponds

This pond is located 50 metres south west of the most southern boundary of the quarry and is located at an approximate level of 12mOD. The pond appears to be spring fed and it is understood that it reduces in level during drought periods. Borehole B has been drilled uphill of Pollyahunipa to a depth of 70m (-51 m OD). No groundwater was encountered during drilling which took place over 2 days. No voids or areas of karstification were encountered during the drilling. Water level has risen and stabilsed at a depth of approximately 10.6 m below the ground surface. The existing information indicates that the spring is fed from an underground flowpath to the west which then continues south to the estuary at Lough Corrib. Based on the existing information it is considered highly unlikely that the present quarrying activities will affect levels in Pollyahunipa and associated ponds.

B. Cong Canal

Cong canal is located some 250 metres to the east of the quarry at an elevation of approximately 20 mOD and is therefore generally above the level of quarrying. It is understood that the canal is largely unlined. Leakage from the canal has been detected from investigations near Lough Mask and there are observable seepages from the quarry face at present (ESP 2006). The construction of the Cong canal (1845-55) lowered the water level of Lough Mask by some 2m and causes surface flow to take place between the lakes via the canal when the water level in Lough Mask exceeds 17m O.D. Prior to this, the underground routes transmitted all of the inter lake discharge; flows in excess of 50m3/s must have emerged from the Cong Springs. At present the Cong canal is dry for an average of 90 days per year and during this period the Cong springs discharge about 17m3/s. Water from the Cong canal recharges to groundwater (strip recharge) along its entire length and in all but the highest groundwater conditions.

C. Hatchery Mill Pond

The hatchery mill pond is located some 650 metres south east of the quarry and is located at a level of approximately 12 mOD. The pond is used as a hatchery for salmon. It is understood that the group of springs feeding the pond always function and are fed by one of the major underground flowpaths from Lough Mask. The springs have been investigated by divers and found to issue from enlarged bedding planes at a depth of some 20 metres. Based on the existing information it is considered unlikely that the present quarrying activities will affect levels in the Mill Pond.

D. Ellechrisasaun spring

This spring is located some 300 metres to the south of the quarry which supplies a marshland area and tributary to Lough Corrib. It is understood that the springs here dry up during low groundwater conditions. The spring discharges water from the western part of the isthmus as well as from the Lough Mask sinks. Based on the existing information it is considered unlikely that the present quarrying activities will affect levels at the spring.

E. Horse hole or Pollahopple

This feature is located some 340 metres to the south west of the quarry, is spring fed, and it is understood that the pond dries up during drought periods. This feature is fed from a spring located to the south west and is not in the water catchment area of the quarry. Based on the existing information it is considered unlikely that the quarrying activities will affect levels in the pond.

F. The well at Pigeon Hole

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It is understood that the yield from this well varies from 250 -1000 m3/day and the well is fed by the stream at the bottom of the well. From our visit to the well it appears that there is sewage pollution of the groundwater and the well is no longer in use.

G. Lough Corrib

Lough Corrib is located some 2 kilometres to the south of the quarry and is fed by the regional groundwater flow. It is unlikely that the effects of present or future quarrying will affect water levels in the Lough.

8.137 The site is mapped by the EPA as underlain by the **Cong Robe GWB**. Refer to **Figure 8.8** for Groundwater Body Delineation.

8.138 The Cong Robe GWB is reported to span an area of 440 km^2.

8.139 The GSI (2004) reports that "the rocks in this **GWB** are generally devoid of intergranular permeability. Groundwater flows through fissures, faults, joints and bedding planes. In pure bedded limestones these openings are enlarged by karstification which significantly enhances the permeability of the rock. Karstification can be accentuated along structural features such as fold axes and faults. Groundwater flow through karst areas is extremely complex and difficult to predict. As flow pathways are often determined by discrete conduits, actual flow directions will not necessarily be perpendicular to the assumed water table contours, as shown by several tracing studies (Drew and Daly, 1993). The tracer tests show that groundwater can flow across surface water catchment divides and beneath surface water channels. Flow velocities can be rapid and variable, both spatially and temporally. Rapid groundwater flow velocities indicate that a large proportion of groundwater flow occurs in enlarged conduit systems. Groundwater flow in highly permeable karstified limestones is of a regional scale. Flow path lengths can be up to a several kilometres, for example 9.6 km from Ballyglunin Cave to Aucloggeen Spring. Overall, groundwater flow will be towards the River Clare and L. Corrib, but the highly karstified nature of the bedrock means that locally groundwater flow directions can be highly variable."

Water Framework Directive Mapping, Status, Risk & Assessments

8.140 EPA Envision mapping provides information on WFD names, codes, status, risk and report links for all cycles of the WFD, for which Ireland is currently in its 3rd Cycle.

8.141 WFD data are available to all at https://gis.epa.ie/EPAMaps/Water and it is this mapping resource that has been used to populate the Desk Study baseline and WFD assessment, reported later.

8.142 On a macro scale, the site sits in the EPA mapped Corrib Catchment (HA30), which is reported to have an area of 3,114 km^2.

8.143 All 3rd Cycle information for the Corrib catchment, and its associated waterbodies, is reported in a May 2024 3rd Cycle report available at https://www.catchments.ie/data/#/catchment/30.

8.144 The Corrib Catchment is described by the EPA as "This catchment includes the area drained by the River Corrib and all streams entering tidal water between Renmore Point and Nimmo's Pier, Galway, draining a total area of 3,112km². The largest urban centre in the catchment is Galway City. The other main urban centres in this catchment are Tuam, Ballinrobe, Claremorris and Ballyhaunis. The total population of the catchment is approximately 116,866 with a population density of 38 people per km². This catchment is characterised by a wide, flat, limestone plain occupying the eastern two-

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thirds of the catchment which terminates in the large lakes of Corrib and Mask that abut against the igneous granites of Galway and the metamorphic uplands of southwest Mayo. The entire area of this catchment east of the large lakes is karstifed and groundwater and surface water are highly interconnected in this region."

8.145 On a micro scale the site is situated in the EPA mapped sub catchment named the Cong[Canal]_SC_010, Sub catchment ID 30_17.

8.146 The EPA river sub basin name is the CONG CANAL_010 [EU_CD IE_WE_30C060300], which is reported to have a length of 97 km and a catchment area of c.192 km^2.

8.147 The Cong Canal flows from north to south, generally and discharges to the WFD named Lake Waterbody 'Corrib Upper' [IE_WE_30_666b], mapped in the Western District, Corrib HA, and reported as having an area of c.116 km^2.

8.148 Lough Corrib is not mapped as a Priority Area for Action and there are no LAWPRO reports for it. Desk Studies for LAWPRO PAA's are available here: https://lawaters.ie/desktop-studies/.

8.149 The site's licensed discharge point is c. 1.4 km streamflow length from Lough Corrib.

8.150 The Cong Canal flows from the EPA WFD named Lake Waterbody 'Mask' [IE_WE_30_665a], also mapped in the Western District, Corrib Hydrometric Area, and reported as having an area of c. 78 km^2.

8.151 Lough Mask is a High Ecological Status Objective (HSO) waterbody and it is reported as not currently meeting its environmental objective of High. There are 12 HSO waterbodies in the Corrib catchment and seven are not meeting their objective of High, including Mask. Lough Corrib is not mapped as an HSO waterbody.

8.152 Under the LAWPRO work of the WFD, the Mask Carra Priority Area for Action (PAA) overlaps with 25 protected areas including Special Areas of Conservation (SACs); Special Protected Areas (SPAs); Proposed Natural Heritage Areas (pNHAs); Fresh Water Pearl Mussel (Margaritifera) sensitive areas; Salmonid Waters and Nutrient Sensitive Areas (LAWPRO, 2018).

8.153 LAWPRO (2021) provides excellent baseline detail for Lough Carra and Lough Mask, as a Priority Area for Action. However, given that the application site is not within the contributing catchment of Lough Mask, by virtue of its southerly and downgradient position relative to the lake, no further detail is required for this particular study.

8.154 The EPA mapped Groundwater Body (GWB) name for WFD reporting is, the same as the GSI's (2004) GWB Descriptor Sheet name, the Cong-Robe GWB [IE_WE_G_0019], which is described as Karstic and has an area of c.517 km^2.

8.155 The Status and Risk of each of the waterbodies associated with the site, as listed above, are reported in the 3rd Cycle Corrib catchment report (May 2024), as follows:

- Lough Mask is mapped as Good Status (2016 – 2021) and 3rd Cycle At Risk: Pressures are reported as Agriculture and Invasive Species.
- Cong Canal is mapped as Good Status (2016 – 2021) and 3rd Cycle NOT AT RISK.
- Lough Corrib (Corrib Upper) mapped as Good Status (2016 – 2021) and 3rd Cycle 3rd Cycle NOT AT RISK.

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- Cong Robe GWB mapped as Good Status (2016 – 2021) and 3rd Cycle At Risk: Significant Pressures are reported as 'Unknown' and Agriculture. The reason that the GWB is mapped as At Risk is because the surface waters have nutrient issues and are reported to be in 'Chemical Quality Diminution'. The EPA conceptualises a GWB as 'At Risk' in this karstic aquifer flow regime because groundwater provides baseflow to the rivers and if the rivers are in poor ecological health, it is assumed that groundwater is a partial reason. For the particular situation in the vicinity of the application site, the surface waters named the Cong Canal and Corrib Upper (Lake) are both monitored and reported as Good Status and Not At Risk. Therefore, it is concluded that for the local area, the mapped 'At Risk' macro scale Cong Robe GWB WFD classification is not connected with current or planned activities at the quarry.

8.156 On a Corrib Catchment Scale, the 3rd Cycle Report suggests that 70% (112 number) of waterbodies are currently meeting their environmental objective of Good or High Ecological Status.

8.157 With respect to the 70% of waterbodies currently meeting their environmental objectives, the Corrib Catchment (HA30) 3rd Cycle Report (May, 2024) reports percentages by water body type as follows:

- Rivers: of the 97 mapped rivers, 58 are achieving objectives and that is c.60%.
- Canals: reported as n/a [note, the EPA maps the Cong Canal as an artificial waterbody].
- Lakes: of the 30 mapped lakes, 24 are achieving objectives and that is c.80%.
- Groundwater: of the 31 mapped GWBs, 30 are achieving objectives and that is c.97%.

8.158 With respect to the site under consideration and its associated water environment, the lake and Cong Canal are in relatively good WFD condition.

8.159 The quarry has operated through all WFD Cycles and at no stage has it ever been reported by the EPA report as a Pressure.

Groundwater Supply Wells

8.160 There are no water supply wells located on the site (or within 4km of the site) according to the GSI wells database (www.gsi.ie). Local survey of homeowners on the nearest boundary roads of the quarry suggest that there are no domestic supply wells.

8.161 There are NO wells located down gradient of the site with respect to potential flow directions from the site.

8.162 There are NO groundwater sourced Public Supply Wells (PWS) within the radius of influence of the subject quarry's operations.

Group Water Scheme Supply Wells

8.163 The Cong Robe GWB (2004) descriptor sheet states that "Flow path lengths can be up to a several kilometres in length. Overall groundwater flow will be towards the rivers and lakes".

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8.164 There is no scientific doubt that the direction of groundwater flow is from Lough Mask through the isthmus of bedrock, in which the site sits, and on to Lough Corrib. There are no GWS abstractions upstream or downstream of the subject quarry's operations with respect to the north south and north east to south west general groundwater flow directions.

8.165 The EPA December 2024 Register of Abstractions cites one abstraction in the Cong-Robe Groundwater Body and this is the 'Cross Group Water Scheme Co-operative Society Ltd'. The amount registered for abstraction is reported to be 580m3/d from two abstraction locations in the GWB. Whilst the EPA Abstraction Register does not give location details, Cross village is 5km to the east of the quarry. Groundwater flow direction suggests that the quarry and Cross GWS abstractions could not be linked.

8.166 Therefore, given the recharge and flow mechanisms, the quarry does not pose a threat to water supply wells.

Geoheritage Sites

8.167 As requested in the GSI's Response to Scoping (**Appendix 8.6**), County Geoheritage Sites (CGS) associated with the site and wider environment are considered.

8.168 The CGSs that warrant consideration with respect to the site and its proposed development, are as follows:

- Cong Springs and Pigeon Hole, Co. Galway (GR 114001, 255389), under IGH themes: IGH1 Karst, IGH16Hydrogeology. A number of complex karst features; caves, springs, dolines, epikarst outcrop & limestone pavement. The springs are some of the largest worldwide and the area is an intricate and complex karst system.
- Curreighnabannow Spring, Co. Mayo (GR 114944, 255827), under IGH theme: IGH1 Karst, IGH16 Hydrogeology. A major spring of the extensive underground drainage system between Lough Mask and Lough Corrib. The spring is the highest of the Cong springs and is one that operates at successively higher levels as stage levels rise. The site contributes to a major water supply source and it is one of the most important karst sites in County Mayo and County.
- **Lough Mask**, Co. Mayo (GR 110315, 263412), under IGH theme IGH14. A large shallow solutional lake occupying the limestone lowlands to the east of the Maumtrasna and Partry mountains.
- **Castle Lake (Lough Mask)** (GR 112765, 259158), under IGH theme IGH1. A long, narrow solutional lake at SE end of Lough Mask. Castle Lake (& Dringeen Bay) is situated on the Cong Isthmus karst limestone landscape. Cong Canal traverses the SW end of lake.
- **Lough Corrib, Co. Galway** (GR 118000, 244185) under IGH14, IGH1 and IGH7. A large lake situated between County Galway's western acidic uplands and the limestone lowlands.

8.169 As part of EIAs completed for the site in 2017, 2019 and 2020, Hydro-G has previously presented impact assessments on each of those CGSs. In overall summary, the pre-63 area of the quarry has already exposed the subsurface between Lough Mask and Lough Corrib and Lough Mask and the Cong Springs and Pigeon Hole. Therefore, if there was an "extensive underground drainage system between Lough Mask and Lough Corrib" under the application area we would have experienced it in complete flooding of the site and cessation of operations because no pumps can manage that volume of water. The present Section 4 Discharge Licence's 10,000 m3/d Emission Limit Value for

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Discharge Volume is never achieved. This is expanded on and discussed to conclusion in the Section of this Chapter entitled 'Conceptual Understanding of the Site & Environment', which integrates all Desk Study, Site Investigation and Long Term Monitoring Data.

Site Investigations

8.170 This is a Water Chapter.

8.171 Site Investigations relating to the nature and characteristic of the bedrock are presented in the Land, Soils & Geology Chapter.

8.172 Considering that this is a study of a site that is mapped by the GSI as a karst conduit aquifer, there is particular significance in the Site Investigation findings of very complete core retrieval in the bedrocks SI boreholes. Was there any evidence of conduits or water strikes in the bedrock boreholes drilled throughout the site in all historic phases of EIA at the quarry? The answer is no, many boreholes have been drilled at the site, deep core holes have also been drilled, neither conduits nor cracks nor water strikes nor any subterranean evidence of karst have ever been found in bedrock.

8.173 Detailed assessment of the nature of the bedrock was completed and reported in Colthurst (2014) and the results are discussed in detail in the Land, Soils & Geology Chapter. Of significance is that the Calcium Carbonate pureness of the limestone analysed in the laboratory increases with depth in the profile: with CaCO3 % increasing from 95% at the current permitted elevation to 99.95% in the subterranean elevation of -12m OD proposed for quarrying in this application. Further, the Total Impurities decreases from 5% to 1% as the -12m OD elevation is approached.

8.174 In summary, as presented in the Land, Soils & Geology Chapter and also in Figure 8.9 of this chapter, Site Investigation boreholes drilled across the entire site and particular to the application area here, in the northern portion of the site, include as follows:

- Twenty One boreholes were drilled in the northern part of the site, which is the Stage 1 part of the site granted permission to +5 mOD and now seeking permission to continue to Stage 2 and a proposed completion elevation of -12m OD.
- An additional Twenty Two boreholes were drilled throughout the southern areas of the site.
- The purpose of the boreholes was to try to find evidence of groundwater flow and karst conduits. None were found in the total of Forty-Three boreholes drilled.
- Each borehole was 4" diameter, drilled with the blast rig. Hydro-G was on site for each borehole's drilling and logging. Each borehole returned the exact same lithology. There were no changes and no features of note. Therefore, a generalised table of details is presented in Appendix 8.11, rather than volumes of BH logs presenting no information except that there is solid limestone rock all the way through the profile.
- With respect to all drilling results, returns presented a grey and black, solid, limestone, very hard, no conduits, no water strikes in the zone of 10m OD to lowest depth drilled elevation of minus 8.6m OD. The limestone was pale grey in northern part of proposed vertical extension area and dark cherty limestones in the southern zone. This is not uncommon in the limestone of the site.

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- In addition to the 43 blast holes drilled, Five Core Holes were drilled (Locations A to E) to base of hole elevations of c. -50m OD (BHs C, D, E), c. -90m OD (BHB) and c. -183m OD (BH A in the Pre 63 Area).
- In addition to the 43 blast holes and 5 core holes, there are 4 Groundwater Monitoring Boreholes at the site. These are used for the routine monitoring of levels and groundwater hydrochemistry at the site. These NW BHs (GW1 – GW4) range in depth from 50 to 90m below ground level and have base of hole elevations ranging from of c. -30m OD to c. -67m OD.
- It is therefore concluded that a total of 52 bored holes at the site and all progress to depths deeper than the -12m OD proposed elevation of this application.

8.175 Subsequent to drilling, the bedrock was tested for its saturated borehole's hydraulic conductivity (Ksat) using falling head response tests in each of the boreholes, except BH6 & BH7, which were subsequently accidentally covered by spoil heaps. The results for the bedrock are presented in Table 8-6.

Table Error! No text of specified style in document.**.6: Saturated Hydraulic Conductivity Results for the Bedrock = No Conduits, very low Ksat.**

		Borehole Drilling Information						Falling Head Response Tests: Hydraulic Conductivity Result			
	NGR	Ground Level Elevation (m OD)	Depth Drilled (m)	Base of Borehole Elevation (m OD)	Drilling Notes/ Limestone encountered/Karst Conduits?	BH Water Level (m bgl) February 2018	BH Water Level (m OD) February 2018	Ksat (m/s)	Ksat (m/d)	Ksat (m/d)	Hydraulic Conductivity Comment/ Primary or Secondary Porosity?
BH 1	38327, 40418	11	21.6	-10.6	4" diameter holes, drilled with blast rig, returned gray and black, solid, limestone, very hard, no conduits, no water strikes in the zone of 10m OD to lowest depth drilled elevation of minus 8.6m OD. Pale grey in northern part of proposed vertical extension area and dark cherty limestones in the southern zone.	2.1	8.9	4E-07	0.03	3.E-02	Hence, the karst CONDUIT Aquifer classification.These Ksat (m/d) results present a limestone matrix that has a slower conductance of water than a heavy clay. This is classic limestone matrix porosity of no ability to transmit water.
BH 2	38315, 40400	10.5	22	-11.5		14.8	-4.3	8E-10	0.00007	7.E-05	
BH 3	38319, 40366	11	22	-11		2	9	4E-08	0.004	4.E-03	
BH 4	38266, 40377	11	21.5	-10.5		10.55	0.45	5E-09	0.0004	4.E-04	
BH 5	38257, 40370	10	21.5	-11.5		3.55	6.45	2E-09	0.0002	2.E-04	
BH 6	38265, 40349	11	21	-10		lost in spoil heaps					
BH 7	38266, 40349	10	21.6	-11.6							
BH 8	38328, 40464	12	22	-10		0.5	11.5	3E-08	0.0025	3.E-03	
BH 9	38320, 40489	13	22	-9		4	9	8E-10	0.0001	1.E-04	
BH 10	38304, 40505	13	21.6	-8.6		1.2	11.8	1E-08	0.0008	8.E-04	
BH 11	38240, 40515	13	21.6	-8.6		0.95	12.05	2E-07	0.02	2.E-02	
								7E-08	6E-03	6E-03	**Average**
								8E-10	7E-05	7E-05	**Min**
								4E-07	3E-02	3E-02	**Max**

8.176 With respect to hydraulic conductivity results, the Ksat results average 10^{-8} m/s, which suggests that the limestone bedrock has a slower conductance of water than a heavy CLAY. This is the classic limestone **matrix** porosity of **no ability to transmit water**. Hence, the karst CONDUIT Aquifer classification means that one has to find a conduit to find groundwater.

8.177 Borehole details and the hydraulic response test results are presented in The Lands, Soils & Geology Chapter's Appendix series, which presents the hydraulic response test graphs and test details.

8.178 Not much store is placed in the groundwater levels in each borehole because the hydraulic response test results suggest that the boreholes act as a sump for water in the floor that has been blasted.

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These boreholes in the floor do not represent local or regional natural groundwater levels in a quarry floor setting in karst.

Long Term on-Site Monitoring Data

8.179 In terms of existing data available, the assessment is fortunate in that there is a long-term dataset for the operational phase in relation to water management and monitoring within the site and the receiving waters. Hydrological and hydrogeological responses at McGrath's Limestone Quarry at Cregaree Quarry, Cong, Co Mayo are monitored at monthly intervals. The following is of significance. On a site local scale, the record for hydrological and hydrogeological monitoring includes as follows:

- Four groundwater monitoring boreholes for which there is a long-term monthly record going back to December 2011. [Borehole IDs GW1 – GW4]. Monitoring of groundwater levels and quality takes place monthly and Annual Environmental Reports (AERs) are submitted.
- A continuous automated monitoring system on the discharge from the site providing the daily record of flow volume and the physiochemical parameters of Electrical Conductivity, pH and turbidity for the period 2012 to current, ongoing.
- Laboratory Analysis of Quarterly samples for the Discharge, Upstream and Downstream on the Cong Canal relative to the licensed discharge point, are monitored by the site on a monthly basis for the purposes of the review of the discharge licence.

8.180 Results for all site monitoring are presented in Appendix 8.12.

8.181 Long Term Site Monitoring Results suggest, as follows:

- Groundwater Quality is good and conforms to the Threshold Values of the Groundwater Regulations (2010, as amended). Results are presented in Appendix 8.12's Table (A).
- Groundwater Levels: There is no downward trend in water levels. An upgradient BH (GW1) and a downgradient BH (GW4) are monitored quarterly, as per the Conditions of the Section 4 Licence for the site. There are annual fluctuations due to the nature of the holes having an unsealed subsoil bedrock interface. This is normal. Results are presented in Appendix 8.12's Table (B). Spot monitoring for water levels in a selection of the remaining historic blast rig holes reveals no changes in water levels because those boreholes are drilled in dry bedrock with no primary porosity and the holes act as self-contained sumps.
- Discharge Quality: There is 100% compliance for each of the parameters specified for Quarterly Monitoring for the Emission Limit Values of the Section 4 Discharge Licence W/391/05_R1 (2019), with the exception of one exceedance, out of 12 events, for Ammonia N in December 2024 and one exceedance for COD in April 2023. Compliance in 100% of the sampling events was achieved for the parameters pH, BOD, COD, Suspended Solid, Nitrates, Total P, Ortho-P, Petroleum Range Organics and Total Hydrocarbons. Results are Tabulated in Appendix 8.12. In particular, it is noted for significant parameters, as follows:

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- BOD is always < 1 mg/l, *i.e.* the LOD of the analyser. The samples conform to the High Status Objectives for ortho-P in the Surface Water Regulations (2009, as amended).
- 90% of the time Suspended Solids (SS) are < 2 mg/l, i.e. the LOD of the analyser. On the one other sampling event the result was 6 mg/l and the ELV is 20mg/l. The discharge has a SS that is 1/5th of what is required by the Salmonid Regulations. This means that the Fisheries downstream are afforded continued protection and illustrates the high quality of the site's water, which was considered suitable for sensitive experiments, further supporting the conclusion that the quarry's water remains of excellent condition.
- With respect to the ELV for Ammonia as N, the ELV is 0.1 mg/l and on 10 occasions the sampling result was an order of magnitude lower than the ELV: on a subset of 3 of those 11 occasions, the result was two orders of magnitude lower than the ELV. There is no residual impact from ammonia nitrates used in the explosives on site.
- Total P and ortho-P were universally < LOD in the discharge. The samples conform to the High Status Objectives for ortho-P in the Surface Water Regulations (2009, as amended).
- Nitrates in the discharge are always lower than the 10 mg/l as NO3 ELV.
- There are never detections in the discharge samples for Total Hydrocarbons, of patterns known to the laboratory.

- Discharge Volumes: As conditioned by the Section 4 Discharge Licence W/391/05_R1 (2019), the site's discharge is monitored continuously for Volume, Temperature, Electrical Conductivity and Turbidity. A Weekly Excel Report with hourly values for all 4 parameters is sent to the site by the M2M Service Provider. A separate M2M Excel Report with a Daily Total Summary for each week accompanies the reported hourly log data. Results are presented in Appendix 8.12's Tables (C) & (D). On receipt each week, Hydro-G reviews the data to ensure that no exceedances occur. The data suggests, as follows:
  - Note: All data are reported to Galway County Council as per the Conditions of the Section 4 Discharge Licence W/391/05_R1 (2019). ONLY A SUBSET of the data are presented here for December 2023 to December 2024, for the purpose of conciseness and to demonstrate all season's response.
  - Refer to Appendix 8.12's Table 8.12 (C) for Daily Discharge Volumes for the period December 2023 to December 2024.
  - Discharge varies throughout the year according to rainfall. Values of zero (0m3/d) are recorded for some days in dry months.
  - The average daily discharge volume is 2,145 m3/d.
  - The peak discharge rate recorded was 7,347 m3/d in January 2024.
  - It is reiterated that the Water Management Lagoon has a design settlement capacity in excess of the Section 4 Licence permitted ELV of 10,000 m3/d.

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- Summary statistics for Hourly Records are provided in Table 8.12 (D) for the requisite parameters measured hourly: outlet flow, pH, EC and NTU.
- The hourly ELV for volume is never exceeded because the pumps in use are limited to the ELV. Hourly variations in the other parameters are neither unusual nor problematic in terms of receiving environment impact.

Flood Risk

8.182 There is therefore no Flood Risk presented by the development proposal. There is no flood risk in the area because of the scales of flow possible in the Cong Canal.

8.183 The last historic flood event recorded by OPW Floodmaps for Cong was in 1990. There have been no reported flood incidences for Cong following the historic national flood events of 2009 and 2014/2015. Therefore, the cause of the 1990 event must have been rectified.

8.184 The percentage volume of the actual discharge and the permitted licensed discharge, relative to all flows in the surface water environment, are insignificant.

8.185 The site's licensed discharge volume of 10,000m3/d, although it seems like a large value, is 0.4% of the OPW reported 50%tile volume of water flowing into Lough Corrib and 0.1% of the OPW reported 50%tile volume of water flowing out of Lough Corrib.

8.186 Neither the site nor the area are mapped by OPW Flood Maps as having risk potential on the basis of either groundwater pluvial, fluvial or groundwater.

8.187 The Mayo County Council County Development Plan (2022 – 2028)'s Strategic Flood Risk Assessment identifies Cong as a Tier 4 Rrual Settlement and the 1990 event is documented for some houses in Cong Village. However, the Plan concludes the No need for further assessment and "Low sensitivity to increase in flows."

Conceptual Understanding of the Site, the Proposed Development and Interactions

8.188 The quarry is a large limestone bedrock quarry that has been in existence for decades.

8.189 Lough Corrib is to the south of the site, and most likely receives groundwater from the direction of the site, and it is mapped by the EPA as Good Status (2016 – 2021) and 3rd Cycle Not At Risk.

8.190 The Cong Canal flows outside and alongside the site's eastern boundary and it is mapped by the EPA as Good Status (2016 – 2021) and 3rd Cycle Not At Risk. This waterbody receives the site's discharge, under Section 4 Licence (2019).

8.191 Regionally, groundwater generally flows From North to South, from the direction of Lough Mask towards Lough Corrib, which is to the south of the quarry.

8.192 The magnitude of groundwater flowing underground, and above ground in the Cong Canal, from Lough Mask is colossal. There are OPW hydrometric stations upgradient of the site and downgradient of all the springs and Cong itself, the Cong Weir provides OPW data that integrates the flow in the Cong Canal with surface manifestations of groundwater that arise in the springs of Cong. The site's actual measured peak discharge volumes are <0.1% of the volume of water measured as flowing over the Cong Weir when the site's peak discharge is occurring.

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8.193 Scale negates impacts on a quantitative (flooding) and qualitative (hydrochemistry and PWS risks). There is no risk potential proposed by the site because everything happening outside it is of a far grander scale, hydrologically and hydrogeologically.

8.194 With respect to hydrogeology, the site is mapped as part of a limestone body that is a Regionally Important Karst (conduit) Aquifer. The macro scale environment in which the quarry site is conceptualised by national hydrogeologists as a "Swiss Cheese" type of subterranean world of karst caves and conduits and very large underground flow rates: springs abound to the south of the site in Cong. Perception would be that this is a high risk location with respect to encountering conduits. However, there is no significant groundwater at the site.

8.195 The fact that the quarry is able to operate in this hydrogeological environment is interesting and entirely related to the type of rock that exists at the McGrath Limestone site: geological formation names and characteristics are key to understanding how the site is able to remain viable when there are such large flows of water flowing alongside it in the Cong Canal to the east and also appearing in springs to the east, south east and south west.

8.196 The reason that there is no hydro- in the geology of the site is because the bedrock that is being quarried is a different type of limestone named the Cong Formation, which underlies the quarry, compared to the adjacent Cong Canal Formation (NL) that is easier for rainfall to dissolve and that is the reason it is home to all the mapped karst features: the swallow holes on the southern shores of Lough mask and the output points are all in the NL formation, rather than in the quarry's CO formation.

8.197 On a site scale, no ground water was detected in 52 site investigation boreholes.

8.198 The subsurface has been explored to elevations of -10 m OD to -18m OD at 21 locations within the application area, which is the northerly portion of the overall quarry site.

8.199 In the southerly portion of the site, *i.e.,* the pre-63 area, the subsurface was probed at 22 locations to elevations of -20m OD to -40m OD. No groundwater or conduit transit zones were encountered.

8.200 Four Core Holes to depth, throughout the site, did not find evidence of groundwater movement through conduits or broken features. The Core Holes in the application area have targeted to depths that exceed the proposed -12m OD application elevation by >40m. The Core Hole in the southern area of the site investigated to -181 m OD. Almost 100% Core recovery was achieved in all Core Holes.

8.201 The best karst expertise for the area and bedrock/aquifer information suggests that the major karst flows could be 30-40 m below sea level (Drew, D., pers. comm., 2015). Therefore, impacts are not an issue with respect to the proposed -12m OD excavation depth proposed.

8.202 Field measurements for saturated hydraulic conductivity in site investigation boreholes suggests that the bedrock has no secondary porosity (karst or conduits) and that the matrix porosity of the limestone (sedimentary rock) is the same as a heavy CLAY.

Envisaged Dewatering Volumes

8.203 No karst features and no water strikes have been encountered and none are expected as the quarry deepens.

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8.204 The calculations presented in Hydro-G (2019) remain valid and the Emission Limit Value of 10,000 m3/d will suffice as the amount of water that will require discharge in the future, considering rainfall, storms, and any groundwater that might be encountered.

Effects, Impact Assessment Methodology & Structure

8.205 This EIA and EIAR were completed in accordance with enacted EU and Irish legislation pertaining to Environmental Impact Assessment (Directive 2014/52/EU, meaning the EIA Directive and Irish EIA Regulations (2018, as amended 2020). As previously stated, the complete list of Guidance and Legislation employed in the completion of this work was presented in **Appendix 8.4**.

8.206 The Impact Assessment was completed with reference to Guidance relating to EIA and the preparation of EIA Reports, which includes the EU (2017); Department of Housing, Planning and Local Government (2018) and EPA (2022) on Guidelines on the information to be contained in Environmental Impact Assessment Reports.

8.207 Criteria for assessing importance of site attributes and their magnitude of importance were taken from the NRA Guidelines (NRA, 2008) and 'Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements' (IGI, 2013).

8.208 The tools and structure of the assessment of Effects and Potential Impacts were detailed in **Appendix 8.6**, in which Industry Standard Tables for rating of the Importance of Environmental Criteria, Significance of Effects, Impacts, Mitigation Measures, Residual Impacts and more are presented.

8.209 In addition to the application of Irish Guidelines as outlined in EPA (2022) and NRA (2008), and in the absence of Irish Guidance specifically focussed on quarries and hydrogeology, the work presented in this EIAR Section has also applied UK practical guidance as published by the UK Environment Agency (the public body equivalent of the Irish EPA). The UK Guidance provides a 'Hydrogeological impact appraisal for dewatering abstractions' (Boak, R. et. al. (2007) and the approach is succinctly outlined in **Appendix 8.7**.

Development Phases Considered

8.210 The evaluation of Potential Effects and Impact Assessment completed considered phases as follows:

- Construction (enabling) Phase
- Operational Phase
- Landscaping, Restoration, Decommissioning & Aftercare.

Description of Likely Effects

8.211 The procedure for determination of potential impacts on the receiving hydrogeological environment was to identify potential receptors within the site boundary and surrounding

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environment and use the information gathered during the field work and desk study to assess the degree to which these receptors will be impacted upon.

8.212 The application site lies within and adjacent to the existing quarry void, and when considered as a cumulative site, will be of moderate to large size.

8.213 The site is therefore considered to be an attribute of high importance.

8.214 In line with best practice, the individual impacts will be considered with respect to the application site, plus the cumulative impacts with respect to the existing and application site.

8.215 Groundwater, the Cong Canal, the Cong River and Lough Corrib SAC & SPA are potential receptors.

Potential Impacts

8.216 The main anticipated impact associated with the proposed quarry extension (by deepening), in relation to hydrogeology, relates to the potential contamination of groundwater from quarrying activities and the subsequent risk posed to the Cong Canal, Cong River and Lough Corrib SAC & SPA. As mentioned previously, water is discharged from the floor sump and pumped to a concrete settlement system before being discharged to the Cong Canal.

8.217 Hydro-G completed assimilation capacity simulations for the 2019 discharge licence review and the ELVs are justifiable in the context of ensuring compliance with the Surface Water Regulations and Groundwater Regulations (2010). Hence, GCC issued a revised licence, which is presented in Appendix 8.2.

8.218 A detailed assessment of all Potential Effects associated with all phases of the proposed development, on different environmental components are presented in Table 8.7, Duration, Frequency and Type of Effect are presented.

8.219 The direct impacts identified as likely to occur during the enabling (construction) stage are deemed to none because the site is ready to continue from its current rock state to deeper.

8.220 The direct impacts identified as likely to occur during the operational stage are deemed to be slight to moderate and long-term in nature.

8.221 The restoration stage of the project describes the aftercare phase that follows the cessation of activities. The direct impacts identified as likely to occur during the restoration stage are deemed to be Significant to Moderate and permanent in duration.

8.222 Indirect impacts (or secondary impacts) are those which are not a direct result of the proposed activity, often produced away from the project site or because of a complex pathway. A negative indirect impact is that silt deposition can impact surface water habitats. A positive indirect impact is that raw materials extracted and processed bring benefits to the progression of society housing and ensuring road safety by enabling the maintenance of roads.

8.223 Consideration has also been given to environmental impacts associated with unplanned events such as intense rainfall events, spillage, accidents, fire, trespassing, etc. The impacts identified as likely to occur due to unplanned events are deemed to be slight to significant and brief in duration.

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Table 8.7 Summary of Potential Effects

Phases	Activity	Attribute	Importance of attribute	Nature and description of the effect	Quality	Significance	Extent & Context	Probability of effects (pre-mitigation)	Frequency & Duration	Type of effect
Construction (Enabling)	There will be no Construction Phase because the site has already been enabled. The "Stage 1" permitted under the 37L Grant permitted the extraction to +5m OD. Therefore, all soils subsoils and stockpiling have taken place, as per Details Submitted with the previous Application. The current proposal is to continue into the underlying bedrock.									
Operational Phase	Movement of aggregate stockpiles	Surface Waters	Surface Water: Extremely High	Mobilisation and migration of suspended solids Sediment deposition in surface water features. Disruption of sensitive riverine habitats	Negative / Adverse	Significant	Cong Canal, Cong River, Lough Corrib	Likely	Occasional, Temporary	Direct & Indirect
	Extraction of bedrock	Bedrock aquifer	Aquifer: Extremely High	Permanent removal of bedrock for society's use.	Negative / Adverse	Slight	Bedrock aquifer within site boundary	Likely	Permanent	Direct
	Blasting of bedrock	Surface Waters & Groundwater	Surface Water & Groundwater: both Extremely High	Deterioration in groundwater and surface water quality	Negative / Adverse	Moderate	Cong Canal, Cong River, Lough Corrib, Cong Robe GWB.	Unlikely (Blast Technology is Advanced)	Temporary, Long-term	Direct
	Use of quarrying machinery and equipment – spillages during	Surface Waters & Groundwater	Surface Water & Groundwater: both Extremely High	Contamination of surface waters and groundwaters with hydrocarbons	Negative / Adverse	Moderate	Cong Canal, Cong River, Lough Corrib, Cong Robe GWB.	Likely	Temporary, Rarely	Direct

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Phases	Activity	Attribute	Importance of attribute	Nature and description of the effect	Quality	Significance	Extent & Context	Probability of effects (pre-mitigation)	Frequency & Duration	Type of effect
	refuelling, use and storage of lubricants									
	Quarry dewatering – lowering of groundwater levels in surrounding area	Bedrock aquifer	Aquifer: Extremely High	Reduction in spring flows. Reduction in baseflow to surface waters.	Negative / Adverse	Moderate	Lough Mask, Cong Canal, Cong River, Lough Corrib, Cong Robe GWB.	Likely	Long-term, Constant, Reversible	Direct
	Use of sump and Settlement pond.	Surface Waters	Surface Water: Extremely High	Removal and entrapment of particulate matter entrained in waters leaving site	Positive	Significant	Cong Canal, Cong River & Lough Corrib.	Likely	Long-term, Constant	Direct
	Cleaning of settlement ponds.	Surface Waters	Surface Water: Extremely High	Improves efficiency of settlement ponds & attenuation Mobilisation and migration of suspended solids	Neutral	Not Significant	Cong Canal, Cong River & Lough Corrib.	Likely	Long-term, Annual	Direct
	Use of wheelwash	Surface Waters	Surface Water: Extremely High	Removal and entrapment of particulate matter attached to haulage vehicles	Positive	Slight	Cong Canal, Cong River & Lough Corrib.	Likely	Long-term, Constant	Direct
	Wheelwash maintenance	Surface Waters	Surface Water: Extremely High	Improves wheelwash and reduces Mobilisation and migration of suspended solids	Neutral	Not Significant	Cong Canal, Cong River & Lough Corrib.	Unlikely	Long-term, Annual	Direct

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Phases	Activity	Attribute	Importance of attribute	Nature and description of the effect	Quality	Significance	Extent & Context	Probability of effects (pre-mitigation)	Frequency & Duration	Type of effect
	Use of hydrocarbon interceptors	Surface Waters & Groundwater	Surface Water: Extremely High	Entrapment of hydrocarbons lost during refuelling/discharge	Positive	Slight	Cong Canal, Cong River, Lough Corrib & Cong Robe GWB.	Likely	Long-term, Constant	Direct
	Use of Office Toilet Facilities, On-Site WWT Plant & Discharge Zone	Groundwater	Surface Water: Extremely High	Discharge of treated wastewater to groundwater (nutrient and bacteriological)	Negative / Adverse	Imperceptible	Cong Robe GWB	Unlikely	Long-term, Constant	Direct
	Pumped discharge of quarry waters	Surface Waters	Surface Water: Extremely High	Deterioration in surface water quality	Negative / Adverse	Slight	Cong Canal, Cong River & Lough Corrib.	Unlikely	Long-term, Constant	Direct
	Use of concrete batching plant at main site to work materials from the planning application area	Surface Waters & Groundwater	Surface Water & Groundwater: both Extremely High	Contamination of Surface Waters and groundwaters with cementitious material	Negative / Adverse	Moderate	Cong Canal, Cong River, Lough Corrib & Cong Robe GWB.	Unlikely	Long-term, Constant	Direct
	Monitoring	Surface Waters & Groundwater	Surface Water & Groundwater: both Extremely High	Monitoring of discharge rates, suspended solids, discharge water quality, receiving surface water quality, groundwater quality	Positive	Not Significant to Imperceptible	On- and off-site	Unlikely	Long-term, hourly, quarterly, annually	Direct

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Phases	Activity	Attribute	Importance of attribute	Nature and description of the effect	Quality	Significance	Extent & Context	Probability of effects (pre-mitigation)	Frequency & Duration	Type of effect
Restoration Phase	Removal of semi-mobile and mobile plant (pumps, generators, etc.)	Surface Waters & Groundwater	Surface Water & Groundwater: both Extremely High	Elimination of hydrocarbon sources	Positive	Slight	Within site boundary	Likely	Permanent	Direct
	Dismantling and removal of fixed plant & machinery (batching plant, wheelwash, etc.)	Surface Waters & Groundwater	Surface Water & Groundwater: both Extremely High	Elimination of hydrocarbon sources	Positive	Slight	Within site boundary	Likely	Permanent	Direct
	Landscaping and movement of infrastructure and overburden stockpiles necessary to facilitate site restoration	Surface Waters & Groundwater	Surface Water & Groundwater: both Extremely High	Mobilisation and migration of suspended solids Sediment deposition in channels disrupting sensitive riverine habitats	Negative / Adverse	Moderate	Cong Canal, Cong River, Lough Corrib & Cong Robe GWB.	Likely	Temporary, Occasional	Direct & Indirect
	Cessation of pumping & discharge	Surface Waters & Groundwater	Surface Water & Groundwater: both Extremely High	Recovery of groundwater levels Reduction of flood risk Reduction in risk of contamination to surface waters	Positive	Significant	Within site boundary and Groundwater Conduit Flow path Radius, if there is one.	Likely	Permanent	Direct
Unplanned	Major Spillage	Surface Waters & Groundwater	Surface Water & Groundwater: both Extremely High	Hydrocarbon contamination	Negative / Adverse	Significant	Within site boundary and Groundwater Conduit Flow	Likely	Temporary, Rarely	Direct

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Phases	Activity	Attribute	Importance of attribute	Nature and description of the effect	Quality	Significance	Extent & Context	Probability of effects (pre-mitigation)	Frequency & Duration	Type of effect
							path Radius, if there is one.			
	Fire	Surface Waters & Groundwater	Surface Water & Groundwater: both Extremely High	Contamination of spent firefighting waters	Negative / Adverse	Significant	Within site boundary and Groundwater Conduit Flow path Radius, if there is one.	Likely	Brief, Rarely	Direct
	Intense Rainfall Events	Surface Waters & Downstream Homes, Businesses, Village.	Surface Water & Groundwater: both Extremely High	On-site & off-site flooding	Negative / Adverse	Moderate	Cong village.	Likely	Brief, Occasionally	Direct

***** Importance of Attribute in Column 4 was determined on basis of criteria from NRA (2008) and IGI (2013), and informed

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8.224 Mass balance calculations are presented to demonstrate potential for effects of blasting to present nitrogen residues in the discharge waters, which has potential to impact groundwater quality. The risk to groundwater and surface water is assessed by quantifying the resultant concentrations for the potential residual nitrogen compounds Nitrate (NO3), Ammonia (NH4) and Nitrite (NO2).

8.225 Peak activity rates of the extraction activities, blasting frequency and the type of explosives used were supplied to Hydro-G by the quarry manager.

8.226 The explosives used in quarry are Kemex 70. Kemex 70 is a site mixed bulk emulsion explosives produced from emulsion matrix. Emulsion matrix is essentially an aqueous solution of ammonium nitrate emulsified in oil. Kemex products may also contain ammonium nitrate prills, fuel oil, aluminium and/or gassing agents. The Technical Data Sheets (TDS's) and MATERIAL SAFETY DATA SHEET (MSDS's) for explosives, primers and detonators used at the site were used in this simulation.

8.227 Literature suggests that small percentages of N compounds can remain as residual coating on bedrock following blasting. This has the potential to be dissolved when it comes into contact with water, albeit potential concentrations are low. The study that is most referenced was completed by Environment Canada in 1988 (Ferguson & Leask, 1988). This study outlines a procedure for determining the residual N compounds for various mine site types. The stepwise procedure used in the 1988 study for predicting aqueous concentrations of N species, is as follows:

a) Calculate the annual leached nitrogen loading (kg/year) for the entire site based upon annual explosive mass usage and residual N fraction associated with explosive type.

b) Separate the leached nitrogen loading among quarry components (e.g. entering surface water, remaining on extracted rock etc.).

c) Separate into loadings of N compounds (Nitrate, Nitrite and Ammonia), and

d) Calculate the flow concentration.

8.228 The concentrations of N species in discharge water from the proposed extension at the application site quarry are calculated using this procedure. This is presented in Table 8.8, below.

8.229 The highest residual is for nitrate (99%), and upper limits of the ranges are used in all cases to determine the concentration of N species in pumped water. These are very conservative assumptions.

8.230 The calculation also assumes that 100% of residual N is dissolved in drainage waters and is subsequently pumped from the quarry by dewatering. The results of calculations presented in Table 8.8 clearly show that the residual N compounds would have concentrations each significantly less than 1 mg/l N. Specifically, resultant concentrations in waters within the

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quarry, if impacted by explosives within the entire quarry site area, would be: 0.29 mg/l NO3, 0.004 mg/l NH4 and 0.007 mg/l NO2.

Table8.8: N compound concentrations for explosives in dewatering discharge

EXPLOSIVE MASS BALANCE		
65	Total Quarry area	ha
19	**Proposed area for rock blasting**	**ha**
190,000	Proposed new area for working	m2
17	Average depth of extraction	m
3,230,000	Volume of rock to be extracted	m3
2,745,500	Rock Volume accounting for 15% losses	m3
0.4	Explosive Mass Required (Generally, at quarry)	kg/m3
1,098,200	Explosives Mass Required	kg
54,910	Explosives Mass Required per year	kg/yr
NITROGEN MASS BALANCE		
94%	% Explosive mass as Ammonium Nitrate	%
35%	% Ammonium Nitrate as N	%
18,065	Mass of N	kg/yr
0.06	Residual Fraction	
1,084	Residual N	kg/yr
N COMPOUNDS**		
1,041	Residual NO_3 *(75-99% of Residual N value of 604 kg/yr)*	kg/yr
16	Residual NH_4 *(0.5 - 24% of Residual N value of 604 kg/yr)*	kg/yr
27	Residual NO_2 *(0-6% of Residual N value of 604 kg/yr)*	kg/yr
WATER BALANCE		
10,000	Section 4 Permitted Daily Quarry Discharge	m^3/day
3,650,000,000	Quarry Discharge	litres/yr
NITROGEN COMPOUND CONCENTRATIONS***		
Residual NO_3	***0.29***	*mg/L*
Residual NH_4	***0.004***	*mg/L*
Residual NO2	***0.007***	*mg/L*
*** Calculation of Residual Concentrations = (kg/yr*10^6 = mg/yr)/(litres/yr)		

8.231 Overall, the residual concentrations meet the requirements of the Threshold Values of the Groundwater Regulations (2010) & the targets set out in both the Freshwater Fish Directive and Salmonid Waters Regulations. Even if the calculated masses are added the background concentration in the groundwater, which is currently baseline at present at ~ 2 mg/l NO3, there is no expected exceedance of any EQS value for N species for Regulatory Limits specified in either the Groundwater Regulations (2010) or Surface Water Regulations (2009).

8.232 The risk of impact to local water quality arising from the use of explosives at the site is therefore negligible. These calculations are based on PEAK abstraction rates.

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8.233 The Cong Robe GWB is reported to have an approximate area of 440 km2 (GSI, 2004) and the GSI assigns a whole GWB area weighted average pre-cap groundwater recharge value of c.800 mm/yr.

8.234 The volume of groundwater associated with this groundwater body is 352,000,000 m3/yr, approximately.

8.235 Table 8.9 presents the quantitative water balance for the Groundwater Body. Most of the groundwater catchment is upgradient of the quarry because the quarry sits close to the northern shores of Lough Corrib, to which the GWB discharges to.

Table 8.9: Groundwater Quantitative Balance

WFD GWB Quanititative Compliance Assessment	
GSI assigned area for 'Cong Robe' Groundwater Body (km2)	440
Cong Robe' Groundwater Body Area as (m2)	440,000,000
AVERAGE Across Region GSI Effective Rainfall (mm/yr)	900
AVERAGE Across Region GSI Groundwater Recharge (mm/yr)	800
GSI Groundwater Recharge (m/yr)	0.8
Groundwater Recharge to GWB = [0.8m rainfall recharge x 440,000,000 m2 area] (m3/yr)	352,000,000
AVERAGE Groundwater Recharge to Clare Corrib GWB as (m3/d)	964,384
Section 4 Discharge Licence (W/391/05_R1) maximum daily discharge volume from the quarry (m3/d)	10,000
Annual Discharge based on MAX daily discharge from the quarry (m3/yr)	3,650,000
Hydro-G Calculation	
Proportion of Quarry's discharge volume as a % of GWB's annual rechange amount to groundwater from rain falling on its catchment (%)	**1.0**

8.236 The significance of the water balance information presented in Table 8.9 is that the water pumped from the quarry, when related to groundwater volume in the underlying GWB, would represent only 1 % of groundwater flowing through the GWB. This would be a very small volume in any circumstances. However, the quarry sits at the bottom of the GWB and close to the point of discharge of the groundwater in this GWB. Therefore, the data in Table 8.9 provides further verification that the site essentially has no groundwater component and the rainfall water balance is further verified.

8.237 WFD Working Group Guidance GW5 (2004b) assigns a rating of **'No Potential for Impact'** for a 1% result.

8.238 The Groundwater Balance presented as Table 8.9 relates to the Impact Potential of the site and the proposed development. With reference to the EPA (December 2024) Register of Abstractions the only other abstraction registered for the Cong-Robe GWB is the 'Cross Group Water Scheme Co-operative Society Ltd.' for a Total Annual Volume of 87,600 m3/yr. When the

McGrath's Cong Abstraction and the Cross Group Water Scheme abstraction are added the total volume abstracted is 3,737,600 m3/yr relative to the calculated available groundwater recharge flow through value of 352,000,000 m3/yr, which was calculated using GSI mapped Groundwater Recharge values as outlined in Table 8.9. The resultant Impact Potential is 1.1% when all groundwater abstractions are considered. That value of 1.1% remains within the **'No Potential for Impact' classification rating of the** WFD Working Group Guidance GW5 (2004b).

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Impact Assessment Discharge

8.239 The impact assessment relating to discharge has been addressed during the Revision of the Section 4 Discharge Licence in 2019. The Licence ELVs were determined so as to result in no impact on surface water or groundwater environments and full compliance with the Surface Water Regulations (2009) and Groundwater Regulations (2010).

8.240 The site's monitoring data suggest compliance with the Conditions of the Licence. A letter of Compliance from Galway County Council, dated January 2025, is presented in Appendix 8.2 with a copy of the Discharge Licence.

8.241 A conclusion of no potential for impact resulting from the discharge is adopted.

Mitigation Measures

8.242 The significant potential Effects identified in Table 8.7, above, are resolved under the mitigation measures set out under Table 8.10, below.

8.243 The key principles of avoidance, prevention, reduction and remedy/off-set have been adhered to in this regard.

Residual Impacts

8.244 Residual Impacts, following Mitigation Measures, are also presented in Table 8.10.

8.245 There are no anticipated residual impacts on the hydrological or hydrogeological environment as a result of the proposed quarry extension in the vertical plane and the site's standard mitigation measures. The bedrock at depth has little porosity and this has been proven by field measurement in the course of this work. Not much new groundwater will be encountered at the site because the conduits are not there. The site has been dealing with its groundwater allotment for years and it has easily been managed and no impacts have been detected in either the Cong Robe Groundwater Body or the Lough Corrib lake environment.

8.246 Assuming implementation of the mitigation measures described above, the majority of residual impacts on the hydrological and hydrogeological environment during all phases are assessed to be unlikely and imperceptible.

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Table 8.10 Summary of Mitigation Measures & Residual Effects

Phases	Potential Impact			Mitigation Measure	Residual Effect (following Mitigation)	
	Activity	Attribute/ Receiving Environment	Character of Potential Impact	Description of Mitigation	Significance or Quality of Effect	Probability
Construction (Enabling) Phase	Mitigation Measures for the Construction Phase are not required because the site has already been enabled, and therefore there is no Construction Phase. The "Stage 1" permitted under the 37L Grant permitted the extraction to +5m OD. Therefore, all soils subsoils and stockpiling have taken place, as per Details Submitted with the previous Application. The current proposal is to continue into the underlying bedrock.					
Operational Phase	Extraction of bedrock	Bedrock aquifer	Removal of Bedrock for society's use.	No Mitigation Measures are possible and neither are they necessary. The same Extreme Groundwater Vulnerability remains, as it was before the quarry operated: the Region is mapped as Extreme because of the naturally thin soil cover and exposed limestone. The limestone is 100's of metres deep (150m Deep Core Hole completed in Pre-63 Area = Solid Rock. The proposed 1 more bench is inconsequential in terms of the Regional resource of bedrock remaining *in situ*).	Imperceptible	Unlikely
	Blasting of bedrock	Surface Waters & Groundwaters	Deterioration in groundwater and surface water quality	Bedrock blasting at all sites is Gardai controlled and can only be completed by Industry specialists. In the EIAR, a sequence of calculations were presented to estimate the residuals of all nitrogen species (Nitrate, Ammonia, Nitrite) in all site waters after blasting. The results of the calculations show that the simulated resultant concentrations all N Species are microscopically very low and satisfy the relevant Environmental Quality Standards (EQSs) of the Surface Water Regulations by at least an order of magnitude. It is surmised that the risk of impact to local water quality is imperceptible.	Imperceptible	Unlikely
	Use of quarrying machinery and equipment – spillages during refuelling, use and storage of lubricants	Surface Waters & Groundwaters	Contamination of surface waters and groundwaters with hydrocarbons	Excavations of rock will follow best management practices for maintenance of machinery. Fuelling, lubrication and storage areas and site offices are remote from surface water features, remote from the floor sump and settlement lagoons. ALL fuel tanks and other site activities (e.g. fuel storage, refuelling, adding hydraulic oils, etc) will be bunded. ALL Refueling vehicles will carry Standard Operating Procedure Spill Kits. All bunded storage tanks will have Standard Operating Procedure Spill Kits in immediate proximity. Waste and fuel materials will be stored in designated areas that are isolated from surface water drains and open excavations. Hazardous wastes such as waste oil, chemicals and preservatives, will be stored in sealed containers. All waste containers (including all ancillary equipment such as vent pipes and refuelling hoses) will be stored within a secondary containment system (e.g. a bund for static tanks or a drip tray for mobile stores and drums). The bunds will be capable of storing 110% of the tank capacity. Where more than one tank is stored, the bund must be capable of holding 110% of the largest tank of 25% of the aggregate capacity (whichever is greater). Drip trays used for drum storage must be capable of holding at least 25% of the drum capacity. Where more than one drum is stored the drip tray must be capable of holding 25% of the aggregate capacity of the drums stored. Regular monitoring of water levels within drip trays and bunds due to rainfall will be undertaken to ensure sufficient capacity is maintained at all times.	Imperceptible	Unlikely

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Phases	Potential Impact			Mitigation Measure	Residual Effect (following Mitigation)	
	Activity	Attribute/ Receiving Environment	Character of Potential Impact	Description of Mitigation	Significance or Quality of Effect	Probability
				Oil which accumulates within the petrol interceptor shall be regularly removed by an appropriately licensed contractor. In addition, the petrol interceptor shall be appropriately maintained in accordance with the manufacturer's specification. Regular visual monitoring of the settlement lagoons and settlement/clarifier tank will be undertaken to ensure no visual oil or fuel contamination is present.		
	Quarry dewatering – lowering of groundwater levels in surrounding area	Bedrock aquifer	Reduction in third party well yields Reduction in spring flows Reduction in baseflow to surface waters	There are no domestic wells in proximity because the application area under consideration is bounded to the east by the Cong Canal and the large nature of the overall site precludes development, and hence effects, to the north, west, south. There will be no significant net loss or gain in the GWB system because volume intercepted and managed at the site represents, by calculated water balance, 1% of the regional groundwater volume. All waters arising at the site are Discharged under Section 4 Licence (revised in 2019, and therefore current with legislation). Therefore, the potential for reduction in spring flows or interruption with baseflow is Mitigated by the valid licence.	Imperceptible	Unlikely
	Use of settlement ponds	Surface Waters	Removal and entrapment of particulate matter entrained in waters leaving site	The site's Settlement Lagoons are in use and have the benefit of prior planning. The Mitigation Measure is in place: discharge waters pass through a sequence of baffled existing settlement ponds, which are maintained in good condition. These serve to clarify pumped quarry waters prior to them leaving site. The Conditions of the site's Section 4 Licence specify continuous monitoring of the discharge and this is a Mitigation Measure already in place. The quarry sump and settlement lagoon system have sufficient volumetric capacity to accommodate all waters for the required residence time. Discharge will be of a quality that will not have a detrimental impact on surface water quality in terms of suspended solids.	Imperceptible	Unlikely
	Cleaning of settlement ponds	Surface Waters	Improves efficiency of settlement ponds, attenuation Mobilisation and migration of suspended solids	Particulate matter captured in settlement ponds to be transferred to bunds.	Imperceptible	Unlikely
	Use of wheelwash	Surface Waters	Removal and entrapment of particulate matter attached to haulage vehicles	A wheel wash facility exists near the site offices and the roads have sprinkler systems. Regular monitoring and maintenance of the wheel wash's tank and silt traps will be undertaken in accordance with the manufacturer's specifications	Imperceptible	Unlikely
	Wheelwash maintenance	Surface Waters	Improves of wheelwash Mobilisation and migration of suspended solids	The wheelwash is to be maintained in accordance with manufacturer's specifications.	Imperceptible	Unlikely
	Use & maintenance of hydrocarbon interceptors	Surface Waters	Entrapment of hydrocarbons lost during refuelling/discharge	The site's infrastructure is already in place to manage solids and interception of oils in the baffled settlement lagoon system prior to discharge.	Imperceptible	Unlikely

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Phases	Potential Impact			Mitigation Measure	Residual Effect (following Mitigation)	
	Activity	Attribute/ Receiving Environment	Character of Potential Impact	Description of Mitigation	Significance or Quality of Effect	Probability
Restoration Phase	Pumped discharge of quarry waters	Surface Waters	Increase flood risk to downgradient receptors	The void on the floor of the quarry is large enough to accommodate and holdback all extreme rainfall events until the storms have passed in the downstream systems. A large range of flows is readily accommodated, naturally, in the Cong Canal, Cong River and Lough Corrib.	Imperceptible	Unlikely
	Pumped discharge of quarry waters	Surface Waters	Deterioration in surface water quality	The Section 4 Licence was reviewed in 2019. Assimilation capacity in the receiving surface and groundwaters has been proved (Hydro-G, 2019 – Appendix 8.3 of this EAIR.	Imperceptible	Unlikely
	Use of concrete batching plant at main site to work materials from the planning application area	Surface Waters & Groundwaters	Contamination of surface waters and groundwaters with cementitious material	Concrete and other cement-based products are highly alkaline and can have a significant Negative / Adverse impact on water quality. The water system at the concrete batching plant is a closed loop system with all wash waters recirculated. Hence there will be no entry of cement based products into adjacent surface waters, mitigating the risk to the aquatic environment.	Imperceptible	Unlikely
	Monitoring	Surface Waters & Groundwaters	Monitoring of discharge rates, suspended solids, discharge water quality, receiving surface water quality, groundwater quality	The Conditions of the existing Section 4 Licence prescribe monitoring. There is no Mitigation needed. The action is Positive.	Imperceptible	Unlikely
	Removal of semi-mobile and mobile plant (pumps, generators, etc.)	Surface Waters & Groundwaters	Elimination of hydrocarbon sources	Positive impact. No mitigation required.	None	None
	Dismantling and removal of fixed plant & machinery (batching plant, wheelwash, etc.)	Surface Waters & Groundwaters	Elimination of hydrocarbon sources	Positive impact. No mitigation required.	None	None
	Landscaping and movement of overburden stockpiles necessary to facilitate site restoration	Surface Waters & Groundwaters	Mobilisation and migration of suspended solids Sediment deposition in channels disrupting sensitive riverine habitats	Site restoration will take place on a phased basis as extraction is completed in defined areas of the site. In the final restoration of boundaries with adjoining lands levels will be graded to harmonise with the surrounding landscape. Perimeter silt fence to be installed at the toe of any overburden stockpiles. Restored areas to be vegetated to enhance stability.	Imperceptible	Unlikely
	Cessation of pumping & discharge	Surface Waters & Groundwaters	Recovery of groundwater levels Reduction of flood risk Reduction in risk of contamination to surface waters	Post-completion groundwater levels will return to current baseline levels, thereby partially filling any voids. These voids may be left as open waterbodies for recreational or ecological benefits.	None	None

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Phases	Potential Impact			Mitigation Measure	Residual Effect (following Mitigation)	
	Activity	Attribute/ Receiving Environment	Character of Potential Impact	Description of Mitigation	Significance or Quality of Effect	Probability
Unplanned events	Major Spillage	Surface Waters & Groundwaters	Hydrocarbon contamination	As specified above, Spill Kits are SOP and all Refueling vehicles will carry those Spill Kits; bunded tanks, drip trays, appropriate containers in appropriate locations will be ensured.	Imperceptible	Unlikely
	Fire	Surface Waters & Groundwaters	Contamination of spent firefighting waters	Used firefighting water which may be potentially contaminated may be contained via shutoff valves at the hydrocarbon interceptors. Contained firefighting water will be disposed of appropriately by a licensed contractor.	Imperceptible	Unlikely
	Intense Rainfall Events	Surface Waters & Downstream Homes, Businesses, Village.	On-site & off-site flooding. Cong Village is downstream.	The floor of the quarry is large and this is the mitigation measure. The pumps in the sump can be shut off it there is a threat of flooding, caused by storm events, in the wider environment.	Imperceptible	Unlikely

Cumulative & In Combination Impacts

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8.247 The application area forms part of an overall working quarry where processing, manufacturing plant and associated ancillary facilities are located along with extraction areas.

8.248 A search of the Mayo and Galway County Council online planning search facilities indicates that there are no other planned developments in the vicinity of the application site that have the potential to have any significant cumulative effects with the proposed development.

8.249 There are two other quarries located in the vicinity of the quarry with one located approximately 0.9km to east and another located approximately 1.9km to the north east. Both quarries are in the region of 1.5 hectares in area and are subject to rock extraction and processing on a small scale basis. Due to the low level of extraction at these, it is unlikely that there would be an in combination impact associated with these developments.

8.250 The cumulative impact assessment considered proposed and permitted activities within the Corrib Catchment. Discretion has been used to select those activities most likely to have an in-combination effect with the application site.

8.251 There are activities such as planned windfarms, other limestone bedrock quarries, Uisce Eireann abstractions and discharges of treated wastewater. However, the location of the site, in the isthmus of two very large and significant water bodies, has the effect of reducing potential for interaction or in combination effects with other developments.

8.252 The application site is self-contained and a robust groundwater and surface water monitoring programme is already in place to quantify the hydrological and hydrogeological regime within the site and in the surrounding environs.

Transboundary Impacts

8.253 EIA Directive 2014-52-EU invokes the Espoo Convention on Environmental Impact Assessment in a Transboundary Context (1991) and applies its definition of transboundary impacts.

8.254 Given the location of the site at c.119 km, approximately, at its closest position to the border with Northern Ireland, which is to the north east of the site, the nature, size and scale of the proposed development, and the fact that water from the catchment flows in a southerly direction towards Lough Corrib, it is expected that the development will not have any significant transboundary effects with respect to water bodies.

Do Nothing Scenario

8.255 This item requires consideration of the effect on the environment as it would be in the future should the proposed works not be carried out.

8.256 If the development did not proceed, the site of the proposed development would remain an exposed quarry floor and quarry void in the southern half of the site and scrubland in the elevated north-eastern half of the site, as per the current site status. Thus, it would be expected that the application site would not undergo any changes in a 'do-nothing' scenario.

8.257 In this work, the site has been assessed as sitting on an isthmus of competent limestone bedrock, between the Lough Carra Mask SAC complex and Lough Corrib SAC, SPA, pNHA, with no evidence of large volume conduits carrying groundwater. The site's volumes of waters arising are relatively small considering its large size and relative to other limestone quarries in

other locations. The waters arising at the site are primarily driven by rainfall and shallow groundwater interflow through the epikarst subsoil bedrock interface.

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8.258 Interception of groundwaters and discharge of same from the site will not significantly change the groundwater dynamics component of the site in its current condition because there is no net loss of water arising from the operation of the site but there would be a retention of a large lake if the Do Nothing Scenario were adopted.

8.259 Under the 'Do-Nothing' scenario, where planning consent is not achieved, there would be a continuance of quarrying and ancillary activities on site as part of previous permissions. As such, the 'Do-nothing' scenario has been subject to the rigors of a previous EIA (Earth Science Partnership, 2006, 2016, 2017, 2020).

8.260 When planning consents at the site expire, the restoration phase would involve the removal of all infrastructure and the return of the site to a secure wildlife refuge / amenity. The natural progression to lake or water feature would take place over the course of a 6 and 10 ten-year period, on the basis of the size of the void and the measured rate of discharge currently. This would result in an attendant increase in the biodiversity interest and amenity of the site and environs.

8.261 If the proposed development did not proceed, the aggregate resource would remain unused *in situ*, and the local supply of quality aggregates, asphalt and concrete products would be more restricted, the availability of materials for road maintenance would be constrained until another large company filled the need. Given that the other company would be remote from Cong and south Mayo, there would be increased traffic and increased cost of materials, due to the nuances of the market and material's availability.

8.262 If the proposed development did not proceed, there would be an increase in heavy goods vehicles from a wider extent in the county and from a different hub.

8.263 It is expected that the site would not undergo any changes in terms of surface and groundwater under a 'do-nothing' scenario, and that the interception and discharge from the site will not significantly change the groundwater dynamics component of the site.

8.264 The nature of the void and on-site water management lagoon system provides significant attenuation capacity, which has a positive effect of reducing flood risk to local watercourses when compared with the pre-development regime. The proposed activities include restoration of the site following completion of targeted bedrock extraction.

8.265 Quarrying in the local area is established and has been integrated into the local environment. It is therefore considered more appropriate to continue activities at the current application site, as opposed to opening a new quarry on a greenfield site to meet the demands of the construction industry.

8.266 The demand for rock resources continues to be driven by the ongoing need for housing, roads, shopping centres, data centres, and industrial parks. The 'Do-Nothing' scenario would create a temporary supply shortfall in the construction market, which would eventually restore itself, but likely at a higher cost to the consumer. With respect to this water assessment, and water dependent habitats and species, given that the quarry has been in operation for many decades and there is no observable environmental or ecological effect there is no reason to enter the Do Nothing Scenario.

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8.267 McGraths Limestone (Cong) Ltd. operates an Environmental Management System that is approved to ISO 14001:2015. Quarry management have comprehensive Standard Operation Procedures in place for all components of its activities at the site.

8.268 With respect to groundwater monitoring, there is routine monitoring of Groundwater Quality and Levels and Quality each Month for the four Long Term Groundwater Monitoring Wells.

8.269 With respect to discharge monitoring, the Conditions of the Section 4 Licence for the site (W/391/05_R1, 2019) specify continuous monitoring for pH, temperature, turbidity, flow and Electrical Conductivity. The monitoring infrastructure is in place and the site, and Hydro-G, receive a weekly monitoring report every Monday morning.

8.270 With respect to discharge monitoring, the Conditions of the Section 4 Licence for the site (W/391/05_R1, 2019) also specify spot samples for the Discharge quality for ELVs, as specified and shown in Appendix 8.2. This is completed by the site and samples are collected on the same day and analysed in an accredited laboratory.

8.271 The site routinely samples, at the same time as sampling the discharge for laboratory analysis, the upstream and downstream Cong Canal river water. This is a site initiated monitoring protocol so as to ensure assessment of continued assimilation capacity in the receiving water.

8.272 Monitoring measures will continue as usual and they verify whether the development is impacting on the hydrological and/or hydrogeological, and that the mitigation measures are effective.

8.273 The site's Standard Operation Management Plan addresses all potentially polluting activities and includes an emergency response procedure.

8.274 All personnel working on the site are trained in the implementation of the procedures. As a minimum, the manual is formulated in consideration of the standard best international practice including but not limited to:

- EPA (2006) Environmental Management Guidelines for the Extractive Industry (Non-Scheduled Minerals).
- CIRIA, 2011. Control of Water Pollution from Construction Sites, Guidance for Consultants
- CIRIA, 2005. Environmental Good Practice on Site (C650).
- EI, 2005. Oil Storage Guidelines (BPGCS005).
- Environment Agency, 2004. UK Pollution Prevention Guidelines (PPG).

8.275 Hydrocarbon and silt interceptors are serviced and maintained on a regular basis by an independent licensed contractor.

8.276 Regular inspections of the site infrastructure (settlement ponds, hardstanding, drainage infrastructure, on site WWTP and discharge zone, etc.) are undertaken by a designated person.

8.277 The quarry manager understands that it is part of his work and overall responsibility to ensure that all operations are carried out in such a way as to minimise potential impacts water receptors. The quarry manager is in constant communication, and works in the same office, as the operative monitoring the performances of pollution control measures adopted to ensure that the proposed development is not impacting on the environment.

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8.278 The EIAR guidelines (EPA, 2022) highlight that the interaction of impacts to the hydrological and hydrogeological environment arising from the proposed activities, with potential receptors identified in other EIAR chapters, must be given due consideration.

8.279 Ecology – migration of suspended sediment from the site can impact stream bed habitats, in the Cong River, the Fisheries Hatchery and potentially extending to Lough Corrib. Comprehensive mitigation measures are already built in to site management procedures to prevent loss of suspended solids from the site.

8.280 Ecology - Use of quarrying machinery and equipment can result in spillages during refuelling, use and storage of lubricants, resulting in release of hydrocarbons to water. Where hydrocarbons enter surface watercourses there may be adverse impact on flora and fauna. Comprehensive mitigation measures are already built in to site management procedures to prevent spillages of hydrocarbons from the quarry activities.

8.281 Noise – pumping of water between the sump and the first settlement lagoon, as well as the activities of crushing bedrock and screening aggregates could give rise to increase noise emissions. Given the relatively small size of the pump, the fact it is submerged, and the fact that it is not powered by generator, no noise nuisance is envisaged.

8.282 Noise - Given the large size of the site and the lack of significant development, as well as the road along its southern boundary that is not densely developed, as well as the extensive forestry to the south, in combination with the fact that water is used during the processing of rock, no noise nuisance is envisaged during crushing and screening.

8.283 Air quality & climate – the removal of bedrock by blasting and crushing and screening of bedrock has the potential to generate dust and contribute to climate emissions. The continued supply of materials for road maintenance, construction of homes and businesses has the potential to enable continued traffic and consumerism, each of which also contribute to climate emissions.

8.284 Each of these issues and the mitigation measures that are proposed are addressed in detail in the relevant chapters of the EIAR. These impacts are considered to be negative, but with mitigation measures in place, their significance can be reduced.

Application of Dewatering Impact Appraisal Methodology (UK EA)

In addition to the usual impact assessment, description of likely impacts and mitigation measures presented above, Hydro-G presented a UK Environment Agency (Boak, R. et. al., 2007) 'best practice' approach to a hydrogeologically focussed assessment (refer to Appendix 8.8). As previously outlined, the UK EA's approach suggests a stepwise thought-process. Following on from the completed desk and field studies, Hydro-G answers to each of the steps can be summarised as follows:

- ***Step 1:*** Establish the regional water resource status:

  Answers:

  Groundwater is mapped as a Regionally Important Karst Conduit Aquifer, named the Cong Robe groundwater body, assigned EPA WFD Good Status (EPA 2016-2021) & 3rd Cycle Not At Risk.

  Surface Waters:

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(a) The site has operated for decades adjacent to the Cong Canal, which flows outside and along its eastern boundary. The Cong Canal remains assigned EPA WFD Good Status (EPA 2016-2021) & 3rd Cycle Not At Risk.

(b) Lough Corrib (SAC, SPA, pNHA) is downstream of the site and it is mapped as EPA WFD Good Status (EPA 2016-2021) & 3rd Cycle Not At Risk.

- ***Step 2:*** Develop a conceptual model for the abstraction and the surrounding area:

  Answer = Almost all the recharge to the site is rainfall driven with most contributions from the subsoil/bedrock transition zone ingresses of recent rainfall. No conduits were determined during borehole drilling in the floor of the proposed deepening area. No conduits were encountered in any of the 49 site investigation boreholes drilled across the entire quarry site, for which the current application area is a subset. The application site will be extracted down to a final proposed floor level of -12m OD. The conceptual model, based on drilling and hydraulic response testing, is that there will be little new groundwater encountered. The porosity of the bedrock is low at 10^{-8} m/s. This is very low. For a karst system, groundwater ingress is relatively low. Discharge measurements quantify a usual discharge volume range of c. 300 to c.5,500 m3/d. The site's water balance accounts for 1 % of the groundwater body's water balance. This would be a very small volume in any circumstances. However, the quarry sits at the bottom of the GWB and close to the point of discharge of the groundwater in this GWB. Therefore, the data provides further verification that the site will essentially continue to have no groundwater component and the rainfall water balance is further verified.

- ***Step 3:*** Identify all potential water features that are susceptible to flow impacts:
  - Lough Mask SAC
  - Cong Canal
  - Lough Corrib SAC, SPA, pNHA

- ***Step 4:*** Apportion the likely flow impacts to the water features.

  Answer = None,

  - No effects have been determined to date. Overriding value of significance is that the interception amount at the quarry represents 1% of the Cong Robe groundwater body's water balance.

- ***Step 5:*** Allow for the mitigating effects of any discharges, to arrive at net flow impacts:

  Answer *= Discharge of waters that are surplus to dust suppression and product generation requirements is discharged from the site under Licence from Galway County Council (GCC). Monitoring data, submitted to GCC as part of the discharge license review, demonstrates that the quality of the quarry's discharge could be described under the 'High Status' water quality parameters of the Surface Water Regulations. As stated, all waters arising at the site represent 1 % of the Cong Robe groundwater body's water balance and so, even accounting for product use, the net flow potential for impact is negligible.*

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- ***Step 6:*** Assess the significance of the net flow impacts.

  Answer = Negligible significance

- ***Step 7:*** Define the search area for drawdown impacts.

  Answer = The groundwater flow mechanism is Karst Conduit flow with extremely low measured hydraulic conductivity in the matrix of the bedrock boreholes. However, no conduits were determined during extensive site investigations. Drawdown, being a primary porosity bedrock media concept, **is not applicable to the site**. Routine monitoring of the existing groundwater monitoring boreholes suggests that excavations have not impacted groundwater levels. There are no local third party boreholes to survey.

- ***Step 8:*** Identify all features in the search area that could be impacted by drawdown.

  Answer = Refer to comment at Step 7, above. An extending drawdown radius concept does not apply to the site.

- ***Step 9:*** For all these features, predict the likely drawdown impacts.

  Answer = None predicted.

- ***Step 10:*** Allow for the effects of measures taken to mitigate the drawdown impacts.

  Answer = Not relevant.

- ***Step 11:*** Assess the significance of the net drawdown impacts.

  Answer = Not applicable

- ***Step 12:*** Assess the water quality impacts.

  Answer =

  - Surface water assimilation capacity simulations, as part of the 2019 discharge licence review process, revealed that there would be NO CHANGE in concentrations in the Cong Canal and therefore it is safely concluded that there could be no change either then in the downstream Lough Corrib.
  - Groundwater assimilation capacity simulations have been completed and demonstrate no change in resultant groundwater concentrations.
  - Additional calculations have been completed with respect to explosives residues and no water quality impact is predicted.

- ***Step 13:*** If necessary, redesign the mitigation measures to minimise the impacts.

- Not necessary.

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- ***Step 14:*** Develop a monitoring strategy.
  - Monthly spot sampling of discharge and groundwater monitoring is routine at the site.
  - The site's Section 4 Licence (W/391/05_R1) specifies, as a Condition, continuous monitoring of the site's discharge characteristic for Volume, Temperature, pH, EC and NTU. This will continue.

Conservation Objective Site Protection Measures (NATURA 2000)

8.285 **Lough Corrib SAC, SPA and pHNA:** The main risk associated with the future proposed working within McGraths Quarry, Cong, Co. Mayo is the initially perceived potential adverse impact it could have on the Lough Corrib SAC. However, dewatering volumes are relatively low, at generally <2,500 m3/d, and the competent solid nature of the rock and Geological Survey of Ireland classifications on groundwater recharge suggest that the site's potential interference in the wider groundwater catchment's water balance is insignificant. Transition zone ingresses at times of heavy rainfall is the primary source of water in the quarry and this settles in the sump at the lowest level of the quarry and is pumped to a concrete tank settlement system that has been proven to be fit for purpose and can accommodate 10,000m3/d.

8.286 With the proposed expansion of the rock excavation area within the existing quarry the quarry floor will be lowered. This could result in a small increase in the volume of water in the quarry: the same volume of rainfall runoff will fall on a similar area – it will just be ground at a lower elevation, with the same runoff co-efficient and volumes derived.

8.287 The site received a revised Section 4 water discharge licence from GCC in 2019 and the ELVs are justifiable in the context of no change in the resultant concentrations and this ensures maintaining favourable habitat in local surface water receptors and groundwater, whether that is the Cong Canal or Lough Corrib or the underlying Cong Robe groundwater body. This justification is supported by the fact that assimilation capacity simulations suggest no change whatsoever in groundwater concentrations. This is because the discharge quality is good and the volume of discharge is relatively small with respect to the volume of groundwater flowing regionally.

8.288 **Lough Carra Mask Complex SAC:** Hydro-G offers that the Lough Mask Carra Complex SAC is upgradient of the quarry in terms of groundwater flow direction. Given that, as previously reported in prior applications for consent, no karst conduits or underground connections have been found in all site investigations it is highly unlikely that there are subterranean connections between the quarry and Lough Mask. Yes, the Cong Canal passes along the eastern boundary of the quarry and the Cong Canal connects Mask to Corrib. However, no major water has been encountered over the long-term operation of the quarry and the depths already achieved in the 'Pre 63' area (Area A). Therefore, I confidently assert that the proposed activity at the quarry does not have any potential to affect the Lough Mask Carra Complex SAC.

8.289 **Ballymaglancy Cave SAC:** Hydro-G offers that this bat cave is highly unlikely to be affected by proposed activity at the quarry site. The caves are sufficiently remote from the site, they are not reliant on water and given that blasting has been ongoing at the quarry for decades and have not affected the caves: the caves are listed and described in a 2018 NPWS (2018)

document Conservation objectives supporting document – lesser horseshoe bat (Rhinolophus hipposideros).

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PWS Protection Measures

8.290 EPA Envision mapping, as tabulated earlier in this report, presented Drinking Water Protection Areas that have been considered and the development's potential for Impact has been assessed.

8.291 Uisce Eireann responded to scoping and their queries were all addressed, as presented in Appendix 8.6.

8.292 In high level overview, there is no potential and there is Zero Risk posed by the development to sources of PWS.

8.293 Lough Carra and Lough Mask are to the north and upgradient, water flow is from north to south and therefore the site has no potential to affect either lake's hydrochemical quality.

8.294 Further, Lough Mask has a direct hydrological connection to drain *via* an overland flow mechanism to Lough Corrib *via* the Cong Canal, which flows outside and alongside the quarry's eastern boundary. As stated, the Cong Canal is the Licenced receiver of all waters arising on the site. Therefore, there is no potential for quantitative impact on any waterbody because any water lost from either Lough Mask or the Cong Canal, into the site, is discharged back into the same hydrological and hydrogeological system.

8.295 With respect to Lough Corrib as a source of PWS, as previously stated, there is a PWS intake at Luimnagh, which is on the eastern shore of Lough Corrib in a very sheltered inlet and at a distance of c.20km to the south east of the site. It is entirely reasonable to offer that for magnitude of the PWS abstraction at Luimnagh is not entirely sustained by lake water in such a sheltered recessed inlet. The intake is more probably influenced significantly by groundwater from a spring discharge on the shoreline, with groundwater flow direction coming from north east to south west.

8.296 There is an Uisce Eireann PWS intake at the Terryland PWS Intake at Galway city, which is c.34km south of the site. The Terryland PWS intake is not directly from Lough Corrib but it is on the Corrib_020 river that discharges from the lake. A conclusion of No Potential for Risk posed by the proposed development on the Terryland PWS intake is scientifically justified on the basis of scale. Given the large magnitude of the contributing catchment to the entire Lough Corrib system (Upper and Lower) before the Terryland PWS abstraction location at the most southerly part of the lake, the large magnitude of discharge flows quantified at Galway City's OPW Hydrometric Station.

8.297 With respect to PWS supplied by GWS wells, there is no scientific doubt that the direction of groundwater flow is from Lough Mask through the isthmus of bedrock, in which the site sits, and on to Lough Corrib. There are no GWS abstractions within radius of influence of the subject quarry's operations. Given the complex recharge and flow mechanisms in karst conduit-controlled aquifers, and the fact that groundwater movement is rapid and follows irregular flow paths, the quarry's operations do not pose a threat to nearby water supply wells.

Water Framework Directive Compliance Assessment

8.298 Lough Mask (IE_WE_30_665a) is mapped as Good Status (2016 – 2021) and 3rd Cycle At Risk: Pressures are reported as Agriculture and Invasive Species. Neither the permitted quarry nor

the proposed application area contribute to the waters entering Lough Mask. Therefore, there is no potential for the site to affect Lough Mask's WFD Status or Risk.

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8.299 The Cong Canal (IE_WE_30C060300) is mapped as Good Status (2016 – 2021) and 3rd Cycle NOT AT RISK. The site's Section 4 Licence to Discharge treated water (W/391/05_R1) to the Cong Canal was issued in 2019 and the Emission Limit Values (ELVs) are specified so as to ensure compliance with the Environmental Quality Objectives (EQOs) of the Surface Water Regulations (2009, as amended) and the Threshold Values of the Groundwater Regulations (2010, as amended). The hydrochemical characteristic of the site's discharge conforms with EQOs for High Status surface waters. Therefore, there is no potential for the site to deleteriously affect the Cong Canal's WFD Status or Risk. If the agricultural pressures surrounding Lough Carra and Mask were rectified, the site's discharge has potential to assist in the Cong Canal improving its WFD Status to HIGH STATUS.

8.300 Lough Corrib (Corrib Upper) (IE_WE_30_666b) is mapped as Good Status (2016 – 2021) and 3rd Cycle 3rd Cycle NOT AT RISK. The site has operated for decades in the catchment of Lough Corrib and the lake remains Good Status. Invasive Species is the reported Pressure (EPA, 2019) and likely a significant reason why the Corrib Upper waterbody is not High Status. The quarry does not present an invasive species conveyance risk. As stated, the hydrological contribution from the quarry is water that can be classified as High Status waters. Therefore, the quarry presents an opportunity to assist in the achievement of better quality conditions in Lough Corrib.

8.301 The Cong Robe GWB (IE_WE_G_0019) is mapped as Good Status (2016 – 2021) and 3rd Cycle At Risk: Significant Pressures are reported as 'Unknown' and Agriculture. The reason that the GWB is mapped as At Risk is because the surface waters have nutrient issues and are reported to be in 'Chemical Quality Diminution'. The EPA conceptualises a GWB as 'At Risk' in this karstic aquifer flow regime because groundwater provides baseflow to the rivers and if the rivers are in poor ecological health, it is assumed that groundwater is a partial reason. For the particular situation in the vicinity of the application site, the surface waters named the Cong Canal and Corrib Upper (Lake) are both monitored and reported as Good Status and Not At Risk. Therefore, it is concluded that for the local area, the mapped 'At Risk' macro scale Cong Robe GWB WFD classification is not connected with current or planned activities at the quarry.

8.302 Further, with respect to Quantitative Groundwater Body Status and Risk, a numerical water balance has been completed for the underlying Cong Robe GWB (IE_WE_G_0019) and reported in this work and the result is that the abstraction/licensed discharge of waters from the site accounts for 1% of the available groundwater resource volume. When the site's abstraction/discharge is considered in combination with all other EPA (2024) registered abstractions from the Cong-Robe GWB the result is that 1.1% of the available groundwater resource volume is affected. Both 1% and 1.1% values are within the **'NO Potential for Impact'** category of the WFD (2004b) Working Group GW5 Guidance Document on Groundwater Abstractions.

List of Figures

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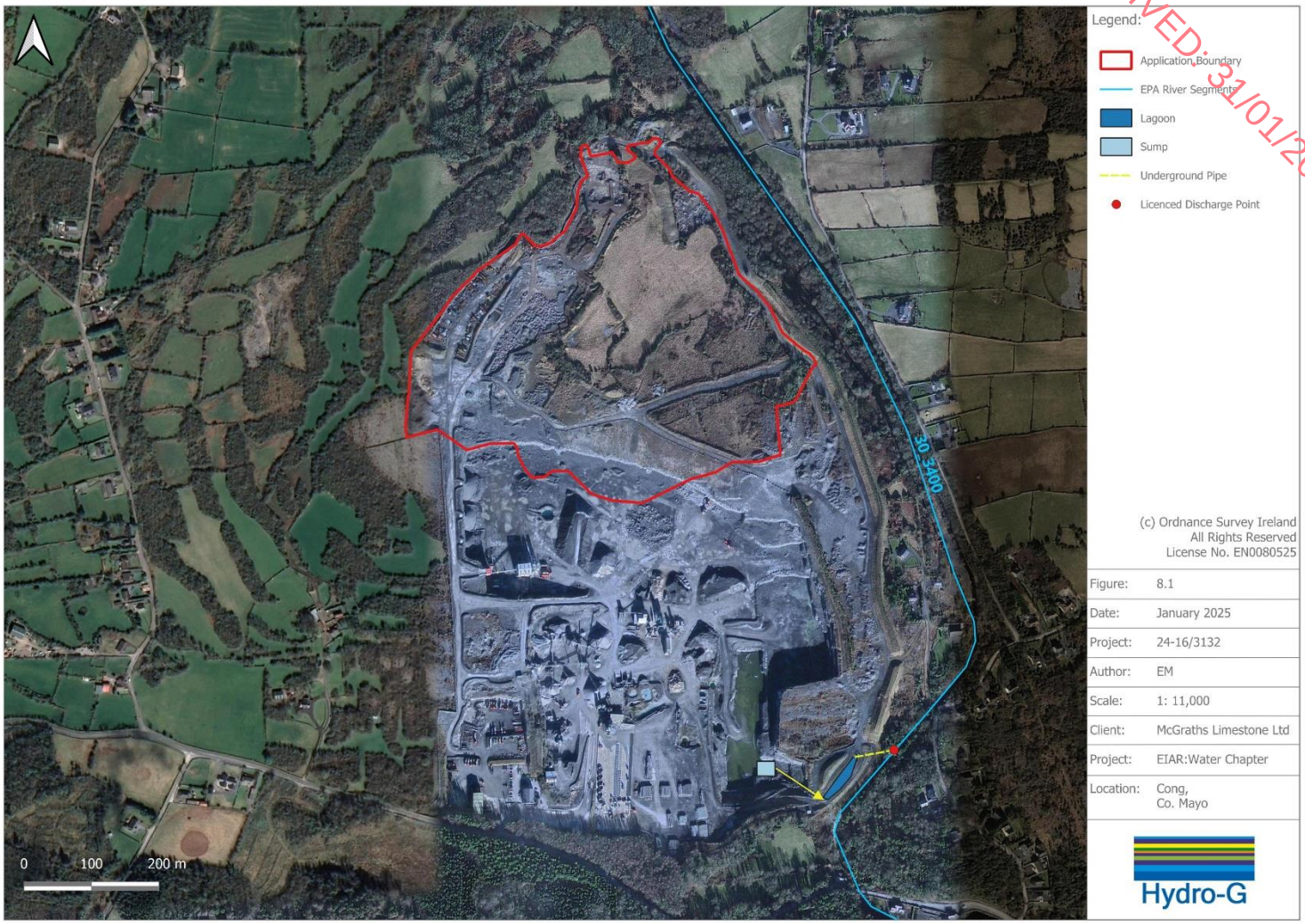

Figure 8.1 Site Layout and Discharge Location

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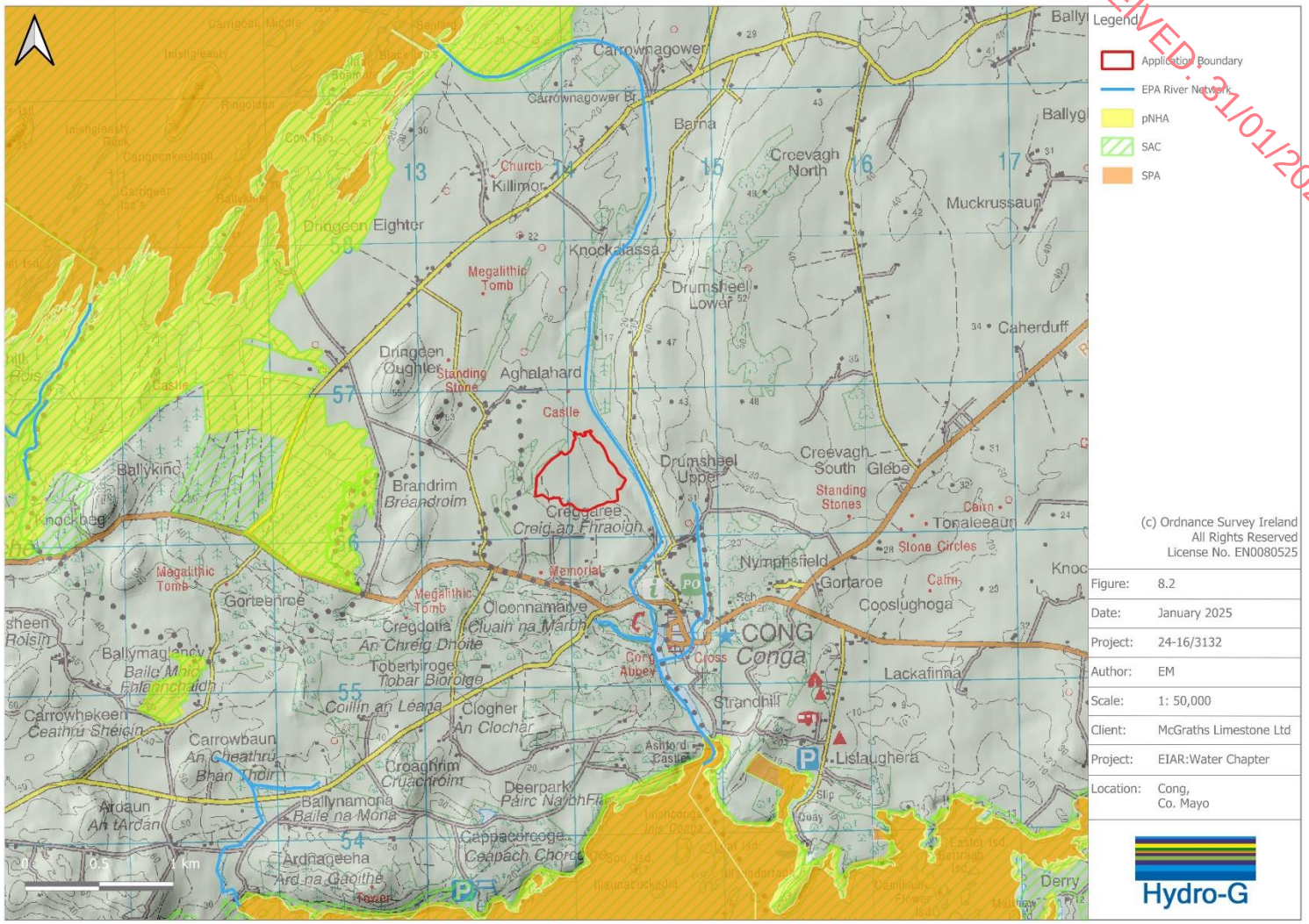

Figure 8.2 Designated Sites

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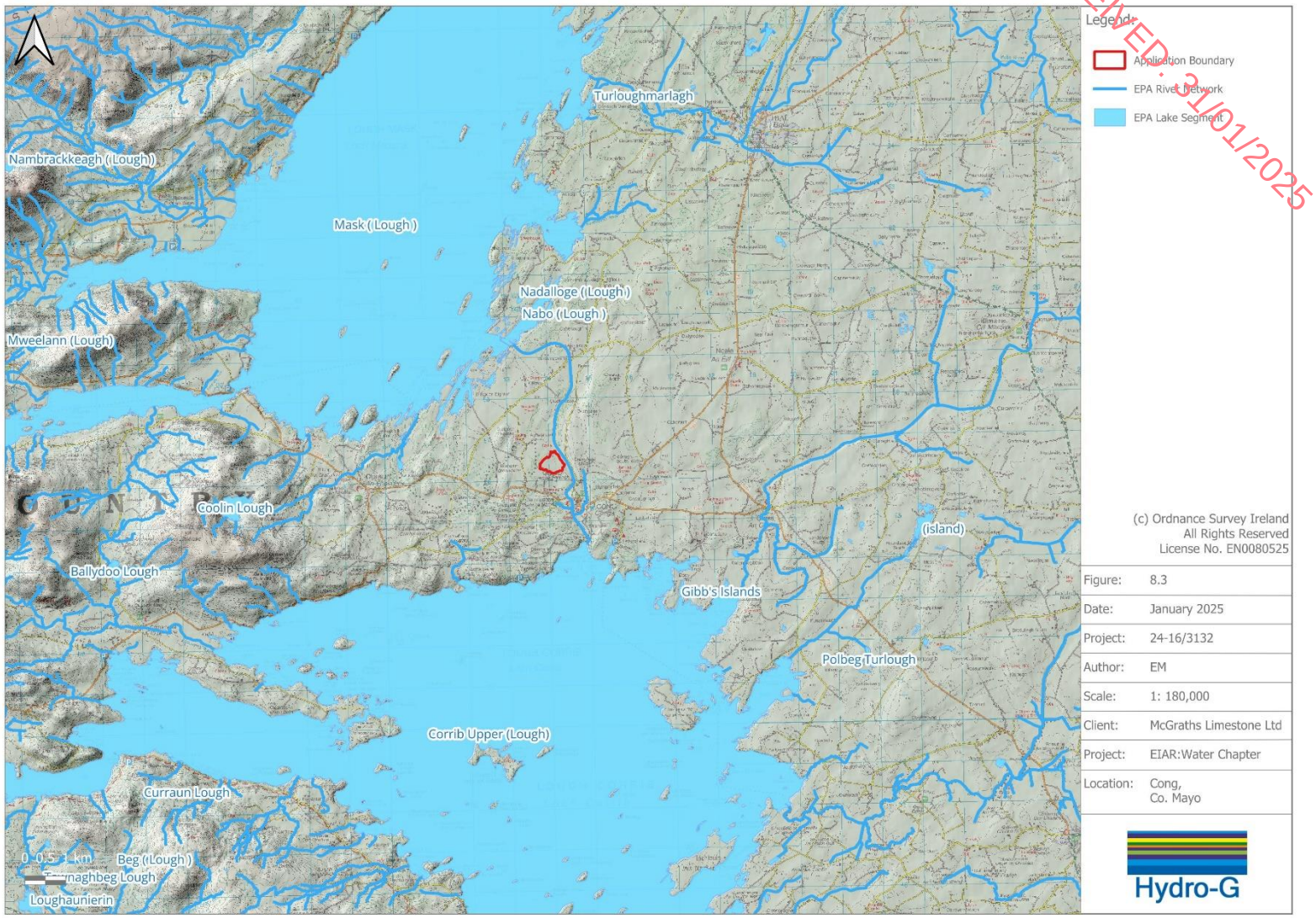

Figure 8.3 Regional Hydrology

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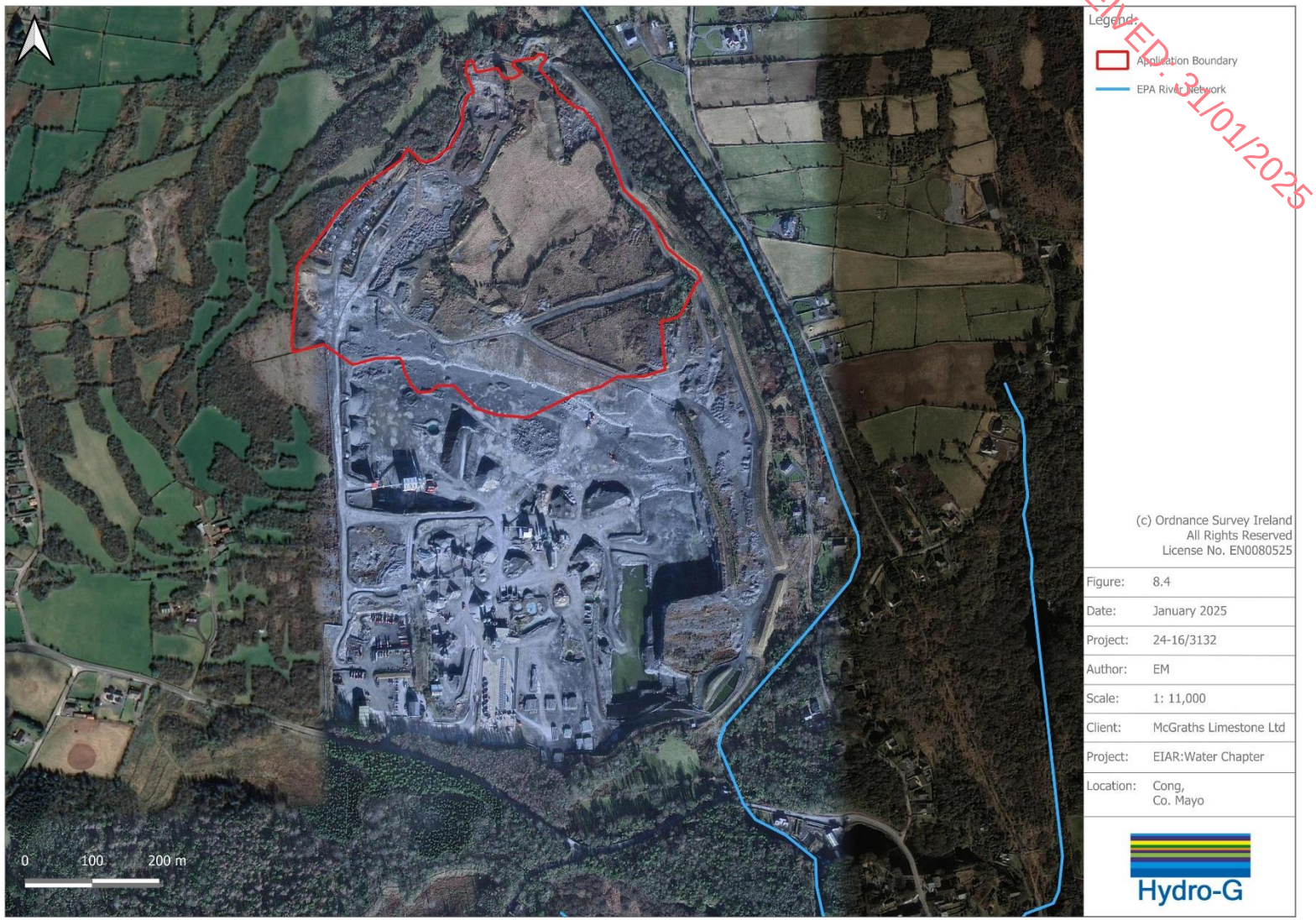

Figure 8.4 Local Hydrology

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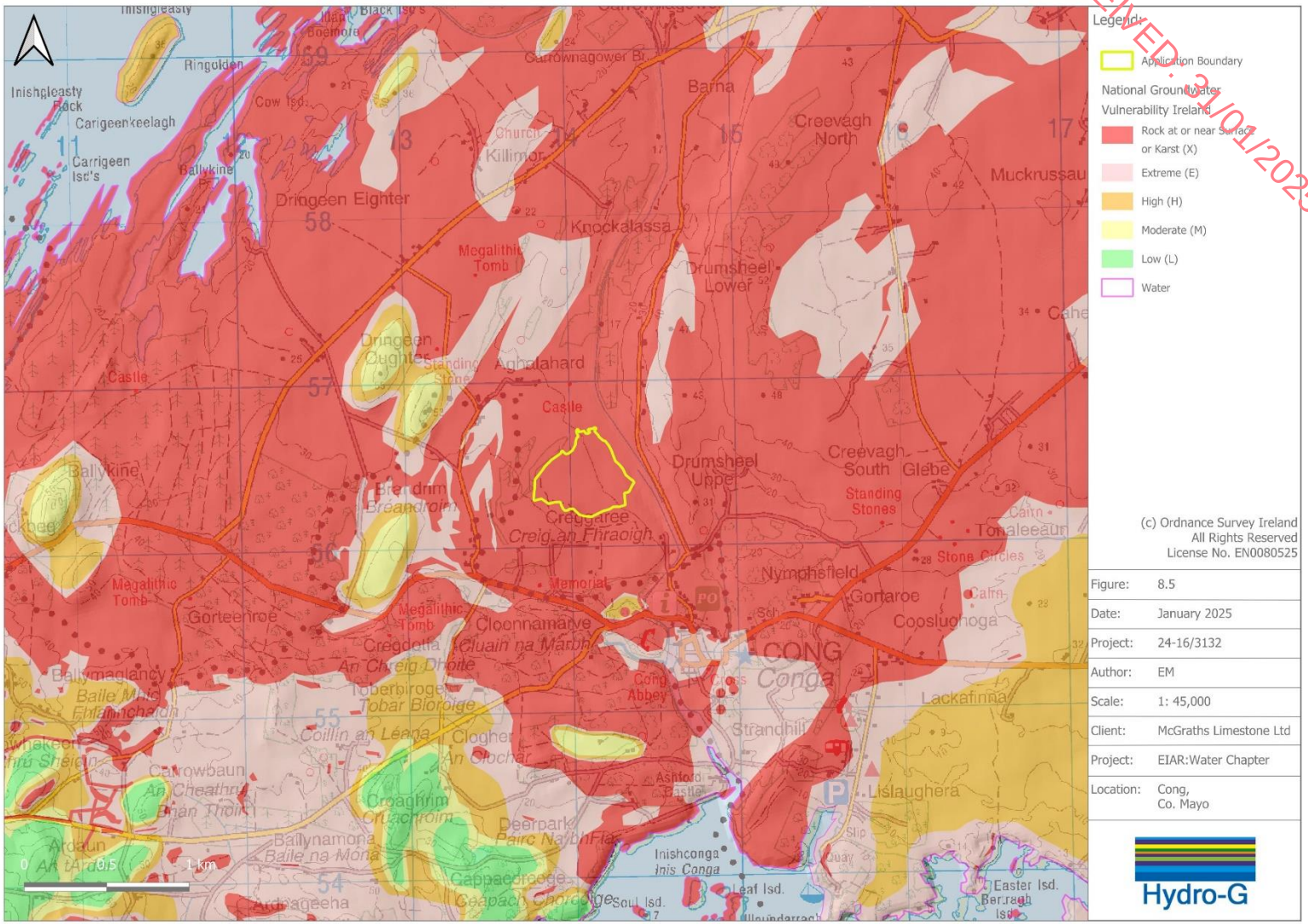

Figure 8.5 Groundwater Vulnerability

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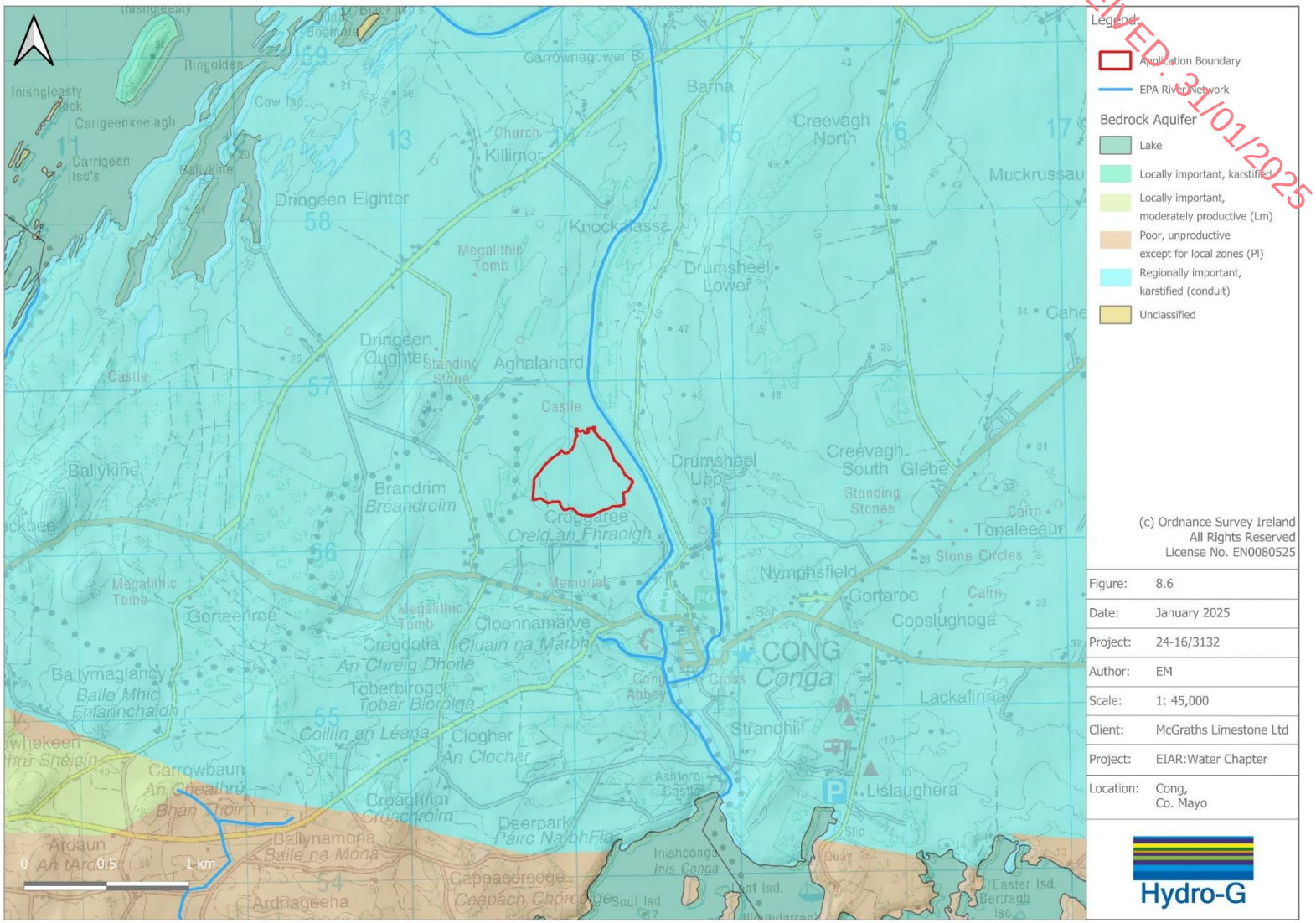

Figure 8.6 Aquifer

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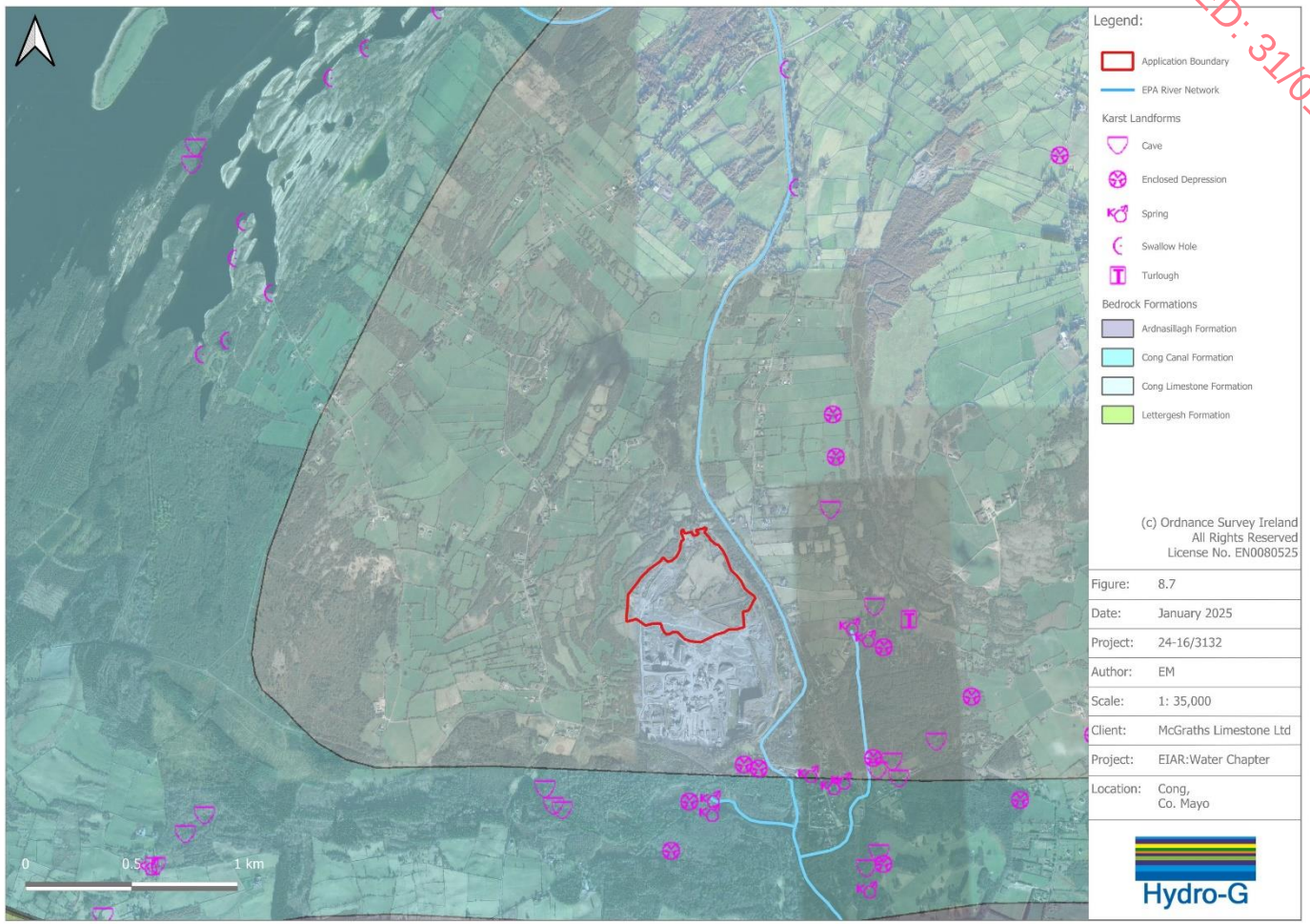

Figure 8.7 Karst

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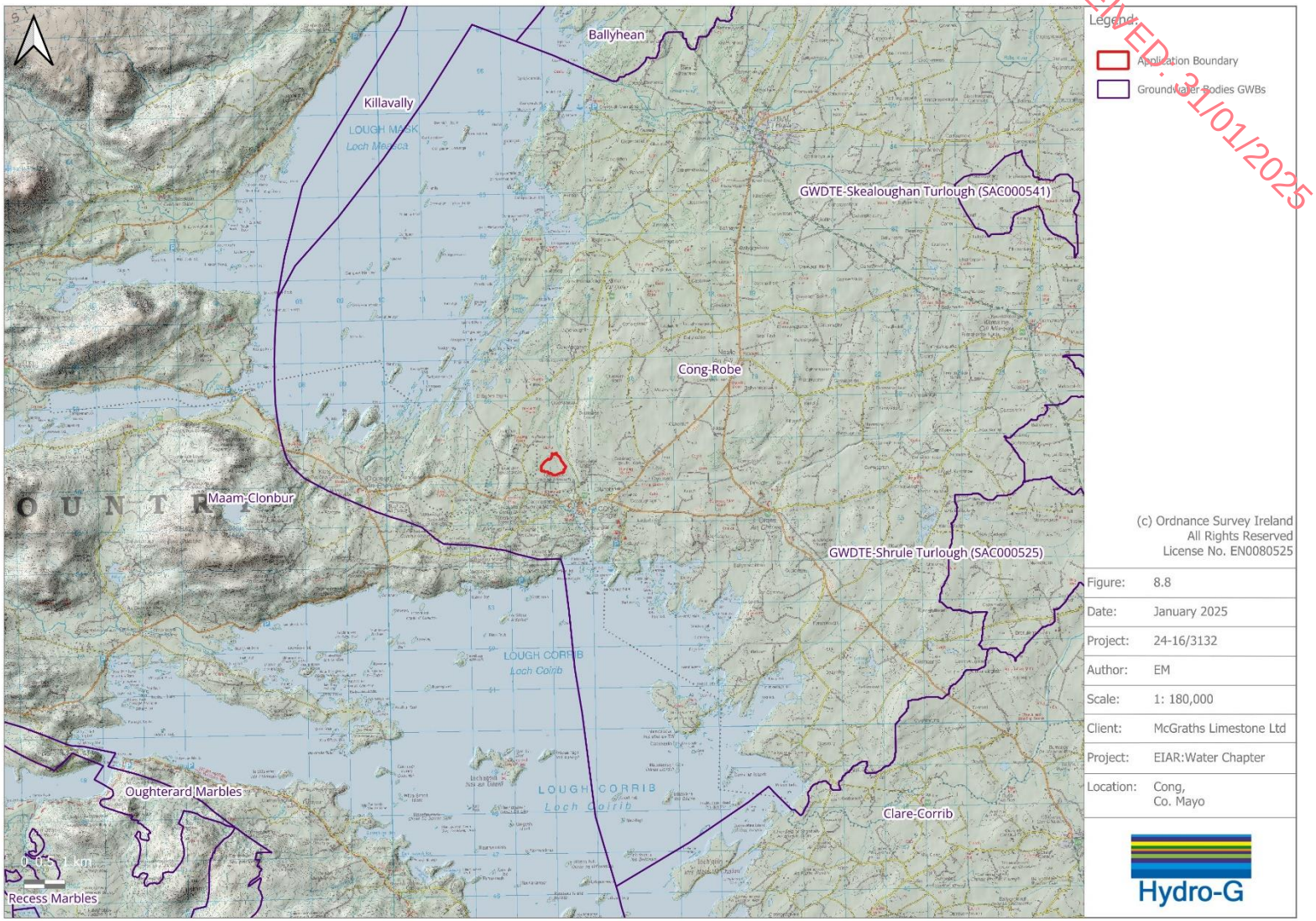

Figure 8.8 Groundwater Body Delineation

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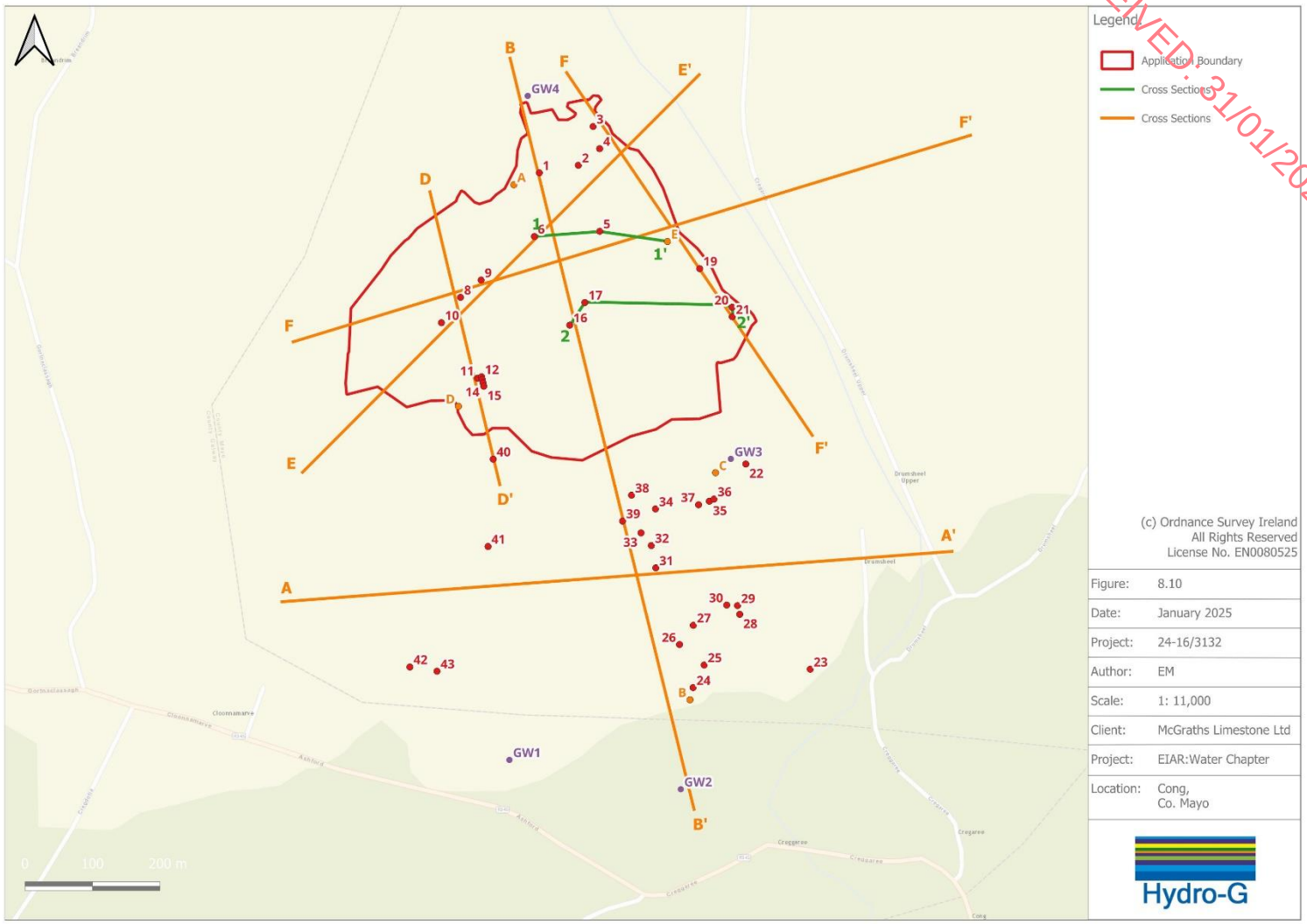

Figure 8.9 All Borehole Locations

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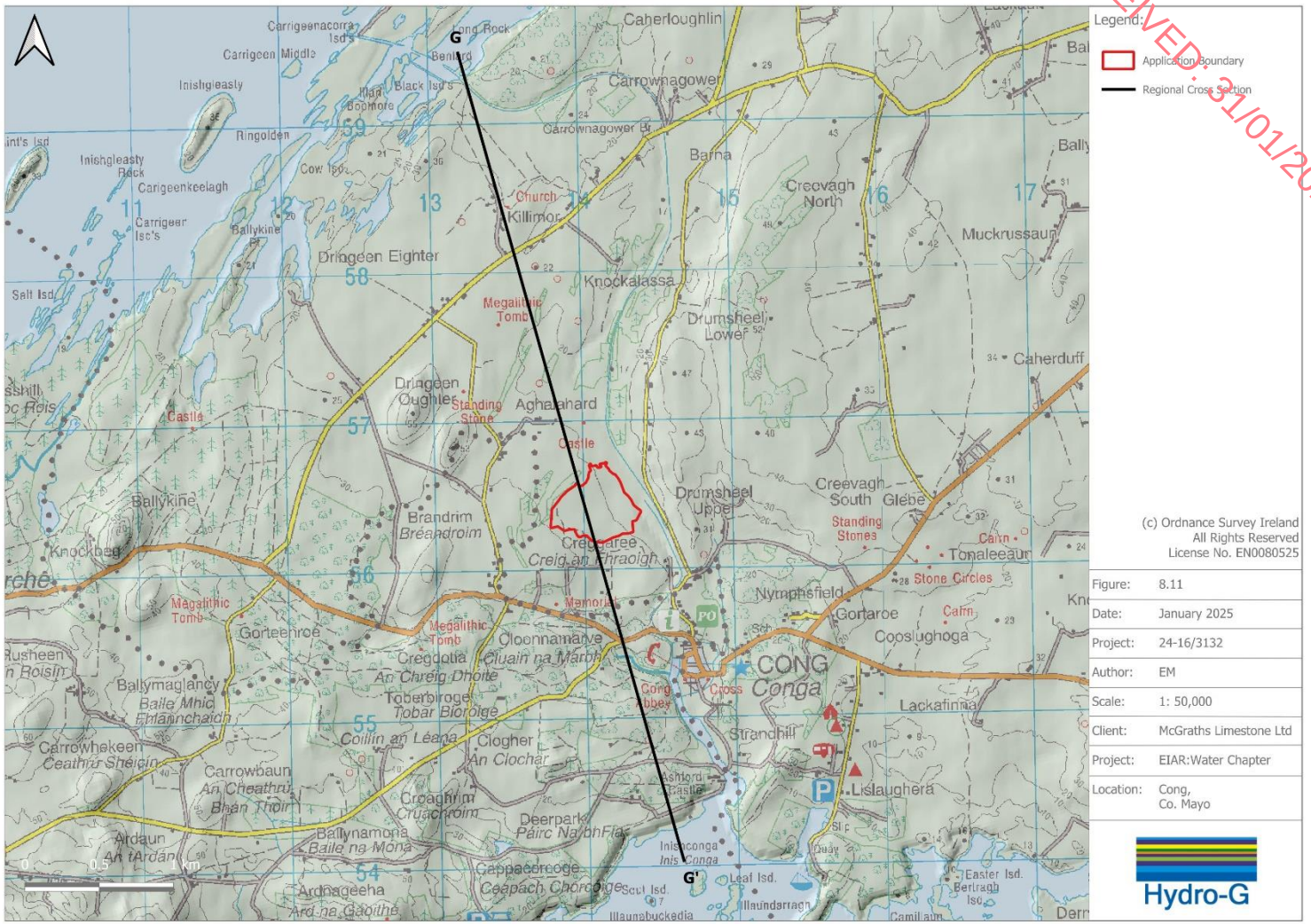

Figure 8.10 Site Cross Sections

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APPENDICES

Contents

Appendix 8.1 Statement of Expertise

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8.1.1 The evaluation of the Water (hydrological and hydrogeological) environment and the assessment of Effects and Potential Impacts, with Mitigation Measures and Remedial Impacts, was completed by Dr. Pamela Bartley (Hydro-G) who is considered a karst groundwater specialist with quarry, Section 4 Discharge Licencing and Public Water Supply expertise.

8.1.2 Hydro-G holds the required Professional Indemnity Insurance, Employers and Public Liability Insurance.

8.1.3 Pamela is a member of Engineers Ireland and the International Association of Hydrogeologists (Irish Group).

8.1.4 Pamela is a water focussed civil engineer with almost 30 years of practical experience in field-based groundwater investigations, drilling, instrumentation, surface water sampling, flow gauging and impact assessments, public water supply from groundwater boreholes, quarry assessments, Section 4 Discharge Licensing and wastewater treatment using Nature Based Systems.

8.1.5 Pamela completed her primary training in the RTC system. She completed a Certificate in Civil Engineering in Letterkenny RTC and a Diploma in Water and Wastewater Engineering at Sligo RTC in the early 1990's. Her Bachelor of Engineering degree was completed in the school of Civil Engineering at Queen's University, Belfast, and her postgraduate education at the School of Civil Engineering at Trinity College, Dublin (TCD). She completed an MSc. in Environmental Engineering at the School of Civil Engineering at TCD, which had geotechnical, hydrology, hydrogeology and legislation specialities and later a hydrogeologically focussed Ph.D at TCD.

8.1.6 Pamela is considered an Expert Service Provider to Uisce Eireann, she is a panel hydrogeologist, PSCS and PSDP approved and Supplier Number 1855 applies.

8.1.7 With respect to the extractive industry, Pamela is conserved an EIA specialist with discharge licensing competency in the context of the Water Pollution Act, enacted Irish Regulation and EU Directives.

8.1.8 She has completed impact assessments and assisted in successful permission attainment for many regionally important quarries in SAC settings.

8.1.9 Pamela's quarry assessments, successful EIARs gaining planning and associated Section 4 Discharge Licences include, as follows:

(i) Bennettsbridge Limestone, Co. Kilkenny consent to continue at an existing site following previous refusals at Board level and successful review update of the Section 4 Discharge Licence (ENV/W/78, 2017) permitting a range of 22,000m3/d as the annual average with maximums up to 70,000m3/d throughout the rainfall season. The discharge is to a drain that discharges to the River Nore. The large range is because it is a diffuse karst aquifer and during high rainfall there is a large volume of water on the floor carried through the epikarst of the walls.

(ii) Mc Grath Limestone Works Ltd, Cong, Co. Galway (W391/05_R1, 2019) permitting a discharge of 10,000m3/d to the Cong Canal upstream of Lough Corrib (SAC, SPA, proposed NHA & Public Water Supply for Galway City and environs).

(iii) Churchill Stone Ltd. (Cassidys), Keeloges, Churchill, Letterkenny, Co. Donegal. Section 4 Discharge (Lwat65) permitting discharge to a headwater and upstream of the commencement of mapping for a Pearl Mussel River.

(iv) Harrington Concrete and Quarries, Ardgaineen, Co. Galway (W_502_22) permitting a discharge of 1,435m3/d to a grassed vegetation area, following an oil interceptor, and subsequent discharge to groundwater *via* a Nature Based System in a conduit karst aquifer in a Hydrometric Area of Lough Corrib SAC and SPA.

(v) MC Group, Castleisland (W214), Co. Kerry, permitting a discharge of 540m3/d to surface water.

Each of these quarries operates within SAC catchments or in proximity to NHA Bogs and they have successfully managed their discharge, under licence, for many years.

Appendix 8.2 Section 4 Discharge Licence W/391/05_R1 (2019) & Galway County Council Compliance Letter (01/25)

RECEIVED: 31/01/2025

COMHAIRLE CHONTAE NA GAILLIMHE

LOCAL GOVERNMENT (WATER POLLUTION) ACT, 1977, AS AMENDED,

RECEIVED 31/01/2025

LICENCE TO DISCHARGE TRADE OR SEWAGE EFFLUENT TO WATERS

McGraths Limestone Works Ltd.,
Cregaree,
Cong,
Co. Mayo

Reference No. in Register W/391/05_R1

Galway County Council in exercise of the powers conferred on it by the Local Government (Water Pollution) Act 1977, as amended, hereby grants a licence, **Reference Number W/391/05_R1** to discharge of trade effluent emanating from settlement lagoons (i.e. trade effluent from quarry operations and surface water runoff from the quarry area) located at **McGrath's Quarry, Cregaree, Cong, County Mayo** to surface water subject to the conditions set out in the Schedule hereto.

Signed this 13th **day of** December, **2019 on behalf of Galway County Council.**

Valerie Loughnane for

Valerie Loughnane
A/Director of Services,
Planning, Environment and Emergency Services

IMPORTANT NOTICE

Any person may, **before the expiration of the prescribed period, appeal to An Bord Pleanala** against the grant or refusal of a licence, the conditions attached to a licence or the amendment or deletion of conditions or the attachment of new conditions following review of a licence. (See Section 8 Local Government (Water Pollution) Act, 1977, as amended).

The prescribed period as per Article 26 of the Local Government (Water Pollution) Regulations 1978 and 1992 is the period of one month beginning on the date of the grant or refusal of the licence or in the case of a decision of the Local Authority following on a review of a licence the date of that decision. (The relevant date is as shown above).

An appeal must be made in writing, stating the subject matter of the appeal and the grounds of appeal and must be accompanied by a deposit of €126. The address of An Bord Pleanala is 64 Marlborough Street, Dublin 1.

An Bord Pleanala, after consideration of any appeal lodged with it, may direct the Local Authority to grant or revoke a licence or to amend or attach conditions relating to it.

SCHEDULE TO LICENCE NO. W/391/05_R1

RECEIVED: 31/01/2025

1. Scope

This licence relates to the discharge of trade effluent emanating from settlement lagoons (i.e. trade effluent from quarry operations and surface water runoff from the quarry area) located at McGrath's Quarry, Cregaree, Cong, County Mayo to surface water. The maximum permitted daily discharge under this licence is 10,000 m^3 per day and 408.16 m3 per hour. Should any change be made to the development or the treatment system a review of the current licence must be sought by the licencee.

Any conditions attached to this licence are binding on any person discharging, or causing or permitting the discharge of, effluent to which this licence relates.

2. Discharge Effluent

2.1. Effluent Discharge

The Licensee shall not discharge, cause or permit the discharge of any effluent which has not been treated.

2.2. Treated Effluent Discharge

The treated effluent shall be discharged to the Cong Canal without posing a risk to surface or ground waters.

2.3. Discharge Effluent Performance Standards

The treated effluent, **prior to its discharge** to the Cong Canal, shall comply with the following standards:

The **pH** of the discharge from the secondary settlement lagoon and oil interceptor shall not exceed the range of 6-9 pH units.

The **five-day Biochemical Oxygen Demand** content of the discharge from the treatment plant shall not exceed 5mg/l,

The **Chemical Oxygen Demand** content of the discharge from the treatment plant shall not exceed 20mg/l.

The **Suspended Solids** content of the discharge from the treatment plant shall not exceed 20mg/l,

The **Nitrate** content of the discharge from the treatment plant shall not exceed 10mg/l NO_3,

The **Ammonia** content of the discharge from the treatment plant shall not exceed 0.1mg/l NH_4 as N

The **Total Phosphorous** content of the discharge from the treatment plant shall not exceed 2mg/l P

The **Ortho-Phosphorous** content of the discharge from the treatment plant shall not exceed 0.03mg/l PO_4 as P.

The **Total Hydrocarbons** content of the discharge from the treatment plant shall not exceed 0.5mg/l.

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3. Analysis

3.1. Effluent Analysis

Analysis of the treated effluent prior to its discharge to the Cong Canal shall be carried out by **an approved accredited laboratory** (ISO 17025 INAB Accreditation or its equivalent replacement). The required parameters and frequency of analysis are outlined below. Sampling dates shall be spread evenly throughout the year.

The analysis results shall be **forwarded** to the Environment Section of Galway County Council:

Parameter	Monitoring frequency	Analysis to be performed by accredited laboratory
Flow	Continuous - Daily	
Conductivity	Continuous - Daily	
Turbidity	Continuous - Daily	
pH	Continuous - Daily	
Colour and visual inspection	Daily	
Temperature	Quarterly	√
Biochemical Oxygen Demand	Quarterly	√
Chemical Oxygen Demand	Quarterly	√
Suspended Solids	Quarterly	√
Nitrates NO_3	Quarterly	√
Ammonia NH_4 as N	Quarterly	√
Total Phosphorus P	Quarterly	√
Ortho-Phosphorous PO_4 as P	Quarterly	√
Total Hydrocarbons including Diesel range organics and petroleum range organics	Bi annually	√

The analysis results for samples taken should be made available electronically in a format compatible with Galway County Council's system for recording results.

The analysis results should be submitted electronically to wastewaterresults@galwaycoco.ie within two weeks of the date of sampling. The results should be submitted in the appropriate excel format for importation to Galway County Council's electronic system in addition to a certified copy of the results. Further details can be obtained from the Environment Section.

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4. Groundwater Analysis

Quarterly analysis of the existing groundwater monitoring wells shall be carried out by an approved accredited laboratory. Results of the same shall be forwarded to the Environment Section of Galway County Council.

Analysis shall be carried out on the following parameters; water level, pH, turbidity, conductivity, nitrates and suspended solids.

5. Treatment Lagoon

All surface water runoff and quarry effluent shall be treated in the settlement lagoon prior to discharge. The settlement lagoon shall be capable of fulfilling the requirements of this licence as outlined in condition No. 2 above. The Environment Section of Galway County Council must be notified of any proposed alternations to the treatment system.

6. Metering

An approved flow meter shall be fitted to the discharge pipe to allow for the measuring and recording of the daily volume discharged. These records shall be maintained and be available on request to Galway County Council staff.

7. Ready access

Access to the treatment plant and all its installations, shall be allowed to authorised persons appointed under the provisions of the Water Pollution Acts, 1977 as amended.

The treatment works site shall be developed to provide access to the plant by road vehicles for the purposes of de-sludging and maintenance work. It shall be isolated from its surroundings by secure and safe boundaries to prevent interference with, or damage to, the plant or discharge outlet.

8. Sampling Chamber

A sampling chamber is to be maintained, adequately sized to allow for the taking of samples of the treated effluent, in a safe manner. Ready access to the sampling chamber must be provided at all times.

9. Caretaker

The inspection and maintenance of the treatment plant shall be the responsibility of the Licensee, and carried out by a nominated caretaker whose name, address and contact

telephone numbers shall be furnished to the Environment Section of Galway County Council in writing within **four weeks** of the date of the grant of the licence. Galway County Council must be notified of any personnel changes with regard to the caretaker, within **two weeks** of such change.

The maintenance caretaker shall be adequately trained and familiarised with the operation and maintenance of the network and treatment system. The caretaker shall ensure that all equipment is operating in accordance with supplier's specifications and that all probes are regularly maintained and calibrated.

RECEIVED 31/02/2025

10. Maintenance Contract

The Licensee shall enter into a contract with the supplier of any equipment or other approved contractors for the servicing of all equipment.

A copy of the servicing contract shall be furnished by the Licensee to Galway County Council for approval within **four weeks** of the date the licence comes into effect. No change shall subsequently be made in the nature of the maintenance contract without the prior agreement of Galway County Council in writing being first obtained.

Records of the following shall be maintained and be available on request to Galway County Council staff:

a) All servicing of the plant and equipment

b) Daily volumes of treated effluent discharged

11. Notification of Non-Compliance

The Environment Section of Galway County Council must be notified of any malfunction of the treatment system that is likely to result in a failure to comply with the performance standards set out in Condition No. 2.3 or the pollution of any surface or ground waters.

12. Sludge Removal

All sludge generated shall be disposed of off-site without causing nuisance. The sludge disposal operation must be carried out in accordance with good practice so as to minimise the risk of surface or ground water pollution. Where sludge is disposed of on agricultural land this shall be done in accordance with the provisions of the European Communities Waste Management (Use of Sewage Sludge in Agriculture) Regulations, 1998 to 2001 and the European Communities (Good agricultural Practice for Protection of Waters) Regulations 2017. Records of de-sludging and the disposal of all sludge shall be maintained and made available on request to Galway County Council.

13. EPA Guidelines

All works must be carried out in accordance to the EPA guidelines 'Environmental Management in Extractive Industry (Non-Scheduled Minerals)'.

14. Annual Contribution

The Licensee shall pay Galway County Council such reasonable contribution towards the cost of monitoring the discharge as the Authority considers necessary for the performance of its duties under the Water Pollution Acts 1977, as amended. The Licensee shall pay Galway County Council a minimum annual contribution of €550.

This amount to be paid shall be adjusted annually in accordance with the Consumer Price Index value appertaining at the time when the payment becomes due. Galway County Council reserves the right to alter the rate of contribution each year in order to take account of the actual cost of monitoring incurred by it in the previous year and estimated for the next year.

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15. Changes in ownership

The Environment Section of Galway County Council must be notified in writing of any change to company ownership and/or trading name within **two weeks** of such a change.

END.

Áras an Chontae,
Cnoc na Radharc, Gaillimh.
H91 H6KX.

Áras an Chontae,
Prospect Hill, Galway.
H91 H6KX.

Fón/Phone: (091) 509 000
Facs/Fax: (091) 509 010
Idirlíon/Web: www.gaillimh.ie
www.galway.ie

@GalwayCoCo
GalwayCounty

Seirbhísí Corparáideacha
Corporate Services
☎(091) 509 225
✉corpserv@galwaycoco.ie

Tithíocht
Housing
☎(091) 509 300
✉housing@galwaycoco.ie

Timpeallacht & Tréidliacht
Environment & Veterinary
☎(091) 509 510
✉environment@galwaycoco.ie

Bóithre, Iompar, Cúrsaí Mara
& Seirbhísí Ginearálta
Roads, Transportation, Marine
& General Services
☎(091) 509 309
✉roads@galwaycoco.ie

Acmhainní Daonna
Human Resources
☎(091) 509 303
✉hr@galwaycoco.ie

Mótarcháin
Motor Taxation
☎(091) 509 099
✉motortax@galwaycoco.ie

Clár na dToghthóirí
Register of Electors
☎(091) 509 310
✉electors@galwaycoco.ie

Seirbhísí Uisce
Water Services
☎(091) 509 505
✉water@galwaycoco.ie

Pobal & Fiontar
Community & Enterprise
☎(091) 509 521
✉community@galwaycoco.ie

Pleanáil
Planning
☎(091) 509 308
✉planning@galwaycoco.ie

Leabharlann
Library
☎(091) 562 471
✉info@galwaylibrary.ie

Comhairle Chontae na Gaillimhe
Galway County Council

RECEIVED: 31/01/2025

McGrath Limestone Works Ltd.
Cregaree
Cong
Co. Galway

3rd January 2025

Re: Discharge Licence Reference Number W 391/05R1

A Chara,

On the 30th October 2024 a site visit was carried out at McGrath Limestone Quarry, Cong, Co. Galway. A sample of treated discharge was taken from the lagoon, on that date. The laboratory results for the analysis of the sample taken are attached.

The results are in compliance with your discharge licence no. W 391/05R1. To ensure on-going compliance, the treatment plant must continue to be supervised and maintained on a regular basis.

Under condition 3 of your discharge licence you are required to arrange to have samples of the treated effluent analysed on a quarterly basis. Galway County Council received results for samples taken during 2024. These results were also compliant with your discharge licence.

If you have any queries regarding your discharge licence, please contact David O Connell or Fintan Donnelly at 091 509510.

Is mise le meas,

David O'Connell

David O Connell,
Acting Assistant Scientist,
Environment Section.

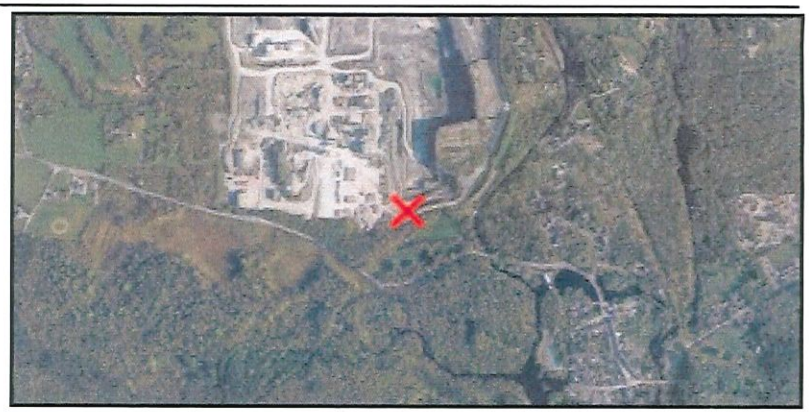
Laboratory Analysis Report

Sample Location : Private WWTP - Licenced
W 391/05 Mcgrath Limestone Works Ltd., Station : DP1200DPW391/050001
Grid Coordinates : X: 114280 Y: 255690

Sample Details : Reference : 24445589
Template : W 391/05 McGrath Limestone Works Ltd.
Sampled by : Galway County Council
Sample Date: 30/10/2024 @ 09:00 Method: Grab

Laboratory : Roscommon Co Co
Analyst : Lab Admin

Sample Notes : ---- ----



Sample Parameters		Parameter Standards		Results	
Parameter	Unit	Max. Limit	Min. Limit	Date	Result
Ammonia N	mg/l	--	--	30/10/24	0.142
Biological Oxygen Demand	mg/l	25	--	30/10/24	< 1
COD Chemical Oxygen Demand	mg/l	100	--	30/10/24	< 20
Ortho-Phosphate P	mg/l	--	--	30/10/24	< 0.006
pH	pH units	9	6	30/10/24	7.9
Suspended Solids	mg/l	35	--	30/10/24	< 2.5
Total Nitrogen N	mg/l	--	--	30/10/24	1.24
Total Phosphorus P	mg/l	--	--	30/10/24	< 0.01

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Approved pp D O'Connell : Date 3/1/2025 Signed Dwd O'Connell David O'Connell, Executive Technician

Queries in relation to this report should be addressed to environ@galwaycoco.ie

Appendix 8.3 Hydro-G (2019) Discharge Licence Report

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Hydro-G

Discharge TO Surface Water: Cong Canal

EXISTING DISCHARGE Licence W391/05

Site Request's Galway County Council REVIEW

REPORT

Quarry Site Characterisation

&

Assimilation Capacity Simulation

REQUEST: Increase Discharge Volume ELV to 10,000 m3/d and consequently amend hydrochemical ELVS to ensure Surface Water Regulation (2009) Compliance

McGraths Limestone Works
Cregaree
Cong
Co Mayo
F31 W425

Local Government (Water Pollution) Acts 1977 & 1990

Consultant Pamela Bartley

June 2019

Hydro-G
50 Henry St.
Galway
H91 F4X

pamela@hydro-g.com

091 449950

087 8072744

RECEIVED: 31/01/2025

Project No.:	161298_Cong Discharge Licence
Report Status:	**FINAL**
Report Title:	Discharge Licence Assessment REVIEW Report: REQUEST Increase Discharge Volume Emission Limit Volume (ELV) of Licence W391/05 to 10,000 m3/d and amend hydrochemical ELVs to ensure Surface Water Regulation (2009) compliance.
Date:	26th June 2019

Prepared by:

Pamela Bartley

Dr. Pamela Bartley B.Eng, M.SC., Ph.D.

NOTE

This report is for the use solely of the party to whom it is addressed, and no responsibility is accepted to any third party.

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Contents

Appendices

1 Executive Summary

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- Mc Grath Limestone Works Ltd, Cong, Co. Mayo holds a Section 4 discharge licence for the discharge of quarry waters to the Cong Canal (Reference No. W391/05). That licence was issued in 2007 by Galway County Council. While the quarry landholding sits primarily in County Mayo, the discharge point is in County Galway.

- The maximum permitted daily discharge volume specified in W391/05 is 864m3/d. The Emission Limit Values (ELVs) of W391/05 are presented in Table 1.

Table 1 McGraths Limestone Cong Discharge Licence Conditions (W391/05) – Issued 2007

Flow	not exceed 432m3/12 hrs and 36 m3/hr	**MAX permitted discharge Q (m3/d)**
		864
ELVs	**Concentrations (mg/l)**	**Record Stipulations**
Suspended Solids	35	**Monthly in house, Quarterly by Accredited Laboratory**
Nitrate as NO3	50	**Quarterly by Accredited Laboratory**
Total Hydrocarbons	1	**Bi-Annually by Accredited Laboratory**
COD	100	**Quarterly by Accredited Laboratory**
BOD	25	**Quarterly by Accredited Laboratory**
Temperature	>20 °C	**Monthly in house, Quarterly by Accredited Laboratory**
pH	6 to 9 range	**Daily automated, Continuous Record**
Colour	no change	**Daily visual inspection, no sheen, no excess solids**
Conductivity	should not change significantly from day to day	**Daily automated, Continuous Record**
Turbidity	shall not change significantly from day to day	**Daily automated, Continuous Record**

- The enactment of the Surface Water Regulations (SI 272 of 2009) into Irish Law changed the Environmental Quality Objectives for discharges to surface water. The licence holder has requested that Hydro-G assess the Conditions of the existing licence and evaluate that the Conditions are appropriate to the site and that the requirements of the Surface Water Regulations are complied with.

- Hydro-G has applied the known characteristics of the discharge and OPW hydrometrics for the receiving water to complete the required assimilation capacity simulations for the receiving waters. The results are then discussed in the context of compliance with Surface Water's Environmental Quality Objectives as defined by the Surface Water Regulations (2009).

- The overall objective of the evaluation now presented by the site is to present the case for reasoned and justified revised Discharge Licence Conditions to Galway County Council so that the existing licence can be amended with Conditions that are appropriate to the volumes of water being managed at the site. The site consulted with Inland Fisheries, Galway County Council, the EPA and NPWS. Direct conversations were held between Dr. Pamela Bartley and the Inland Fisheries team for Galway, with Ms. Christina Ryan and Mr. David O Connell of Galway County Council's Environment Section, EPA hydrometrics (Dr. Conor Quinlan), EPA Groundwater Section (Dr. Matt Craig) and EPA

- Regularisation of the Conditions of the existing licence will more easily facilitate administrative compliance with Environmental Quality Objectives of the Surface Water Regulations (2009). For example, the current licence does not reference Emission Limit Values for the parameters Ammonia-N or ortho-P, which are parameters of note in the Surface Water Regulations (2009).

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- The Groundwater Regulations (2010) & the Birds and Natural Habitats Regulations (2011) were also enacted post issue of W391/05. The works completed here also consider the discharge in the context of those two other relevant Regulations. The significance of the Groundwater Regulations (2010) was raised following consultation with Galway County Council and the EPA. Given that the receiving water is the Cong Canal and that this is classified as a 'Artificial' channel under Water Framework Directive Classifications (Dr. Jenny Deakin, EPA) and as a known losing stream to groundwater in summer (Dr. Conor Quinlan, EPA) and Dr. Matt Craig's (EPA) suggestion is that streams and rivers that lose to groundwater (and go dry) aren't really adequately captured by solely applying the assimilative capacity approach or direct discharge to groundwater approach. The direct discharge to groundwater guidance suggests that streams which end up in swallow holes (or by inference have significant loss to groundwater) should follow the direct discharge to groundwater approach. Therefore, the information presented here addresses assimilative capacity simulations for the surface water system and the groundwater system.

- **In terms of information used in the assessment:**

1. The Cong Canal receives the discharge. The Cong Canal leads from Lough Mask, to the north of the site, and through to the Cong River, which feeds into Lough Corrib, to the south of the site. The OPW measure **flow in the Cong Canal/Cong River/Cong Weir system**. Carronagower Stn is upstream of the discharge. It is appropriate to use the OPW hydrometrics as a measure of how much water flows past the quarry and receives its discharge. Using these OPW hydrometrics, the assimilative capacity of the receiving water can be determined. The pertinent OPW hydrometric information is summarised in Table 2.

Table 2 OPW Summary Flow Data for the Cong Canal

	CONG CANAL RECEIVING WATER	
	UPSTREAM OPW DATA	DOWNSTREAM OPW DATA
	Carrownagower (OPW Stn 30017)	Cong Weir (OPW Stn 30031)
MAX Q (m3/d)	5,015,261	7,883,309
50%tile (m3/d)	1,221,955	2,478,816
75%tile (m3/d)	479,347	1,529,798
95%tile (m3/d)	null*	770,515

*Because the OPW records the upstream flow station on the Cong Canal to have a 95%tile flow rate as null and following advice from the EPA's Dr. Conor Quinlan & Dr. Matt Craig, Hydro-G adopted a Groundwater Discharge approach for the summer condition and a Surface Water Assimilation capacity simulation strategy for Autumn/Winter/Spring discharge condition.

2. The site records its **discharge volume to the Cong Canal** on a continuous automated recorded flow measurement system. The site discharges a range from zero to 8,000m3/d, approximately. Rainfall drives the range. The 2019 winter daily discharge volume from the quarry is quantified by continuous flow meter on the outlet of the settlement systems as 1,620m3/d (Table 3). When the Cong Canal is dry, there is usually little discharge from the quarry. During the official drought of 2018 the discharge from the quarry was 0 - 25m3/d;

3. The site monitors **the hydrochemical quality of the receiving water (upstream and downstream) and the hydrochemical quality of the actual discharge itself.** Monthly routine monitoring has been completed since issue of the Licence. In 2018 Hydro-G initiated a more comprehensive monitoring suite for the discharge and receiving surface waters so that Surface Water Regulation (2009)

parameters were included as well as Salmonid Regulations (1988) and Fish Life Directive (2006) parameters. These data were employed in the assimilation capacity simulations. Following on from a consultation meeting with Galway County Council in May 2019, the issue of the Cong Canal having unusual hydrometrics and the fact that it was classified as an 'Artificial' water body and had a null 95%tile dataset led Ms. Christina Ryan (GCC) to suggest that consultation with the EPA was warranted. The outcome of that consultation resulted in the suggestion to consider the discharge as a surface water discharge when the Cong Canal had water in it and a Groundwater Discharge when the Canal was dry and 'losing' water. The new consideration as a Groundwater Discharge necessitated sampling for bacteriological content of the discharge. This was completed on two occasions in late May. All data are presented as Appendices to this report.

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Therefore, we have quantified

1. flow in the receiving water,
2. discharge flow into the receiving water &
3. the quality of the receiving water upstream, the quality of the discharge going into it and the resultant quality downstream.

Assimilation Capacity Simulation have been completed and reported herein. Results can be compared to Surface Water (2009) and Groundwater (2010) Regulation Objectives.

- On the basis of my calculations, the Environmental Quality Objectives of the European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (SI No 272 of 2009) can be adhered to for revised Conditions for the actual discharge volumes for the quarry. This application for review requests a maximum ELV for discharge volume of 10,000m3/d. As previously stated, the 2018 - 2019 maximum Q was 8,000 m3/d, approximately. Some future climate change resilience is required over the 8,000 m3/d current maximum Q. The Emission Limit Values for Hydrochemistry are appropriate for most parameters as specified in the original Discharge Licence W391/05. However, in the context of increasing the flow volume ELV of the Licence, the site proposes a reduction in concentrations for some parameter ELVs. For example, the BOD ELV should be reduced slightly in order to maintain compliance with High Status EQS of the Surface Water Regulations. In addition, the site now presents justified Ammonia-N and MRP-P ELVS to be added to Conditions of the Licence because they are parameters specified in the Surface Water Regulations (2009). As previously stated, they are not currently listed in the Conditions of the existing Licence. Assimilation capacity simulations have been conducted for the Cong Canal and the downstream Cong River. The latter river was added as a simulation point request from GCC's Ms. Christina Ryan and Dr. Jenny Deakin (EPA) supplied the water quality dataset for Stn No. RS30C060300, Station Name Ashford Castle Bridge. This station was added for the purposes of Appropriate Assessment and Lough Corrib potential impact. In overall summary, given that there was no breach of Regulation EQS's on the Cong Canal at the point of discharge and that there is significant additional flow at the Ashford Castle Stn., overview assimilation capacity simulations suggest no potential for increases in EQS's at the Ashford Castle downstream monitoring point prior to entry to Lough Corrib.

- On the basis of my calculations, the Environmental Quality Objectives of the European Communities Environmental Objectives (Groundwater) Regulations, 2009 (S.I. No. 9/2010) and S.I. No. 366 of 2016 - EUROPEAN UNION ENVIRONMENTAL OBJECTIVES (GROUNDWATER) (AMENDMENT) REGULATIONS 2016 can be adhered to for revised Conditions for the discharge characteristic for the quarry. As Dr. Matt Craig (EPA) contributed in consultation "*from the data presented it would appear that the discharge is not adding anything significant that would be of environmental concern and would be comparable to the quality of water naturally present in the canal if it was flowing. As the receptors to be protected are the same receptors that could be impacted naturally and if the discharge is of the same quality as exists naturally then the discharge is not adding to the issue. As such it could be permissible as a direct discharge*

to groundwater. The above is presented by way of narrative, as in my opinion this is a surface water discharge (as per option 1), but following the process for option three demonstrates that the concerns for groundwater are explained and addressed via your assessment(s). As such, if an assimilative capacity assessment during mean flows & low flows (Q95) is acceptable and if the option 3 (including microbiological) Technical Assessment (4.5.1.1 and 4.5.2.2) is documented and appears ok, then in reality this should continue to be treated as a surface water discharge and should be authorised as such."

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- The requested revised, scientifically justified, Conditions are presented by Hydro-G in Table 14, which for reference purposes, also presents the Existing ELVs of W391/05.

- With respect to information required for those considering the Birds and Natural Habitats Regulations (2011) and 'Appropriate Assessment', the following summary points are pertinent:

    1. Assimilation Capacity Simulations for the revised volume discharge of 10,000 m3/d suggests no change in any parameter of note in the Surface Water Regulations (2009);

    2. The quality of the water discharging from the site is of such a high quality that it itself complies with the EQSs of the Surface Water Regulations (2009) and therefore, even if the Cong Canal were dry at any time in the season, the discharge to it would be a net gain of acceptable quality water to downstream systems;

    3. Mitigation measures are in place to prevent impact. The engineered concrete settlement tanks have a treatment capacity of 10,886m3/d and this is higher than the proposed ELV Q of 10,000m3/d.

- With respect to national designations and EPA assigned water quality 'Status' (EPA 2010 – 2015):

    1. Lough Mask is SAC, SPA, pNHA & Status is 'GOOD';
    2. Lough Corrib SAC SPA, pNHA & its WFD Status is 'GOOD';
    3. The links between Mask & Corrib are the Cong Canal & River SAC & their Status is 'GOOD';
    4. The groundwater underlying the area is the 'Cong Robe' Groundwater Body and its Status is 'GOOD'.

The Good Status designations reflects the EPA published dataset for the time period 2010 – 2015 and is concurrent with working operations at the quarry site and its discharge to the hydrological system. Therefore, good management practice and appropriate discharge is concluded for the site.

- Overall, daily works at the site, a long-term monthly monitoring record for upstream, the discharge and downstream water quality on the Cong Canal, in combination with the required assimilation capacity simulations, demonstrate that there will be no impacts on groundwater and surface water. The site has had no measurable negative impact on the environment over its >50 years operation. No negative impacts on Annex II species or on the Lough Corrib cSAC or SPA have been detected. Within the site boundary, a short–term increase in suspended solids in run-off water could potentially release suspended solids from the internal roads of the quarry during high intensity rainfall events. However, mitigation measures exist, and the settlement lagoon systems are appropriately engineered and sized. Any resulting discharge in low flow periods will result in an imperceptible, neutral impact on the Cong River, with no breaching of the regulatory limits for salmonid waters.

- The now proposed Discharge Volume ELV of 10,000m3/d has been proven by assimilation capacity simulations to demonstrate that resultant concentrations in the Cong Canal as presented in Table 14, which also presents the Environmental Quality Objectives for rivers and lakes of the Surface Water Regulation (2009) complies with the Surface Water Regulations (2009 and the Groundwater Regulations (2010). In addition, downstream water quality results for the Cong Canal demonstrates the validity of no impact assimilation capacity simulation results (Table 14).

1.0 Introduction

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McGrath Limestone Works Ltd, Cong, Co. Mayo holds a Section 4 discharge licence for the discharge of quarry waters to the Cong Canal (Reference No. W391/05). That licence was issued in 2007 by Galway County Council. While the quarry is primarily in County Mayo, the discharge point is in county Galway. McGraths Quarry are requesting amendments to the Conditions and Emission Limit Values (ELVs) in their exiting Discharge Licence. Site automated monitoring results suggest that the current maximum daily volume ELV does not appropriately reflect the volume of waters being managed at the site. The enactment of the Surface Water Regulations (SI 272 of 2009) into Irish Law changed the Environmental Quality Objectives for discharges to surface water. The licence holder has requested that Hydro-G assess the Conditions of the existing licence and evaluate that the Conditions are appropriate to the site and the receiving waters. Hydro-G has considered the characteristics of the discharge and the hydrometric and hydrochemical details for the receiving waters.

The objective of this evaluation is to present reasoned and justified revised Discharge Licence Conditions to Galway County Council so that the existing licence can be amended with Conditions that are appropriate to the water management regime at the site and facilitate administrative compliance with Environmental Quality Objectives of the Surface Water Regulations (2009). For example, the current licence does not reference ammonia or ortho-P, which are parameters of note in the Surface Water Regulations (2009). The Groundwater Regulations (2010) & the Birds and Natural Habitats Regulations (2011) were also enacted post issue of W391/05. The works completed here also consider the discharge in the context of those other relevant Regulations.

The existing Licence W391/05, with the specific wordings of the Conditions and ELVs, is presented as Appendix A. Hydro-G now presents those same existing ELVs of W391/05 in Table 1, purely for the purposes of presenting data in tabular format for evaluation, as follows:

Table 1 McGraths Limestone Cong Discharge Licence Conditions (W391/05) – Issued 2007

Flow	not exceed 432m3/12 hrs and 36 m3/hr	**MAX permitted discharge Q (m3/d)**
		864
ELVs	**Concentrations (mg/l)**	**Record Stipulations**
Suspended Solids	35	**Monthly in house, Quarterly by Accredited Laboratory**
Nitrate as NO3	50	**Quarterly by Accredited Laboratory**
Total Hydrocarbons	1	**Bi-Annually by Accredited Laboratory**
COD	100	**Quarterly by Accredited Laboratory**
BOD	25	**Quarterly by Accredited Laboratory**
Temperature	>20 °C	**Monthly in house, Quarterly by Accredited Laboratory**
pH	6 to 9 range	**Daily automated, Continuous Record**
Colour	no change	**Daily visual inspection, no sheen, no excess solids**
Conductivity	should not change significantly from day to day	**Daily automated, Continuous Record**
Turbidity	shall not change significantly from day to day	**Daily automated, Continuous Record**

2.0 The Site

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Overall, the McGrath Quarry area is 67.7 hectares, approximately.

The quarry is located on the north-western outskirts of Cong village, north of the R346 road to Clonbur, and immediately west of the Cong Canal. Most of the quarry is in County Mayo. A small part of the quarry, essentially its surface water discharge point, is in County Galway.

The ITM coordinates for central to the overall site are ITM Easting: 514150, ITM Northing 756180. The site and its local geographical setting, including surface waters, is presented in Figure 1.

The northern boundary of the quarry is 2.5 km south-southeast of Lough Mask's south eastern shores. Cong village is 0.5km, approximately, to the south east of the quarry's southern boundary. The centre of the quarry is 2km, approximately, north of Lough Corrib.

The land area focus is a small part of the regional hydrogeological regime when we consider the 67.7 hectares quarry area in the context of the 'isthmus' of limestone land between Lough Mask and Lough Corrib, in which the quarry is situated, having a total area of 8000 hectares, approximately. The site represents 0.84% of the limestone isthmus between the two lakes.

The objective of this 'Discharge Licence' evaluation is to present a reasoned and justified request for amendments in the Conditions of the existing Discharge Lice W391/05. The case is presented in the context of enacted Irish Regulations: namely the Surface Water Regulations (2009), the Groundwater Regulations (2010) & the Birds and Natural Habitats Regulations (2011).

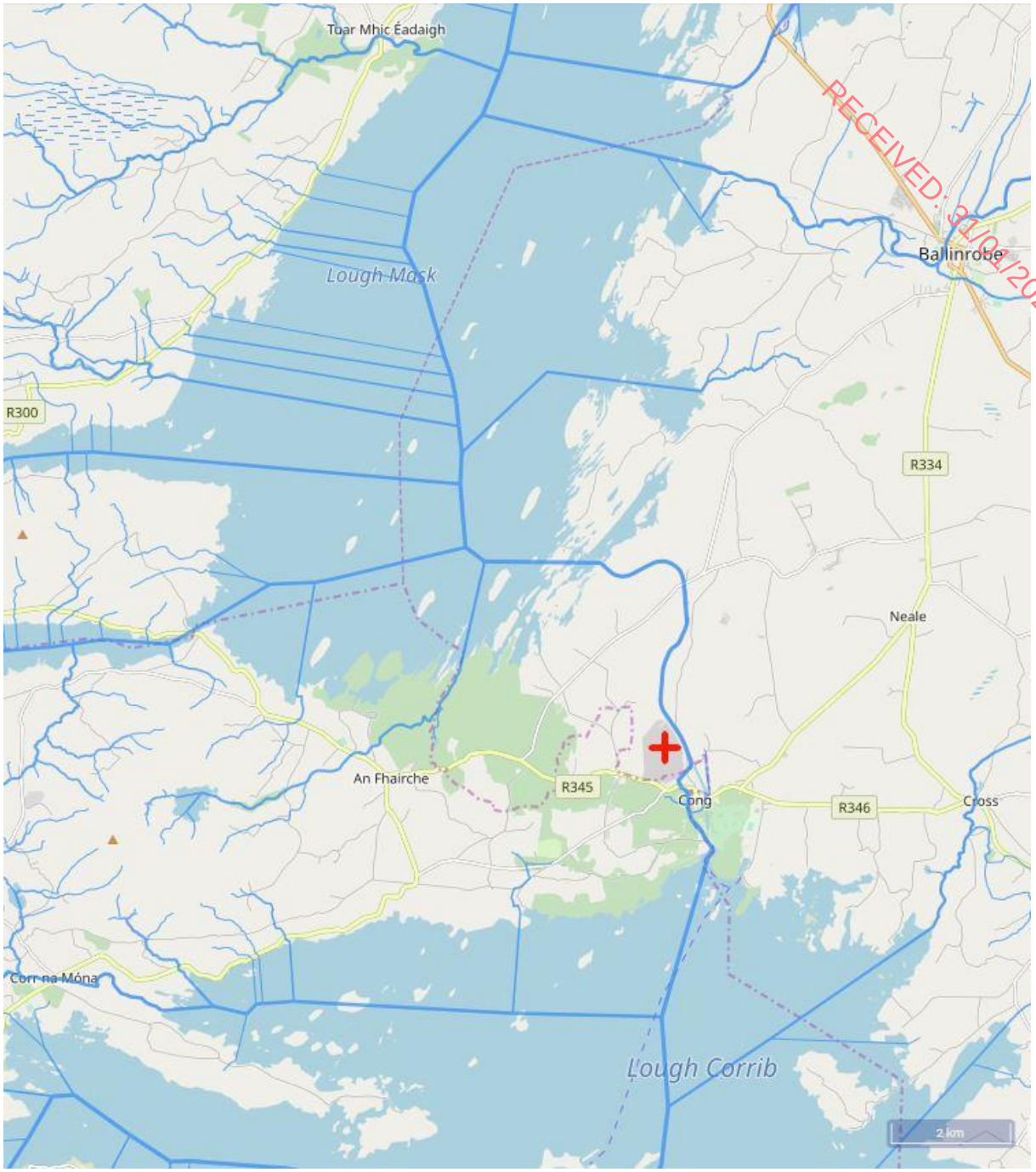

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Figure 1 Site Location [ ]

2.1 Water Management & Discharge Volumes Arising at the Site

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Discharge Licence W391/05 specifies its scope, as follows:

Schedule to Licence (W391/05) 'SCOPE':

"This licence refers to the lagoon discharge of McGraths Limestone Works Ltd. Located Cregaree Quarries, Cregaree, Cong, Co. Galway. Surface water runoff and groundwater ingested on site are pumped from the sump to the settlement lagoon and discharged to Cong Canal."

Water flows by gravity from all worked areas to a sump in the southern portion floor. From there it is pumped up the wall of a face to an engineered concrete tank settlement system.

Since 2006 waters collected in the lowest elevation of the excavation and the SW corner's sump are pumped to the constructed settlement lagoons before discharging to the adjoining Cong Canal. The discharge is licenced by Galway County Council (Licence ref. W391/05). Prior to 2006, there was only settlement in the sump and pumping from there to the Cong canal. It was the application for and issuing of the discharge licence that resulted in the settlement lagoons being built. The quarry's settlement lagoon system is located in the south-east portion of the quarry. The water from the quarry is passed through a settlement tank which has the following dimensions (ESP, 2006):

- Total Area = 877.9 m^2
- Depth = 2.3 – 2.5 m
- Total volume = 1877 m^3

The design flow rate through the system is 12.4m3/m2/day. Therefore, the maximum outflow is 10,866 m3/day (408.16m3/hour).

The water in the concrete tanks passes through two weirs with baffle boards to prevent any floating materials escaping and has an outlet tank that conveys discharge by pipe to the Cong Canal and one which returns back to the quarry. Generally, pumping from the floor sump happens overnight only, unless there are high rainfall events.

There are no major springs or groundwater ingress points within the site. Groundwater responses are in the epikarst shallow system and area responsive to recent rainfall. This is common in many karst settings. Rain is the major player. Rain falling in the fields surrounding the void and on the grounds of the quarry itself. Rain travels through thin soil cover of local lands or rock at surface and finds its natural escape route to the quarry void. This 'interflow' rainfall then enters the upper bedrock zones of solutionally enlarged, weathered limestone bedrock close to the subsoil interface and natural land surface. This rainfall then flows either horizontally or vertically until it reaches a solid impenetrable bedrock platform or floor of limestone. McGraths limestone is impenetrable and like most good limestone rock resource areas, it has no primary porosity. Therefore, rain water runoff travels along the top of the solid limestone until it hits a drop that is caused by a change in floor elevation because of a W-E trending bench. This W-E trending wall is along a line of quarry wall face that marks the of the northern portion that is the boundary of the 'pre- 63 (Area A)'. The rain runoff water then falls to the lower elevation exposed limestone quarry floor, which is a solid limestone mass and so, again, the over-ground water continues to move in a southerly direction under gravity towards the quarry's retention sump on the floor in the south western corner of the quarry. This sump is an excavated rock pool that accommodates the submersible pumps.

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When any new area of limestone within the void is worked, whether that is to the already permitted deeper extraction depths or excavations extending laterally, the rain that falls on any areas within the site will follow the same path and the same discharge route. Rainfall generated at any newly proposed area for deepening will still fall from the quarry wall face onto the stepped bench below. You see, the most southerly extent of the void space at the site is deeper than all other areas of the site. It is 'pre-63'. The quarry is working its rock extraction in a northward direction from its southern 'pre-63'. The settlement systems are in the south. All waters running off rocks flows by gravity to the southern management systems. Rainfall runoff generated at the site follows the same pathway today as it did in the year 1990 and in and it continues to follow the same path today in 2019. With respect to potential risks regarding rainfall runoff on the floor of any working quarry appropriate water management measures have been achieved at this site and this is substantiated by the good quality water reported in the monthly monitoring regime (Appendix B). Appropriately sized sumps in the southern deepest floor (Pre-63) and engineered settlement lagoons exist. The concrete tank settlement lagoons are chambered with baffle walls and the discharge is fully automated for continuous recording of flow volume, pH and Conductivity. Monitoring of groundwater levels and abstraction/discharge volumes exist. The Annual Environmental Reports (AERs) substantiate this.

The site has a telemetric continuous flow monitoring system that is managed by CSL. The 2018 daily discharge volume data are presented in Figure 2, which shows that the usual discharge amount does not exceed 3,000m3/d.

However, when a heavy rainfall occurs in the catchment, the discharge can peak to 8,000 m3/d. At this same time the natural catchment derived upstream flow in the Cong Canal, from Lough Mask to Lough Corrib, increases also.

Figure 3 presents the daily discharge volumes through January 2019 in which the discharge volume peak discharges associated with rainfall peaks in the catchment are shown for the winter recharge period October 2018 – April 2019.

The site's manager provided validation of the discharge, pump activity and water management system and the details are presented in Table 2.

Table 3 Presents the Telemetric Weekly Report (CSL subcontract) for the site for each week February 2019 – May 2019. These data show that the daily discharge was 1,861 m3/d, on average, with a peak daily discharge of 3,114 m3/d in the week starting 17/3/19.

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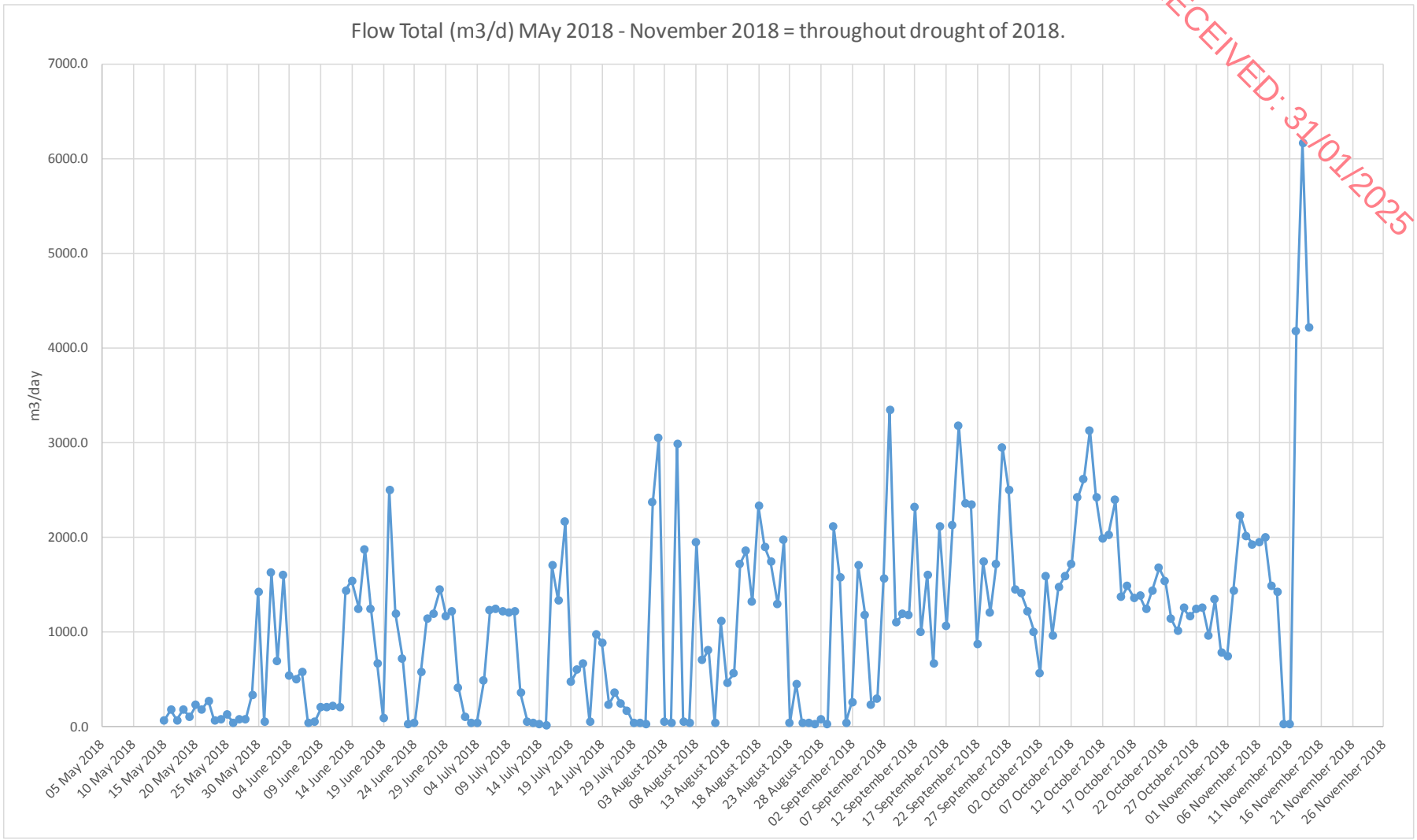
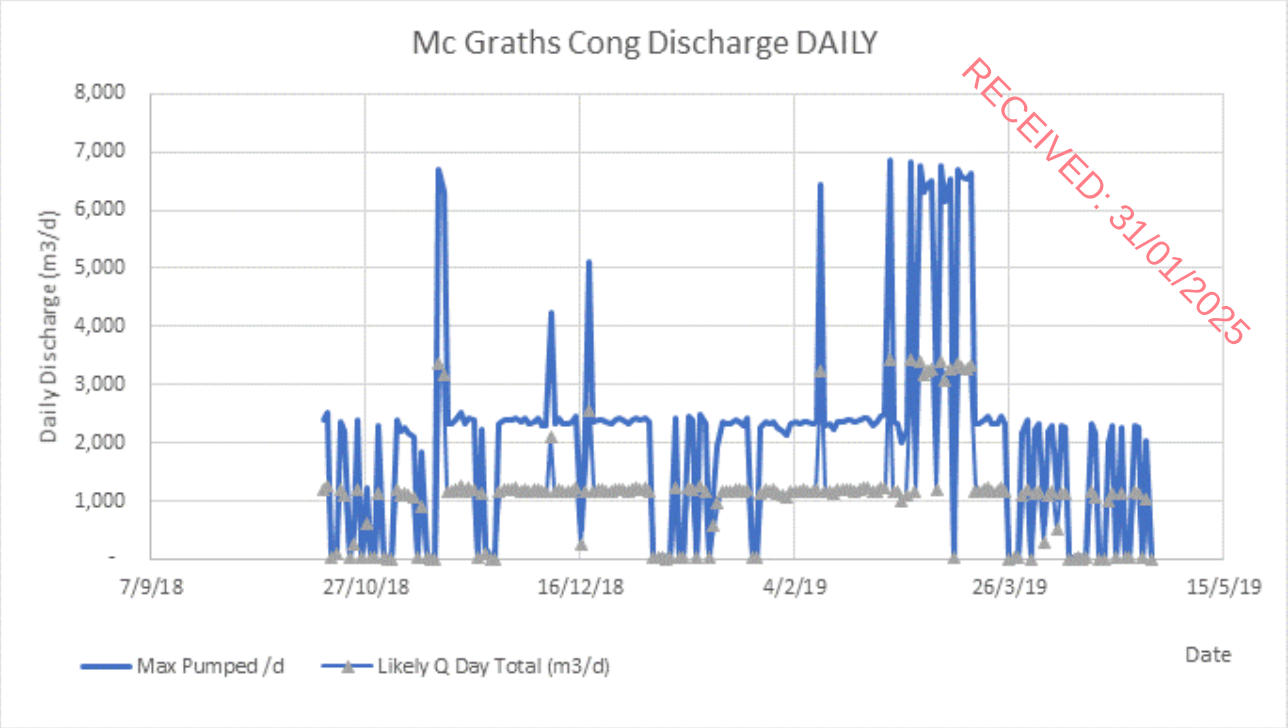


Figure 2 **Daily discharge volume data 2018.**



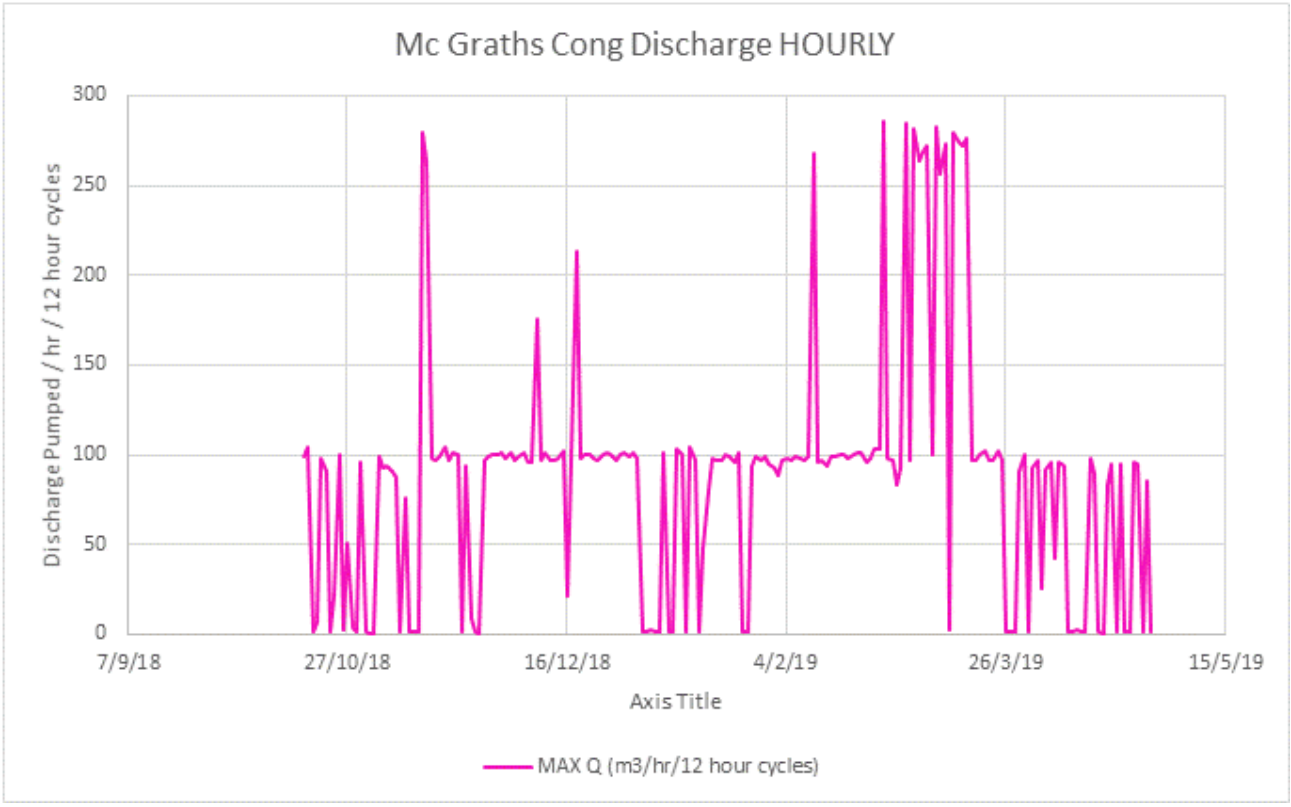


Figure 3 **Discharge Volumes associated with rainfall peaks in the catchment October 2018 – April 2019.**

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Table 2 Discharge, pump activity and water management system details December 2018 check.

pumps cong quarry		NOVEMBER -DECMBER 2018					
10" pump	6" pump	FLOATS	NIGHTS only	GOING ALL TIME	OFF	DATE	WEATHER
few hr on	yes	yes	6"all night	6" all ,10 few hours		26/11/2018	dry
no	yes	yes	6"all night	6" only		27/11/2018	dry morn-shower evening
no	yes	yes	6"all night	6" only		28/11/2018	heavy rain torrential morning
no	yes	yes	6"all night	6" only		29/11/2018	heavy showers.
yes	yes	yes	6"all night	yes x 2		30/11/2018	dry all day-slight showers rain in evening
yes	yes	yes	6"all night	yes x 2		01/12/2018	heavy showers all day
no	yes	yes	6"all night	6" only		02/12/2018	heavy showers all day
no	yes	yes	6"all night	6" only		03/12/2018	dry and sunny no rain
no	yes	yes	6"all night	6" only		04/12/2018	dry,overcast no rain
1/2 day	yes	yes	6"all night	6" only		05/12/2018	light showers,mainly dry
5-6 hrs	yes	yes	6"all night	6" only,10 5-6 hrs		06/12/2018	heavy rain thurs eve-fri morn
10 hrs	yes	yes	6"all night	6" only,10 -10 hrs		07/12/2018	dry morn ,heavy showers evening
no	yes	yes	6"all night	6" only		08/12/2018	rain heavy showers
no	yes	yes	6"all night	6" only		09/12/2018	rain all day
no	yes	yes	6"all night	6" only		10/12/2018	showers-not much rain
no	yes	yes	6"all night	6" only		11/12/2018	dry morning afternoon showers
6 hours	yes	yes	6"all night	6" only -6 hr 10"		12/12/2018	showers
no	yes	yes	6"all night	6" only		13/12/2018	heavy rain
no	yes	yes	6"all night	6" only		14/12/2018	showers
6 hours	yes	yes	6" all night	6" ONLY10" 6 HRS		15/12/2018	heavy rain all nigt
6 hours	yes	yes	6" all night	6" ONLY10" 6 HRS		16/12/2018	heavy showers
off	yes	yes	6" all night	6" only		17/12/2018	few showers-no much rain.
8-10 hrs	yes	yes	6" all night	6" & 10"		18/12/2018	heavy rain evening
8-10 hrs	yes	yes	6" all night	6" & 10"		19/12/2018	light rain most of day
8-10 hrs	yes	yes	6" all night	6" & 10"		20/12/2018	dry most of day
6 hours	yes	yes	6" all night	6" & 10" 6 hours		21/12/2018	rain all day
NOTES:	6" PUMP IS ON LOWER LEVEL THAN 10"-IF ITS ON FLOATS,10" ONLY KICKS IN IN HEAVY RAINFALL						
	SO 6" IS GOING FULLTIME AT MOMENT..NOV-DEC.						

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Table 3 **CSL Telemetric Weekly Report Cong Discharge Data February 2019 – May 2019.**

	McGraths Cong Average Daily Discharge Volume (m3/d) Feb - June 2019					1,620				
	For Week Commencing:	10/02/2019	For Week Commencing:	17/02/2019	For Week Commencing:	24/02/2019				
Feb-19	Daily Average Discharge (m3/d)	2,385	Daily Average Discharge (m3/d)	2,075	Daily Average Discharge (m3/d)	1,373				
	Weekly Total Discharge (m3)	16,692	Weekly Total Discharge (m3)	14,524	Weekly Total Discharge (m3)	9,608				
	For Week Commencing:	03/03/2019	For Week Commencing:	10/03/2019	For Week Commencing:	17/03/2019	For Week Commencing:	24/03/2019		
Mar-19	Daily Average Discharge (m3/d)	2,229	Daily Average Discharge (m3/d)	2,671	Daily Average Discharge (m3/d)	3,114	Daily Average Discharge (m3/d)	1,722		
	Weekly Total Discharge (m3)	15,601	Weekly Total Discharge (m3)	18,696	Weekly Total Discharge (m3)	21,799	Weekly Total Discharge (m3)	12,051		
	For Week Commencing:	31/03/2019	For Week Commencing:	07/04/2019	For Week Commencing:	14/04/2019	For Week Commencing:	21/04/2019	For Week Commencing:	28/04/2019
Apr-19	Daily Average Discharge	1,442	Daily Average Discharge	1,266	Daily Average Discharge	1,611	Daily Average Discharge (m3/d)	1,197	Daily Average Discharge (m3/d)	1,244
	Weekly Total Discharge (m3)	10,096	Weekly Total Discharge (m3)	8,865	Weekly Total Discharge (m3)	11,276	Weekly Total Discharge (m3)	8,382	Weekly Total Discharge (m3)	8,706
	For Week Commencing:	05/05/2019	For Week Commencing:	12/05/2019	For Week Commencing:	19/05/2019	For Week Commencing:	26/05/2019	For Week Commencing:	02/06/2019
May Jun 2019	Daily Average Discharge (m3/d)	1,375	Daily Average Discharge (m3/d)	647.43	Daily Average Discharge (m3/d)	926	Daily Average Discharge (m3/d)	914	Daily Average Discharge (m3/d)	1,345
	Weekly Total Discharge (m3)	9,625	Weekly Total Discharge (m3)	4,532	Weekly Total Discharge (m3)	6,487	Weekly Total Discharge (m3)	6,398	Weekly Total Discharge (m3)	9,415

2.2 Discharge Quality

The site has monitored water quality for the upstream, downstream and discharge quality on a monthly basis since 2014. The accredited laboratory certificates of analysis are presented in Appendix B for all water monitoring at the site 2014 - 2019. Since 2014, the Certificates of analysis show a discharge quality with BOD, SS, COD, Nitrates below the limit of detection of the laboratory analyser. There have been a couple of storm event breaches but the ELVs of the discharge licence are complied with mostly. Refer to Appendix B.

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Discharge quality results are presented in Table 4, in summary format, and in Appendix B as the accredited laboratory issued Certificates of Analysis from CLS. Monthly Monitoring was completed from December 2018 to May 2019.

In summary, Table 4 demonstrates the monthly monitoring results show that the **discharge water quality can be described as meeting the criteria of High Status Quality** when considered with the EQSs of the Surface Water Regulations (2009). Each of the parameters BOD, COD and SS recording at below the limit of Detection of the laboratory analyser.

Hydro-G initiated a more detailed than usual water quality monitoring programme in December 2018. The list of parameters analysed were expanded to include all relevant to the EQSs of the Surface Water Regulations (2009) and the Salmonid Regulations.

Originally, this discharge assessment considered the discharge as a pure surface water. Then the EPA suggested groundwater assimilation capacity assessment for the summer condition when there was a discharge from the quarry to the dry canal. Therefore, analysis for bacteriological content of the discharge was added to the sampling programme and the results are presented in Appendix B as Certificates of Analysis and in Table 5.

Table 4 Discharge Water quality December 2018 – May 2019.

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		Settlement Lagoon OUTLET = Discharge								Hydro-G Comment regarding Regulatory Compliance & Other
	Month	Dec-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	AVERAGE	UNITS	
pH	pH Units	8.0	8.1	8.1	8.4	8.2	8.2	8.1	pH Units	Exceptional quality discharge. Compliant with Discharge Licence Conditions, Surface Water Regulations (2009) High Status Criteria, Salmonid Regulations (1988) & Fish Life Directive 2006. The discharge from the lagoons has Suspended Solids, BOD, COD, MRP-P each below the Limit of Detection of the accredited laboratory analysers. Low chloride & low hardness signifies surface water and rainwater contributions rather than groundwater. Turbidity average = 1.23 NTU, which is close to Drinking Water Regulation quality.
Suspended Solids	mg/l	5	<2	<2	<2	<2	<2	<2	mg/l	
Turbidity	N.T.U.	1.6	0.9	0.5	3.3	0.5	0.6	1.23	N.T.U.	
Conductivity @20C	uS/cm	290	297	286	286	292	276	288	uS/cm	
BOD	mg/l	<1	<1	<1				<1	mg/l	
COD	mg/l	22	<10	<10				11	mg/l	
Chloride	mg/l	15.1	16.9	15.4	15.4	17.2	15.8	16	mg/l	
Potassium, total	mg/l	4	3	3	7	3	4	4	mg/l	
Sodium, total	mg/l	10	10	10	10	10	10	10	mg/l	
Hardness, Total as CaCO3	mg/l	147	149	148				148	mg/l	
Ammonia as NH3-N	mg/l	0.057	0.015	0.011	0.019	0.007	<0.006	0.02	mg/l	
Ammonium as NH4-N	mg/l	0.061	0.015	0.012	0.02	<0.01	<0.01	0.02	mg/l	
Nitrate as NO3	mg/l	6.5	6.83	3.27	4.46	2.54	2.00	4.27	mg/l	
Nitrite as NO2	mg/l	0.021	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	mg/l	
Molybdate Reactive Phosphorus as PO4-P	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/l	
Sulphate	mg/l	33.8	36.3	38.3				36.13	mg/l	
Copper, dissolved	ug/l	<1	<1	<1				<1	ug/l	
Zinc, total	ug/l	<5	<5	<5				<5	ug/l	
Extractable Hydrocarbons/TPH	ug/l	Unknown instrument signal/pattern= not detected					<0.01	<0.01	ug/l	
CLS Sample No.		916883	919643	925539	936484	941885	950678			
CLS Report No.		377915	378771	380698	384310	385911	388318			
Receipt Date		06/12/18	14/12/18	21/01/19	07/03/19	28/03/19	01/05/19			

3.0 Hydrology & Hydrogeology of the Area

3.1 Surface Water HYDROLOGY: Hydrometric Data for the Receiving Water

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The upstream OPW Hydrometric Station is Carrownagower.

One downstream OPW Hydrometric Station in this system, prior to the Cong River joining Lough Corrib, is the Cong Weir.

The location of each station is presented in Figure 4, as is the site.

The flow characteristics for each station, as presented by the OPW (www.waterlevel.ie) are shown in Figure 5.

OPW flow statistic data (Figure 3) presents flow in the Cong Canal in the m3/s units. These data can be converted to m3/d so as to facilitate comparison with the daily discharge volume emitted from the quarry site. The pertinent OPW hydrometric information is converted from m3/s to m3/d in Table 5, as follows:

Table 5 OPW hydrometric statistics (Figure 4) converted from OPW units of m3/s to m3/d for ease of reference with quarry discharge data.

	CONG CANAL RECEIVING WATER	
	UPSTREAM OPW DATA	DOWNSTREAM OPW DATA
	Carrownagower (OPW Stn 30017)	Cong Weir (OPW Stn 30031)
MAX Q (m3/s)	58.047	91.242
MAX Q (m3/d)	5,015,261	7,883,309
50%tile (m3/s)	14.143	28.69
50%tile (m3/d)	1,221,955	2,478,816
75%tile (m3/s)	5.548	17.706
75%tile (m3/d)	479,347	1,529,798
95%tile (m3/s)	null*	8.918
95%tile (m3/d)	null*	770,515

OPW flow volumes supplied for the Carrownagower station on the Cong Canal, upgradient of the quarry, suggest as follows:

- daily minimum flow for the Carrownagower station on the Cong Canal is zero.
- maximum daily recorded flows are half a million m3/d

The Cong Canal discharge has a large range of daily flow volumes. This is because the whole hydrological system of the lakes and the karst are driven by the rain falling on the catchments. The discharge from the quarry also has a wide range of flows. At times of high flow in the Cong Canal, the quarry's discharge will be a higher volume. At times of low flow in the Cong canal, so too will the discharge driven from the catchment to the quarry and to the discharge from the

settlement lagoons – so too, will that be low. The Cong Canal flows to the Cong River. There is an Inland Fisheries hatchery between the quarry and the Cong River. However, the quarry and the Hatchery are not connected because the hatchery takes its incubation and operation waters from the Mill Pool at its site, which is fed by a massive groundwater spring in a deep pond central to the hatchery. The Hatchery has its own discharge licence. LA Reference No W057/78; Licence Holder Name Cong Fish Hatchery; Facility Address Cong, Co Mayo, LA Name Galway County Council. Flow in the Cong River is year-round and is maintained by discharge from two spring fed tributaries and a large spring in the Mill Pond (Hatchery Mill Spring) in Cong village from which flow has been measured as 150,000m3/day while the Cong Canal was dry (Geological Survey of Ireland, 2004). The GIS estimate total spring discharge in Cong village to be >3 million m3/d (GSI, 2004).

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The relevance of the stated volumes and rates of flow is that massive amounts of water flow in this catchment. Total combined discharge from Lough Mask in the direction of Lough Corrib approaches 1 billion m3/year. Hydrometric data for the downstream station is so useful because while the upstream Stn records null as the 95%tile, the downstream has a high 95%tile because it picks up the three massive Groundwater springs in Cong village and so groundwater flow is quantified AND is massive.

With regard to the flow characteristic in the receiving surface water and groundwater system, Hydro-G designed simulations to cover all bases, as follows:

1. In the wet hydrological seasons of autumn/winter/spring this is 100% a surface water discharge and the average Q from the quarry is **1,620m3/d** (Table 3). It is the Mean Flow Condition that is relevant here;

2. In summer, the discharge can be conceptualised as a direct discharge to groundwater and an overview assimilation capacity simulation demonstrates that the discharge is Groundwater Regulation (2010 and 2016) compliant for the summer time discharge volume and ELVs proposed. This is because the **discharge** quality itself presents EQS Concentrations that conform to High Status Waters. This makes the proposal feasible. Groundwater Assimilation capacity when there is discharge to the surface dry canal – the canal loses groundwater all the time in this hydrometric scenario. As previously stated, the amount of groundwater flowing in the system, for the purposes of assigning a groundwater volume flow component for the assimilation capacity model simulations, is the difference between the 95%tile value for Carrownagower and Cong Weir in the last line of Table 5. The groundwater flow volume is therefore 770,515 m3/d for the usual summer condition groundwater assimilation capacity simulation. The maximum flow volume discharged after a summer storm in August 2018 was 3,000 m3/d (Figure 2). This is employed for the groundwater assimilation capacity simulation. The relativity is that there is one unit of 'High Status' water quality discharge from the quarry to 256 units of 'Good Status' groundwater flowing under the Cong Canal through to the Cong Weir system and on to Lough Corrib. The quality of the water from the quarry is better quality than the groundwater it is joining. Therefore, no deleterious impact is possible. Nonetheless, groundwater assimilation capacity simulations are presented in Section 3.

Previous evaluations of the quarry's pumped volumes demonstrated that it is mostly rainfall that is being intercepted and discharged (Hydro-G Water Chapter, 2015). The OPW flow data for the Cong Canal allow inference that the quarry's discharge is a small fraction of flow in the Cong Canal. With respect to any potential that the quarry might have to affect flooding or present flood risk? There is no flood risk because the Cong Canal and its downstream surface water system can convey massive flows, as demonstrated in Table 5.

Following on from Hydro-G's consultation with GCC and the EPA (May 2019), the assimilation capacity simulation is as follows:

1. Surface water assimilation capacity using the upstream Carrownagower Stn Flow to evaluate assimilation of the discharge WHEN THE CANAL HAS WATER IN IT. The applicable flow condition for the Cong Canal for the model simulation is the 50% tile flow, which is 1,221,955 m3/d and that volume of water is to receive the average discharge volume, which is recorded and averaged to be 1,620 m3/d (Table 3). The dilution factor is therefore 1 unit of discharge into 754 units of water flowing in the Cong Canal.

2. Groundwater Assimilation capacity when there is discharge to the surface dry canal – the canal loses groundwater all the time in this hydrometric scenario. The amount of groundwater flowing in the system, for the purposes of assigning a groundwater volume flow component for the assimilation capacity model simulations, is the difference between the 95%tile value for Carrownagower and Cong Weir in the last line of Table 5. The groundwater flow volume is therefore 770,515 m3/d for the usual summer condition groundwater assimilation capacity simulation. The maximum flow volume discharged after a summer storm in August 2018 was 3,000 m3/d (Figure 2). This is employed for the groundwater assimilation capacity simulation. The relativity is that there is one unit of 'High Status' water quality discharge from the quarry to 256 units of 'Good Status' groundwater flowing under the Cong Canal through to the Cong Weir system and on to Lough Corrib. The quality of the water from the quarry is better quality than the groundwater it is joining. Therefore, no deleterious impact is possible. Nonetheless, groundwater assimilation capacity simulations are presented in Section 3.

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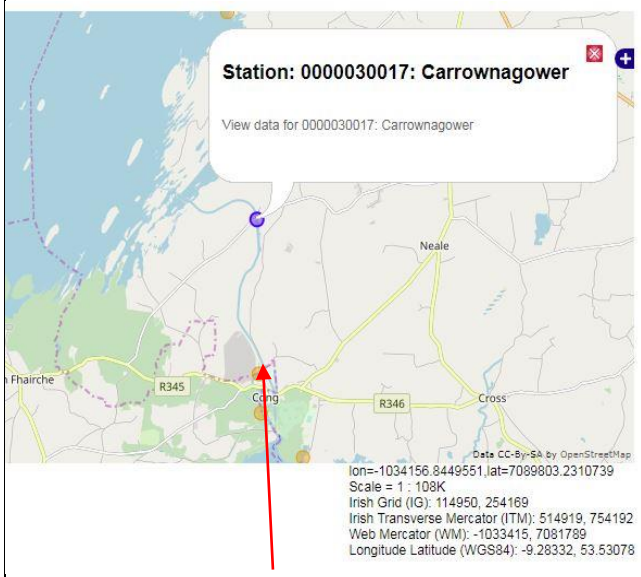
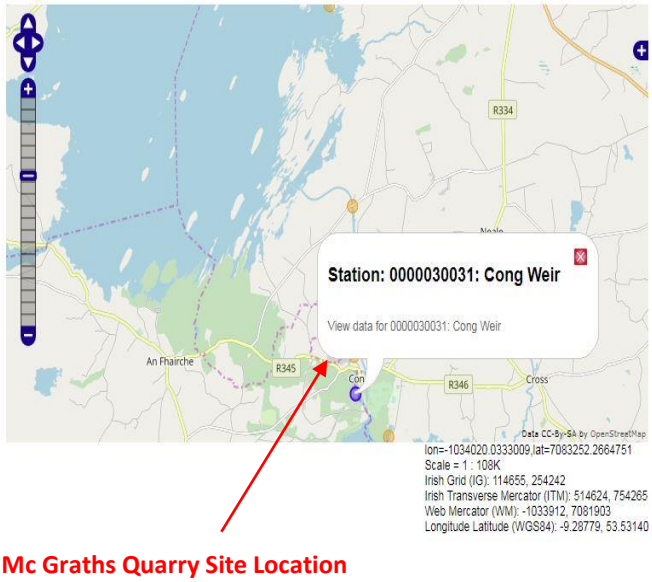
Figure 4 OPW Hydrometric Stations & McGraths Site Location.





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Station number	30017
Station name	Carrownagower
Latitude	53.57355667
Longitude	-9.289988889
Station type	General Surface water
River	CONG CANAL
Catchment	---
River Basin District	WESTERN RBD

Parameter | Metadata | Statistics | Annual Max | Download

DURATION PERCENTILES

Flows equalled or exceeded for the given percentage of time (m3/s)
(Data derived for the period 2007 to 2013)

1%	5%	10%	25%	50%	75%	90%	95%	99%
58.047	49.703	40.747	28.415	14.143	5.548	null	null	null

Levels equalled or exceeded for the given percentage of time (mAOD Poolbeg)
(Data derived for the period 2007 to 2013)

1%	5%	10%	25%	50%	75%	90%	95%	99%
19.808	19.348	18.979	18.421	17.504	16.439	15.846	15.837	15.832

Station number	30031
Station name	Cong Weir
Latitude	53.53859889
Longitude	-9.28876
Station type	General Surface water
River	CONG
Catchment	CORRIB
River Basin District	WESTERN RBD

Parameter | Metadata | Statistics | Annual Max | Download

DURATION PERCENTILES

Flows equalled or exceeded for the given percentage of time (m3/s)
(Data derived for the period 2000 to 2013)

1%	5%	10%	25%	50%	75%	90%	95%	99%
91.242	73.128	61.812	43.617	28.69	17.076	11.447	8.918	6.48

Levels equalled or exceeded for the given percentage of time (mAOD Poolbeg)
(Data derived for the period 2000 to 2013)

1%	5%	10%	25%	50%	75%	90%	95%	99%
10.559	10.452	10.365	10.216	10.067	9.912	9.812	9.763	9.694

Figure 5 OPW Flow Statistics for the Upstream (Carrownagower) & Downstream (Cong Weir) Stns.

3.2 Hydrochemical Data for River Upstream

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The site has monitored water quality for the upstream, downstream and discharge quality on a monthly basis since 2014. The accredited laboratory certificates of analysis are presented in Appendix B for all water monitoring at the site 2014 - 2019. In summary, the monthly monitoring results show that the Cong Canal's water quality upstream of the discharge is of High Status Quality with each of the parameters BOD, COD and SS recording at below the limit of Detection of the laboratory analyser and pH 8, on average, as presented in Table 6.

Table 6 Summary Average Water Quality Results 2014 – 2018 Cong Canal upstream of the Discharge.

Test	Result	Unit
On-Site Temperature	8.0	°C
Suspended Solids	<5	mg / l
COD Total	10	mg/l O2
pH	8.4	Units
BOD 5 day Total with ATU	<2	mg/l O2
Nitrate	<5.0	mg/l NO3

For the purposes of this Licence Condition review request, in the context of Surface Water Regulations (2009) parameters, Hydro-G initiated a more extensive parameter water quality monitoring programme in December 2018. The results for the Cong Canal Upstream are presented in Table 7

The significance of the water quality results for the receiving water is commented upon in Table 8.

Table 7 Recent Water Quality for the Cong Canal upstream of the Discharge December 2018 – April 2019

Cong Canal Upstream								AVERAGE	UNITS	Surface Water Regulations (2009) ELVs
	Month	Dec-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19			
pH	pH Units	8.0	8.1	8.2	8.2	8.1	8.3	8.1	pH Units	6 - 9 range
Suspended Solids	mg/l	<2	3	<2	<2	3	<2	<2	mg/l	not specified
Turbidity	N.T.U.	0.4	0.4	0.8	0.5	1.6	0.4	0.68	N.T.U.	not specified
EC	uS/cm	242	240	249	235	232	232	238	uS/cm	not specified
BOD	mg/l	<1	<1	<1				<1	mg/l	1.3 mg/l High Status Mean
COD	mg/l	31	<10	12				16	mg/l	not specified
Chloride	mg/l	13.8	14.8	14.9	14.9	15.1	15.3	14.5	mg/l	not specified
Potassium, total	mg/l	1	1	3	1	1	1	1	mg/l	not specified
Sodium, total	mg/l	8	8	10	8	9	9	9	mg/l	not specified
Hardness, Total as CaCO3	mg/l	112	109	116				112	mg/l	not specified
Ammonia as NH3-N	mg/l	0.010	0.007	0.081	0.011	0.006	<0.006	0.02	mg/l	0.09 mg/l Total Ammonia as N High Status 95%tile
Ammonium as NH4-N	mg/l	0.01	<0.01	0.087	0.011	<0.01	<0.01	0.02	mg/l	
NO3	mg/l	1.53	1.5	1.9	2.13	1.88	1.97	1.82	mg/l	not specified
Nitrite as NO2	mg/l	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	mg/l	not specified
Molybdate Reactive Phosphorus as PO4-P	mg/l	<0.01	<0.01	0.014	<0.01	<0.01	<0.01	<0.01	mg/l	0.025
Sulphate	mg/l	<5	6.4	6.69				5.2	mg/l	not specified
Copper, dissolved	ug/l	<1	<1	<1				<1	ug/l	not specified
Zinc, total	ug/l	<5	<5	<5				<5	ug/l	not specified
Extractable Hydrocarbons / TPH	ug/l	unknown signal = no detection					<0.01	<0.01	ug/l	not specified
CLS No.		916871	919642	925538	936482	941883	950676			
CLS Report No.		377914	378770	380697	384308	385909	388316			
Receipt Date		06/12/18	14/12/18	21/01/19	07/03/19	28/03/19	01/05/19			

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Table 8 Hydro-G's comments on the significance of the results for the Cong Canal receiving water.

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Cong Canal Upstream	AVERAGE	UNITS	Surface Water Regulations (2009) ELVs	Hydro-G Comment regarding Regulatory Compliance & Other
pH	**8.1**	**pH Units**	6 - 9 range	6 - 9 range pH units required = GOOD
Suspended Solids	**<2**	**mg/l**	not specified	High Status water Upstream water where SS is < the LOD of the analyser. SW Regs do not specify Suspended Solids concentration limit value. Salmonid Regulations 1988 & Fish Life Directive 2006 specify 25mg/l SS = Compliant.
Turbidity	**0.68**	**N.T.U.**	not specified	Hydro-G Comment = very low NTU = Drinking Water Reg Quality
EC	**238**	**uS/cm**	not specified	Low Conductivity reflects rainfall effect rather than limestone groundwater
BOD	**<1**	**mg/l**	1.3 mg/l High Status Mean	BOD concentration is < LOD of Analyser = Excellent Quality. Compliant with Salmonid Regulations 1988, Fish Life Directive 2006 & SW Regs 2009.
COD	**16**	**mg/l**	not specified	COD is not specified in any Regulations. COD is low at <20 mg/l, on average. This signifies a good quality.
Chloride	**14.5**	**mg/l**	not specified	Hydro-G Comment = relatively low if Limestonne Aquifer value were to be considered but the 15mg/l range indicates rainwater Lough Mask discharge to the Cong Canal and rainfall effects rather than groundwater component feeding the Canal.
Hardness, Total as CaCO3	**112**	**mg/l**	not specified	Hydro-G Comment = this is a relatively low hardness for Irish Limestone environment (according to GW3 WFD Calcareous "these indicate that the low values are caused by rapid throughput of groundwater in the bedrock or overlying subsoils, river water shortcircuiting, or non-limestone subsoils contributing part or most of the flow.")
Ammonia as NH3-N	**0.02**	**mg/l**	0.09 mg/l Total Ammonia as N High Status 95%tile	Cong Canal upstream is SW REGS 2009 HIGH STATUS. All results are Salmonid Regulation
NO3	**1.82**	**mg/l**	not specified	not specified in Surface Water Regulations.
Nitrite as NO2	**<0.017**	**mg/l**	not specified	Nitrite concentration is so low that it is below
PO4-P	**<0.01**	**mg/l**	0.025	Results for upstream, discharge & downstream are generally below the limit of detection of the analyser. All results are SW REGS 2009 HIGH STATUS MEAN Concentration ≤ 0.025 mg/l PO4-P COMPLIANT.

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3.3 Groundwater Hydrogeology

The Groundwater Body underlying the site is called the 'Cong Robe' Groundwater Body [European_Code IE_WE_G_0019]. The GSI GWB descriptor sheet is presented as Appendix C.

Hydro-G suggests that there is not much chance of groundwater interception at significant volumes because the quarry itself is in a bedrock that is so solid, so pure and so impermeable. The limestone under the quarry is mapped as **the CONG formation** (CO Fm) (Figure 6). Daly & Drew (1993) state that groundwater flow velocities in their tracer tests could be 200 – 600m /d. Therefore, the conduits would have to be large and they would be obvious to see in the exposed W-E face that forms the southern boundary of the 'substitute consent' area and the northern boundary of the 'Pre-63' area. Therefore, I offer that this operating quarry is not a significant player in the hydrogeological regime because it would be more or less impossible to operate a quarry within that scale of hydrogeological activity. If it was intercepting waters at these scales, it would not be financially viable to operate because of the pumping infrastructure required and dewatering in order to maintain dry working would not be possible. Purely for illustrative purposes, if McGraths Limestone, Cong were dealing with only 0.001% of the total combined discharge from Lough Mask in the direction of Lough Corrib approaches 1 billion m3/year, they would need 170 number 6" pumps to maintain dry workings: they have 2 pumps at the site and this keeps them dry.

Figure 6 demonstrates that the Cong Formation limestone Bedrock (CO Fm) underlying the quarry **does not extend** to the shores of the lakes to the north (Mask) **OR** to the south (Corrib). It is the Cong Canal formation (NL) that caresses the quarries limestone mass. The NL is shapes around in a 'C' type caress with Lough Mask on one side and the quarry's Cong Fm in its 'C' (Plate1). It is clear from the GSI mapping that it is the NL limestone's formation that is the most prone and mapped with karst features. The NL Fm bounds with Lough Mask. The NL formation, along with the Cong Canal, provides the travel paths for water from Lough Mask to Lough Corrib. Hydrologically, water travels along surface routes using the Cong Canal. Hydrogeologically, the best karst expertise for the area and bedrock/aquifer information suggests that the major karst flows could be 30-40 m below sea level (Drew, D., pers. comm., 2015).

The paper series GSI Sheet 11, 1: 100,000 Bedrock map shows the NL formation to the north, along the shores of Lough Mask, and to the south of the quarry (evident by the mapped line of caves and spring discharges). This dips steeply under the quarry. The quarry itself is underlain by the more solid limestone than that limestone that bounds the shores of both Lough mask and Lough Corrib. Karst conduit lines dip at Lough mask and travel deep carrying the karst waters from north to south via sinking swallow holes in the north NL formation to discharges in caves and springs at the point of contact between the quarry's underlying CO formation and the southerly portion of the NL formation in the vicinity of Cong village. The point of bedrock contact to the south is outside the quarry's southern boundary.

3.4 Groundwater Quality

The site monitors groundwater quality at four locations within the quarry on a monthly routine basis. The full dataset is presented in Appendix B. The Certificates of Analysis are presented in Appendix B for the monitoring period 2014 to 2019 and summary Tables are presented for each of the four boreholes. In summary, pH is 7.6, on average, EC is usually between 350 and 400 uS/cm and nitrate is below the detection limit of the analyser on most occasions. There are issues with SS being around 3 – 4 mg/l but this is because of sediment in the bottom of the piezometers. Suspended solids are not a parameter listed for Groundwater Assessment. In anycase, the dilution factor afforded, as presented in Section 2

Following on from advice from the EPA, given that Groundwater Assimilation capacity evaluation was relevant to the site when the Cong Canal is dry, Hydro-G established the bacteriological content of the discharge. All samples

returned zero counts of bacteria. Given zero bacteriological content and the fact that there is one unit of 'High Status' water quality discharge from the quarry to 256 units of 'Good Status' groundwater flowing under the Cong Canal through to the Cong Weir system and on to Lough Corrib. The quality of the water from the quarry is better quality than the groundwater it is joining. Therefore, no deleterious impact is possible and the EQOs of the Groundwater Regulations (2010) are adhered to.

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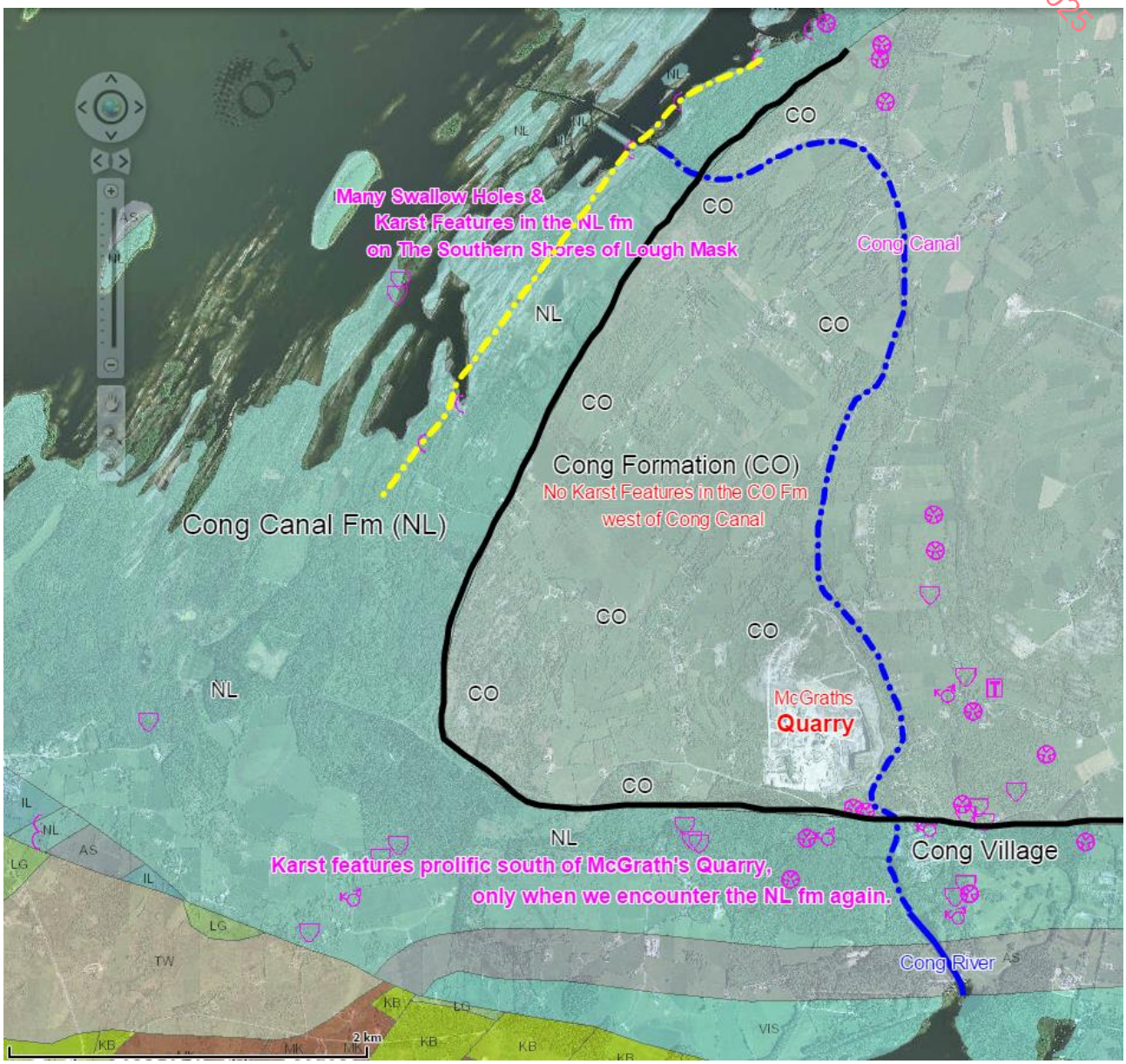

Figure 6 Geological Formations

Figure 6 illustrates the differentiation between the Cong Formation (CO) limestone, which underlies the quarry, and the Cong Canal Formation (NL) that holds all the karst features: the swallow holes on the southern shores of Lough mask and the output points are all in the NL, rather than in the quarry's CO formation. Image taken from GSI, 2015 (www.online mapping) with annotations by added for purposes of clarity by Pamela Bartley.

3.5 WFD 'Status' of the Receiving Water Environment

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The WFD and EPA assigned 'Status' of the receiving water Cong Canal [European_Code IE_WE_30C060300] is 'Good'. The specific details for the surface water are shown in Table 9. The published dataset relates to 2010 – 2015, which reflects operations at the quarry and their discharge since 2007 licensing. The EPA and GCC supplied the hydrochemical datasets for the Cong Canal and Ashford Castle downstream water body. These were employed by Hydro-G in the assimilation capacity simulations.

Table 9 WFD Status 2010 – 2015 Surface Water Cong Canal (https://gis.epa.ie/EPAMaps/)

European_Code	IE_WE_30C060300
Name	CONG CANAL_010
Status	Good
Period_for_WFD_Status	SW 2010-2015
Acidification_Conditions	Pass
Bio_Status	Good
Chemical_SW_Status	
Dissolved_Oxygen_Saturation	Pass
Dissolved_Oxygen_(mgl)	
Fish_Status	
General_Conditions	Pass
Hydromorphological_Cond	
Invertebrate_Status	Good
Molybdate_Reactive_Phosphorous	
Nitrate	High
Nutrient_Conditions	Pass
Other_Oxygenation_Conditions	High
Oxygenation_Conditions	Pass
pH	Pass
Supporting_Chemistry_Conditions	Pass

The WFD and EPA assigned 'Status' of the underlying 'Cong Robe Groundwater Body is GOOD. The specific details for the surface water are shown in Table 10. The published dataset reflates to 2010 – 2015, which reflects operations at the quarry and their discharge since 2007 licensing.

Table 10 Ground Waterbody WFD Status 2010-2015IE_WE_G_0019

European_Code	IE_WE_G_0019
NAME	Cong-Robe
Waterbody_Type	Groundwater
Status	Good

The WFD and EPA assigned 'Status' of the Lough Cara/Mask Complex, upstream of the quarry, and Lough Corrib, downstream, are both Good. The specific details are shown in Table 11. The published dataset reflates to 2010 – 2015, which reflects operations at the quarry and their discharge since 2007 licensing.

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Table 11 WFD Status 2010 – 2015 Lough Cara Mask & Lough Corrib (https://gis.epa.ie/EPAMaps/)

European_Code	IE_WE_30_665a	**European_Code**	IE_WE_30_666b
NAME	Mask	**NAME**	Corrib Upper
Status	Good	**Status**	Good
Period_for_WFD_Status	SW 2010-2015	**Period_for_WFD_Status**	SW 2010-2015
Acidification_Conditions	High	**Acidification_Conditions**	High
Bio_Status	Good	**Bio_Status**	Good
General_Conditions	High	**Chemical_SW_Status**	Failing to achieve good
Hydromorphological_Cond		**Fish_Status**	High
Invertebrate_Status		**General_Conditions**	High
Macroalgae_Status		**Macrophyte_Status**	High
Macrophyte_Status	Good	**Molybdate_Reactive_Phosphorous**	
Molybdate_Reactive_Phosphorous		**Nutrient_Conditions**	High
Nonionised_Ammonia		**Other_Aquatic_Flora_Status**	Good
Nutrient_Conditions	High	**Other_Nutrient_Conditions**	High
Other_Aquatic_Flora_Status	Good	**Oxygenation_Conditions**	High
Other_Acidification_Conditions		**pH**	High
Other_Nutrient_Conditions	High	**Phytobenthos_Status**	Good
Oxygenation_Conditions	High	**Phytoplankton_Status**	High
pH	High	**Specific_Pollutant_Conditions**	Pass
Phytobenthos_Status		**Supporting_Chemistry_Conditions**	High
Phytoplankton_Status	High	**Thermal_Conditions**	High
Supporting_Chemistry_Conditions	High	**Total_Phosphorous**	High
Thermal_Conditions	High		
Total_Phosphorous	High		

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3.6 Designations

Designations are presented in Table 12.

The northern boundary of the quarry is 2.5 km south-southeast of Lough Mask's south eastern shores. Cong village is 0.5km, approximately, to the south east of the quarry's southern boundary. The centre of the quarry is 2km, approximately, north of Lough Corrib.

Table 12 WFD Status 2010 – 2015 Lough Cara/Mask Complex, upstream of the quarry, and Lough Corrib, downstream (https://gis.epa.ie/EPAMaps/)

S.A.C
Lough Carra/Mask Complex SAC

Site_Name	Lough Carra/Mask Complex SAC
SiteCode	001774
URL	Link to More Information
EU_PA_Type	Habitats
EU_PA_Code	IE0001774

S.P.A.
Lough Mask SPA

Site_Name	Lough Mask SPA
SiteCode	004062
URL	Link to More Information
EU_PA_Type	Birds
EU_PA_Code	IE0004062

Natural Heritage Areas
001774

SITECODE	001774
Site_name	Lough Carra/Mask Complex

S.A.C
Lough Corrib SAC

Site_Name	Lough Corrib SAC
SiteCode	000297
URL	Link to More Information
EU_PA_Type	Habitats
EU_PA_Code	IE0000297

S.P.A.
Lough Corrib SPA

Site_Name	Lough Corrib SPA
SiteCode	004042
URL	Link to More Information
EU_PA_Type	Birds
EU_PA_Code	IE0004042

Natural Heritage Areas
000297

SITECODE	000297
Site_name	Lough Corrib

3.7 River Basin Management Plan Details

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In 2018 the Basin Management Plan for Ireland 2018-2021 was launched, and it sets out the actions that Ireland will take to improve water quality and achieve 'good' ecological status in water bodies (rivers, lakes, estuaries and coastal waters) by 2027. The Plan provides a national framework for improving the quality of waters. This is a 2nd cycle plan and for the 2nd Cycle, the Eastern, South Eastern, South Western, Western and Shannon River Basin Districts are now merged to form one national River Basin District: The Plan is very political speak and talk focussed about future aims and economy rather than science. It refers to programmes that are getting under way such as catchments.ie.. The document itself makes no specific reference to any points of note of relevance to this assessment.

3.8 Fish Life & The Inland Fisheries, Ireland, Hatchery @ Cong

Mc Grath's Quarry, Hydro-G & Earth Science Partnership met in Galway in January 2019 and discussed the requirements of Inland Fisheries with respect to our proposals to reevaluate Conditions of the Licence. The main outputs from that meeting were as follows:

- The IFI staff present at the meeting had no scientific concerns regarding the ELVs of the Discharge Licence because their water is not connected to the site's discharge or the Cong Canal. They take their water from the hatchery's Mill Pond. This Mill Pond is a deep pond that has a groundwater spring feed. The volumes of water available to the hatchery are phenomenal and the IFI have no concerns regarding the quarry. The quarry has been in operation for so long that any effects or problems would have manifested to date.

- The requirements for the water quality of the fish are not as onerous as the Surface Water EQSs of the Surface Water Regulations. IFI is content with 25mg/l SS criteria.

- It is IFIs intention to maintain one facility that will be used for research and necessary stocking. Cong, Co. Mayo has been identified as the site with most potential. This is due to the quality and quantity of its water supply which is an important consideration for fish production. Ultimately the hatchery at Cong is expected to be an upgraded facility capable of housing a modern hatchery research facility.

Nevertheless, it was agreed at that meeting that the site would present this report for consultation prior to lodging with Galway County Council: REASON = to ensure that the administrative process for Condition modification would not be impeded by lack of consultation/collaboration.

4.0 Assessment

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This section presents my evaluation of the potential effect of the discharge in the context of regulatory obligations. Overall, assessment of this discharge consent requires consideration as to whether the discharge itself is feasible in the context of the European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009) and the Groundwater Regulations (2010 and 2016). It was consultation with GCC and the EPA that added consideration with respect to the Groundwater Regulations, for the reasons outlined by Dr. Matt Craig and Dr. Conor Quinlan, as follows:

"from the data presented it would appear that the discharge is not adding anything significant that would be of environmental concern and would be comparable to the quality of water naturally present in the canal if it was flowing. As the receptors to be protected are the same receptors that could be impacted naturally and if the discharge is of the same quality as exists naturally then the discharge is not adding to the issue. As such it could be permissible as a direct discharge to groundwater. The above is presented by way of narrative, as in my opinion this is a surface water discharge (as per option 1), but following the process for option three demonstrates that the concerns for groundwater are explained and addressed via your assessment(s). As such, if an assimilative capacity assessment during mean flows & low flows (Q95) is acceptable and if the option 3 (including microbiological) Technical Assessment (4.5.1.1 and 4.5.2.2) is documented and appears ok, then in reality this should continue to be treated as a surface water discharge and should be authorised as such." Dr. Matt Craig, EPA.

With regard to the flow characteristic in the receiving surface water and groundwater system, Hydro-G designed simulations as follows:

1. In the wet hydrological seasons of autumn/winter/spring this is 100% a surface water discharge and the average Q from the quarry **is 1,620m3/d, on average.** It is the surface water system that receives this volume.

2. In summer, the discharge can be conceptualised as a direct discharge to groundwater through the 'losing' Cong Canal and an overview assimilation capacity simulation demonstrates that the discharge is Groundwater Regulation (2010 and 2016) compliant for the summer time discharge volume and ELVs proposed. This is because the **discharge** quality itself presents EQS Concentrations that conform to High Status Waters. This makes the proposal feasible. The groundwater flow volume quantified by default using OPW data presented in Table 5, which facilitates calculation that there is one unit of 'High Status' water quality discharge from the quarry to 256 units of 'Good Status' groundwater flowing under the Cong Canal through to the Cong Weir system and on to Lough Corrib. The quality of the water from the quarry is better quality than the groundwater it is joining. Therefore, no deleterious impact is possible.

In addition, this assessment requires consideration as to whether the proposed discharge complies with the requirements of the Habitats Directive (92/43/EEC) and the Irish enactment of this Directive, namely the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477/2011). The requirements under Article 6(3) of the Habitats Directive in respect of Screening (Stage 1) and Appropriate Assessment (Stage 2) require a number of conclusions/determinations/decisions to be made. Of note is that following on from a review of other Section 4 discharges in the area (https://gis.epa.ie/EPAMaps/) and my catchment inspection/assessment on the ground, I determine that there is no need to do additional assimilation capacity simulations for consideration of 'In Combination' because there is only one other licensed discharge that is documented to occur **and t**hat is the **I**IF Hatchery Licence and it is to a distinct **surface water** system downstream of Mc Grath's discharge. **Yes, they both connect to Lough Corrib but the hydrometrics of the system as previously presented in Section 2.3, page 8 of this report: "**The relevance of the stated volumes and rates of flow is that massive amounts of water flow in this catchment. Total combined discharge from Lough Mask in the direction of Lough Corrib approaches 1 billion

m3/year**" NEGATE THE NEED FOR COMBINED Assimilative capacity simulations on two discharge licenses that represent <0.1% of the water flowing to Lough Corrib.**

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Section 4.0 is structured as follows:

- Section 4.1 presents an evaluation of compliance with the requirements of the European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009) by assimilation capacity simulations as suggested in the LANSTG (2011) guidance document. The effect of the discharge is simulated in terms of the assimilation capacity of the receiving water and compare simulation outputs to the requirements of the European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009. In the wet hydrological seasons of autumn/winter/spring this is a surface water discharge and the average Q from the quarry is 1,632m3/d, on average. It is the Mean Flow Condition that is applicable to simulation with the average discharge. However, for the purposes of ultra conservative simulations, the max proposed discharge volume ELV of 10,000 m3/d is was simulated with the lowest flow for the CONG Canal i.e. 0.5m3/s hypothetical 95%tile. Hydro-G chose this strategy Because the OPW records 95%tile as null. Therefore, Hydro-G suggests that adopting a low value hypothetical daily equivalent for a 0.5m3/s as the 95%tile flow rate is defensible given that the OPW 50% tile is 14m3/s and OPW 75% tile is 5.5m3/d/s. Simulation outputs for the surface water regulation (2009) evaluation are presented in Table A1, below.
- Section 4.2 presents the groundwater assimilation capacity simulation and demonstrates compliance with the Groundwater Regulations (2010).
- Section 4.3 discusses the simulation results in the context of the potential effect of the discharge on fish life.
- Section 4.4 presents in the context of the requirements of Article 42 of Part 5 of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477/2011) and requirements for a screening for Appropriate Assessment.

4.1 Surface Water Regulations (2009) Assessment

The requirements of the European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009) are considered. I have adopted the formula and simulation methodologies suggested by DoEHLG (2011) in the Guidance for Assessing Discharges. The pumping system can pump 10,000m3/d. It is in place for storm event management. The lagoon's treatment capacity is in excess of 10,000 m3/d. As previously stated, the range is large because the surface water systems are rainfall dependent in wide catchment area. Hydro-G offers that because the receiving waters have a large flow during high recharge times then administratively it makes sense to set a high volume of discharge for evaluation because it is not a TARGET volume, but it is an Emission Limit Value. Setting the volume at 10,000m3/d for assimilative capacity simulation evaluation facilitates ease of compliance and administration for the peak events. Simulation of the 10,000m3/d ELV proposed allows evaluation with respect to meeting the requirements of the Surface Water Regulation (2009) Environmental Quality Objectives.

With respect to assimilation capacity simulation outputs, **the outcome of the simulation as presented in Table A1 demonstrates that for the 2**019 review requested Conditions, all parameters are compliant with Surface Water Regulation SI 272 of 2009's 95%tile condition EQS for Ortho-P, BOD and Ammonia-N & Compliant with the Salmonid Regulations requirement with respect to pH and Suspended Solids. There is no increase in any parameters. Simulation results suggest that a license volume ELV of 10,000m3/d is permissible for ELV's as presented in Table 14.

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Table A1 (1 of 3) Surface Water Assimilation Capacity Simulation Results

McGraths Cong 2019 Proposed ELV Q = 10,000 m3/d Discharge

T = (FC+fc)/(F+f)

MRP-P

T = RESULTANT concentration in the receiving water (mg/l)	**T**	**0.01**	**mg/l**
F = 95%tile RECEIVING river flow (m3/s)	F	0.50	m3/s
C = Baseline concentration in UPSTREAM receiving water (mg/l)	C	**0.01**	mg/l
f = Flow discharging to receiving waters (m3/s)	f	0.12	m3/s
c = PROPOSED ELV concentration in discharge (mg/l)	c	0.03	mg/l

Surface Water Regulations 2009 (SI 272 of 2009) Surface WATER EQS's (mg/l)

0.035	0.075	0.025	0.045
Good Status Mean	GOOD STATUS	High Status Mean	High Status 95%tile

HYDRO-G COMMENT = Resultant MRP-P concentration in the Cong Canal is High Status Compliant (SI 272 of 2009)

BOD

T = RESULTANT concentration in the receiving water (mg/l)	**T**	**1.3**	**mg/l**
F = 95%tile RECEIVING river flow (m3/s)	F	0.500	m3/s
C = Baseline concentration in UPSTREAM receiving water (mg/l)	C	**0.5**	mg/l
f = Effluent flow discharging to receiving waters (m3/s)	f	0.1157	m3/s
c = PROPOSED ELV concentration in discharge (mg/l)	c	5.00	mg/l

Surface Water Regulations 2009 (SI 272 of 2009) Surface WATER EQS's (mg/l)

1.5	2.6	1.3	2.2
Good Status Mean	GOOD STATUS 95%tile	High Status Mean	High Status 95%tile

HYDRO-G COMMENT = Resultant BOD concentration in the Cong Canal is High Status Compliant (SI 272 of 2009)

Ammonia-N

T = (FC+fc)/(F+f)

T = RESULTANT concentration in the receiving water (mg/l)	**T**	**0.04**	**mg/l**
F = 95%tile RECEIVING river flow (m3/s)	F	0.500	m3/s
C = Baseline concentration in UPSTREAM receiving water (mg/l)	C	0.03	mg/l
f = Effluent flow discharging to receiving waters (m3/s)	f	0.1157	m3/s
c = PROPOSED ELV concentration in discharge (mg/l)	c	0.10	mg/l

Surface Water Regulations 2009 (SI 272 of 2009) Surface WATER EQS's (mg/l)

0.065	0.14	0.04	0.09
Good Status Mean	GOOD STATUS	High Status Mean	High Status 95%tile

HYDRO-G COMMENT = Resultant Ammonia N concentration in the Cong Canal is High Status Compliant (SI 272 of 2009)

Nitrates as NO3

T = (FC+fc)/(F+f)

T = RESULTANT concentration in the receiving water (mg/l)	**T**	**3**	**mg/l**
F = 95%tile RECEIVING river flow (m3/s)	F	0.500	m3/s
C = Baseline concentration in UPSTREAM receiving water (mg/l)	C	1.8	mg/l
f = Effluent flow discharging to receiving waters (m3/s)	f	0.1157	m3/s
c = PROPOSED ELV concentration in discharge (mg/l)	c	10.00	mg/l

Nitrates as NO3

not specified in Regulations but resultant NO3 is good quality with respect to 50mg/l NO3 limit of the Nitrates Directive.

Table A1 (2 of 3) Surface Water Assimilation Capacity Simulation Results (continued)

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McGraths Cong 2019 Proposed ELV Q = 10,000 m3/d Discharge

Suspended Solids				Suspended Solids
T = (FC+fc)/(F+f)				European Communities (Quality of Salmonid Waters) Regulations (SI 293/1988) (mg/l)
T = RESULTANT concentration in the receiving water (mg/l)	T	5.4	mg/l	
F = 95%tile RECEIVING river flow (m3/s)	F	0.500	m3/s	
C = Baseline concentration in UPSTREAM receiving water (mg/l)	C	2	mg/l	HYDRO-G COMMENT = 25 mg/l SS Limit complied with in resultant 2.2 mg/l SS in downstream Surface Water
f = Effluent flow discharging to receiving waters (m3/s)	f	0.1157	m3/s	
c = PROPOSED ELV concentration in discharge (mg/l)	c	20.00	mg/l	

Total Hydrocarbons				Total Hydrocarbons
T = (FC+fc)/(F+f)				European Communities (Quality of Salmonid Waters) Regulations (SI 293/1988) (mg/l)
T = RESULTANT concentration in the receiving water (mg/l)	T	0.10	mg/l	
F = 95%tile RECEIVING river flow (m3/s)	F	0.500	m3/s	
C = Baseline concentration in UPSTREAM receiving water (mg/l)	C	0.01	mg/l	Regulation requires that there be no sheen
f = Effluent flow discharging to receiving waters (m3/s)	f	0.1157	m3/s	
c = PROPOSED ELV concentration in discharge (mg/l)	c	0.50	mg/l	

COD				COD
T = (FC+fc)/(F+f)				
T = RESULTANT concentration in the receiving water (mg/l)	T	17	mg/l	
F = 95%tile RECEIVING river flow (m3/s)	F	0.500	m3/s	
C = Baseline concentration in UPSTREAM receiving water (mg/l)	C	16	mg/l	HYDRO-G COMMENT = not specified in Regulations: Good Quality resultant concentration
f = Effluent flow discharging to receiving waters (m3/s)	f	0.1157	m3/s	
c = PROPOSED ELV concentration in discharge (mg/l)	c	20.00	mg/l	

Turbidity				Turbidity
T = (FC+fc)/(F+f)				
T = RESULTANT concentration in the receiving water (mg/l)	T	1	mg/l	
F = 95%tile RECEIVING river flow (m3/s)	F	0.500	m3/s	
C = Baseline concentration in UPSTREAM receiving water (mg/l)	C	0.68	mg/l	HYDRO-G COMMENT = not specified in Regulations: Good Quality resultant concentration
f = Effluent flow discharging to receiving waters (m3/s)	f	0.1157	m3/s	
c = PROPOSED ELV concentration in discharge (mg/l)	c	5.00	mg/l	

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Table A1 (3 of 3) Surface Water Assimilation Capacity Simulation Results (continued)

McGraths Cong 2019 Proposed ELV Q = 10,000 m3/d Discharge

	Electrical Conductivity				**Electrical Conductivity**
T = (FC+fc)/(F+f)					HYDRO-G COMMENT = not specified in Regulations: Good Quality resultant concentration
T = RESULTANT concentration in the receiving water (mg/l)	**T**	**203**	**uS/cm**		
F = 95%tile RECEIVING river flow (m3/s)	F	0.500	m3/s		
C = Baseline concentration in UPSTREAM receiving water (mg/l)	C	238	uS/cm		
f = Effluent flow discharging to receiving waters (m3/s)	f	0.1157	m3/s		
c = PROPOSED ELV concentration in discharge (mg/l)	c	50.00	mg/l		

	pH				**pH**
T = (FC+fc)/(F+f)					HYDRO-G COMMENT = not specified in Regulations: Proposed pH range 6 - 9 pH. Simulation presented for 8 average to demonstrate no change resultant because discharge flowrate is a small fraction of 95%tile flow in receiving water Cong Canal.
T = RESULTANT concentration in the receiving water (mg/l)	**T**	**8.00**	**mg/l**		
F = 95%tile RECEIVING river flow (m3/s)	F	0.50	m3/s		
C = Baseline concentration in UPSTREAM receiving water (mg/l)	C	8.00	mg/l		
f = Effluent flow discharging to receiving waters (m3/s)	f	0.1157	m3/s		
c = PROPOSED ELV concentration in discharge 6 - 9 pH(mg/l)	c	8.00	mg/l		

Table 14 Surface Water Regulation (2009) defensible discharge Licence Emission Limit Values 2019 Review McGraths Cong.

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	McGrath Limestone Works Ltd., Cong. Discharge Licence Conditions 2007 Licence (W391/05)	Site Initiated Review 2019 Requested ELVs	Upstream Cong Canal Receiving Water AVERAGE WQ Result 2018 - 2019	95%tile Downstream Resultant Concentration in the Cong Canal [Assimilation Capacity Simulation Result]	Surface Water Regulation (2009) EQS's	Current Monitoring Requirments specified in W391/05 [Site Proposes to Retain as is]
Flow	not exceed 864m3/d and not exceed 432m3/12 hrs and not exceed 36 m3/hr.	not exceed 10,000 m3/d and not exceed 5,000m3/12 hrs and not exceed1 416m3/hr				
ELVs	Concentrations (mg/l)	Concentrations (mg/l)	Concentrations (mg/l)	Concentrations (mg/l)	Concentrations (mg/l)	W391/05 Monitoring Record Stipulations
Suspended Solids	35	20	<2	5.4	not specified	Monthly in house, Quarterly by Accredited Laboratory
Nitrate as NO3	50	10	1.82	3	not specified	Quarterly by Accredited Laboratory
MRP-P	not specified	0.03	<0.01	0.01	0.045 mg/l MRP-P High Status 95%tile	Quarterly by Accredited Laboratory
Ammonia	not specified	0.1	0.02	0.04	0.09 mg/l Ammonia as N High Status 95%tile	Quarterly by Accredited Laboratory
Total Hydrocarbons	1	0.5	0.01	0.1	not specified	Bi-Annually by Accredited Laboratory
COD	100	20	16	17	not specified	Quarterly by Accredited Laboratory
BOD	25	5	<1	1.3	2.2 mg/l BOD High Status 95%tile	Quarterly by Accredited Laboratory
Temperature	<20 ^{o}C	<20 oC	<20 oC	<20 oC	<20oC	Monthly in house, Quarterly by Accredited Laboratory
pH	6 to 9 range	6 to 9 range	6 to 9 range	6 to 9 range	6 to 9 range	Daily automated, Continuous Record
Colour	no change	no change	no change	no change	not specified	Daily visual inspection, no sheen, no excess solids
Conductivity	not change significantly from day to day	not change significantly from day to day	238	203	not specified	Daily automated, Continuous Record
Turbidity	not change significantly from day to day	not change significantly from day to day	0.68	1	not specified	Daily automated, Continuous Record

Therefore, the receiving waters' response to the proposed discharge from the site is acceptable for 10,000m3/d max daily volume. It therefore logically follows that the current permitted 864m3/d is also defensible in the context of SSurface Water Regulation (2009) compliance. The site is therefore compliant. The hydrochemical response for ammonia-N, ortho-P or BOD meets the requirements of the European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009).

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As previously stated, the site has monitored water quality for the upstream, downstream and discharge quality on a monthly basis since 2014. The accredited laboratory certificates of analysis are presented in Appendix B for all water monitoring at the site 2014 - 2019.

In summary, the monthly monitoring results show that the Cong Canal's water quality DOWNSTREAM of the discharge retains the same excellent water quality as the upstream location.

As previously stated, Hydro-G initiated a more extensive monitoring programme parameter set in December 2018. The reason being to support this application for review. Results demonstrate that each of the parameters BOD, COD and SS usually recorded below the limit of Detection of the laboratory analyser. Results are presented in Table 15.

Results demonstrate the acceptability of the discharge as it occurs now – for the range zero to 8,000m3/d. Given that the lagoons have the treatment capacity to treat 10,866 m3/day, it is proposed that the requested 10,000 m3/d ELV for discharge volume is acceptable and justified.

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Table 15 Cong Canal Downstream Water Quality of Discharge from McGraths Quarry, Cong Canal December 2018 to April 2019.

Cong Canal Downstream of Discharge from McGraths Quarry								Surface Water Regulations (2009) ELVs	Hydro-G Comment regarding Regulatory Compliance
	Month	Dec-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19		
pH	pH Units	8.1	8.1	8.1	8.2	8.2	8.3	6 - 9 range	6 - 9 range pH units required = OK
Suspended Solids	mg/l	<2	8	<2	<2	2	<2	not specified	SW Regs do not specify Suspended Solids concentration limit value. Salmonid Regulations 1988 & Fish Life Directive 2006 specify 25mg/l SS and for that the SW is Compliant.
Turbidity	N.T.U.	0.5	0.4	0.4	0.5	0.5	0.5	not specified	Hydro-G Comment = very low NTU = Drinking Water Reg Quality
Conductivity @20C	uS/cm	232	238	246	235	232	233	not specified	not specified
BOD	mg/l	<1	<1	<1				1.3 mg/l High Status Mean	BOD concentration is < LOD of Analyser = Excellent Quality. Compliant with Salmonid Regulations 1988, Fish Life Directive 2006 & SW Regs 2009.
COD	mg/l	29	10	13				not specified	COD is not specified in any Regulations. COD is low. This signifies a good quality.
Chloride	mg/l	12.6	14.8	14.8	14.9	15.1	15.3	not specified	Hydro-G Comment = relatively low if Limestonne Aquifer value were to be considered but the 15mg/l range indicates rainwater Lough Mask discharge to the Cong Canal and rainfall effects rather than groundwater component feeding the Canal.
Potassium, total	mg/l	1	1	1	1	1	1	not specified	Low concentrations. SW Regs do not specifty. GW Regs specify Threshold Values that are more than ten times these these concentrations.
Sodium, total	mg/l	9	8	9	8	9	9	not specified	
Hardness, Total as CaCO3	mg/l	111	109	116				not specified	Hydro-G Comment = this is a relatively low hardness for Irish Limestone environment
Ammonia as NH3-N	mg/l	0.016	0.011	0.019	0.011	0.009	<0.006	0.09 mg/l Total Ammonia as N High Status 95%tile	Cong Canal Downstream is SW REGS 2009 HIGH STATUS. All results are Salmonid Regulation & Fish Life Directive Compliant.
Ammonium as NH4-N	mg/l	0.016	0.012	0.021	0.011	<0.01	<0.01		
Nitrate as NO3	mg/l	1.39	1.53	1.87	2.06	1.85	1.97	not specified	not specified in Surface Water Regulations. Concentrations are <2 mg/l NO3, on average, which is very low in the context of the Nitrates Directive 50 mg/l NO3 limit and the Groundwater Regulations 37.5 mg/l NO3 Threshold Value for the evaluation of Trend Reversal needs.
Nitrite as NO2	mg/l	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	not specified	Nitrite concentration is below the LOD of analyser.
PO4-P	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.025	Results for upstream, discharge & downstream are below the limit of detection of the analyser. All results are SW REGS 2009 HIGH STATUS MEAN Concentration ≤ 0.025 mg/l PO4-P COMPLIANT.
Sulphate	mg/l	<5	6.49	6.96				not specified	low wrt to GW Regs (2010) 187.5 mg/l Threshold Value
Copper, dissolved	ug/l	<1	<1	<1				not specified	below limit of detection of accredited laboratory analyser: deemed compliant
Zinc, total	ug/l	<5	<5	<5				not specified	
Extractable Hydrocarbons	ug/l	unknown signal = not detected					<0.01	not specified	"Unknown Pattern" = Laboratory confirms that "Unknown Pattern" means that any substance detected by = NOT Petroleum signal known to analyser's programme. Therefore = RESULT = NOT Hydrocarbons
CLS Lab No.		916889	919644	925541	936483	941884	950677		
CLS Report		377916	378772	380699	384309	385910	388317		
Receipt Date		06/12/18	14/12/18	21/01/19	07/03/19	28/03/19	01/05/19		

4.2 Groundwater Regulation Evaluation

In this regard, May 2019 additional sampling for bacteriological load demonstrated that there is no microbial load in the discharge and the 2014 – 2019 Groundwater Monitoring record presents Nitrate concentrations < 5mg/l NO3. This is baseline nitrate and below the LOD of the analyser. The hydrochemical characteristic of the discharge presents a 'High Status' water. The 'status' of that underlying groundwater is 'Good'. Therefore, when a higher quality discharge hits a good status water, and the relative hydraulics is that one unit of groundwater is added to here is no potential for impact to the groundwater system.

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Groundwater Assimilation capacity when there is discharge to the surface dry canal – the canal loses groundwater all the time in this hydrometric scenario. The amount of groundwater flowing in the system, for the purposes of assigning a groundwater volume flow component for the assimilation capacity model simulations, is the difference between the 95%tile value for Carrownagower and Cong Weir in the last line of Table 5. The groundwater flow volume is therefore 770,515 m3/d for the usual summer condition groundwater assimilation capacity simulation. The maximum flow volume discharged after a summer storm in August 2018 was 3,000 m3/d (Figure 2). This is employed for the groundwater assimilation capacity simulation. The relativity is that there is one unit of 'High Status' water quality discharge from the quarry to 256 units of 'Good Status' groundwater flowing under the Cong Canal through to the Cong Weir system and on to Lough Corrib. The quality of the water from the quarry is better quality than the groundwater it is joining. Therefore, no impact is possible.

Groundwater Assimilation Capacity simulation model results are presented in Table 16.

Table 16 Groundwater Assimilation Capacity simulation

Resultant Groundwater Concentrations: Cong Groundwater		Mc Graths Quarry Discharge = Groundwater Regulation (2010) Compliant							
EPA (2011) Part 2: Cgw = [(Cin x Qin) + (Cgwu x Qgw)] / (Qin + Qgw) where Cgw = resulting concentration in groundwater Cin = concentration in the infiltrating water Qin = volumetric rate of infiltrating water Cgwu = concentration in the aquifer from upgradient areas Qgw = groundwater flow rate through the aquifer						Max Summer Storm discharge from site to dry Cong Canal Hydraulic Loading 3000m3/d discharge to 770,515 m3/d GW flow			
Cong Mc Graths 3,000 m3/d summer max discharge to GW system with known 770,515 m3/d GW flow component		BOD	SS	Temp	pH	Total Ammonia	Total Nitrogen	Nitrate	Ortho-P as P
	units	mg/l	mg/l	oC	-	mg/l N	mg/l N	mg/l NO3	mg/l P
Discharge Characteristic (Table 4 Hydro G DL Report		1	2	10	8.1	0.02	5	4.27	0.01
Concentration at Delivery to GW (Cin mg/l)		1	2	10	8.1	0.02	5	4.27	0.01
Influents	Q (m3/d)	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
	Qin (l/d)	3,000,002	3,000,002	3,000,002	3,000,002	3,000,002	3,000,002	3,000,002	3,000,002
	Discharge Zone Area (m2) Cong Canal point o entry	1	1	1	1	1	1	1	1
	boundary length (m)	1	1	1	1	1	1	1	1
	Q GW (l/d)	770,515	770,515	770,515	770,515	770,515	770,515	770,515	770,515
Groundwater Baseline Quality		1	2	8	7.5	0.01	5	5	0.010
Simulation Constituents	(mg/d)	3000002	6000004	30000021	24300017	60000	15000010	12810009	30000
	(mg/d)	770515	1541030	6164120	5778863	7705	3852575	3852575	7705
	(l/d)	3770517	3770517	3770517	3770517	3770517	3770517	3770517	3770517
Simulation Output= Calculated Resultant Groundwater Concentration	Resultant Cgw (mg/l)	1.0	2.0	9.6	8.0	0.02	5.00	4.42	0.010
OVERALL COMMENT		NO SIGNIFICANT CHANGE IN ANY PARAMETER'S GROUNDWATER CONCENTRATION							
Groundwater Regulations 2010	GW Regs 2010 Threshold Value (TV)					0.175	not specified	37.50	0.035
	Trend Reversal Point Value of GW Regs 2010 (ie. 75% of TV)					0.131	not specified	28.125	0.026
OVERALL COMMENT		GW Regulation (2010) COMPLIANT							
Evaluation	% of GW Regs TV Allocation used at Site					10	not specified	12	29
GW Regs 2010 Parameter						Total Ammonia	Total Nitrogen	Nitrate	Ortho - P
		complies with Groundwater Regulations (2010)							

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The discharge is Groundwater Regulation Compliant. There is no significant increase in any GW Regulation (2010) parameter.

4.3 Fish Life Evaluation

Assimilation capacity simulation of resultant ammonia concentrations suggest that resultant ammonium concentrations are acceptable for the 2019 requested Conditions.

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Ammonium is a relevant parameter because:

- Of its indirect toxicity, hence possibly affecting aquatic organisms, including fish. Being a nitrogen compound, possibly adding as a nutrient to risks of eutrophication.
- While orthophosphate is typically the limiting nutrient in the eutrophication equation, nitrogen is also a nutrient of some importance.

Simulated resultant concentrations for Ammonium-N suggest compliance with the mandatory concentrations of the Fish Life Directive (2006) for salmonid and cyprinid waters. Similarly, the simulated resultant concentrations for BOD, Suspended Solids and pH comply with the requirements of the Fish Life Directive (2006) for salmonid and cyprinid waters. Assimilation capacity simulations suggest that the discharge is feasible and complies with the hydrochemical standards set out in the Salmonid Regulations 1988.

4.4 Appropriate Assessment

Article 42 of Part 5 of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477/2011) requires that a screening for Appropriate Assessment… "shall be carried out by the public authority to assess, in view of best scientific knowledge and in view of the conservation objectives of the European site, if that plan or project, individually or in combination with other plans or projects is likely to have a significant effect on the European site" BEFORE consent is given and that a public authority may direct the applicant to furnish additional information necessary for the purposes of the Regulation.

In the requirements of Article 42 (2) of the European Communities (Birds And Natural Habitats) Regulations (2011) I have completed a screening. In order to inform an Appropriate Assessment, information of use includes as follows:

1. Adopting the Source > Pathway > Receptor Risk Assessment Methodology:

    a. Source = Discharge an existing business quarry for >14 years. The hydraulic loading presents a value of <8,000m3/d but the data has ranged from 25m3/d to 8,000m3/d, approximately. However, extreme values in the record can be related to high rainfall events or gaps in the record associated with weekends and bank holidays. I am suggesting that a 10,000m3/d ELV is feasible from a Surface Water Regulation (2009) compliance perspective and is administratively robust for the future.

    b. Pathway = The Cong Canal is the Pathway to Lough Corrib SAC.

    c. Target = Lough Corrib SAC. I have considered the Special Conservation Interests range of birds, which are listed in S.I. No. 212 of 2010, and wetland habitats that support them.

The overall assessment conclusion is that the discharge does not have the potential to impact downstream SACs, SPAs or any other site, such as Galway Bay Complex or any other European site.

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5.0 Mitigation Measures

Mitigation measures are already in place in terms of the existing management systems that are adhered to in the site's ISO/NSAI and other quality systems. The existing concrete tank settlement lagoon systems do now appropriately control quality of discharge even in the maximum storm throughput of 8,000m3/d, approximately. Laboratory analysis for the discharge and Cong Canal substantiate the system's efficacy. The results demonstrate a high-quality discharge and resultant low concentrations for SS and BOD and turbidity in the downstream surface water. The receiving water downstream of the discharge, in the Cong Canal, complies with the High Status EQS's of the Surface Water Regulations (2009) and Groundwater Regulation (2010).

6.0 Cumulative Impacts

Neither overall groundwater quality nor surface water quality have been impacted by the cumulative effect of the entire quarry area and so it is inferred that the area has not created any potential for impact. This is substantiated by the EPA water quality datasets for Lough Mask, Cong Canal, Cong River and Lough Corrib. Hydro-G have reviewed water quality data from 2002 – 2015. Inland Fisheries downstream data for the hatchery at Cong, and their sampling record surface waters in the environs of the quarry itself (Box File of historical paper record data retained at Hydro-G), in combination with McGrath's own on-site monitoring record for water quality correlate with the EPA's quality record.

The 'in-combination' effect is also determined to be non-existent. All water quality datasets supplied for the surface waters are indicative of a high-quality water not impacted by the quarry or Inland Fisheries hatchery at Cong.

Evaluation of the OPW supplied dataset for hydrometrics, presenting water level stage levels in the lakes and the linking Cong Canal and Cong River hydrometric stations, suggest no evidence of McGrath's quarry causing deleterious impact on quantities of water discharged from Lough Mask to Lough Corrib. As detailed in Hydro-G's May 2015 Report, flood is not an issue either.

7.0 Discussion

On the basis of my calculations, assimilation capacity simulations suggest that the discharge volume can be increased to 10,000 m3/d and still the river will conform to the HIGH Status EQS characteristics of the Surface Water Regulations. Assimilation capacity simulations suggest that the proposed ELVs for 2019 review are acceptable (Table 12) in the context of the Surface Water Regulations (2009) and the Groundwater Regulations 2010. The discharge is also acceptable in the context of the Habitats Birds Regulations.

Galway County Council requested commentary on assimilation capacity at stations further down on the Cong River and into Lough Corrib. The fact that assimilation capacity simulations demonstrate Regulatory compliance at the immediate point of downstream of the quarry and in the groundwater system simulation, it follows that there can be no resultant increase further downstream at the Cong Weir or Lough Corrib. parameter at the point of assimilation capacity simulation.

The site's results for Suspended Solids are so low (<2mg/l SS) that they are below the Limit of Detection of the accredited laboratory analyser. The same is true for BOD and other parameters. The site has been discharging for almost >14 years and the entire surface water system and groundwater system is GOOD Status (https://gis.epa.ie/EPAMaps/).

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8.0 Overall Conclusions

I have independently assessed and simulated the Cong Canal's response to assimilating 10,000m3/d maximum ELV Volume and assess as follows:

- Surface Water Regulation (2009) compliant for ortho-P;
- Surface Water Regulation (2009) compliant for BOD;
- Surface Water Regulation (2009) compliant for Ammonia-N.
- Groundwater Regulation (2010) compliant.

Overall, a 10,000m3/d ELV volume can be licensed and is acceptable for the receiving water environment. I make this assessment in the context of the requirements of the European Communities Environmental Objectives (Surface Water Regulations) Regulations, 2009 (S.I. No. 272 of 2009), the requirements of the European Communities (Quality of Salmonid Waters) Regulations, 1988 (S.I. 293/1988), the requirements of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477/2011).

I conclude that on the proposed ELV MAX of 10,000 m3/d individually, or in combination with other plans or projects is not likely to have a significant effect on any European Sites.

It is considered that the proposed discharge can comply with the requirements of the European Communities Environmental Objectives (Surface Water Regulations) Regulations, 2009 (S.I. No. 272 of 2009), the requirements of the European Communities (Quality of Salmonid Waters) Regulations, 1988 (S.I. 293/1988), the requirements of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477/2011) and the requirements of the European Communities Environmental Objectives (Groundwater) Regulations 2010 (S.I. No. 9/2010).

As presented earlier in this report, assimilation capacity simulations support the proposed 2019 ELVs.

The ELVs now proposed suggest that a license volume of 10,000 m3/d is defensible and permissible for ELV's as previously presented in Table 14 and reproduced here. Given that the site requests that the max daily discharge volume ELV is increased from 864 m3/d to 10,000 m3/d, it logically follows that the ELVs for hydrochemical concentration sin that discharge will reduce. The requested, defensible, regulatory compliant ELVs are as follows.

- 20 mg/l Suspended Solids;
- 10 mg/l NO3
- 0.03 mg/l MRP-P

- 0.1 mg/l Ammonia
- 0.5 mg/l Total Hydrocarbons
- 20 mg/l COD
- 5 mg/l BOD
- <20oC temperature
- 6 to 9 pH range
- Colour = no change.
- 10,000 m3/d maximum discharge volume.

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For the purpose of comparison, Table 17 presents existing (2018) and proposed (2019) ELVS.

Table 17 Comparing existing (2018) and proposed (2019) ELVS.

	McGrath Limestone Works Ltd., Cong. Discharge Licence Conditions 2007 Licence (W391/05)	Site Initiated Review 2019 Requested ELVs
Flow	not exceed 864m3/d and not exceed 432m3/12 hrs and not exceed 36 m3/hr.	not exceed 10,000 m3/d and not exceed 5,000m3/12 hrs and not exceed1 416m3/hr
ELVs	Concentrations (mg/l)	Concentrations (mg/l)
Suspended Solids	35	20
Nitrate as NO3	50	10
MRP-P	not specified	0.03
Ammonia	not specified	0.1
Total Hydrocarbons	1	0.5
COD	100	20
BOD	25	5
Temperature	<20°C	<20 oC
pH	6 to 9 range	6 to 9 range
Colour	no change	no change
Conductivity	not change significantly from day to day	not change significantly from day to day
Turbidity	not change significantly from day to day	not change significantly from day to day

Readers are referred to Table 4's presentation of the actual discharge quality, which is equivalent to High Status classification surface water, to confirm that the proposed 2019 ELVs are already achieved by the lagoon systems on site at present.

Pamela Bartley

Signed: _____ Date: ___11th June 2019 _

Dr. Pamela Bartley BEng, MSc, PhD

REFERENCES & Bibliography

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Drew D.P. and Daly D. (1993) Groundwater and Karstification in Mid-Galway, South Mayo and North Clare. A joint Report: Department of Geography, Trinity College Dublin and Groundwater Section, Geological Survey of Ireland. Geological Survey of Ireland Report Series 93/3 (Groundwater), 86 pp

Directive 2006/44/EC of the European Parliament and of the Council of 6 September 2006 on the quality of freshwaters needing protection or improvement in order to support fish life.

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LASNTG (2011) 'Guidance, Procedures and Training on the Licensing of Discharges to Surface Waters and to Sewer for Local Authorities'. Water Services Training Group.

NPWS (2011) Conservation objectives

www.wfdireland.ie. Historic Status Reports

S.I. No. 272/2009 - European Communities Environmental Objectives (Surface Waters) Regulations 2009.

S.I. No. 9/2010 - European Communities Environmental Objectives (Groundwater) Regulations 2010.

S.I. No. 477/2011 - European Communities (Birds and Natural Habitats) Regulations 2011.

S.I. No. 366 of 2016 - EUROPEAN UNION ENVIRONMENTAL OBJECTIVES (GROUNDWATER) (AMENDMENT) REGULATIONS 2016

S.I. No. 605 of 2017. EUROPEAN UNION (GOOD AGRICULTURAL PRACTICE FOR PROTECTION OF WATERS) REGULATIONS 2017. S.I. No. 605 of 2017.

Appendix A

Discharge Licence W391/05

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Do Thag:

Do Thag.

COMHAIRLE CHONTAE NA GAILLIMHE
GALWAY COUNTY COUNCIL

Telephone: (091) 509000
Fax: (091) 509010
E-Mail: @galwaycoco.ie
Web: www.gaillimh.ie
www.galway.ie

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Iasachtaí/Deontais Tithíochta
(091) 509 301
Housing Loans/Grants

Iarratais Tithíochta
(091) 509 300
Housing Applications

Comhshaoil
(091) 509 302
Environment

Acmhainní Daonna
(091) 509 303
Personnel

Mótarcháin
(091) 509 099
Motor Taxation

Ceadúnais Tiomána
(091) 509 305
Driving Licences

Seirbhísí Uisce
091) 509 306
Water Services

Pobal & Fiontar
(091) 509 066
Community & Ent.

Pleanáil
(091) 509 308
Planning

Innealtóireacht
(091) 509 309
Engineering

15th February 2007

McGrath Limestone Works Ltd.,
c/o Earth Science Partnership Ltd.,
James Street,
Westport,
Co. Mayo.

Reference number: Discharge Licence Application W/391/05

A Chara,

I hereby give you notice that Galway County Council has, by order dated 14th February 2007, decided to **grant** a Discharge Licence to the above named, for the discharge of effluent emanating from Settlement Lagoons through a percolation area located at **Cregaree Quarries, Cregaree, Cong, Co. Galway.**

The Applicant or any other person may appeal a decision to An Bord Pleanála within one month of the date of the grant or refusal of a licence. Any appeal to An Bord Pleanála must be accompanied by the appropriate fee.

Mise le meas

Ann Dolan
A/Senior Executive Technician
Environment Section

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COMHAIRLE CONTAE NA GAILLIMHE

LOCAL GOVERNMENT (WATER POLLUTION) ACT, 1977 & 1990

LICENCE TO DISCHARGE TRADE OF SEWAGE EFFLUENT TO WATERS

McGrath Limestone Works Ltd.,
C/O Earth Science Partnership Ltd.,
James Street,
Westport,
Co.Mayo.

Reference No. in Register
W/391/05

Galway County Council in exercise of the powders conferred on it by the Local Government (Water Pollution) Act 1977 as amended by the Local Government (Water Pollution) Act 1990, hereby grants a licence, Reference number **W/391/05** to discharge trade effluent from settlement lagoons (*i.e. trade effluent from quarry operations and surface water runoff from the quarry area*) at **McGrath Limestone Works Ltd.** located at **Cregaree Quarries, Cregaree, Cong. Co. Galway** to Cong Canal via percolation subject to the conditions set out in the Schedule hereto.

Signed this 14th **day of** Feb **2007**

On behalf of Galway County Council.

COUNTY SECERTARY

IMPORTANT NOTICE

Any person may, **before the expiration of the prescribed period, appeal to An Bord Pleanala** against the grant or refusal of a licence, the conditions attached to a licence or the amendment or deletion of conditions or the attachment of new conditions following review of a licence. (See Section 8 Local Government (Water Pollution) Act, 1977).

The prescribed period as per Article 26 of the Local Government (Water Pollution) Regulations 1978 and 1992 is the period of one month beginning on the date of the grant or refusal of the licence or in the case of a decision of the Local Authority following on a review of a licence the date of that decision. (The relevant date is as shown above).

An appeal must be made in writing, stating the subject matter of the appeal and the grounds of appeal and must be accompanied by a deposit of €126. The address of An Bord Pleanala is 64 Marlborough Street, Dublin 1.

An Bord Pleanala, after consideration of any appeal lodged with it, may direct the Local Authority to grant or revoke a licence or to amend or attach conditions relating to it.

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SCHEDULE TO LICENCE NO. W/391/05

1. Scope

This licence refers to the lagoon discharge of McGraths Limestone Works Ltd. located Cregaree Quarries, Cregaree, Cong. Co. Galway. Surface water runoff and ground water ingested on site are pumped from the sump to the settlement lagoon and discharged to Cong Canal.

2. Lagoon Discharge

2.1. Discharge

The Licensee shall not discharge, cause or permit the discharge of any contaminated surface water or process water directly to any surface water or groundwater without prior treatment.

2.2. Treated Discharge

The treated discharge shall be discharged to Cong Canal without posing a pollution risk to surface or ground waters.

2.3. Discharge Performance Standards

The treated discharge, **prior to its release** to Cong Canal, shall comply with the following standards:

(a) The **Suspended Solids** concentration of the discharge from the secondary settlement lagoon and oil interceptor shall not exceed 35mg/litre,

(b) The **Nitrate** NO_3^- concentration of the discharge from the secondary settlement lagoon and oil interceptor shall not exceed 50mg/l

(c) The **Total Hydrocarbon** concentration of the discharge from the secondary settlement lagoon and oil interceptor shall not exceed 1 mg/l.

(d) The **Chemical Oxygen Demand** concentration of the discharge from the secondary settlement lagoon and oil interceptor shall not exceed 100mg/l

(e) The **Biochemical Oxygen Demand** concentration of the discharge from the secondary settlement lagoon and oil interceptor shall not exceed 25mg/l

(f) The **Temperature** of the discharge from the secondary settlement lagoon and oil interceptor shall not exceed 20°C

(g) The **pH** of the discharge from the secondary settlement lagoon and oil interceptor shall not exceed the range of 6-9 pH units.

(h) The **Flow** of the discharge from the settlement lagoon and oil interceptor shall not exceed a volume of $432m^3$/12 hours and $36m^3$/hr

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(i) The **Colour** of the discharge from the secondary settlement lagoon should not change significantly from day to day nor should there be any evidence of oil and excess solids on visual inspection

(j) The **Conductivity** of the discharge from the secondary settlement lagoon and oil interceptor should not change significantly from day to day

(k) The **Turbidity** of the discharge from the secondary settlement lagoon and oil interceptor shall not change significantly from day to day

3. Discharge Analysis

Analysis of the treated water prior to its discharge shall be carried out by an approved accredited laboratory where readings are not taken on site. The frequency of analysis and the parameters are outlined below. Results of the same shall be forwarded to the Environment Section of Galway County Council on a quarterly basis:

Parameter	Monitoring frequency	Analysis to be performed by accredited laboratory
Flow	Continuous - Daily	
Colour and visual inspection	Daily	
Conductivity	Continuous - Daily	
Turbidity	Continuous - Daily	
pH	Continuous - Daily	
	Quarterly	√
Temperature	Monthly	
	Quarterly	√
Total Suspended Solids	Monthly	
	Quarterly	√
Nitrates NO_3^-	Quarterly	√
Chemical Oxygen Demand	Quarterly	√
Biochemical Oxygen Demand	Quarterly	√
Total Hydrocarbons including Diesel range organics and petroleum range organics	Bi annually	√

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4. Groundwater Analysis

Monthly analysis of the existing groundwater monitoring wells shall be carried out by an approved accredited laboratory. Results of the same shall be forwarded to the Environment Section of Galway County Council on a quarterly basis:

Analysis shall be carried out on the following parameters; water level, pH, conductivity, nitrates and suspended solids.

5. Treatment Lagoon

5.1. Treatment process

All surface water runoff and quarry effluent shall be treated in the settlement lagoon prior to discharge. The settlement lagoons shall be capable of fulfilling the requirements of this licence as outlined in condition No. 2 above. Failing this it will be necessary for the licensee to make the necessary changes to the system. The Environment Section of Galway County Council must be notified of any proposed alternations to the treatment process.

The volume of water in the settlement lagoon shall normally be maintained at a volume not in excess of 65% of the capacity of the lagoon.

During wet periods surface run off must be stored in the base of the quarry and discharged over longer periods of time at a rate not exceeding $36m^3$/hour.

5.2. Metering

An approved flow meter shall be fitted to the discharge pipe to allow for the measuring and recording of the daily volume discharged. These records shall be maintained and be available on request to Galway County Council staff. The maximum volume of water discharged from the settlement lagoon via the oil baffle weirs is $36m^3$ per hour.

5.3. Ready access

Access to the settlement lagoons and all its installations, shall be allowed to authorised persons appointed under the provisions of the Local Government (Water Pollution) Acts, 1977 and 1990.

5.4. Sampling

A composite sampler shall be installed at the end of treatment to allow for the taking of samples of the treated discharge in a safe manner. Ready access to the sampling chamber must be provided at all times.

5.5. Caretaker

The day to day inspection and maintenance of the settlement lagoon shall be the responsibility of the Licensee. The caretaker shall ensure that all pumps and meters are operating correctly and are part of the maintenance programme. Records of all servicing shall be maintained and be available on request to Galway County Council staff. A copy

of this licence shall be issued to all relevant personnel whose duties relate to any condition of the licence. The name and address of this appointed person shall be supplied to the Environment Section of Galway County Council with 4 week from the issuing of this licence. In the event of any change in personnel this change shall be made known immediately.

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5.6. Notification of Non Compliance

The Environment Section of Galway County Council must be notified as soon as practicable after the occurrence of any of the following:

- Any discharge that does not comply with the requirements of the licence
- Any incident with potential for environmental contamination of surface water of groundwater

The licensee shall include as part of the notification, date and time of the incident, details of the occurrence and the steps taken to minimize the emissions and avoid recurrence.

The licensee shall notify the Environment Section of Galway County Council prior to further processing that may impact the effective working of the treatment system.

6. EPA Guidelines

All works must be carried out in accordance to the EPA guidelines 'Environmental Management in Extractive Industry (Non-Scheduled Minerals)'.

7. Annual Contribution

The Licence holder shall pay to Galway County Council an annual contribution of €550. The contribution will be used towards the cost of such monitoring of the activity, as the Council considers necessary for ht e performance of its duties under the Water Pollution Act 1977-1990.

This amount to be paid shall be adjusted annually in accordance with the Consumer Price Index value appertaining at the time when the payment becomes due. Galway County Council reserves the right to alter the rate of contribution each year in order to take account of the actual cost of monitoring incurred by it in the previous year and estimated for the next year.

8. Changes in ownership

The Environment Section of Galway County Council must be notified in writing of any change to company ownership and/or trading name.

END.

Appendix B

Water Quality Results

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B.1 Additional Analysis = Bacteria Sampling Discharge Quality (As Requested by Dr. Matt Craig EPA). ZERO COUNTS = < LOD of Analyser: Lab op procedure to analyses diluted sample is the reason the LOD is reported in that scale. Confirmed in conversation with the laboratory that it is <LOD result = considered zero but cannot be reported that way because of dilution.

B2. Certificates of Analysis December 2018 – May 2019 (Hydro-G extended parameter List to demonstrate Surface Water Regulation 2009 Compliance).

B3. Site's historical Certificates of Analysis (Compliance Monitoring, therefore, parameter list is as per Discharge Licence W391/05.

Complete Laboratory Solutions
[Tel] 091 574355
[Fax] 091 574356
[Email] services@cls.ie
[web] www.cls.ie

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CERTIFICATE OF ANALYSIS

Client : Dr. Pamela Bartley
HYDRO-G
50 Henry Street
Galway
Galway

Report No. : 390367
Date of Receipt : 29/05/2019
Start Date of Analysis : 29/05/2019
Date of Report : 04/06/2019
Order Number : 10708
Sample taken by : Client

Lab No	Sample Description	Test	Ref.	Result	Units
958351	McGraths Limestone Cong Discharge 28.05.2019	Clostridium Perfringens in Water	I, R	< 10 result obtained from a 1 in 10 dilution	cfu/100ml
		E coli (Filtration) (Environmental Waters)	I, R	<1000 result obtained from a 1 in 1000 dilution	cfu/100ml
		Total Coliforms (Filtration) (Environmental Waters)	I, R	<1000 result obtained from a 1 in 1000 dilution	cfu/100ml
		Enterococci (Waters- Incubated at 37°C and 44 °C)	I, R	<10 result obtained from a 1 in 10 dilution	cfu/100ml

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 108T

Approved by: Stephanie Folan

Stephanie Folan
Account Manager

See below for test specifications and accreditation status.
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0cfu is reported in waters, this refers to 'not detected in volume tested'
It is recommended that water samples requiring microbiological analysis should be tested within 24 hours of sampling.

Complete Laboratory Solutions,
Ros Muc, Connemara,
Co. Galway

Complete Laboratory Solutions,
MedPharma Division,
Unit 3a, Small Business Park, Mervue, Galway

Symbol Reference - I:17025 accredited; S:Subcontracted; R:Analysis carried out in Ros Muc; M:Analysis carried out in MedPharma

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In-House Test	Specification	17025	GMP/FDA*	ISO**
Clostridium Perfringens in Water	CLS 43	Yes	No	Yes
E coli (Filtration) (Environmental Waters)	CLS 16	Yes	No	Yes
Total Coliforms (Filtration) (Environmental Waters)	CLS 16	Yes	No	Yes
Enterococci (Waters- Incubated at 37°C and 44 °C)	CLS 42	Yes	No	Yes

*Analysis carried out in a GMP approved, FDA inspected facility (MedPharma site only).
**Laboratory Analysis, Sampling, Food Safety Monitoring and Analysts on Contract are all ISO 9001 certified.

Lab No	Sample ID	Sample Condition on Receipt	Sampling Date
958351	McGraths Limestone Cong Discharge 28.05.2019	Good condition	28/05/2019

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CERTIFICATE OF ANALYSIS

Client : Dr. Pamela Bartley
HYDRO-G
50 Henry Street
Galway
Galway

Report No. : 390368
Date of Receipt : 29/05/2019
Start Date of Analysis : 29/05/2019
Date of Report : 04/06/2019
Order Number : 10708
Sample taken by : Client

Lab No	Sample Description	Test	Ref.	Result	Units
958352	McGraths Limestone Cong Discharge 29.05.2019	Clostridium Perfringens in Water	I, R	< 10 result obtained from a 1 in 10 dilution	cfu/100ml
		E coli (Filtration) (Environmental Waters)	I, R	<1000 result obtained from a 1 in 1000 dilution	cfu/100ml
		Total Coliforms (Filtration) (Environmental Waters)	I, R	<1000 result obtained from a 1 in 1000 dilution	cfu/100ml
		Enterococci (Waters- Incubated at 37°C and 44 °C)	I, R	<10 result obtained from a 1 in 10 dilution	cfu/100ml

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 108T

Approved by: Stephanie Folan

Stephanie Folan
Account Manager

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0cfu is reported in waters, this refers to 'not detected in volume tested'
It is recommended that water samples requiring microbiological analysis should be tested within 24 hours of sampling.

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MedPharma Division,
Unit 3a, Small Business Park, Mervue, Galway

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In-House Test	Specification	17025	GMP/FDA*	ISO**
Clostridium Perfringens in Water	CLS 43	Yes	No	Yes
E coli (Filtration) (Environmental Waters)	CLS 16	Yes	No	Yes
Total Coliforms (Filtration) (Environmental Waters)	CLS 16	Yes	No	Yes
Enterococci (Waters- Incubated at 37°C and 44 °C)	CLS 42	Yes	No	Yes

*Analysis carried out in a GMP approved, FDA inspected facility (MedPharma site only).
**Laboratory Analysis, Sampling, Food Safety Monitoring and Analysts on Contract are all ISO 9001 certified.

Lab No	Sample ID	Sample Condition on Receipt	Sampling Date
958352	McGraths Limestone Cong Discharge 29.05.2019	Good condition	29/05/2019

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MedPharma Division,
Unit 3a, Small Business Park, Mervue, Galway

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CERTIFICATE OF ANALYSIS

Client : Dr. Pamela Bartley
HYDRO-G
50 Henry Street
Galway
Galway

Report No. : 377913
Date of Receipt : 06/12/2018
Start Date of Analysis : 06/12/2018
Date of Report : 19/12/2018
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	Ref.	Result	Units
916860	Floor Sump Cong	Suspended Solids	I, R	<2	mg/l
		Turbidity	I, R	1.0	N.T.U.
		pH	I, R	7.9	pH Units
		Sodium, total	I, R	10	mg/l
		Chloride	I, R	14.3	mg/l
		Ammonium as NH4	I, R	0.012	mg/l
		Nitrate as NO3	I, R	5.04	mg/l
		Nitrite as NO2	I, R	<0.017	mg/l
		Potassium, total	I, R	4	mg/l
		Magnesium, total	I, R	5	mg/l
		Sulphate	I, R	26.5	mg/l
		Ammonia as NH3	I, R	0.011	mg/l
		Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	I, R	<0.01	mg/l
		Hardness, Total as CaCO3	S,	141	mg/l

ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.108T

Approved by: Barbara Lee

Barbara Lee
Environmental Scientist

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[web] www.cls.ie

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In-House Test	Specification	17025	GMP/FDA*	ISO**
Suspended Solids	CLS 13	Yes	No	Yes
Turbidity	CLS 30	Yes	No	Yes
pH	CLS 26	Yes	No	Yes
Sodium, total	ICP-MS CLS129	Yes	No	Yes
Chloride	Konelab CLS 36	Yes	No	Yes
Ammonium as NH4	Konelab CLS 40	Yes	No	Yes
Nitrate as NO3	Konelab CLS 39	Yes	No	Yes
Nitrite as NO2	Konelab CLS 37	Yes	No	Yes
Potassium, total	ICP-MS CLS129	Yes	No	Yes
Magnesium, total	ICP-MS CLS129	Yes	No	Yes
Sulphate	Konelab CLS 88	Yes	No	Yes
Ammonia as NH3	Konelab CLS 40	Yes	No	Yes
Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	Konelab CLS 35	Yes	No	Yes

*Analysis carried out in a GMP approved, FDA inspected facility (MedPharma site only).
**Laboratory Analysis, Sampling, Food Safety Monitoring and Analysts on Contract are all ISO 9001 certified.

Lab No	Sample ID	Sample Condition on Receipt	Sampling Date
916860	Floor Sump Cong	Good condition	05/12/2018

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CERTIFICATE OF ANALYSIS

Client : Dr. Pamela Bartley
HYDRO-G
50 Henry Street
Galway
Galway

Report No. : 377914
Date of Receipt : 06/12/2018
Start Date of Analysis : 06/12/2018
Date of Report : 20/12/2018
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	Ref.	Result	Units
916871	Cong Canal Upstream	BOD	I, R	<1	mg/l
		Suspended Solids	I, R	<2	mg/l
		COD	I, R	31	mg/l
		Turbidity	I, R	0.4	N.T.U.
		pH	I, R	8.0	pH Units
		Sodium, total	I, R	8	mg/l
		Chloride	I, R	13.8	mg/l
		Ammonium as NH4	I, R	0.01	mg/l
		Nitrate as NO3	I, R	1.53	mg/l
		Nitrite as NO2	I, R	<0.017	mg/l
		Potassium, total	I, R	1	mg/l
		Sulphate	I, R	<5	mg/l
		Zinc, total	I, R	<5	ug/l
		Ammonia as NH3	I, R	0.010	mg/l
		Copper, dissolved	I, R	<1	ug/l
		Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	I, R	191 **Unknown Pattern	ug/l
		Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	I, R	<0.01	mg/l
		Hardness, Total as CaCO3	S,	112	mg/l

** Note: The comment expressed here is an interpretation and is not INAB accredited

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 108T

Approved by: Barbara Lee

Barbara Lee
Environmental Scientist

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Complete Laboratory Solutions,
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In-House Test	Specification	17025	GMP/FDA*	ISO**
BOD	CLS 12	Yes	No	Yes
Suspended Solids	CLS 13	Yes	No	Yes
COD	CLS 52	Yes	No	Yes
Turbidity	CLS 30	Yes	No	Yes
pH	CLS 26	Yes	No	Yes
Sodium, total	ICP-MS CLS129	Yes	No	Yes
Chloride	Konelab CLS 36	Yes	No	Yes
Ammonium as NH4	Konelab CLS 40	Yes	No	Yes
Nitrate as NO3	Konelab CLS 39	Yes	No	Yes
Nitrite as NO2	Konelab CLS 37	Yes	No	Yes
Potassium, total	ICP-MS CLS129	Yes	No	Yes
Sulphate	Konelab CLS 88	Yes	No	Yes
Zinc, total	ICP-MS CLS 129	Yes	No	Yes
Ammonia as NH3	Konelab CLS 40	Yes	No	Yes
Copper, dissolved	ICP-MS CLS 129	Yes	No	Yes
Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	CLS 147	Yes	No	Yes
Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	Konelab CLS 35	Yes	No	Yes

*Analysis carried out in a GMP approved, FDA inspected facility (MedPharma site only).
**Laboratory Analysis, Sampling, Food Safety Monitoring and Analysts on Contract are all ISO 9001 certified.

Lab No	Sample ID	Sample Condition on Receipt	Sampling Date
916871	Cong Canal Upstream	Good condition	05/12/2018

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CERTIFICATE OF ANALYSIS

Client : Dr. Pamela Bartley
HYDRO-G
50 Henry Street
Galway
Galway

Report No. : 377915
Date of Receipt : 06/12/2018
Start Date of Analysis : 06/12/2018
Date of Report : 20/12/2018
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	Ref.	Result	Units
916883	Cong Settlement Lagoon Outlet	BOD	I, R	<1	mg/l
		Suspended Solids	I, R	5	mg/l
		COD	I, R	22	mg/l
		Turbidity	I, R	1.6	N.T.U.
		pH	I, R	8.0	pH Units
		Sodium, total	I, R	10	mg/l
		Chloride	I, R	15.1	mg/l
		Ammonium as NH4	I, R	0.061	mg/l
		Nitrate as NO3	I, R	6.5	mg/l
		Nitrite as NO2	I, R	0.021	mg/l
		Potassium, total	I, R	4	mg/l
		Sulphate	I, R	33.8	mg/l
		Zinc, total	I, R	<5	ug/l
		Ammonia as NH3	I, R	0.057	mg/l
		Copper, dissolved	I, R	<1	ug/l
		Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	I, R	185 **Unknown Pattern	ug/l
		Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	I, R	<0.01	mg/l
		Hardness, Total as CaCO3	S,	147	mg/l

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Approved by: Barbara Lee

Barbara Lee
Environmental Scientist

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In-House Test	Specification	17025	GMP/FDA*	ISO**
BOD	CLS 12	Yes	No	Yes
Suspended Solids	CLS 13	Yes	No	Yes
COD	CLS 52	Yes	No	Yes
Turbidity	CLS 30	Yes	No	Yes
pH	CLS 26	Yes	No	Yes
Sodium, total	ICP-MS CLS129	Yes	No	Yes
Chloride	Konelab CLS 36	Yes	No	Yes
Ammonium as NH4	Konelab CLS 40	Yes	No	Yes
Nitrate as NO3	Konelab CLS 39	Yes	No	Yes
Nitrite as NO2	Konelab CLS 37	Yes	No	Yes
Potassium, total	ICP-MS CLS129	Yes	No	Yes
Sulphate	Konelab CLS 88	Yes	No	Yes
Zinc, total	ICP-MS CLS 129	Yes	No	Yes
Ammonia as NH3	Konelab CLS 40	Yes	No	Yes
Copper, dissolved	ICP-MS CLS 129	Yes	No	Yes
Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	CLS 147	Yes	No	Yes
Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	Konelab CLS 35	Yes	No	Yes

*Analysis carried out in a GMP approved, FDA inspected facility (MedPharma site only).
**Laboratory Analysis, Sampling, Food Safety Monitoring and Analysts on Contract are all ISO 9001 certified.

Lab No	Sample ID	Sample Condition on Receipt	Sampling Date
916883	Cong Settlement Lagoon Outlet	Good condition	05/12/2018

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CERTIFICATE OF ANALYSIS

Client : Dr. Pamela Bartley
HYDRO-G
50 Henry Street
Galway
Galway

Report No. : 377916
Date of Receipt : 06/12/2018
Start Date of Analysis : 06/12/2018
Date of Report : 20/12/2018
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	Ref.	Result	Units
916889	Cong Canal Downstream	BOD	I, R	<1	mg/l
		Suspended Solids	I, R	<2	mg/l
		COD	I, R	29	mg/l
		Turbidity	I, R	0.5	N.T.U.
		pH	I, R	8.1	pH Units
		Sodium, total	I, R	9	mg/l
		Chloride	I, R	12.6	mg/l
		Ammonium as NH4	I, R	0.016	mg/l
		Nitrate as NO3	I, R	1.39	mg/l
		Nitrite as NO2	I, R	<0.017	mg/l
		Potassium, total	I, R	1	mg/l
		Sulphate	I, R	<5	mg/l
		Zinc, total	I, R	<5	ug/l
		Ammonia as NH3	I, R	0.016	mg/l
		Copper, dissolved	I, R	<1	ug/l
		Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	I, R	174 **Unknown Pattern	ug/l
		Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	I, R	<0.01	mg/l
		Hardness, Total as CaCO3	S,	111	mg/l

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ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 108T

Approved by: Barbara Lee

Barbara Lee
Environmental Scientist

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In-House Test	Specification	17025	GMP/FDA*	ISO**
BOD	CLS 12	Yes	No	Yes
Suspended Solids	CLS 13	Yes	No	Yes
COD	CLS 52	Yes	No	Yes
Turbidity	CLS 30	Yes	No	Yes
pH	CLS 26	Yes	No	Yes
Sodium, total	ICP-MS CLS129	Yes	No	Yes
Chloride	Konelab CLS 36	Yes	No	Yes
Ammonium as NH4	Konelab CLS 40	Yes	No	Yes
Nitrate as NO3	Konelab CLS 39	Yes	No	Yes
Nitrite as NO2	Konelab CLS 37	Yes	No	Yes
Potassium, total	ICP-MS CLS129	Yes	No	Yes
Sulphate	Konelab CLS 88	Yes	No	Yes
Zinc, total	ICP-MS CLS 129	Yes	No	Yes
Ammonia as NH3	Konelab CLS 40	Yes	No	Yes
Copper, dissolved	ICP-MS CLS 129	Yes	No	Yes
Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	CLS 147	Yes	No	Yes
Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	Konelab CLS 35	Yes	No	Yes

*Analysis carried out in a GMP approved, FDA inspected facility (MedPharma site only).
**Laboratory Analysis, Sampling, Food Safety Monitoring and Analysts on Contract are all ISO 9001 certified.

Lab No	Sample ID	Sample Condition on Receipt	Sampling Date
916889	Cong Canal Downstream	Good condition	05/12/2018

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CERTIFICATE OF ANALYSIS

Client : Dr. Pamela Bartley
HYDRO-G
50 Henry Street
Galway
Galway

Report No. : 378769
Date of Receipt : 14/12/2018
Start Date of Analysis : 14/12/2018
Date of Report : 22/12/2018
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	Ref.	Result	Units
919641	Floor Sump Cong	Suspended Solids	I, R	<2	mg/l
		Turbidity	I, R	1.2	N.T.U.
		pH	I, R	8.1	pH Units
		Sodium, total	I, R	10	mg/l
		Chloride	I, R	17.2	mg/l
		Ammonium as NH4	I, R	0.023	mg/l
		Nitrate as NO3	I, R	8.14	mg/l
		Nitrite as NO2	I, R	<0.017	mg/l
		Potassium, total	I, R	2	mg/l
		Magnesium, total	I, R	6	mg/l
		Sulphate	I, R	41.8	mg/l
		Ammonia as NH3	I, R	0.022	mg/l
		Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	I, R	<0.01	mg/l
		Hardness, Total as CaCO3	S,	154	mg/l

ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.108T

Approved by:

Luiza Singh

Luiza Singh
Environmental Scientist

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In-House Test	Specification	17025	GMP/FDA*	ISO**
Suspended Solids	CLS 13	Yes	No	Yes
Turbidity	CLS 30	Yes	No	Yes
pH	CLS 26	Yes	No	Yes
Sodium, total	ICP-MS CLS129	Yes	No	Yes
Chloride	Konelab CLS 36	Yes	No	Yes
Ammonium as NH4	Konelab CLS 40	Yes	No	Yes
Nitrate as NO3	Konelab CLS 39	Yes	No	Yes
Nitrite as NO2	Konelab CLS 37	Yes	No	Yes
Potassium, total	ICP-MS CLS129	Yes	No	Yes
Magnesium, total	ICP-MS CLS129	Yes	No	Yes
Sulphate	Konelab CLS 88	Yes	No	Yes
Ammonia as NH3	Konelab CLS 40	Yes	No	Yes
Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	Konelab CLS 35	Yes	No	Yes

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Lab No	Sample ID	Sample Condition on Receipt	Sampling Date
919641	Floor Sump Cong	Good condition	13/12/2018

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Client : Dr. Pamela Bartley
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50 Henry Street
Galway
Galway

Report No. : 378770
Date of Receipt : 14/12/2018
Start Date of Analysis : 14/12/2018
Date of Report : 22/12/2018
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	Ref.	Result	Units
919642	Cong Canal Upstream	BOD	I, R	<1	mg/l
		Suspended Solids	I, R	3	mg/l
		COD	I, R	<10	mg/l
		Turbidity	I, R	0.4	N.T.U.
		pH	I, R	8.1	pH Units
		Sodium, total	I, R	8	mg/l
		Chloride	I, R	14.8	mg/l
		Ammonium as NH4	I, R	<0.01	mg/l
		Nitrate as NO3	I, R	1.5	mg/l
		Nitrite as NO2	I, R	<0.017	mg/l
		Potassium, total	I, R	1	mg/l
		Sulphate	I, R	6.4	mg/l
		Zinc, total	I, R	<5	ug/l
		Ammonia as NH3	I, R	0.007	mg/l
		Copper, dissolved	I, R	<1	ug/l
		Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	I, R	36 **Unknown Pattern	ug/l
		Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	I, R	<0.01	mg/l
		Hardness, Total as CaCO3	S,	109	mg/l

ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 108T

Approved by:

Luiza Singh

Luiza Singh
Environmental Scientist

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[web] www.cls.ie

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In-House Test	Specification	17025	GMP/FDA*	ISO**
BOD	CLS 12	Yes	No	Yes
Suspended Solids	CLS 13	Yes	No	Yes
COD	CLS 52	Yes	No	Yes
Turbidity	CLS 30	Yes	No	Yes
pH	CLS 26	Yes	No	Yes
Sodium, total	ICP-MS CLS129	Yes	No	Yes
Chloride	Konelab CLS 36	Yes	No	Yes
Ammonium as NH4	Konelab CLS 40	Yes	No	Yes
Nitrate as NO3	Konelab CLS 39	Yes	No	Yes
Nitrite as NO2	Konelab CLS 37	Yes	No	Yes
Potassium, total	ICP-MS CLS129	Yes	No	Yes
Sulphate	Konelab CLS 88	Yes	No	Yes
Zinc, total	ICP-MS CLS 129	Yes	No	Yes
Ammonia as NH3	Konelab CLS 40	Yes	No	Yes
Copper, dissolved	ICP-MS CLS 129	Yes	No	Yes
Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	CLS 147	Yes	No	Yes
Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	Konelab CLS 35	Yes	No	Yes

*Analysis carried out in a GMP approved, FDA inspected facility (MedPharma site only).
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Lab No	Sample ID	Sample Condition on Receipt	Sampling Date
919642	Cong Canal Upstream	Good condition	13/12/2018

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CERTIFICATE OF ANALYSIS

Client : Dr. Pamela Bartley
HYDRO-G
50 Henry Street
Galway
Galway

Report No. : 378771
Date of Receipt : 14/12/2018
Start Date of Analysis : 14/12/2018
Date of Report : 22/12/2018
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	Ref.	Result	Units
919643	Cong Settlement Lagoon Outlet	BOD	I, R	<1	mg/l
		Suspended Solids	I, R	<2	mg/l
		COD	I, R	<10	mg/l
		Turbidity	I, R	0.9	N.T.U.
		pH	I, R	8.1	pH Units
		Sodium, total	I, R	10	mg/l
		Chloride	I, R	16.9	mg/l
		Ammonium as NH4	I, R	0.015	mg/l
		Nitrate as NO3	I, R	6.83	mg/l
		Nitrite as NO2	I, R	<0.017	mg/l
		Potassium, total	I, R	3	mg/l
		Sulphate	I, R	36.3	mg/l
		Zinc, total	I, R	<5	ug/l
		Ammonia as NH3	I, R	0.015	mg/l
		Copper, dissolved	I, R	<1	ug/l
		Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	I, R	34 **Unknown Pattern	ug/l
		Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	I, R	<0.01	mg/l
		Hardness, Total as CaCO3	S,	149	mg/l

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 108T

Approved by:

Luiza Singh

Luiza Singh
Environmental Scientist

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[web] www.cls.ie

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In-House Test	Specification	17025	GMP/FDA*	ISO**
BOD	CLS 12	Yes	No	Yes
Suspended Solids	CLS 13	Yes	No	Yes
COD	CLS 52	Yes	No	Yes
Turbidity	CLS 30	Yes	No	Yes
pH	CLS 26	Yes	No	Yes
Sodium, total	ICP-MS CLS129	Yes	No	Yes
Chloride	Konelab CLS 36	Yes	No	Yes
Ammonium as NH4	Konelab CLS 40	Yes	No	Yes
Nitrate as NO3	Konelab CLS 39	Yes	No	Yes
Nitrite as NO2	Konelab CLS 37	Yes	No	Yes
Potassium, total	ICP-MS CLS129	Yes	No	Yes
Sulphate	Konelab CLS 88	Yes	No	Yes
Zinc, total	ICP-MS CLS 129	Yes	No	Yes
Ammonia as NH3	Konelab CLS 40	Yes	No	Yes
Copper, dissolved	ICP-MS CLS 129	Yes	No	Yes
Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	CLS 147	Yes	No	Yes
Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	Konelab CLS 35	Yes	No	Yes

*Analysis carried out in a GMP approved, FDA inspected facility (MedPharma site only).
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Lab No	Sample ID	Sample Condition on Receipt	Sampling Date
919643	Cong Settlement Lagoon Outlet	Good condition	13/12/2018

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CERTIFICATE OF ANALYSIS

Client : Dr. Pamela Bartley
HYDRO-G
50 Henry Street
Galway
Galway

Report No. : 378772
Date of Receipt : 14/12/2018
Start Date of Analysis : 14/12/2018
Date of Report : 22/12/2018
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	Ref.	Result	Units
919644	Cong Canal Downstream	BOD	I, R	<1	mg/l
		Suspended Solids	I, R	8	mg/l
		COD	I, R	10	mg/l
		Turbidity	I, R	0.4	N.T.U.
		pH	I, R	8.1	pH Units
		Sodium, total	I, R	8	mg/l
		Chloride	I, R	14.8	mg/l
		Ammonium as NH4	I, R	0.012	mg/l
		Nitrate as NO3	I, R	1.53	mg/l
		Nitrite as NO2	I, R	<0.017	mg/l
		Potassium, total	I, R	1	mg/l
		Sulphate	I, R	6.49	mg/l
		Zinc, total	I, R	<5	ug/l
		Ammonia as NH3	I, R	0.011	mg/l
		Copper, dissolved	I, R	<1	ug/l
		Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	I, R	55 **Unknown Pattern	ug/l
		Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	I, R	<0.01	mg/l
		Hardness, Total as CaCO3	S,	109	mg/l

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 108T

Approved by:

Luiza Singh

Luiza Singh
Environmental Scientist

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Complete Laboratory Solutions,
MedPharma Division,
Unit 3a, Small Business Park, Mervue, Galway

Symbol Reference - I:17025 accredited; S:Subcontracted; R:Analysis carried out in Ros Muc; M:Analysis carried out in MedPharma

Complete Laboratory Solutions
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[web] www.cls.ie

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In-House Test	Specification	17025	GMP/FDA*	ISO**
BOD	CLS 12	Yes	No	Yes
Suspended Solids	CLS 13	Yes	No	Yes
COD	CLS 52	Yes	No	Yes
Turbidity	CLS 30	Yes	No	Yes
pH	CLS 26	Yes	No	Yes
Sodium, total	ICP-MS CLS129	Yes	No	Yes
Chloride	Konelab CLS 36	Yes	No	Yes
Ammonium as NH4	Konelab CLS 40	Yes	No	Yes
Nitrate as NO3	Konelab CLS 39	Yes	No	Yes
Nitrite as NO2	Konelab CLS 37	Yes	No	Yes
Potassium, total	ICP-MS CLS129	Yes	No	Yes
Sulphate	Konelab CLS 88	Yes	No	Yes
Zinc, total	ICP-MS CLS 129	Yes	No	Yes
Ammonia as NH3	Konelab CLS 40	Yes	No	Yes
Copper, dissolved	ICP-MS CLS 129	Yes	No	Yes
Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	CLS 147	Yes	No	Yes
Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	Konelab CLS 35	Yes	No	Yes

*Analysis carried out in a GMP approved, FDA inspected facility (MedPharma site only).
**Laboratory Analysis, Sampling, Food Safety Monitoring and Analysts on Contract are all ISO 9001 certified.

Lab No	Sample ID	Sample Condition on Receipt	Sampling Date
919644	Cong Canal Downstream	Good condition	13/12/2018

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CERTIFICATE OF ANALYSIS

Client : Dr. Pamela Bartley
HYDRO-G
50 Henry Street
Galway
Galway

Report No. : 380531
Date of Receipt : 17/01/2019
Start Date of Analysis : 17/01/2019
Date of Report : 07/02/2019
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	Ref.	Result	Units
925104	Floor Sump Cong 16.01.19	Suspended Solids	I, R	2	mg/l
		Turbidity	I, R	1.4	N.T.U.
		pH	I, R	8.1	pH Units
		Sodium, total	I, R	9	mg/l
		Chloride	I, R	15.4	mg/l
		Ammonium as NH4	I, R	0.012	mg/l
		Nitrate as NO3	I, R	3.19	mg/l
		Nitrite as NO2	I, R	<0.017	mg/l
		Potassium, total	I, R	2	mg/l
		Magnesium, total	I, R	4	mg/l
		Sulphate	I, R	24.8	mg/l
		Ammonia as NH3	I, R	0.011	mg/l
		Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	I, R	<0.01	mg/l
		Hardness, Total as CaCO3	S,	151	mg/l

ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.108T

Approved by: Barbara Lee

Barbara Lee
Environmental Scientist

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In-House Test	Specification	17025	GMP/FDA*	ISO**
Suspended Solids	CLS 13	Yes	No	Yes
Turbidity	CLS 30	Yes	No	Yes
pH	CLS 26	Yes	No	Yes
Sodium, total	ICP-MS CLS129	Yes	No	Yes
Chloride	Konelab CLS 36	Yes	No	Yes
Ammonium as NH4	Konelab CLS 40	Yes	No	Yes
Nitrate as NO3	Konelab CLS 39	Yes	No	Yes
Nitrite as NO2	Konelab CLS 37	Yes	No	Yes
Potassium, total	ICP-MS CLS129	Yes	No	Yes
Magnesium, total	ICP-MS CLS129	Yes	No	Yes
Sulphate	Konelab CLS 88	Yes	No	Yes
Ammonia as NH3	Konelab CLS 40	Yes	No	Yes
Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	Konelab CLS 35	Yes	No	Yes

*Analysis carried out in a GMP approved, FDA inspected facility (MedPharma site only).
**Laboratory Analysis, Sampling, Food Safety Monitoring and Analysts on Contract are all ISO 9001 certified.

Lab No	Sample ID	Sample Condition on Receipt	Sampling Date
925104	Floor Sump Cong 16.01.19	Good condition	16/01/2019

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CERTIFICATE OF ANALYSIS

Client : Dr. Pamela Bartley
HYDRO-G
50 Henry Street
Galway
Galway

Report No. : 380697
Date of Receipt : 21/01/2019
Start Date of Analysis : 21/01/2019
Date of Report : 08/02/2019
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	Ref.	Result	Units
925538	Cong Canal Upstream	BOD	I, R	<1	mg/l
		Suspended Solids	I, R	<2	mg/l
		COD	I, R	12	mg/l
		Turbidity	I, R	0.8	N.T.U.
		pH	I, R	8.2	pH Units
		Sodium, total	I, R	10	mg/l
		Chloride	I, R	14.9	mg/l
		Ammonium as NH4	I, R	0.087	mg/l
		Nitrate as NO3	I, R	1.9	mg/l
		Nitrite as NO2	I, R	<0.017	mg/l
		Potassium, total	I, R	3	mg/l
		Sulphate	I, R	6.69	mg/l
		Zinc, total	I, R	<5	ug/l
		Ammonia as NH3	I, R	0.081	mg/l
		Copper, dissolved	I, R	<1	ug/l
		Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	I, R	33 **Unknown Pattern	ug/l
		Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	I, R	0.014	mg/l
		Hardness, Total as CaCO3	S,	116	mg/l

** Note: The comment expressed here is an interpretation and is not INAB accredited

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 108T

Approved by: Barbara Lee

Barbara Lee
Environmental Scientist

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In-House Test	Specification	17025	GMP/FDA*	ISO**
BOD	CLS 12	Yes	No	Yes
Suspended Solids	CLS 13	Yes	No	Yes
COD	CLS 52	Yes	No	Yes
Turbidity	CLS 30	Yes	No	Yes
pH	CLS 26	Yes	No	Yes
Sodium, total	ICP-MS CLS129	Yes	No	Yes
Chloride	Konelab CLS 36	Yes	No	Yes
Ammonium as NH4	Konelab CLS 40	Yes	No	Yes
Nitrate as NO3	Konelab CLS 39	Yes	No	Yes
Nitrite as NO2	Konelab CLS 37	Yes	No	Yes
Potassium, total	ICP-MS CLS129	Yes	No	Yes
Sulphate	Konelab CLS 88	Yes	No	Yes
Zinc, total	ICP-MS CLS 129	Yes	No	Yes
Ammonia as NH3	Konelab CLS 40	Yes	No	Yes
Copper, dissolved	ICP-MS CLS 129	Yes	No	Yes
Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	CLS 147	Yes	No	Yes
Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	Konelab CLS 35	Yes	No	Yes

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**Laboratory Analysis, Sampling, Food Safety Monitoring and Analysts on Contract are all ISO 9001 certified.

Lab No	Sample ID	Sample Condition on Receipt	Sampling Date
925538	Cong Canal Upstream	Good condition	21/01/2019

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CERTIFICATE OF ANALYSIS

Client : Dr. Pamela Bartley
HYDRO-G
50 Henry Street
Galway
Galway

Report No. : 380698
Date of Receipt : 21/01/2019
Start Date of Analysis : 21/01/2019
Date of Report : 08/02/2019
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	Ref.	Result	Units
925539	Cong Settlement Lagoon Outlet	BOD	I, R	<1	mg/l
		Suspended Solids	I, R	<2	mg/l
		COD	I, R	<10	mg/l
		Turbidity	I, R	0.5	N.T.U.
		pH	I, R	8.1	pH Units
		Sodium, total	I, R	10	mg/l
		Chloride	I, R	15.4	mg/l
		Ammonium as NH4	I, R	0.012	mg/l
		Nitrate as NO3	I, R	3.27	mg/l
		Nitrite as NO2	I, R	<0.017	mg/l
		Potassium, total	I, R	3	mg/l
		Sulphate	I, R	38.3	mg/l
		Zinc, total	I, R	<5	ug/l
		Ammonia as NH3	I, R	0.011	mg/l
		Copper, dissolved	I, R	<1	ug/l
		Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	I, R	13 **Unknown Pattern	ug/l
		Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	I, R	<0.01	mg/l
		Hardness, Total as CaCO3	S,	148	mg/l

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ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 108T

Approved by: Barbara Lee

Barbara Lee
Environmental Scientist

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In-House Test	Specification	17025	GMP/FDA*	ISO**
BOD	CLS 12	Yes	No	Yes
Suspended Solids	CLS 13	Yes	No	Yes
COD	CLS 52	Yes	No	Yes
Turbidity	CLS 30	Yes	No	Yes
pH	CLS 26	Yes	No	Yes
Sodium, total	ICP-MS CLS129	Yes	No	Yes
Chloride	Konelab CLS 36	Yes	No	Yes
Ammonium as NH4	Konelab CLS 40	Yes	No	Yes
Nitrate as NO3	Konelab CLS 39	Yes	No	Yes
Nitrite as NO2	Konelab CLS 37	Yes	No	Yes
Potassium, total	ICP-MS CLS129	Yes	No	Yes
Sulphate	Konelab CLS 88	Yes	No	Yes
Zinc, total	ICP-MS CLS 129	Yes	No	Yes
Ammonia as NH3	Konelab CLS 40	Yes	No	Yes
Copper, dissolved	ICP-MS CLS 129	Yes	No	Yes
Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	CLS 147	Yes	No	Yes
Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	Konelab CLS 35	Yes	No	Yes

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Lab No	Sample ID	Sample Condition on Receipt	Sampling Date
925539	Cong Settlement Lagoon Outlet	Good condition	21/01/2019

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CERTIFICATE OF ANALYSIS

Client : Dr. Pamela Bartley
HYDRO-G
50 Henry Street
Galway
Galway

Report No. : 380699
Date of Receipt : 21/01/2019
Start Date of Analysis : 21/01/2019
Date of Report : 04/02/2019
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	Ref.	Result	Units
925541	Cong Canal Downstream	BOD	I, R	<1	mg/l
		Suspended Solids	I, R	<2	mg/l
		COD	I, R	13	mg/l
		Turbidity	I, R	0.4	N.T.U.
		pH	I, R	8.1	pH Units
		Sodium, total	I, R	9	mg/l
		Chloride	I, R	14.8	mg/l
		Ammonium as NH4	I, R	0.021	mg/l
		Nitrate as NO3	I, R	1.87	mg/l
		Nitrite as NO2	I, R	<0.017	mg/l
		Potassium, total	I, R	1	mg/l
		Sulphate	I, R	6.96	mg/l
		Zinc, total	I, R	<5	ug/l
		Ammonia as NH3	I, R	0.019	mg/l
		Copper, dissolved	I, R	<1	ug/l
		Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	I, R	29 **Unknown Pattern	ug/l
		Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	I, R	<0.01	mg/l
		Hardness, Total as CaCO3	S,	116	mg/l

** Note: The comment expressed here is an interpretation and is not INAB accredited

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 108T

Approved by: Barbara Lee

Barbara Lee
Environmental Scientist

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[web] www.cls.ie

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In-House Test	Specification	17025	GMP/FDA*	ISO**
BOD	CLS 12	Yes	No	Yes
Suspended Solids	CLS 13	Yes	No	Yes
COD	CLS 52	Yes	No	Yes
Turbidity	CLS 30	Yes	No	Yes
pH	CLS 26	Yes	No	Yes
Sodium, total	ICP-MS CLS129	Yes	No	Yes
Chloride	Konelab CLS 36	Yes	No	Yes
Ammonium as NH4	Konelab CLS 40	Yes	No	Yes
Nitrate as NO3	Konelab CLS 39	Yes	No	Yes
Nitrite as NO2	Konelab CLS 37	Yes	No	Yes
Potassium, total	ICP-MS CLS129	Yes	No	Yes
Sulphate	Konelab CLS 88	Yes	No	Yes
Zinc, total	ICP-MS CLS 129	Yes	No	Yes
Ammonia as NH3	Konelab CLS 40	Yes	No	Yes
Copper, dissolved	ICP-MS CLS 129	Yes	No	Yes
Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	CLS 147	Yes	No	Yes
Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	Konelab CLS 35	Yes	No	Yes

*Analysis carried out in a GMP approved, FDA inspected facility (MedPharma site only).
**Laboratory Analysis, Sampling, Food Safety Monitoring and Analysts on Contract are all ISO 9001 certified.

Lab No	Sample ID	Sample Condition on Receipt	Sampling Date
925541	Cong Canal Downstream	Good condition	21/01/2019

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CERTIFICATE OF ANALYSIS

Client : Dr. Pamela Bartley
HYDRO-G
50 Henry Street
Galway
Galway

Report No. : 380697
Date of Receipt : 21/01/2019
Start Date of Analysis : 21/01/2019
Date of Report : 08/02/2019
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	Ref.	Result	Units
925538	Cong Canal Upstream	BOD	I, R	<1	mg/l
		Suspended Solids	I, R	<2	mg/l
		COD	I, R	12	mg/l
		Turbidity	I, R	0.8	N.T.U.
		pH	I, R	8.2	pH Units
		Sodium, total	I, R	10	mg/l
		Chloride	I, R	14.9	mg/l
		Ammonium as NH4	I, R	0.087	mg/l
		Nitrate as NO3	I, R	1.9	mg/l
		Nitrite as NO2	I, R	<0.017	mg/l
		Potassium, total	I, R	3	mg/l
		Sulphate	I, R	6.69	mg/l
		Zinc, total	I, R	<5	ug/l
		Ammonia as NH3	I, R	0.081	mg/l
		Copper, dissolved	I, R	<1	ug/l
		Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	I, R	33 **Unknown Pattern	ug/l
		Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	I, R	0.014	mg/l
		Hardness, Total as CaCO3	S,	116	mg/l

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ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 108T

Approved by: Barbara Lee

Barbara Lee
Environmental Scientist

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In-House Test	Specification	17025	GMP/FDA*	ISO**
BOD	CLS 12	Yes	No	Yes
Suspended Solids	CLS 13	Yes	No	Yes
COD	CLS 52	Yes	No	Yes
Turbidity	CLS 30	Yes	No	Yes
pH	CLS 26	Yes	No	Yes
Sodium, total	ICP-MS CLS129	Yes	No	Yes
Chloride	Konelab CLS 36	Yes	No	Yes
Ammonium as NH4	Konelab CLS 40	Yes	No	Yes
Nitrate as NO3	Konelab CLS 39	Yes	No	Yes
Nitrite as NO2	Konelab CLS 37	Yes	No	Yes
Potassium, total	ICP-MS CLS129	Yes	No	Yes
Sulphate	Konelab CLS 88	Yes	No	Yes
Zinc, total	ICP-MS CLS 129	Yes	No	Yes
Ammonia as NH3	Konelab CLS 40	Yes	No	Yes
Copper, dissolved	ICP-MS CLS 129	Yes	No	Yes
Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	CLS 147	Yes	No	Yes
Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	Konelab CLS 35	Yes	No	Yes

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Lab No	Sample ID	Sample Condition on Receipt	Sampling Date
925538	Cong Canal Upstream	Good condition	21/01/2019

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CERTIFICATE OF ANALYSIS

Client : Dr. Pamela Bartley
HYDRO-G
50 Henry Street
Galway
Galway

Report No. : 380698
Date of Receipt : 21/01/2019
Start Date of Analysis : 21/01/2019
Date of Report : 08/02/2019
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	Ref.	Result	Units
925539	Cong Settlement Lagoon Outlet	BOD	I, R	<1	mg/l
		Suspended Solids	I, R	<2	mg/l
		COD	I, R	<10	mg/l
		Turbidity	I, R	0.5	N.T.U.
		pH	I, R	8.1	pH Units
		Sodium, total	I, R	10	mg/l
		Chloride	I, R	15.4	mg/l
		Ammonium as NH4	I, R	0.012	mg/l
		Nitrate as NO3	I, R	3.27	mg/l
		Nitrite as NO2	I, R	<0.017	mg/l
		Potassium, total	I, R	3	mg/l
		Sulphate	I, R	38.3	mg/l
		Zinc, total	I, R	<5	ug/l
		Ammonia as NH3	I, R	0.011	mg/l
		Copper, dissolved	I, R	<1	ug/l
		Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	I, R	13 **Unknown Pattern	ug/l
		Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	I, R	<0.01	mg/l
		Hardness, Total as CaCO3	S,	148	mg/l

** Note: The comment expressed here is an interpretation and is not INAB accredited

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 108T

Approved by: Barbara Lee

Barbara Lee
Environmental Scientist

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[web] www.cls.ie

RECEIVED: 31/01/2025

In-House Test	Specification	17025	GMP/FDA*	ISO**
BOD	CLS 12	Yes	No	Yes
Suspended Solids	CLS 13	Yes	No	Yes
COD	CLS 52	Yes	No	Yes
Turbidity	CLS 30	Yes	No	Yes
pH	CLS 26	Yes	No	Yes
Sodium, total	ICP-MS CLS129	Yes	No	Yes
Chloride	Konelab CLS 36	Yes	No	Yes
Ammonium as NH4	Konelab CLS 40	Yes	No	Yes
Nitrate as NO3	Konelab CLS 39	Yes	No	Yes
Nitrite as NO2	Konelab CLS 37	Yes	No	Yes
Potassium, total	ICP-MS CLS129	Yes	No	Yes
Sulphate	Konelab CLS 88	Yes	No	Yes
Zinc, total	ICP-MS CLS 129	Yes	No	Yes
Ammonia as NH3	Konelab CLS 40	Yes	No	Yes
Copper, dissolved	ICP-MS CLS 129	Yes	No	Yes
Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	CLS 147	Yes	No	Yes
Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	Konelab CLS 35	Yes	No	Yes

*Analysis carried out in a GMP approved, FDA inspected facility (MedPharma site only).
**Laboratory Analysis, Sampling, Food Safety Monitoring and Analysts on Contract are all ISO 9001 certified.

Lab No	Sample ID	Sample Condition on Receipt	Sampling Date
925539	Cong Settlement Lagoon Outlet	Good condition	21/01/2019

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Unit 3a, Small Business Park, Mervue, Galway

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CERTIFICATE OF ANALYSIS

Client : Dr. Pamela Bartley
HYDRO-G
50 Henry Street
Galway
Galway

Report No. : 380699
Date of Receipt : 21/01/2019
Start Date of Analysis : 21/01/2019
Date of Report : 04/02/2019
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	Ref.	Result	Units
925541	Cong Canal Downstream	BOD	I, R	<1	mg/l
		Suspended Solids	I, R	<2	mg/l
		COD	I, R	13	mg/l
		Turbidity	I, R	0.4	N.T.U.
		pH	I, R	8.1	pH Units
		Sodium, total	I, R	9	mg/l
		Chloride	I, R	14.8	mg/l
		Ammonium as NH4	I, R	0.021	mg/l
		Nitrate as NO3	I, R	1.87	mg/l
		Nitrite as NO2	I, R	<0.017	mg/l
		Potassium, total	I, R	1	mg/l
		Sulphate	I, R	6.96	mg/l
		Zinc, total	I, R	<5	ug/l
		Ammonia as NH3	I, R	0.019	mg/l
		Copper, dissolved	I, R	<1	ug/l
		Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	I, R	29 **Unknown Pattern	ug/l
		Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	I, R	<0.01	mg/l
		Hardness, Total as CaCO3	S,	116	mg/l

** Note: The comment expressed here is an interpretation and is not INAB accredited

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Approved by: Barbara Lee

Barbara Lee
Environmental Scientist

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In-House Test	Specification	17025	GMP/FDA*	ISO**
BOD	CLS 12	Yes	No	Yes
Suspended Solids	CLS 13	Yes	No	Yes
COD	CLS 52	Yes	No	Yes
Turbidity	CLS 30	Yes	No	Yes
pH	CLS 26	Yes	No	Yes
Sodium, total	ICP-MS CLS129	Yes	No	Yes
Chloride	Konelab CLS 36	Yes	No	Yes
Ammonium as NH4	Konelab CLS 40	Yes	No	Yes
Nitrate as NO3	Konelab CLS 39	Yes	No	Yes
Nitrite as NO2	Konelab CLS 37	Yes	No	Yes
Potassium, total	ICP-MS CLS129	Yes	No	Yes
Sulphate	Konelab CLS 88	Yes	No	Yes
Zinc, total	ICP-MS CLS 129	Yes	No	Yes
Ammonia as NH3	Konelab CLS 40	Yes	No	Yes
Copper, dissolved	ICP-MS CLS 129	Yes	No	Yes
Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	CLS 147	Yes	No	Yes
Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	Konelab CLS 35	Yes	No	Yes

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Lab No	Sample ID	Sample Condition on Receipt	Sampling Date
925541	Cong Canal Downstream	Good condition	21/01/2019

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CERTIFICATE OF ANALYSIS

Client : Nicky Mulchrone
McGrath's Limestone Cong Ltd
Cregaree, Cong
Claremorris
Co Mayo

Report No. : 384311
Date of Receipt : 07/03/2019
Start Date of Analysis : 07/03/2019
Date of Report : 25/03/2019
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	Ref.	Result	Units
936485	Cong Sump	Suspended Solids	I, R	<2	mg/l
		Turbidity	I, R	1.6	N.T.U.
		pH	I, R	8.5	pH Units
		Conductivity @20C	I, R	301	uS/cm
		Sodium, total	I, R	9	mg/l
		Chloride	I, R	15.1	mg/l
		Ammonium as NH4	I, R	0.025	mg/l
		Nitrate as NO3	I, R	5	mg/l
		Nitrite as NO2	I, R	<0.017	mg/l
		Ammonia as NH3	I, R	0.024	mg/l
		Potassium	I, R	7	mg/l
		Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	I, R	<0.01	mg/l
		TPH (>C5 - C44) by GC-FID	I, R	<20 **Unknown pattern	ug/l

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Approved by:

Laura Finnegan.

Laura Finnegan
Environmental Scientist

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In-House Test	Specification	17025	GMP/FDA*	ISO**
Suspended Solids	CLS 13	Yes	No	Yes
Turbidity	CLS 30	Yes	No	Yes
pH	CLS 26	Yes	No	Yes
Conductivity @20C	CLS 67	Yes	No	Yes
Sodium, total	ICP-MS CLS129	Yes	No	Yes
Chloride	Konelab CLS 36	Yes	No	Yes
Ammonium as NH4	Konelab CLS 40	Yes	No	Yes
Nitrate as NO3	Konelab CLS 39	Yes	No	Yes
Nitrite as NO2	Konelab CLS 37	Yes	No	Yes
Ammonia as NH3	Konelab CLS 40	Yes	No	Yes
Potassium	ICP-MS CLS129	Yes	No	Yes
Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	Konelab CLS 35	Yes	No	Yes
TPH (>C5 - C44) by GC-FID	CLS 193	Yes	No	Yes

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Lab No	Sample ID	Sample Condition on Receipt	Sampling Date
936485	Cong Sump	Good condition	06/03/2019

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Client : Nicky Mulchrone
McGrath's Limestone Cong Ltd
Cregaree, Cong
Claremorris
Co Mayo

Report No. : 384308
Date of Receipt : 07/03/2019
Start Date of Analysis : 07/03/2019
Date of Report : 22/03/2019
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	Ref.	Result	Units
936482	Cong Upstream	Suspended Solids	I, R	<2	mg/l
		Turbidity	I, R	0.5	N.T.U.
		pH	I, R	8.2	pH Units
		Conductivity @20C	I, R	235	uS/cm
		Sodium, total	I, R	8	mg/l
		Chloride	I, R	14.9	mg/l
		Ammonium as NH4	I, R	0.011	mg/l
		Nitrate as NO3	I, R	2.13	mg/l
		Nitrite as NO2	I, R	<0.017	mg/l
		Ammonia as NH3	I, R	0.011	mg/l
		Potassium	I, R	1	mg/l
		Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	I, R	<0.01	mg/l
		TPH (>C5 - C44) by GC-FID	I, R	34 **Unknown pattern	ug/l

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Approved by:

Laura Finnegan

Laura Finnegan
Environmental Scientist

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In-House Test	Specification	I7025	GMP/FDA*	ISO**
Suspended Solids	CLS 13	Yes	No	Yes
Turbidity	CLS 30	Yes	No	Yes
pH	CLS 26	Yes	No	Yes
Conductivity @20C	CLS 67	Yes	No	Yes
Sodium, total	ICP-MS CLS129	Yes	No	Yes
Chloride	Konelab CLS 36	Yes	No	Yes
Ammonium as NH4	Konelab CLS 40	Yes	No	Yes
Nitrate as NO3	Konelab CLS 39	Yes	No	Yes
Nitrite as NO2	Konelab CLS 37	Yes	No	Yes
Ammonia as NH3	Konelab CLS 40	Yes	No	Yes
Potassium	ICP-MS CLS129	Yes	No	Yes
Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	Konelab CLS 35	Yes	No	Yes
TPH (>C5 - C44) by GC-FID	CLS 193	Yes	No	Yes

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Lab No	Sample ID	Sample Condition on Receipt	Sampling Date
936482	Cong Upstream	Good condition	06/03/2019

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Client : Nicky Mulchrone
McGrath's Limestone Cong Ltd
Cregaree, Cong
Claremorris
Co Mayo

Report No. : 384310
Date of Receipt : 07/03/2019
Start Date of Analysis : 07/03/2019
Date of Report : 22/03/2019
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	Ref.	Result	Units
936484	Cong Discharge	Suspended Solids	I, R	<2	mg/l
		Turbidity	I, R	3.3	N.T.U.
		pH	I, R	8.4	pH Units
		Conductivity @20C	I, R	286	uS/cm
		Sodium, total	I, R	10	mg/l
		Chloride	I, R	15.4	mg/l
		Ammonium as NH4	I, R	0.02	mg/l
		Nitrate as NO3	I, R	4.46	mg/l
		Nitrite as NO2	I, R	<0.017	mg/l
		Ammonia as NH3	I, R	0.019	mg/l
		Potassium	I, R	7	mg/l
		Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	I, R	<0.01	mg/l
		TPH (>C5 - C44) by GC-FID	I, R	<20 **Unknown pattern	ug/l

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Approved by:

Laura Finnegan

Laura Finnegan
Environmental Scientist

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In-House Test	Specification	I7025	GMP/FDA*	ISO**
Suspended Solids	CLS 13	Yes	No	Yes
Turbidity	CLS 30	Yes	No	Yes
pH	CLS 26	Yes	No	Yes
Conductivity @20C	CLS 67	Yes	No	Yes
Sodium, total	ICP-MS CLS129	Yes	No	Yes
Chloride	Konelab CLS 36	Yes	No	Yes
Ammonium as NH4	Konelab CLS 40	Yes	No	Yes
Nitrate as NO3	Konelab CLS 39	Yes	No	Yes
Nitrite as NO2	Konelab CLS 37	Yes	No	Yes
Ammonia as NH3	Konelab CLS 40	Yes	No	Yes
Potassium	ICP-MS CLS129	Yes	No	Yes
Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	Konelab CLS 35	Yes	No	Yes
TPH (>C5 - C44) by GC-FID	CLS 193	Yes	No	Yes

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Lab No	Sample ID	Sample Condition on Receipt	Sampling Date
936484	Cong Discharge	Good condition	06/03/2019

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CERTIFICATE OF ANALYSIS

Client : Nicky Mulchrone
McGrath's Limestone Cong Ltd
Cregaree, Cong
Claremorris
Co Mayo

Report No. : 384309
Date of Receipt : 07/03/2019
Start Date of Analysis : 07/03/2019
Date of Report : 22/03/2019
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	Ref.	Result	Units
936483	Cong Downstream	Suspended Solids	I, R	<2	mg/l
		Turbidity	I, R	0.5	N.T.U.
		pH	I, R	8.2	pH Units
		Conductivity @20C	I, R	235	uS/cm
		Sodium, total	I, R	8	mg/l
		Chloride	I, R	14.9	mg/l
		Ammonium as NH4	I, R	0.011	mg/l
		Nitrate as NO3	I, R	2.06	mg/l
		Nitrite as NO2	I, R	<0.017	mg/l
		Ammonia as NH3	I, R	0.011	mg/l
		Potassium	I, R	1	mg/l
		Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	I, R	<0.01	mg/l
		TPH (>C5 - C44) by GC-FID	I, R	<20 **Unknown pattern	ug/l

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Approved by:

Laura Finnegan

Laura Finnegan
Environmental Scientist

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In-House Test	Specification	I7025	GMP/FDA*	ISO**
Suspended Solids	CLS 13	Yes	No	Yes
Turbidity	CLS 30	Yes	No	Yes
pH	CLS 26	Yes	No	Yes
Conductivity @20C	CLS 67	Yes	No	Yes
Sodium, total	ICP-MS CLS129	Yes	No	Yes
Chloride	Konelab CLS 36	Yes	No	Yes
Ammonium as NH4	Konelab CLS 40	Yes	No	Yes
Nitrate as NO3	Konelab CLS 39	Yes	No	Yes
Nitrite as NO2	Konelab CLS 37	Yes	No	Yes
Ammonia as NH3	Konelab CLS 40	Yes	No	Yes
Potassium	ICP-MS CLS129	Yes	No	Yes
Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	Konelab CLS 35	Yes	No	Yes
TPH (>C5 - C44) by GC-FID	CLS 193	Yes	No	Yes

*Analysis carried out in a GMP approved, FDA inspected facility (MedPharma site only).
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Lab No	Sample ID	Sample Condition on Receipt	Sampling Date
936483	Cong Downstream	Good condition	06/03/2019

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CERTIFICATE OF ANALYSIS

Client : Nicky Mulchrone
McGrath's Limestone Cong Ltd
Cregaree, Cong
Claremorris
Co Mayo

Report No. : 388316
Date of Receipt : 01/05/2019
Start Date of Analysis : 01/05/2019
Date of Report : 14/05/2019
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	Ref.	Result	Units
950676	Cong Upstream	Suspended Solids	I, R	<2	mg/l
		Turbidity	I, R	0.4	N.T.U.
		pH	I, R	8.3	pH Units
		Conductivity @20C	I, R	232	uS/cm
		Sodium, total	I, R	9	mg/l
		Chloride	I, R	15.3	mg/l
		Ammonium as NH4	I, R	<0.01	mg/l
		Nitrate as NO3	I, R	1.97	mg/l
		Nitrite as NO2	I, R	<0.017	mg/l
		Ammonia as NH3	I, R	<0.006	mg/l
		Potassium	I, R	1	mg/l
		Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	I, R	93 **Unknown pattern	ug/l
		Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	I, R	<0.01	mg/l

** Note: The comment expressed here is an interpretation and is not INAB accredited

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Approved by: Barbara Lee

Barbara Lee
Environmental Scientist

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In-House Test	Specification	17025	GMP/FDA*	ISO**
Suspended Solids	CLS 13	Yes	No	Yes
Turbidity	CLS 30	Yes	No	Yes
pH	CLS 26	Yes	No	Yes
Conductivity @20C	CLS 67	Yes	No	Yes
Sodium, total	ICP-MS CLS129	Yes	No	Yes
Chloride	Konelab CLS 36	Yes	No	Yes
Ammonium as NH4	Konelab CLS 40	Yes	No	Yes
Nitrate as NO3	Konelab CLS 39	Yes	No	Yes
Nitrite as NO2	Konelab CLS 37	Yes	No	Yes
Ammonia as NH3	Konelab CLS 40	Yes	No	Yes
Potassium	ICP-MS CLS129	Yes	No	Yes
Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	CLS 147	Yes	No	Yes
Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	Konelab CLS 35	Yes	No	Yes

*Analysis carried out in a GMP approved, FDA inspected facility (MedPharma site only).
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Lab No	Sample ID	Sample Condition on Receipt	Sampling Date
950676	Cong Upstream	Good condition	29/04/2019

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CERTIFICATE OF ANALYSIS

Client : Nicky Mulchrone
McGrath's Limestone Cong Ltd
Cregaree, Cong
Claremorris
Co Mayo

Report No. : 388319
Date of Receipt : 01/05/2019
Start Date of Analysis : 01/05/2019
Date of Report : 14/05/2019
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	Ref.	Result	Units
950679	Cong Sump	Suspended Solids	I, R	<2	mg/l
		Turbidity	I, R	0.8	N.T.U.
		pH	I, R	7.9	pH Units
		Conductivity @20C	I, R	281	uS/cm
		Sodium, total	I, R	10	mg/l
		Chloride	I, R	16	mg/l
		Ammonium as NH4	I, R	<0.01	mg/l
		Nitrate as NO3	I, R	2.28	mg/l
		Nitrite as NO2	I, R	<0.017	mg/l
		Ammonia as NH3	I, R	0.009	mg/l
		Potassium	I, R	3	mg/l
		Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	I, R	930 **Unknown pattern	ug/l
		Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	I, R	<0.01	mg/l

** Note: The comment expressed here is an interpretation and is not INAB accredited

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Approved by: Barbara Lee

Barbara Lee
Environmental Scientist

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est. is an estimated count.

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Symbol Reference - I:17025 accredited; S:Subcontracted; R:Analysis carried out in Ros Muc; M:Analysis carried out in MedPharma

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In-House Test	Specification	17025	GMP/FDA*	ISO**
Suspended Solids	CLS 13	Yes	No	Yes
Turbidity	CLS 30	Yes	No	Yes
pH	CLS 26	Yes	No	Yes
Conductivity @20C	CLS 67	Yes	No	Yes
Sodium, total	ICP-MS CLS129	Yes	No	Yes
Chloride	Konelab CLS 36	Yes	No	Yes
Ammonium as NH4	Konelab CLS 40	Yes	No	Yes
Nitrate as NO3	Konelab CLS 39	Yes	No	Yes
Nitrite as NO2	Konelab CLS 37	Yes	No	Yes
Ammonia as NH3	Konelab CLS 40	Yes	No	Yes
Potassium	ICP-MS CLS129	Yes	No	Yes
Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	CLS 147	Yes	No	Yes
Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	Konelab CLS 35	Yes	No	Yes

*Analysis carried out in a GMP approved, FDA inspected facility (MedPharma site only).
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Lab No	Sample ID	Sample Condition on Receipt	Sampling Date
950679	Cong Sump	Good condition	29/04/2019

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CERTIFICATE OF ANALYSIS

Client : Nicky Mulchrone
McGrath's Limestone Cong Ltd
Cregaree, Cong
Claremorris
Co Mayo

Report No. : 388318
Date of Receipt : 01/05/2019
Start Date of Analysis : 01/05/2019
Date of Report : 15/05/2019
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	Ref.	Result	Units
950678	Cong Discharge	Suspended Solids	I, R	<2	mg/l
		Turbidity	I, R	0.6	N.T.U.
		pH	I, R	8.2	pH Units
		Conductivity @20C	I, R	276	uS/cm
		Sodium, total	I, R	10	mg/l
		Chloride	I, R	15.8	mg/l
		Ammonium as NH4	I, R	<0.01	mg/l
		Nitrate as NO3	I, R	2.00	mg/l
		Nitrite as NO2	I, R	<0.017	mg/l
		Ammonia as NH3	I, R	<0.006	mg/l
		Potassium	I, R	4	mg/l
		Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	I, R	105 **Unknown pattern	ug/l
		Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	I, R	<0.01	mg/l

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Environmental Scientist

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In-House Test	Specification	17025	GMP/FDA*	ISO**
Suspended Solids	CLS 13	Yes	No	Yes
Turbidity	CLS 30	Yes	No	Yes
pH	CLS 26	Yes	No	Yes
Conductivity @20C	CLS 67	Yes	No	Yes
Sodium, total	ICP-MS CLS129	Yes	No	Yes
Chloride	Konelab CLS 36	Yes	No	Yes
Ammonium as NH4	Konelab CLS 40	Yes	No	Yes
Nitrate as NO3	Konelab CLS 39	Yes	No	Yes
Nitrite as NO2	Konelab CLS 37	Yes	No	Yes
Ammonia as NH3	Konelab CLS 40	Yes	No	Yes
Potassium	ICP-MS CLS129	Yes	No	Yes
Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	CLS 147	Yes	No	Yes
Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	Konelab CLS 35	Yes	No	Yes

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Lab No	Sample ID	Sample Condition on Receipt	Sampling Date
950678	Cong Discharge	Good condition	29/04/2019

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CERTIFICATE OF ANALYSIS

Client : Nicky Mulchrone
McGrath's Limestone Cong Ltd
Cregaree, Cong
Claremorris
Co Mayo

Report No. : 388317
Date of Receipt : 01/05/2019
Start Date of Analysis : 01/05/2019
Date of Report : 14/05/2019
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	Ref.	Result	Units
950677	Cong Downstream	Suspended Solids	I, R	<2	mg/l
		Turbidity	I, R	0.5	N.T.U.
		pH	I, R	8.3	pH Units
		Conductivity @20C	I, R	233	uS/cm
		Sodium, total	I, R	9	mg/l
		Chloride	I, R	15.3	mg/l
		Ammonium as NH4	I, R	<0.01	mg/l
		Nitrate as NO3	I, R	1.97	mg/l
		Nitrite as NO2	I, R	<0.017	mg/l
		Ammonia as NH3	I, R	<0.006	mg/l
		Potassium	I, R	1	mg/l
		Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	I, R	92 **Unknown pattern	ug/l
		Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	I, R	<0.01	mg/l

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Suspended Solids	CLS 13	Yes	No	Yes
Turbidity	CLS 30	Yes	No	Yes
pH	CLS 26	Yes	No	Yes
Conductivity @20C	CLS 67	Yes	No	Yes
Sodium, total	ICP-MS CLS129	Yes	No	Yes
Chloride	Konelab CLS 36	Yes	No	Yes
Ammonium as NH4	Konelab CLS 40	Yes	No	Yes
Nitrate as NO3	Konelab CLS 39	Yes	No	Yes
Nitrite as NO2	Konelab CLS 37	Yes	No	Yes
Ammonia as NH3	Konelab CLS 40	Yes	No	Yes
Potassium	ICP-MS CLS129	Yes	No	Yes
Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	CLS 147	Yes	No	Yes
Molybdate Reactive Phosphorus (MRP unfiltered) as PO4-P	Konelab CLS 35	Yes	No	Yes

*Analysis carried out in a GMP approved, FDA inspected facility (MedPharma site only).
**Laboratory Analysis, Sampling, Food Safety Monitoring and Analysts on Contract are all ISO 9001 certified.

Lab No	Sample ID	Sample Condition on Receipt	Sampling Date
950677	Cong Downstream	Good condition	29/04/2019

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Appendix C

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Cong Robe GWB Descriptor Sheet (GSI, 2004)

European Code	IE_WE_G_0019
Groundwater Body Name	Cong-Robe
Flow Regime	Karstic
Groundwater Type	KA

Cong-Robe GWB: Summary of Initial Characterisation.

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Hydrometric Area Local Authority	Associated surface water features	Associated terrestrial ecosystem(s)	Area (km^2)
30 Mayo and Galway Co. Co's.	**Rivers**: Robe, Bulkan, Bunnadober, Cloonbur, Buldan, Scardaun, Ballindine. **Streams**: Cloondaver Stream North. **Canals**: Cong Canal **Lakes**: Bekan, Black, Clare, Crahery, Crohery, Drumady, Deen, Aglimmy, Corrib, Mask, Nambrackkeagh, Nanannagh, Shea, Pig Islands, Pollbaun, Polleamagur, Turloughmarlagh.	Lough Carra/Mask Complex (001774), Carrowkeel Turlough (000475), Kilglassan/Cahervoostia Turlough Complex (000504), Greaghans Turlough (000503), Skealoghan Turlough (000541), Ardkill Turlough (000461), Clyard Kettle Holes (000480), Mocorha Lough (001536), Lough Corrib (000297), Ballymaglancy Cave (000474).	440

Topography		The GWB occupies the area between Claremorris and Clonbur. The land surface is undulating with ground elevations ranging from 10-130 mAOD, sloping gently to the southwest. In the eastern area there are drumlinoid features. Elevations are highest (70-130 mAOD) in the northeast of the GWB and lowest in the southwest around L. Mask (5 mAOD). The GWB is bounded by surface water catchments to the northwest and southeast. At the westerly extent it is bounded by the shores of L. Mask and its most southerly section is bounded by L. Corrib.
Geology and Aquifers	**Aquifer categories**	The main aquifer category in this GWB is: **Rk^c:** Regionally important karstified aquifer dominated by conduit flow.
	Main aquifer lithologies	This GWB is composed of Dinantian Pure Bedded Limestones.
	Key structures	Few faults are mapped in this area; this may reflect the lack of major variation in the rock lithology. The dips are generally less than 5^o in a southerly direction. Between L. Mask and Cong, the bedrock dips 2-5^o to the southeast and in the vicinity of Cong the bedrock dips 10-15^o to the northwest, thus in the area of Cong there is a shallow syncline dipping to the southwest. Well defined N-S and E-W joint sets are evident throughout the area (Drew and Daly, 1993).
	Key properties	**Karstification** is widespread, and in the area of Cong the limestones are extremely karstified (Drew and Daly, 1993). Recorded karst features number 93, but are considered to represent only a fraction of existing features. Turloughs are particularly prevalent in the vicinity of Hollymount. All but two (classed as turloughs) of the currently known karst features occur to the south of the River Robe. It is likely that this is due to the presence of thicker till north of the Robe. Stream density is far greater to the north of the River Robe, illustrated in Figure 1. **Transmissivity and Storativity:** Specific capacities of 1 $m^3/d/m$ and 240 $m^3/d/m$ were obtained for two boreholes in the vicinity of Hollymount, implying variability in transmissivity (Coxon and Drew, 1986). Transmissivity is estimated to range from 1 m^2/d to greater than 250 m^2/d. Well hydrographs show a range of responses to rainfall. This is illustrated in Figure 2. The responses range from less than 1m to greater than 5m. Storativity is low - approximately 0.01-0.02 (Daly, 1985). Many of the spring flows rise and fall quickly in response to rainfall events reflecting the low storativity. Drew and Daly (1986) suggest that the residence time for a tracer is about ten times the initial transit time, indicating low storativity. Furthermore during prolonged drought many springs cease to flow and well yields drop significantly. **Groundwater Velocity, Gradient and Flow directions:** Tracer tests indicate variable groundwater velocities. Groundwater velocities have been measured at 10-100m/hr (Drew and Daly, 1993). Faster velocities exist between L. Mask and L. Corrib – measured 250-600 m/hr. To the east and north of Hollymount flow directions are generally expected to be to the southwest and west. In the area to the south of Hollymount flow directions are east to west under hydraulic gradients of 0.0008-0.00175 (Coxon and Drew (1986); Drew and Daly (1993)). This is illustrated in Figure 3. Between L. Mask and Cong Springs the flow directions are to the south. Although, there are two surface water catchments within the GWB, a *key* aspect is that groundwater can flow across the surface water divides and beneath surface water channels, as evidenced by a positive tracer test linking a turlough east of Cregduff spring to Fountainhill spring (Coxon and Drew, 1986). This is illustrated in Figure 4. As can be seen by comparing Figure 4 and 5 groundwater flow directions do not always relate to expected flow patterns. This is also the case between L.Mask and L. Corrib: tracer tests show there are N-S flow lines between L. Mask and L. Corrib but from the interpreted water table map for the area E-W flow lines could be inferred (Drew and Daly, 1986).
	Thickness	Tracer tests and chemistry suggest that maximum groundwater flux is in the uppermost 10-15 m but karstification extends to a depth of 50m (25 m below sea level) in the Cong area (Drew and Daly, 1993). However, during high water conditions the saturated zone increases in thickness by less than 10 m, thus large amounts of groundwater flows at low stage conditions, i.e., at depths of up to 20-25 m below sea level.
Overlying	**Lithologies**	Till is the dominant subsoil type, covering approximately 64% of the GWB. Cutover Peat comprises 13% of the area. Sand/gravel covers approximately 3% and alluvium approximately 1%. A full breakdown of the subsoil lithology is given in Table 1.

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	Thickness	To the west and south of Kilrush, the subsoil thickness is markedly less, as evidenced by the occurrence of "karstified bedrock at surface" and "rock at surface" – predominantly in the western and southwestern parts of the GWB. To the east of Kilrush the thickness of the till is up to 20 m in places (Coxon and Drew, 1986).
	% area aquifer near surface	Approximately 15% is classified as "karstified bedrock at surface" and "rock at surface" using the subsoils classification. The majority of this area is in the western and southwestern areas.
	Vulnerability	*[Information to be added at a later date]*
Recharge	**Main recharge mechanisms**	Both point and diffuse recharge occur. Diffuse recharge occurs via rainfall percolating through permeable subsoil and rock outcrops. Despite the presence of peat and till, point recharge to the underlying aquifer occurs by means of swallow holes and collapse features/dolines. Dolines have been recorded even in areas of thick peat deposits (Hickey et al, 2002). Point recharge occurs via many small sinks that are present in the low permeability till areas where the subsoil is breached. Along the whole southeastern shore of L. Mask there are swallow holes. Recharge also occurs along 'losing' sections of streams. Water from the Cong canal recharges to groundwater along its entire length and in all but the highest groundwater conditions (Drew and Daly, 1993). Along the river Robe, downstream of Kilrush recharge to groundwater occurs as the water table drops below the bed of the river.
	Est. recharge rates	*[Information to be added at a later date]*
Discharge	**Large springs and large known abstractions (m^3/d)**	Large Springs: Hatchery Springs (150,000 m^3/d) (Cong canal is dry), Bunatober (5,000 m^3/d), Cregduff (7,000 m^3/d), Fountainhill Cross (12,000 m^3/d), Loop Spring (750 m^3/d), Kilrush (1,500 m^3/d), Ballindine (3,000 m^3/d). Total 'natural' spring discharge at Cong was approximately 3 million m^3/d.
	Main discharge mechanisms	The main discharges are to the streams and rivers north of the River Robe and to the large springs to the south. Most of the drainage reaches L. Mask before leaving the lake via a large number of sinks on its southern shore. The two lakes are interconnected by complex conduit systems. Cong Springs is the outlet for the outflow from L. Mask to L. Corrib. Artificial routing of groundwater is also an important discharge mechanism: examples include the Cong Canal and the artificial conduit linking the Cregduff springs to the River Robe. Streams flowing east off the Silurian rocks of the Maam-Clonbur GWB sink underground at the contact with the limestones, emerging from small springs to the south of L. Mask or from the large springs at Cong (Drew and Daly, 1993).
	Hydrochemical Signature	The groundwater has a calcium bicarbonate signature. Data are available for Lissatava GWS (spring) and Ballindine PWS (spring) and selected parameters are presented as follows. Alkalinity (mg/l as $CaCO_3$): Lissatava, N= 13, range 106-416, median 340. Ballindine, N= 15, range 100-380, median 332. Total Hardness (mg/l): Lissatava, range 122-452, median 376 (very hard). Ballindine, range 126-400, median 368. Conductivity (μS/cm): Lissatava, range 612-822, median 730. Ballindine, range 640-752, median 724.
Groundwater Flow Paths		These rocks are generally devoid of intergranular permeability. Groundwater flows through fissures, faults, joints and bedding planes. In pure bedded limestones these openings are enlarged by karstification which significantly enhances the permeability of the rock. Karstification can be accentuated along structural features such as fold axes and faults. Groundwater flow through karst areas is extremely complex and difficult to predict as evidenced by flow lines delineated from tracer tests contrasting with water table maps. As flow pathways are often determined by discrete conduits, actual flow directions will not necessarily be perpendicular to the assumed water table contours, as shown by several tracing studies (Drew and Daly, 1993). Flow velocities can be rapid and variable, both spatially and temporally. Rapid groundwater flow velocities indicate that a large proportion of groundwater flow takes place in enlarged conduit systems. Groundwater flow in highly permeable karstified limestones is of a regional scale. Flow path lengths can be up to a several kilometres in length. Overall groundwater flow will be towards the rivers and lakes, but the highly karstified nature of the bedrock means that locally, groundwater flow directions can be highly variable.

Groundwater & Surface water interactions	The area is drained by the River Robe and its tributaries, however the present day drainage network has been changed by arterial drainage that took place early in the nineteenth century. The Bulkan River located in the western part of the GWB is an artificial outlet for the waters from Cregduff spring. Similarly other turloughs have been linked to Cross Springs via channels up to 8 m deep (Coxon and Drew, 1986). The Cong Canal is a famous artificial conduit, linking L. Mask to L. Cong. Figures 5 and 6 show the pre/post arterial drainage network. According to Coxon and Drew (1983), much of the current stream network is a wet weather runoff system that is inactive during summer months. Thus, prior to drainage, streams sank underground via the turloughs present in the GWB. Many of the streams have well defined losing stretches where they lose water to the underground system (Daly, 1985). All outflows from the entire L. Mask catchment become groundwater before entering L. Corrib. During the winter months there is a disproportionate increase in the flow downstream of Kilrush in the river Robe due to large inflows of groundwater to the river associated with high water tables. During the summer the situation is reversed, with upstream discharges up to 300% greater than downstream due to water being lost via the stream bed to groundwater below as the water table is below that of the river (Drew and Daly, 1993). There is a high degree of interconnection between groundwater and surface water in karstified limestone areas such as in this GWB. Even though large areas of peat and tills overlie the body, collapse features in these areas provide a direct connection between the surface and the groundwater systems. Streams flowing east off the Silurian rocks of the Maam-Clonbur GWB sink underground at the contact with the limestones, emerging from small springs to the south of L. Mask or from the large springs at Cong (Drew and Daly, 1993). The close interaction between surface water and groundwater in karstified aquifers is reflected in their closely linked water quality. Any contamination of surface water is rapidly transported into the groundwater system, and vice versa. Furthermore, there are a number of terrestrial ecosystems within this GWB with varying dependence on groundwater (Duchas National Heritage data).
Conceptual model	• The GWB occupies the area between Claremorris and Cong. The land surface is undulating with ground elevations ranging from 10-130 mAOD, sloping gently to the southwest. Elevations are highest (70-130 mAOD) in the northeast of the GWB and lowest in the southwest around Cong (10-20 mAOD). • The GWB is bounded by surface water catchments to the northwest and southeast. At the westerly extent it is bounded by the shores of L. Mask and its most southerly section is bounded by L. Corrib. • The area is principally drained by the River Robe and its tributaries, however the present day drainage network has been changed significantly by arterial drainage that took place early in the nineteenth century. Much of the current stream network is a storm runoff system and is inactive during summer months. Prior to artificial drainage, streams sank underground via turlough sinks. • Within the GWB, a surface water catchment has been shown to be bypassed by groundwater flowing beneath surface water channels and across surface water catchment divides. Tracer tests have shown that flow lines exist that do not relate to the expected flow lines inferred from water table maps. • A large number of karst features are present, particularly in the southwestern part of the GWB. Features include turloughs, caves, dolines, swallow holes and springs. In the area of Hollymount, turloughs are particularly prevalent. • The GWB is composed primarily of karstified limestone (**Rk^{c}**). Transmissivity is variable. Storativity is low. • Groundwater flows through a network of solutionally enlarged bedding planes, fissures and conduits. • Rapid groundwater flow velocities have been recorded through groundwater tracing. • Recharge occurs via losing streams, point and diffuse mechanisms. Despite the presence of peat and till, point recharge to the underlying aquifer occurs by means of swallow holes and collapse features/dolines. • Most of the groundwater flow occurs in the upper epikarstic layer and in a zone of interconnected solutionally enlarge bedding planes and fissures, generally extending to a depth of 50 m below ground. • In general, the degree of interconnection in karstic systems is high and they support regional scale flow systems. • Some areas in this GWB are of extreme vulnerability due to the thin nature of the subsoil, as well as the frequency of karst features, allowing point recharge. The potential for contaminant attenuation in such aquifers is limited. • The main discharges are to the rivers, large springs, L. Mask and L. Corrib. In winter, groundwater discharges to the many turloughs and transmitted via the artificial channels that were installed to alleviate flooding. • There is a high degree of interaction between surface water and groundwater. There are a number of terrestrial ecosystems which have varying dependence on groundwater. • The groundwater has a calcium bicarbonate signature.
Attachments	Figures 1, 2, 3, 4, 5, 6,. Table 1.
Instrumentation	**Stream gauges:** 30005, 30016, 30017, 30021, 30028, 30031, 30034, 30035, 30036, 30037, 30038, 30039, 30046, 30048, 30085, 30086, 30087. However, none around Cong are read or have any historical data (pers comm. Drew, 2004). **EPA Water Level Monitoring boreholes:** (MAY 64), (MAY 76). **EPA Representative Monitoring points:** (MAY 02), (MAY 32).

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Information Sources	Coxon, C., and Drew, D.P. (1986) *Groundwater flow in the lowland limestone aquifer of eastern Co. Galway and eastern Co. Mayo, western Ireland.* In: Paterson, K & Sweeting M. (eds), New Directions in Karst, Norwich, 259-280. Daly, D. (1985) *Groundwater in County Galway with particular reference to its Protection from Pollution.* Geological Survey of Ireland report for Galway County Council. 98pp. Drew D.P. and Daly D. (1993) *Groundwater and Karstification in Mid-Galway, South Mayo and North Clare.* A Joint Report: Department of Geography, Trinity College Dublin and Groundwater Section, Geological Survey of Ireland. Geological Survey of Ireland Report Series 93/3 (Groundwater), 86 pp Doak, M. (1995) *The Vulnerability to Pollution and Hydrochemical Variation of Eleven Springs (Catchments) in the Karst Lowlands of the West of Ireland*. Unpublished M.Sc. thesis, Sligo Regional Technical College. Hickey, C., Lee, M., Drew, D., Meehan, R. and Daly D. (2002) *Lowland Karst of North Roscommon and Westmeath*. International Association of Hydrogeologists Irish Group. Karst Field Trip October 2002. Unpublished IAH Report. Lee, M. & Daly D. (2003) *County Roscommon Groundwater Protection Scheme*. Main Report. Roscommon County Council & Geological Survey of Ireland, 54pp. Hickey, C., Lee, M., Drew, D., Meehan, R. and Daly D. (2002) Lowland Karst of North Roscommon and Westmeath. International Association of Hydrogeologists Irish Group. Karst Field Trip October 2002. Unpublished IAH Report.
Disclaimer	Note that all calculation and interpretations presented in this report represent estimations based on the information sources described above and established hydrogeological formulae.

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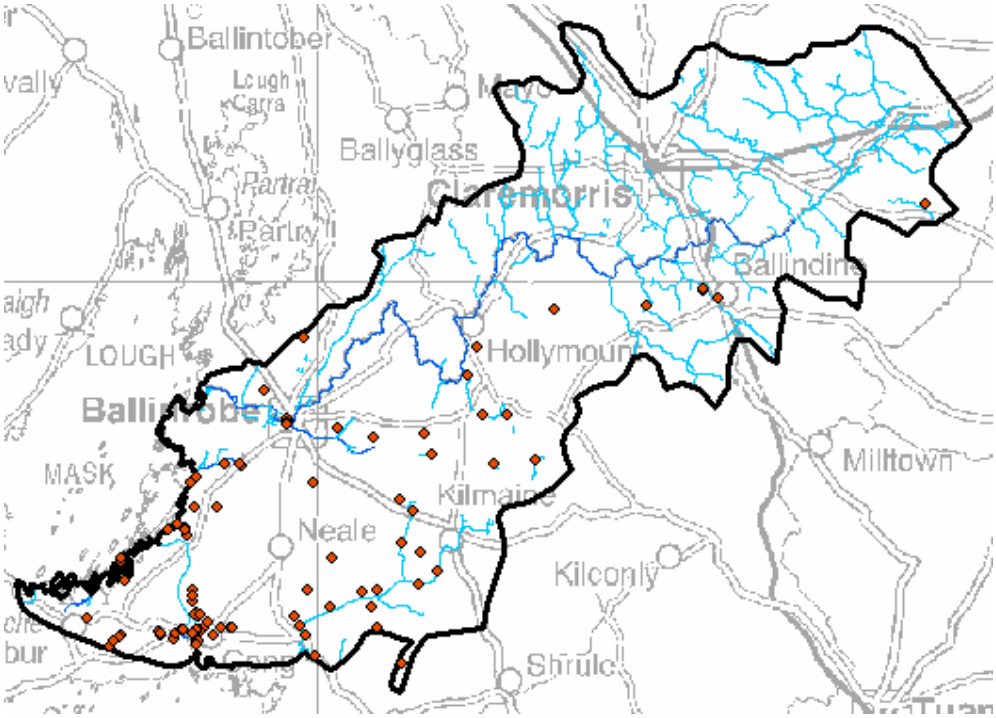

Figure 1. Illustration of the greater stream density north of the Robe and visible karst features generally occurring south of the river.
Note that the boundaries and location of the GWB are also shown.

Figure 2 Borehole hydrographs in the Ballinrobe area (After Coxon and Drew, 1986)

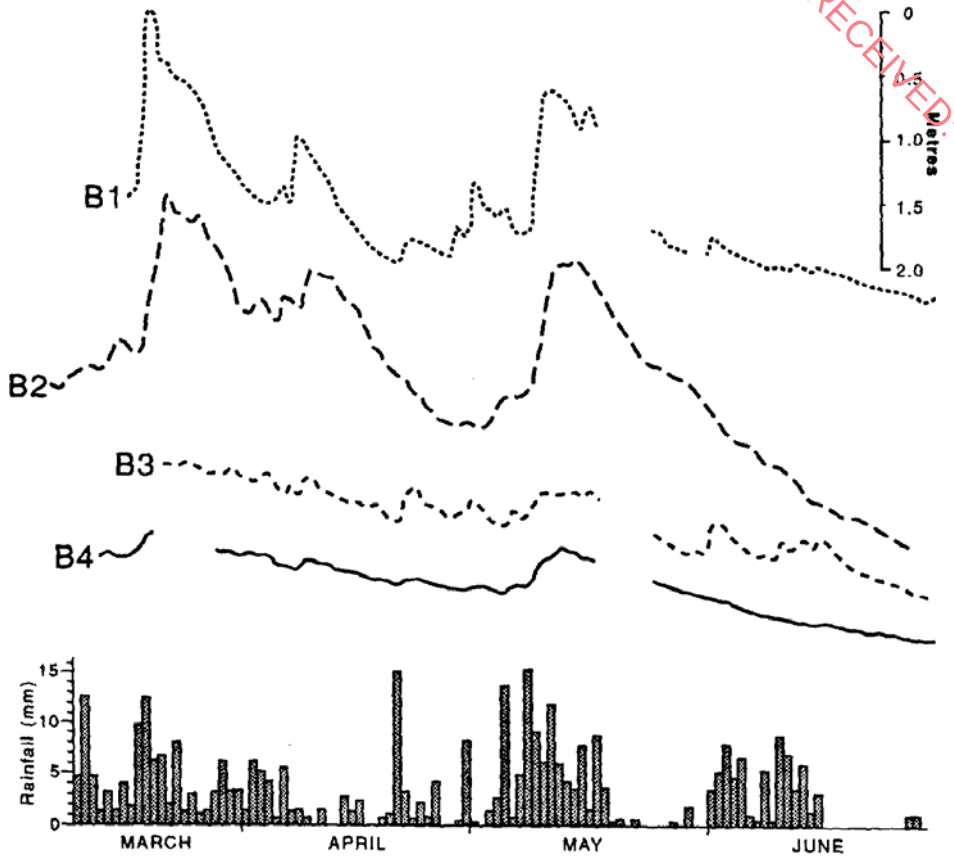

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Figure 3 Water table map Cong-Robe GWB (after Coxon and Drew, 1986)

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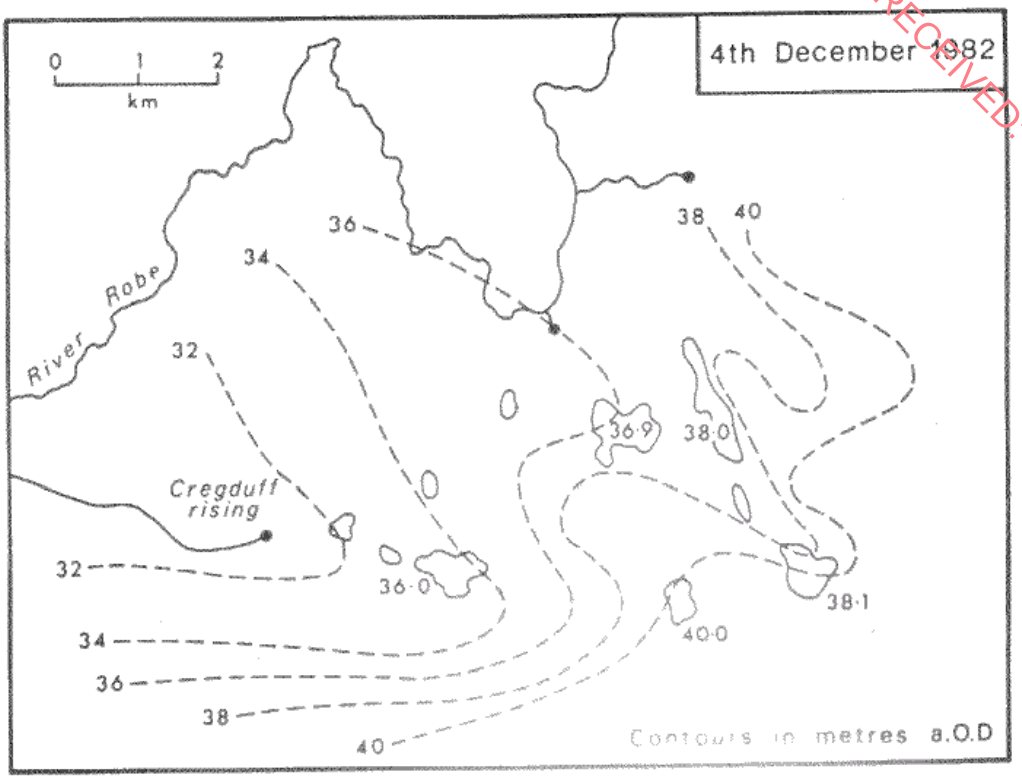

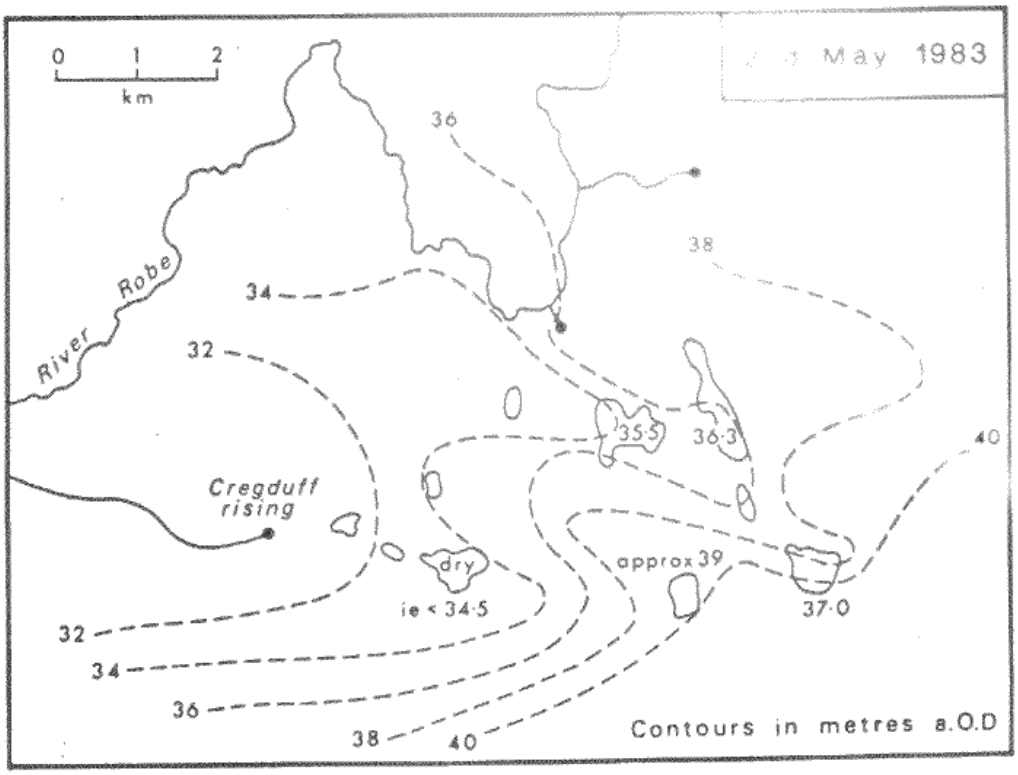

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Figure 4 Tracer tests to Cregduff and Fountainhill Springs (after Coxon and Drew, 1986)

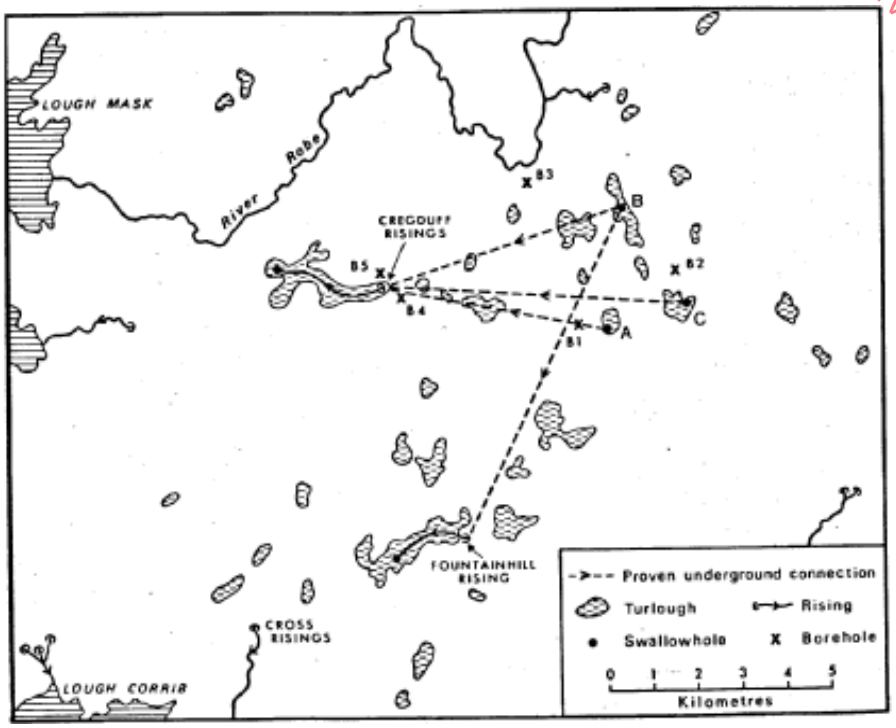

Table 1. Subsoil types in Clare-Corrib Groundwater.

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Parent Material	Code	Area sq km	approx. % cover of gwb
Alluvium	A	3.637994837	1%
Blanket Peat	BktPt	11.69248567	3%
Cutover Peat	Cut	56.02191753	13%
Eskers	Esk	1.876210259	0%
Limestone Sand/gravels (Carboniferous)	GLs	13.68548103	3%
Karstified Bedrock at surface	KaRck	60.51438824	14%
Lake Sediments undiferentiatedL	L	0.339230495	0%
Lake Sediments undiferentiatedL	Lake	1.826843357	0%
Madeground	Made	4.07413035	1%
Marl	Mrl	1.510926882	0%
Rock at Surface	Rck	4.395709499	1%
Raised peat	RsPt	0.08418063	0%
Sandstone and shale till (Lower Palaeozoic)	TLPSsS	8.623704196	2%
Limestone Till	TLs	271.5410855	62%

Figure 5 Pre Arterial Drainage.

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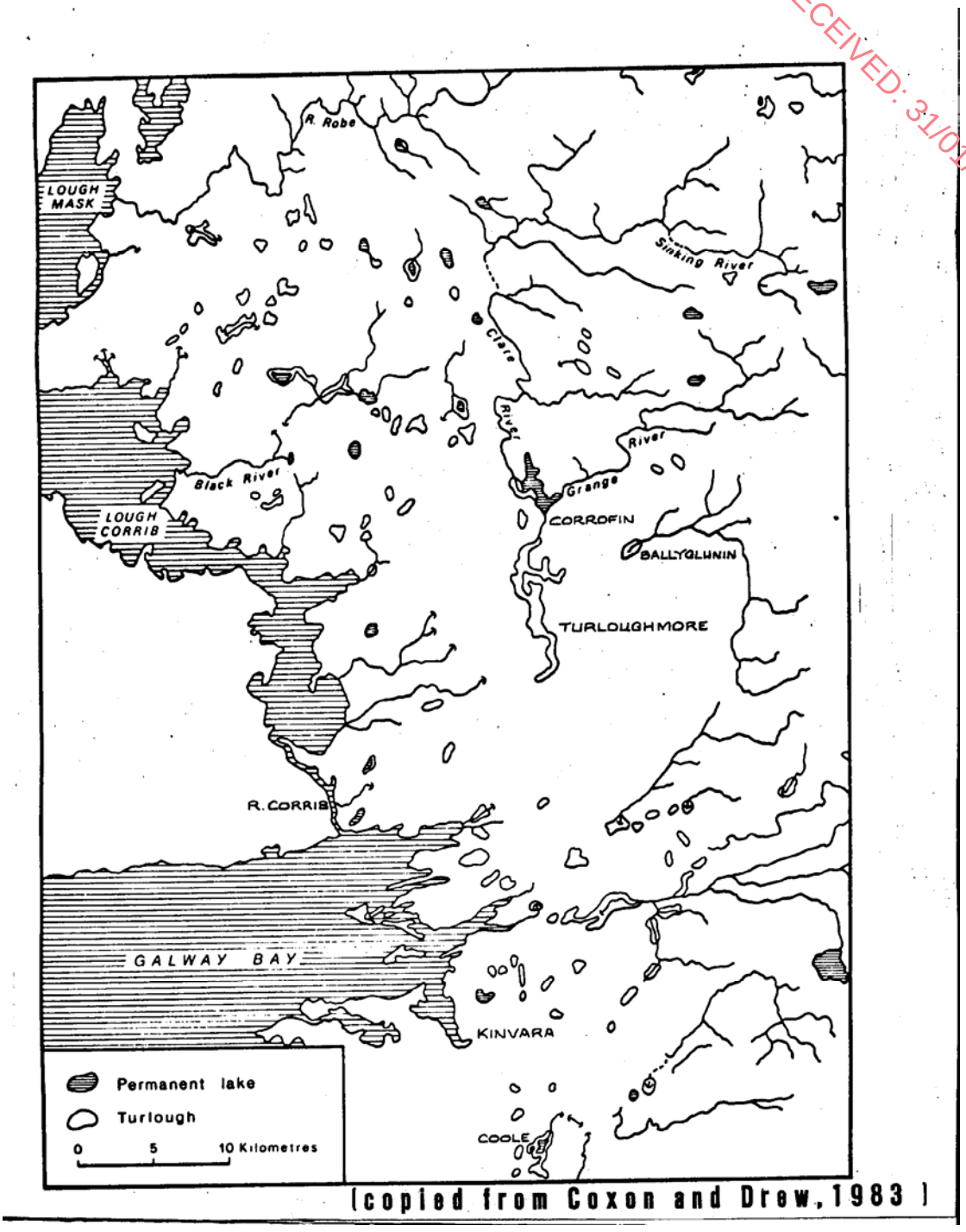

(copied from Coxon and Drew, 1983)

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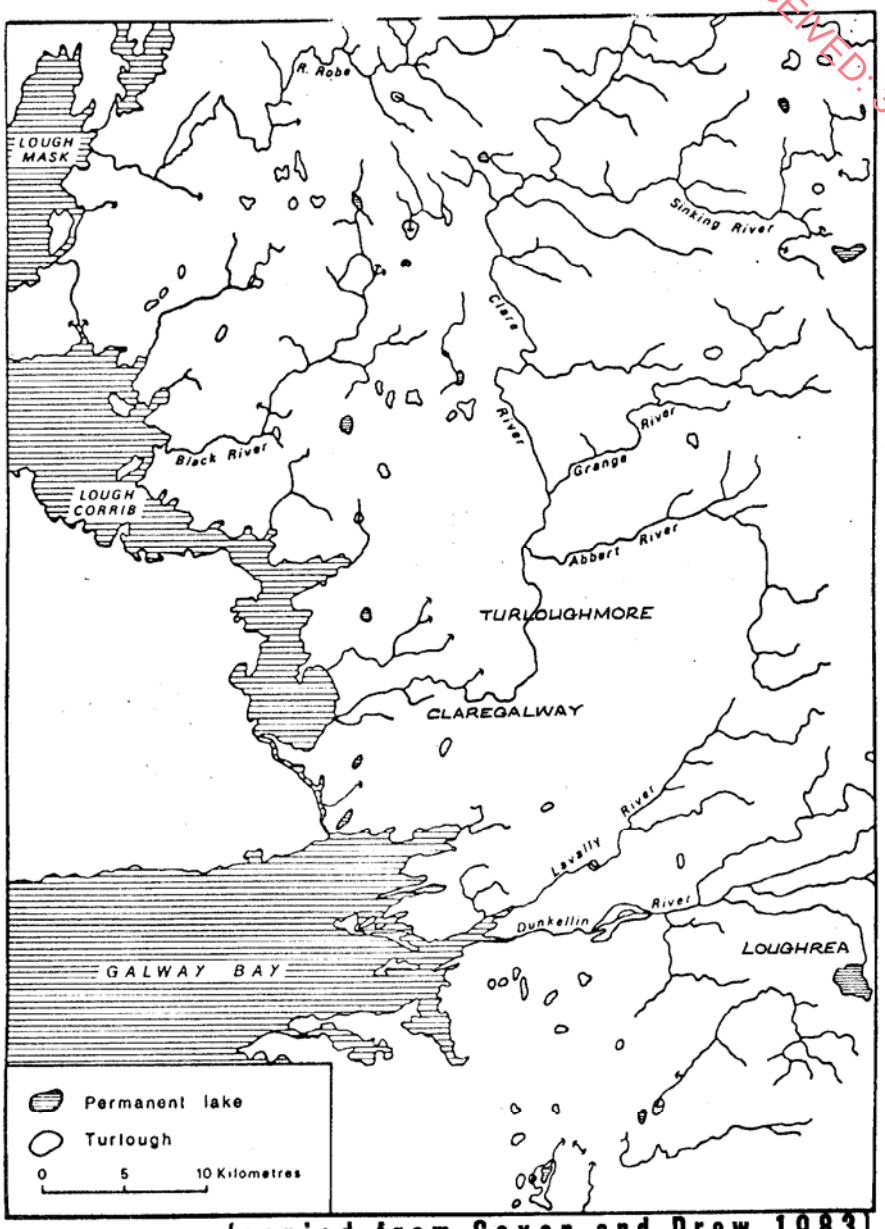
Figure 6 Post Arterial Drainage



[copied from Coxon and Drew, 1983]

Appendix 8.4 Guidance Documents & Legislative Instruments

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1) Department of Environment, Heritage and Local Government (2004) Quarries and Ancillary Activities – Guidelines for Planning Authorities.

2) Department of Housing, Planning and Local Government (2013) Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment.

3) Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy. Official Journal L 327, 22.12.2000, p. 1–73.

4) Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (EIA Directive).

5) EPA (1999) WWT systems for small communities and businesses.

6) EPA (2006) Environmental Management Guidelines for the Extractive Industry (Non-Scheduled Minerals).

7) EPA (2009) Code of Practice WW treatment for single houses.

8) EPA (2011) Guidance on the Authorisation of Discharges to Groundwater. Version 1 - December 2011.

9) EPA (2018) 30_13 Clare[Galway]_SC_060 Subcatchment Assessment WFD Cycle 2.

10) EPA (2021) Code of Practice Domestic Waste Water Treatment Systems (Population Equivalent ≤ 10). Published by the Environmental Protection Agency, Ireland. March 2021.

11) EPA (2022) Guidelines on the information to be contained in Environmental Impact Statements. ISBN 978-1-80009-005-7. May 2022.

12) European Communities (Birds and Natural Habitats) (AMENDMENT) Regulations, 2021. S.I. No. S.I. No. 293 of 2021.

13) European Communities (Birds and Natural Habitats) Regulations, 2011. S.I. No. 477 of 2011, as amended 2021 as S.I. No. 293 of 2021.

14) European Communities (Conservation Of Wild Birds (Lough Corrib Special Protection Area 004042)) Regulations 2012. S.I. No. 455 Of 2012.

15) European Communities (Quality of Salmonid Waters) Regulations, 1988. S.I. No. 293/1988.

16) European Communities Environmental Objectives (Groundwater) (Amendment) Regulations, 2011, S.I. No. 389 of 2011.

17) European Communities Environmental Objectives (Groundwater) (Amendment) Regulations, 2012, S.I. No. 149 of 2012.

18) European Communities Environmental Objectives (Groundwater) (Amendment) Regulations, 2016. S.I. No. 366 of 2016.

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19) European Communities Environmental Objectives (Groundwater) Regulations, S.I. No. 9 of 2010, as amended 2019 as S.I. No. 366 of 2019.

20) European Communities Environmental Objectives (Surface Waters) Regulations 2009 Statutory Instruments S.I. No. 272 of 2009, as amended 2012 (S.I. No. 327 of 2012), 2015 (S.I. No. 386 of 2015) and 2019 (S.I. No. 77 of 2019).

21) European Union (2017) Environmental Impact, Assessment of Projects: Guidance on the preparation of the Environmental Impact Assessment Report (Directive 2011/92/EU as amended by 2014/52/EU). Accessed through the Europa server (http://ec.europa.eu). Paper ISBN 978-92-7974373-3 KH-04-17-939-EN-C doi:10.2779/8247. PDF ISBN 978-92-7974374-0 KH-04-17-939-EN-N doi:10.2779/41362.

22) European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018. S.I. No. 296/2018.

23) European Union (Environmental Impact Assessment) (Environmental Protection Agency Act 1992) (Amendment) Regulations 2020. S.I. No. 191/2020.

24) European Union (Drinking Water) Regulations 2023 (S.I. No. 99 of 2023).

25) European Union Habitats (Lough Corrib Special Area of Conservation 000297) Regulations 2022. S.I. No. 384/2022.

26) Ferguson & Leask (1988) The export of nutrients from surface coal mines. Environment Canada conservation and protection environmental protection pacific and Yukon region west Vancouver, British Columbia.

27) Institute of Geologists of Ireland (IGI, 2002) Geology in Environmental Impact Statements: A Guide

28) Institute of Geologists of Ireland (IGI, 2013). Guidelines for the Preparation of Soils, Geology & Hydrogeology Chapters of Environmental Impact Statements.

29) NRA (2008) Environmental Impact Assessment of National Road Schemes – A Practical Guide.

30) NRA (2009) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes. @ https://www.tii.ie/technical-services/environment/planning/Guidelines-on-Procedures-for-Assessment-and-Treatment-of-Geology-Hydrology-and-Hydrogeology-for-National-Road-Schemes.pdf.

31) Office of Public Works and Department of Environment, Heritage and Local Government (2009) The Planning System and Flood Risk Management: Guidelines for Planning Authorities.

32) SNH (2018) Scottish National Heritage A handbook on environmental impact assessment: Guidance for Competent Authorities, Consultees and others involved in the Environmental Impact Assessment Process in Scotland, Scottish Natural Heritage, 5th Edition, 2018. Section C8.

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Appendix 8.5 Desk Study Resources, Data & Maps

The following Desk Study Resources, Books, Data & Mapping information were used in the compilation of this assessment:

- Boak, et al. (2007) Using Science to Create a Better Place: Hydrogeological Impact Appraisal for Dewatering Abstractions. Environment Agency, Science Report – SC40020/SR1. Bristol, UK.
- Boycott, T., Drew, D., Mullan, G., Podesta, J., Simms, M., Wilson, L. (2019) Caves of Mid-West Ireland. Counties Clare, Galway, Mayo and Roscommon. The University of Bristol Speleological Society.
- Coxon, C., and Drew, D.P. (1986) Groundwater flow in the lowland limestone aquifer of eastern Co. Galway and eastern Co. Mayo, western Ireland. In: Paterson, K & Sweeting M. (eds), New Directions in Karst.
- Colthurst, J. (2014) Quarry at Cregaree, Cong, County Mayo. Report for McGrath Quarry Group Ltd. August 2014.
- Daly, D. (1985) Groundwater in County Galway with particular reference to its Protection from Pollution. Geological Survey of Ireland report for Galway County Council. 98pp.
- Drew D.P. and Daly D. (1993) Groundwater and Karstification in Mid-Galway, South Mayo and North Clare. A Joint Report: Department of Geography, Trinity College Dublin and Groundwater Section, Geological Survey of Ireland. Geological Survey of Ireland Report Series 93/3 (Groundwater), 86 pp.
- Drew, D.P. (1973a) Hydrogeology of the north Co. Galway – south Co. Mayo lowland karst area, Western Ireland. International Speleology 1973, III, Sub –section Ca.
- Drew, D.P. (1973b). Ballyglunin Cave Co. Galway and the hydrology of the surrounding area. Irish Geography Vol. 6, No. 5. pp 610-617.
- EPA (2019) WFD Cycle 2 30_18 Corrib_SC_010 Subcatchment Assessment.
- EPA (2024) WFD 3rd Cycle Corrib Catchment Report (HA 30). Catchment Science & Management Unit Environmental Protection Agency. May 2024.
- EPA Envision System (https://gis.epa.ie/EPAMaps/).
- EPA Online Water Quality Mapping. (https://gis.epa.ie/EPAMaps/).
- ESP (2006). Hydrogeological report. McGrath's Limestone Quarry. Earth Science Partnership.
- Geological Survey of Ireland (GSI) – online mapping resources (www.gsi.ie).
- Gill, M. (2014) Ashford Castle, Co. Galway – Hydrological and Hydrogeological Impact Assessment of Proposed Basement Construction. June 2014. Prepared For: MCCA/OCSC. Prepared By: Hydro-Environmental Services. Project Number P1240.
- GSI (2003, 2005) Bedrock Geology Sheets 11, 14 & 15, 1:100,000 Map Series. Geological Survey of Ireland.
- GSI (2004) 1st Draft Clare-Corrib GWB Description June. 2004 Clare-Corrib GWB: Summary of Initial Characterisation.
- GSI (2019) Lough Corrib, Co. Galway GY093. https://gsi.geodata.gov.ie/downloads/Geoheritage/Reports/GY093_Lough_Corrib.pdf.

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- GSI (2019) Castle Lake (Lough Mask), Co. Mayo M0027. https://gsi.geodata.gov.ie/downloads/Geoheritage/Reports/MO027_Castle_Lake_Lough_Mask.pdf.
- GSI (2019) Cong Springs and Pigeon Hole, Co. Galway. GY036. https://gsi.geodata.gov.ie/downloads/Geoheritage/Reports/GY036_Cong_Springs_and_Pigeon_Hole.pdf.
- GSI (2019) Curreighnabannow Spring, Co. Mayo MO040. https://gsi.geodata.gov.ie/downloads/Geoheritage/Reports/MO040_Curreighnabannow_Spring.pdf.
- GSI (2019) Lough Mask. MO078. https://gsi.geodata.gov.ie/downloads/Geoheritage/Reports/MO078_Lough_Mask.pdf.

- GSI On-line Groundwater database. Aquifer Classification, Aquifer Vulnerability, Teagasc Soil Classification, Subsoils, Karst features, groundwater recharge.

- GWP Consultants and David Jarvis Associates Limited, UK (2014) A Quarry Design Handbook. 2014 Edition.
- Hydro-G (2015) Hydrology & Hydrogeology – EIAR. Substitute Consent Application.
- Hydro-G (2019) Section 4 Discharge Licence Report. Assimilation Capacity and ELVs. Prepared for McGrath Limestone Works in respect of Site Initiated Review of Licence W/391/05 (2007), which became W/391/05_R1 (2019).
- Hydro-G (2020) Hydrology & Hydrogeology – EIAR. PL Application.
- LAWPRO (2018) Lough Mask & Lough Carra Priority Area for Action – Desk Study Summary. https://catchments.ie/wp-content/files/areaforactionreports/AFA0120%20Lough%20Mask%20and%20Lough%20Carra%20AFA%20Report.pdf.
- LAWPRO (2021) Lough Mask and Lough Carra (Mayo) Priority Area for Action Desktop Assessment (AFA0120) Version F01 14th July 2021 Western Region. Copyright © LAWPRO, July 2021 This Report cannot be reproduced without the prior written consent of LAWPRO. https://lawaters.ie/app/uploads/2022/05/AFA0120_Lough-Mask-Lough-Carra_Desktop_Assessment.pdf.
- Long, C.B. and McConnell, B., 1995. Geology of South Mayo. Geological Survey of Ireland 1:100,000 scale Bedrock Geology Map Series, Sheet 11.
- Mayo County Council (2022) County Development Plan 2022 - 2028. Strategic Flood Risk Assessment. JBA Consulting.
- Met Eireann (https://www.met.ie/).
- Moore, J.P. & Walsh, J.J. (2013) Analysis of fracture systems and their impact on flow pathways in Irish bedrock aquifers. Groundwater newsletter. Issue 51. ISSN 0790-7753. Oct 2013.
- National Parks & Wildlife Services Public Map Viewer (www.npws.ie), Site Synopsis, Conservation Objectives & review of the 2015 application consultation notes from NPWS on this site (Kirby & Fossitt).
- National Parks and Wildlife Service (NPWS). Database of Special Areas of Conservation, National Heritage Areas, National Parks, Special Protection Areas including site synopsis reports.

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- NPWS (2017) Conservation Objectives: Lough Corrib SAC 000297. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs. Ordnance Survey of Ireland, Sheet No. 6, 1:50,000.
- OPW Hydrometrics (http://waterlevel.ie/hydro-data/search.html?free=cong).
- Ordnance Survey, Ireland Map Series 1:50,000 Sheets.
- Reclamation Planning in Hard Rock Quarries. Department of Civil & Structural Engineering, University of Sheffield, Edge Consultants & Mineral Industry Research Organisation (2004).
- Water Framework Directive Reports and "Watermaps" Map Viewer (www.wfdireland.ie).
- WFD Working Group (2004a) Guidance document no. GW3: THE CALCAREOUS/ NON-CALCAREOUS ("SILICEOUS") CLASSIFICATION OF BEDROCK AQUIFERS IN THE REPUBLIC OF IRELAND.
- WFD Working Group (2004b) Guidance Document no. GW5: Guidance on the Assessment of the Impact of Groundwater Abstractions.

Appendix 8.6 Scoping Responses of Relevance to Water: GSI & Uisce Eireann

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In this Appendix, the full Text of each Scoping Response are presented in the final pages and the initial section of this Appendix provides the high-level Hydro-G response.

8.6.1 The Geological Survey of Ireland (GSI) responded on the 5th of July 2024 (their Ref: 24/217) with a 5 page detailed cross referencing of important considerations and resources available to the applicant.

- The GSI offered that "With the current plan, there are no envisaged impacts on the integrity of current CGSs by the proposed development. However, if the proposed development plan is altered, please contact Clare Glanville (Clare.Glanville@gsi.ie) for further information and possible mitigation measures if applicable." It is hereby confirmed that all GSI data bases have been used in this assessment and a complete Impact Assessment Potential consideration is presented in relation to the two Geoheritage Sites detailed in the GSI's Scoping Response, as follows:

  "*The audit of County Geological Sites (CGSs) of County Mayo and County Galway were published in 2020 and 2019 respectively.* ***Our records show that there are CGSs adjacent to the limestone quarry.***

  - ***Cong Springs and Pigeon Hole****, Co. Galway (GR 114001, 255389), under IGH themes: IGH1 Karst, IGH16Hydrogeology. A number of complex karst features; caves, springs, dolines, epikarst outcrop & limestone pavement. The springs are some of the largest worldwide and the area is an intricate and complex karst system. Link to Site Report: GW036.*
  - ***Curreighnabannow Spring****, Co. Mayo (GR 114944, 255827), under IGH theme: IGH1 Karst, IGH16 Hydrogeology. A major spring of the extensive underground drainage system between Lough Mask and Lough Corrib. The spring is the highest of the Cong springs and is one that operates at successively higher levels as stage levels rise. The site contributes to a major water supply source and it is one of the most important karst sites in County Mayo and County Galway. Link to Site Report: MO040."*

- As part of EIAs completed for the site in 2017, 2019 and 2020, Hydro-G has previously presented impact assessments on each of those CGSs.
- In overall summary, the pre-63 area of the quarry has already exposed the subsurface between Lough Mask and Lough Corrib and Lough Mask and the Cong Springs and Pigeon Hole. Therefore, if there was an "*extensive underground drainage system between Lough Mask and Lough Corrib"* under the application area we would have experienced it in complete flooding of the site and cessation of operations because no pumps can manage that volume of water. The present Section 4 Discharge Licence's 10,000 m3/d Emission Limit Value for Discharge Volume is never achieved. This is expanded on and discussed to conclusion in the Section of this Chapter entitled 'Conceptual Understanding of the Site & Environment'.
- A final point on the GSI Response to Scoping is that they cited two CGSs, which the assessment will consider, but there are three other associated CGSs that will also be included in this assessment, as follows:

  - **Lough Mask**, Co. Mayo (GR 110315, 263412), under IGH theme IGH14. A large shallow solutional lake occupying the limestone lowlands to the east of the Maumtrasna and Partry mountains. Link to Site Report M0078: https://gsi.geodata.gov.ie/downloads/Geoheritage/Reports/MO078_Lough_Mask.pdf

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- **Castle Lake (Lough Mask)** (GR 112765, 259158), under IGH theme IGH1. A long, narrow solutional lake at SE end of Lough Mask. Castle Lake (& Dringeen Bay) is situated on the Cong Isthmus karst limestone landscape. Cong Canal traverses the SW end of lake. Link to Site Report M0027. https://gsi.geodata.gov.ie/downloads/Geoheritage/Reports/MO027_Castle_Lake_Lough_Mask.pdf
- **Lough Corrib, Co. Galway** (GR 118000, 244185) under IGH14, IGH1 and IGH7. A large lake situated between County Galway's western acidic uplands and the limestone lowlands. Link to Site Report GY093. https://gsi.geodata.gov.ie/downloads/Geoheritage/Reports/GY093_Lough_Corrib.pdf

8.6.2 Uisce Éireann responded on the 1st of July 2024 (their Ref. PN24000005590). Key points from Uisce Éireann's text, italicised here, are summarised and responded to, as follows:

- *Ensure no negative impact to Uisce Éireann's Drinking Water Source(s), Identify & assess Hydrological / hydrogeological pathways between the site and receiving waters.*

  Hydro-G offers: None envisaged. Hydrological pathway is the site's licensed discharge point on the Cong Canal and its discharge to Lough Corrib. Groundwater could also be a pathway. However, the Section 4 Licence was reviewed in 2019 (W/391/05_R1, 2019 Galway County Council) and the Emission Limit Values ensure compliance with the Surface Water Regulations (2019, as amended) and the Groundwater Regulations (2010, as amended): each of which afford more demanding rules on quality than the Drinking Water regulations (2023). Therefore, Drinking Water is deemed safe as a source of PWS and the EIAR addresses this specifically in multiple sections of the EIAR and a specific section at the end entitled PWS Protection Measures.

- *If backfilling, outline sampling to ensure material is inert.*

  Hydro-G offers: Not Applicable to this site.

- *Propose Mitigation Measures and detail in environmental management plan and incident response: Environmental Response Plan.*
- **Hydro-G offers: The EMP is attached to the application. Potential Impacts, Mitigation Measures and Residual Impacts are presented in Tabular format in the final section of the EIAR Chapter for Water.**

- *Nearby Reservoirs.*

  Hydro-G offers: Not Applicable to this site.

- *If connections to sewers or mains supply are needed, apply.*

  Hydro-G offers: Not Applicable to this site.

- *Any upgrading required of UE?*

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Hydro-G offers: No.

- *Interaction with UE sewer?*

  Hydro-G offers: No.

- *Interaction with stormwater Infrastructure of UE?*

  Hydro-G offers: No.

- *UE Infrastructure or wayleaves at the site?*

  Hydro-G offers: Not Applicable to this site.

- *Potential impacts on the assimilative capacity of receiving waters in relation to Uisce Éireann discharge outfalls?*

  Hydro-G offers: Not Applicable to this site. The quality of the site's discharge conforms to the High Status Environmental Quality Objectives of the Surface Water Regulations (2009). The discharge can only improve the Good Status waters of the receiving environment. Projected impact is positive, with respect to Uisce Eireann discharge outfalls.

- *Potential impact on the contributing catchment of water sources or risk to the quality of the water abstracted by Uisce Éireann for public supply should* ***be identified.***

  Hydro-G offers: A specific section of the EIAR deals with this, entitled PWS Protection Measures.

- *Mitigation Measures required in relation to the above and zero risk to any Uisce Éireann drinking water sources (Surface and Ground water).*

  Hydro-G offers: There is Zero Risk. The Quantitative Water Balance suggests that the site's discharge accounts for 1% of the groundwater in the GWB and there is no net loss because the 'abstraction' quickly, after appropriate settlement time, becomes a Discharge returning the waters to the same hydrological system.

  Hydro-G offers: The Conditions of the Section 4 Licence preclude impact.

In overall summary, the 'Source > Pathway > Model' by virtue of the application of the UK EA Dewatering Impact Appraisal Process and, in combination with the Section 4 Discharge Licence W/391/05_R01 (held by the site and reviewed in 2019) enables a conclusion of no residual risk to Lough Corrib as a source of public water supply.

- Readers are again referred to **Appendix 8.2** for a copy of the W/391/05_R01 licence, to **Appendix 8.3** for the Hydro-G (2019) report that supported it, and to **Appendix 8.6** for the detailed response by Hydro-G to each item presented by Uisce Eireann.
- The Impact Tables at the end of the EIAR Water Chapter incorporate all information.

An Roinn Comhshaoil,
Aeráide agus Cumarsáide
Department of the Environment,
Climate and Communications

Geological Survey
Suirbhéireacht Gheolaíochta
Ireland | Éireann

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Rory Brickenden
Quarry Consulting
Cedar Park
Westport
Co. Mayo, F28 PN47

05 June 2024

Re: Deepening of part of the existing permitted limestone quarry at Cregaree, Cong, Co Mayo
Your Ref: 65.01
Our Ref: 24/217

Dear Rory,

Geological Survey Ireland is the national earth science agency and is a division of the Department of the Environment, Climate and Communications. We provide independent geological information and gather various data for that purpose. Please see our website for data availability. We recommend using these various data sets, when conducting the EIAR, SEA, planning and scoping processes. Use of our data or maps should be attributed correctly to 'Geological Survey Ireland'.

The publicly available data referenced/presented here, should in no way be construed as Geological Survey Ireland support for or objection to the proposed development or plan. The data is made freely available to all and can be used as independent scientific data in assessments, plans or policies. It should be noted that in many cases this data is a baseline or starting point for further site specific assessments.

With reference to your email received on the 29 May 2024, concerning the eepening of part of the existing permitted limestone quarry at Cregaree, Cong, Co Mayo, Geological Survey Ireland would encourage use of and reference to our datasets. This data can add to the content and robustness of the SEA process. With this in mind, please find attached a list of our publicly available datasets that may be useful to the environmental assessment and planning process. We recommend that you review this list and refer to any datasets you consider relevant to your assessment. The remainder of this letter and following sections provide more detail on some of these datasets.

Geoheritage

Geological Survey Ireland is in partnership with the National Parks and Wildlife Service (NPWS, Department of Housing, Local Government and Heritage), to identify and select important geological and geomorphological sites throughout the country for designation as geological NHAs (Natural Heritage Areas). This is addressed by the Geoheritage Programme of Geological Survey Ireland, under 16 different geological themes, in which the minimum number of scientifically significant sites that best represent the theme are rigorously selected by a panel of theme experts.

County Geological Sites (CGSs), as adopted under the National Heritage Plan, include additional sites that may also be of national importance, but which were not selected as the very best examples for NHA designation. All geological heritage sites identified by Geological Survey Ireland are categorised as CGS pending any further NHA designation by NPWS. CGSs are now routinely included in County Development Plans and in the GIS of planning departments, to ensure the recognition and appropriate protection of geological heritage within the planning system. CGSs can be viewed online under the Geological Heritage tab on the online Map Viewer.

The audit of County Geological Sites of County Mayo and County Galway were published in 2020 and 2019 respectively. The full report details can be found here and here. **Our records show that there are CGSs adjacent to the limestone quarry.**

> **Cong Springs and Pigeon Hole**, Co. Galway (GR 114001, 255389), under IGH themes: IGH1 Karst, IGH16 Hydrogeology. A number of complex karst features; caves, springs, dolines, epikarst outcrop & limestone pavement. The springs are some of the largest worldwide and the area is an intricate and complex karst system. Link to Site Report: GW036.
>
> **Curreighnabannow Spring**, Co. Mayo (GR 114944, 255827), under IGH theme: IGH1 Karst, IGH16 Hydrogeology. A major spring of the extensive underground drainage system between Lough Mask and Lough Corrib. The spring is the highest of the Cong springs and is one that operates at successively higher levels as stage levels rise. The site contributes to a major water supply source and it is one of the most important karst sites in County Mayo and County Galway. Link to Site Report: MO040.

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With the current plan, there are no envisaged impacts on the integrity of current CGSs by the proposed development. However, if the proposed development plan is altered, please contact Clare Glanville (Clare.Glanville@gsi.ie) for further information and possible mitigation measures if applicable.

Geological Survey Ireland would request that the operator might assist our geological heritage goals with the following (and ideally this would be written into the restoration / closure plan) and be included as a condition of planning as deemed appropriate by the planning authority:

1. Allowing access to quarry faces by appropriate scientists (upon request and with due regards to Health and Safety requirements) during quarrying to check for interesting new stratigraphies / relationships as they might become exposed and to establish if the quarry site is worthy of recognition post extraction and through aftercare/restoration planning.

2. If deemed appropriate in (1) above, leaving a representative section of the quarry face at the end of the quarry life or inclusion of information panels to promote the geology to the public or develop tourism or educational resources if appropriate depending on the future use of the site. Natural exposures are few, or deeply weathered, this measure would permit on-going improvement of geological knowledge of the subsurface.

The Geoheritage Programme tries to promote a partnership between geological heritage and active quarrying, with such measures as those outlined in the 'Geological Heritage Guidelines for the Extractive Industry', which can be downloaded here. This document, written in association with Irish Concrete Federation, acts as a comprehensive guide in the sustainable extraction of natural resources while preserving the geological heritage of Ireland.

Groundwater

Geological Survey Ireland's Groundwater and Geothermal Unit, provides advice, data and maps relating to groundwater distribution, quality and use, which is especially relevant for safe and secure drinking water supplies and healthy ecosystems. Proposed developments need to consider any potential impact on specific groundwater abstractions and on groundwater resources in general. We recommend using the groundwater maps on our Map viewer which should include: wells; drinking water source protection areas; the national map suite - aquifer, groundwater vulnerability, groundwater recharge and subsoil permeability maps**.**

For areas underlain by limestone, please refer to the karst specific data layers (karst features, tracer test database; turlough water levels (gwlevel.ie). Background information is also provided in the Groundwater Body Descriptions. Please read all disclaimers carefully when using Geological Survey Ireland data.

The Groundwater Data Viewer indicates an aquifer classed as a 'Regionally Important Aquifer - Karstified (conduit)' underlies the proposed development.

The Groundwater Vulnerability map indicates the range of groundwater vulnerabilities within the area covered is variable. We would therefore recommend use of the Groundwater Viewer to identify areas of High to Extreme Vulnerability and 'Rock at or near surface' in your assessments, as any groundwater-surface water interactions that might occur would be greatest in these areas.

The Karst Viewer indicates numerous karst features in the vicinity including karst springs, enclosed depressions, turlough and caves.

GWClimate is a groundwater monitoring and modelling project that aims to investigate the impact of climate change on groundwater in Ireland. This is a follow on from a previous project (GWFlood) and the data may be useful in relation to Flood Risk Assessment (FRA) and management plans. Maps and data are available on the Map viewer.

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Geological Survey Ireland has completed Groundwater Protection Schemes (GWPSs) in partnership with Local Authorities, and there is now national coverage of GWPS mapping. A Groundwater Protection Scheme provides guidelines for the planning and licensing authorities in carrying out their functions, and a framework to assist in decision-making on the location, nature and control of developments and activities in order to protect groundwater.

The Groundwater Protection Response overview and link to the main reports is here: https://www.gsi.ie/en-ie/programmes-and-projects/groundwater/projects/protecting-drinking-water/what-is-drinking-water-protection/county-groundwater-protection-schemes/Pages/default.aspx

Geological Mapping

Geological Survey Ireland maintains online datasets of bedrock and subsoils geological mapping that are reliable and accessible. We would encourage you to use these data which can be found here, in your future assessments.

Please note we have recently launched QGIS compatible bedrock (100K) and Quaternary geology map data, with instructional manuals and videos. This makes our data more accessible to general public and external stakeholders. QGIS compatible data can be found in our downloadable bedrock 100k .zip file on the Data & Maps section of our website.

Geohazards

Geohazards can cause widespread damage to landscapes, wildlife, human property and human life. In Ireland, landslides, flooding and coastal erosion are the most prevalent of these hazards. We recommend that geohazards be taken into consideration, especially when developing areas where these risks are prevalent, and we encourage the use of our data when doing so.

Geological Survey Ireland has information available on landslides in Ireland via the National Landslide Database and Landslide Susceptibility Map both of which are available for viewing on our dedicated Map Viewer. Associated guidance documentation relating to the National Landslide Susceptibility Map is also available.

Geological Survey Ireland also engaged in a national project on Groundwater Flooding. The data from this project may be useful in relation to Flood Risk Assessment (FRA) and management plans, and is described in more detail under 'Groundwater' above.

Geochemistry of soils, surface waters and sediments

Geological Survey Ireland provides baseline geochemistry data for Ireland as part of the Tellus programme. Baseline geochemistry data can be used to assess the chemical status of soil and water at a regional scale and to support the assessment of existing or potential impacts of human activity on environmental chemical quality. Tellus is a national-scale mapping programme which provides multi-element data for shallow soil, stream sediment and stream water in Ireland. At present, mapping consists of the border, western and midland regions. Data is available at https://www.gsi.ie/en-ie/data-and-maps/Pages/Geochemistry.aspx.

Geophysical data

Geological Survey Ireland produces high-resolution geophysical data (Magnetic field, electrical conductivity, natural gamma-ray radiation) of soils & rocks as part of the Tellus programme. These data currently cover approximately 75% of the country and provide supporting geological information on a regional scale useful for assessing environmental impact and risk. The Tellus programme provides expertise to the Environmental Protection Agency (EPA) for the determination of radon risk. The data is used in mineral exploration or is useful in aiding site investigation works for large scale projects.

Guidelines

The following guidelines may also be of assistance:

- Institute of Geologists of Ireland, 2013. Guidelines for the Preparation of the Soils, Geology and Hydrogeology Chapters of Geology in Environmental Impact Statements.
- EPA, 2022. Guidelines on the information to be contained in Environmental Impact Assessment Reports (EIAR)

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- Department of Environment, Heritage and Local Government, 2004. Quarries and Ancillary Activities, Guidelines for Planning Authorities.
- Environmental Protection Agency, 2006. Environmental Management in the Extractive Industry: Non-Scheduled Minerals.
- Geological Survey of Ireland - Irish Concrete Federation, 2008. Geological Heritage Guidelines for the Extractive Industry.

Other Comments

Should development go ahead, all other factors considered, Geological Survey Ireland would much appreciate a copy of reports detailing any site investigations carried out. Should any significant bedrock cuttings be created, we would ask that they will be designed to remain visible as rock exposure rather than covered with soil and vegetated, in accordance with safety guidelines and engineering constraints. In areas where natural exposures are few, or deeply weathered, this measure would permit on-going improvement of geological knowledge of the subsurface and could be included as additional sites of the geoheritage dataset, if appropriate. Alternatively, we ask that a digital photographic record of significant new excavations could be provided. Potential visits from Geological Survey Ireland to personally document exposures could also be arranged.

The data would be added to Geological Survey Ireland's national database of site investigation boreholes, implemented to provide a better service to the civil engineering sector. Data can be sent to the Geological Mapping Unit, at mailto:GeologicalMappingInfo@gsi.ie, 01-678 2795.

I hope that these comments are of assistance, and if we can be of any further help, please do not hesitate to the Geological Survey Ireland Planning Team at GSIPlanning@gsi.ie.

Yours sincerely,

Geoheritage and Planning Programme

Enc: Table - Geological Survey Ireland's Publicly Available Datasets Relevant to Planning, EIA and SEA processes.

Geological Survey Ireland's Publicly Available Datasets Relevant to Planning, EIA and SEA processes

following European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018

(S.I. No. 296 of 2018)

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Geological Survey Ireland Programme	Dataset	Relevant EIA Topic	Coverage	Description / Notes / Limitations	Link to Geological Survey Ireland map viewer
Geohazards	Landslide: National landslide database and landslide susceptibility map	Land & Soil/Climate/Landscape	National	Associated guidance documentation relating to the National Landslide Susceptibility Map is also available.	https://dcenr.maps.arcgis.com/apps/webappviewer/index.html?id=b68cf1e4a9044a5981f950e9b9c5625c
Geohazards	Groundwater Flooding (Historic)	Water	Regional	Provide information of historic flooding, both surface water and groundwater. [A lack of flooding presented in any specific location of the map only indicates that a flood has not been detected. It does not indicate that a flood cannot occur in that location at present or in the future]	https://dcenr.maps.arcgis.com/apps/webappviewer/index.html?id=848f83c85799436b808652f9c735b1cc
Geohazards	Groundwater Flooding (Predictive)	Water	Regional	Provides information on the probability of future karst groundwater flooding (where available). [The maps do not, and are not intended to, constitute advice. Professional or specialist advice should be sought before taking, or refraining from, any action on the basis of the flood maps]	https://dcenr.maps.arcgis.com/apps/webappviewer/index.html?id=848f83c85799436b808652f9c735b1cc
Geohazards	Radon Map	Land & Soils/Air	National		http://www.epa.ie/radiation/radonmap/
Geoheritage	County Geological Sites as adopted by National Heritage Plan and listed in County Development Pla	Land & Soils/Landscape	Regional	All geological heritage sites identified by Geological Survey Ireland are categorised as CGS pending any further NHA designation by NPWS.	https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228
Geological Mapping	Bedrock geology:	Land & Soils	National	1:100,000 scale and associated memoirs.	https://dcenr.maps.arcgis.com/apps/webappviewer/index.html?id=de7012a99d2748ea9106e7ee1b6ab8d5&scale=0
Geological Mapping	Bedrock geology:	Land & Soils	Regional	1:50,000 scale	https://dcenr.maps.arcgis.com/apps/webappviewer/index.html?id=de7012a99d2748ea9106e7ee1b6ab8d5&scale=0
Geological Mapping	Quaternary geology: Sediments	Land & Soils	National	1:50,000 scale	https://dcenr.maps.arcgis.com/apps/webappviewer/index.html?id=de7012a99d2748ea9106e7ee1b6ab8d5&scale=0
Geological Mapping	Quaternary geology: Geomorphology	Land & Soils	National	1:50,000 scale	https://dcenr.maps.arcgis.com/apps/webappviewer/index.html?id=de7012a99d2748ea9106e7ee1b6ab8d5&scale=0
Geological Mapping	Physiographic units:	Land & Soils	National	Broad-scale physical landscape units mapped at 1:100,000 scale in order to be represented as a cartographic digital map at 1:250,000 scale	https://dcenr.maps.arcgis.com/apps/webappviewer/index.html?id=afa76a420fc54877843aca1bc075c62b
Geological Mapping	GeoUrban: Spatial geological data for the greater Dublin and Cork areas	Land & Soils	Regional	includes 3D models	https://dcenr.maps.arcgis.com/apps/webappviewer/index.html?id=9768f4818b79416093b6b2212a850ce6&scale=0
Geological Mapping	Geotechnical database	Land & Soils	National	Digitised geotechnical and Site Investigation Reports and boreholes which can be accessed through online downloads	https://dcenr.maps.arcgis.com/apps/webappviewer/index.html?id=a2718be1873d47a585a3f0415b4a724c
Goldmine	Historical data sets including geological memoirs and 6" to 1 mile geological mapping records	land & Soils/Water	National	available online	https://secure.dccae.gov.ie/goldmine/index.html
Groundwater & Geothermal	Groundwater resources (aquifers)	Water	National	Data limited to 1:100,000 scale; sites should be investigated at local scale	https://dcenr.maps.arcgis.com/apps/webappviewer/index.html?id=7e8a202301594687ab14629a10b748ef
Groundwater & Geothermal	Groundwater recharge.	Water	National	Data limited to 1:40,000 scale; sites should be investigated at local scale; long term annual average recharge	https://dcenr.maps.arcgis.com/apps/webappviewer/index.html?id=7e8a202301594687ab14629a10b748ef
Groundwater & Geothermal	Groundwater vulnerability.	Water	National	Data limited to 1:40,000 scale; sites should be investigated at local scale	https://dcenr.maps.arcgis.com/apps/webappviewer/index.html?id=7e8a202301594687ab14629a10b748ef
Groundwater & Geothermal	Group scheme and public supply source protection areas.	Water	National	Not all PWS / GWS have SPZ / ZOC. Check with IW / coco / NFGWS for private supplies.	https://dcenr.maps.arcgis.com/apps/webappviewer/index.html?id=7e8a202301594687ab14629a10b748ef
Groundwater & Geothermal	Groundwater Protection Schemes	Water	National	Data is limited to scale of 1:40,000. Data does not include all of the source protections areas	https://dcenr.maps.arcgis.com/apps/webappviewer/index.html?id=7e8a202301594687ab14629a10b748ef
Groundwater & Geothermal	Catchment and WFD management units.	Water	National		https://dcenr.maps.arcgis.com/apps/webappviewer/index.html?id=7e8a202301594687ab14629a10b748ef
Groundwater & Geothermal	karst specific data layers	water	National	For areas underlain by limestone, includes karst features, tracer test database; turlough water levels (gwlevel.ie).	https://dcenr.maps.arcgis.com/apps/webappviewer/index.html?id=7e8a202301594687ab14629a10b748ef
Groundwater & Geothermal	Wells and Springs	Water	National	Not comprehensive, there may be unrecorded wells and springs	https://dcenr.maps.arcgis.com/apps/webappviewer/index.html?id=7e8a202301594687ab14629a10b748ef
Groundwater & Geothermal	Groundwater body Descriptions	Water	National	Not exhaustive; only those in designated SACs; could be other GWDTEs; for more information contact NPWS / EPA / site investigations	https://www.gsi.ie/en-ie/programmes-and-projects/groundwater-and-geothermal-unit/activities/understanding-ireland-groundwater/Pages/Groundwater-bodies.aspx
Groundwater & Geothermal	Geothermal Suitability maps	land & Soils/Water	National	Also, Roadmap for a Policy and Regulatory Framework for Geothermal Energy, November 2020	https://dcenr.maps.arcgis.com/apps/webappviewer/index.html?id=9ee46bee08de41278b90a991d60c0b9e
Marine & Coastal Unit	INFOMAR - Ireland's national marine mapping programme; providing key baseline data for Ireland's	Water	National		https://secure.dccae.gov.ie/GSI/INFOMAR_VIEWER/
Marine & Coastal Unit	CHERISH - Coastal change project (Climate, Heritage and Environments of Reefs, Islands, and Headla	Water	Regional		http://www.cherishproject.eu/en/
Marine & Coastal Unit	Coastal Vulnerability Index (CVI).	water /Land & Soils	Regional	Currently the project is being carried out on the east coast and will be rolled out nationally	https://www.gsi.ie/en-ie/programmes-and-projects/marine-and-coastal-unit/projects/Pages/Coastal-Vulnerability-Index.aspx
Minerals	Aggregate potential	Land & Soils/Material Assets	National	Consideration of mineral resources and potential resources as a material asset which should be explicitly recognised within the environmental assessment process	https://dcenr.maps.arcgis.com/apps/webappviewer/index.html?id=ee8c4c285a49413aa6f1344416dc9956
Minerals	Active quarries	Land & Soils	National		https://dcenr.maps.arcgis.com/apps/webappviewer/index.html?id=ee8c4c285a49413aa6f1344416dc9956
Minerals	Historic mines	Land & Soils/Cultural Heritage	National	Inventory and Risk Classification 2009. Environmental Protection Agency, Economic Minerals Division and Geological Survey Ireland (DECC).	https://gis.epa.ie/EPAMaps/default?easting=?&northing=?&lid=EPA:LEMA_Facilties_Extractive_Facilities https://www.epa.ie/enforcement/mines/
Tellus	Geochemical data: multi-element data for shallow soil, stream sediment and stream water	Land & Soils	Regional	A national mapping programme	https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=6304e122b733498b99642707ff72f754
Tellus	Airborne geophysical data including radiometrics, electromagnetics and magnetics	Land & Soils	Regional	A national mapping programme	https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=6304e122b733498b99642707ff72f754
Tellus	urban geochemistry mapping (Dublin SURGE project),	Land & Soils	Regional		https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=6304e122b733498b99642707ff72f754

Notes:

1. The maps and data listed above are available on the Geological Survey Ireland map viewer https://www.gsi.ie/en-ie/data-and-maps/Pages/default.aspx

2. Please read all disclaimers carefully when using Geological Survey Ireland data

3. Geological Survey Ireland and Irish Concrete Federation published guidelines for the treatment of geological heritage in the extractive industry in 2008.

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Uisce Éireann Ref: PN24000005590

Planning Authority: Mayo County Council

Issue Date: 1 July 2024

By Email: rbrickenden@quarryconsulting.ie

Re: EIA Scoping Request –EIA Scoping Request for Proposed Deepening of Existing Permitted Limestone Quarry.

Dear Rory Brickenden,

Uisce Éireann has received notification of your Environmental Impact Assessment (EIA) scoping request relating to McGraths Limestone (Cong) Ltd.'s forthcoming planning application for Deepening of Existing Permitted Limestone Quarry. Please see attached, Uisce Éireann's scoping opinion in relation to Water Services.

On receipt of the planning referral, Uisce Éireann will review the finalised (Inc. the proposed hydrological / hydrogeological assessment & Monitoring data) assessment as part of the planning process.

Queries relating to the terms and the EIA scoping opinions below should be directed to planning@water.ie

PP Alí Robinson

Signed on behalf of Dermot Phelan
Connections Delivery Manager

Stiúrthóirí / Directors: Tony Keohane (Cathaoirleach / Chairman), Niall Gleeson (POF / CEO), Christopher Banks, Fred Barry, Gerard Britchfield, Liz Joyce, Patricia King, Eileen Maher, Cathy Mannion, Michael Walsh.
Oifig Chláraithe / Registered Office: Teach Colvill, 24-26 Sráid Thalbóid, Baile Átha Cliath 1, D01 NP86 / Colvill House, 24-26 Talbot Street, Dublin, Ireland D01NP86
Is cuideachta ghníomhaíochta ainmnithe atá faoi theorainn scaireanna é Uisce Éireann / Uisce Éireann is a design activity company, limited by shares.
Cláraithe in Éirinn Uimh.: 530363 / Registered in Ireland No.: 530363.

Uisce Éireann's Response to EIA Scoping Requests

At present, Uisce Éireann does not have the capacity to advise on the scoping of individual projects. However, in general the following aspects of Water Services should be considered in the scope of an EIA where relevant;

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a) Where the development proposal has the potential to impact an Uisce Éireann Drinking Water Source(s), the applicant shall provide details of measures to be taken to ensure that there will be no negative impact to Uisce Éireann's Drinking Water Source(s) during the construction and operational phases of the development. Hydrological / hydrogeological pathways between the applicant's site and receiving waters should be identified as part of the report.

b) Where the development proposes the backfilling of materials, the applicant is required to include a waste sampling strategy to ensure the material is inert.

c) Mitigations should be proposed for any potential negative impacts on any water source(s) which may be in proximity and included in the environmental management plan and incident response.

d) Any and all potential impacts on the nearby reservoir as public water supply water source(s) are assessed, including any impact on hydrogeology and any groundwater/ surface water interactions.

e) Impacts of the development on the capacity of water services (*i.e. do existing water services have the capacity to cater for the new development*). This is confirmed by Uisce Éireann in the form of a Confirmation of Feasibility (COF). If a development requires a connection to either a public water supply or sewage collection system, the developer is advised to submit a Pre-Connection Enquiry (PCE) enquiry to Uisce Éireann to determine the feasibility of connection to the Uisce Éireann network.

   All pre-connection enquiry forms are available from https://www.water.ie/connections/connection-steps/.

f) The applicant shall identify any upgrading of water services infrastructure that would be required to accommodate the proposed development.

g) In relation to a development that would discharge trade effluent – any upstream treatment or attenuation of discharges required prior to discharging to an Uisce Éireann collection network.

h) In relation to the management of surface water; the potential impact of surface water discharges to combined sewer networks and potential measures to minimise and or / stop surface waters from combined sewers.

i) Any physical impact on Uisce Éireann assets – reservoir, drinking water source, treatment works, pipes, pumping stations, discharges outfalls etc. including any relocation of assets.

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j) When considering a development proposal, the applicant is advised to determine the location of public water services assets, possible connection points from the applicant's site / lands to the public network and any drinking water abstraction catchments to ensure these are included and fully assessed in any pre-planning proposals. Details, where known, can be obtained by emailing an Ordnance Survey map identifying the proposed location of the applicant's intended development to datarequests@water.ie

k) Other indicators or methodologies for identifying infrastructure located within the applicant's lands are the presence of registered wayleave agreements, visible manholes, vent stacks, valve chambers, marker posts etc. within the proposed site.

l) Any potential impacts on the assimilative capacity of receiving waters in relation to Uisce Éireann discharge outfalls including changes in dispersion / circulation characterises. Hydrological / hydrogeological pathways between the applicant's site and receiving waters should be identified within the report.

m) Any potential impact on the contributing catchment of water sources either in terms of water abstraction for the development (*and resultant potential impact on the capacity of the source*) or the potential of the development to influence / present a risk to the quality of the water abstracted by Uisce Éireann for public supply should be identified within the report.

n) Where a development proposes to connect to an Uisce Éireann network and that network either abstracts water from or discharges wastewater to a "protected"/ sensitive area, consideration as to whether the integrity of the site / conservation objectives of the site would be compromised should be identified within the report.

o) Mitigation measures in relation to any of the above ensuring a zero risk to any Uisce Éireann drinking water sources (Surface and Ground water).

This is not an exhaustive list.

Please note;

- Where connection(s) to the public network is required as part of the development proposal, applicants are advised to complete the Pre-Connection Enquiry process and have received a Confirmation of Feasibility letter from Uisce Éireann ahead of any planning application.

- Uisce Éireann will not accept new surface water discharges to combined sewer networks.

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Appendix 8.7 Impact Effect Assessment Methodologies & Detail

This appendix provides a logical work through of the procedure for determining likely Effects and completing the Impacts Section of the EIAR's Water Chapter so that all activities are listed from the enabling, operational and restoration phases and for each activity the potential Effects on the water environment are listed and mitigation measures applied to each. For each mitigation measure, residual impacts are then evaluated following consideration of application of the mitigation measure.

1. Legislation and Guidance

As previously stated, the complete list of Guidance and Legislation employed in the completion of this work was presented in Appendix 8.3.

- This EIA was completed in accordance with enacted EU and Irish legislation pertaining to Environmental Impact Assessment (Directive 2014/52/EU, meaning the EIA Directive and Irish EIA Regulations (2018, as amended 2020).
- The Impact Assessment was completed with reference to Guidance relating to EIA and the preparation of EIA Reports, which includes the EU (2017); Department of Housing, Planning and Local Government (2018) and EPA (2022) on Guidelines on the information to be contained in Environmental Impact Assessment Reports.
- Criteria for assessing importance of site attributes and their magnitude of importance were taken from the NRA Guidelines (NRA, 2008) and 'Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements' (IGI, 2013).

The tools and structure of Impact Assessment are presented here. Industry Standard Tables for rating of the Importance of Criteria, Potential Impacts, Mitigation Measure, Residual Impacts are now presented.

2. Significance of Impact

Unless otherwise stated, the EPA's method (2022) of determining the significance of impacts has been applied. There are three components to Table 3.4 of EPA (2022) and they relate to Effects under headings as follows:

I. **Quality, Significance, Extent and Context of Effects**
II. **Probability & Duration of Effects**
III. **Types of Effects**

Each of the components **of EPA (2022)'s Table 3.4** is presented here labelled as Table 1 (a), (b) and (c).

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Table 1 (a) - Criteria and Terminology to be Used in Description of Effects: Quality, Significance, Extent and Context of Effects (EPA, 2022, Table 3.4)

Quality of Effects It is important to inform the non-specialist reader whether an effect is positive, negative or neutral	**Positive Effects** A change which improves the quality of the environment (for example, by increasing species diversity; or the improving reproductive capacity of an ecosystem, or by removing nuisances or improving amenities).
	Neutral Effects No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error.
	Negative/adverse Effects A change which reduces the quality of the environment (for example, lessening species diversity or diminishing the reproductive capacity of an ecosystem; or damaging health or property or by causing nuisance).
Describing the Significance of Effects ''Significance' is a concept that can have different meanings for different topics – in the absence of specific definitions for different topics the following definitions may be useful (also see *Determining Significance* below.).	**Imperceptible** An effect capable of measurement but without significant consequences.
	Not significant An effect which causes noticeable[2] changes in the character of the environment but without significant consequences.
	Slight Effects An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
	Moderate Effects An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.
	Significant Effects An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
	Very Significant An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.
	Profound Effects An effect which obliterates sensitive characteristics
Describing the Extent and Context of Effects Context can affect the perception of significance. It is important to establish if the effect is unique or, perhaps, commonly or increasingly experienced.	**Extent** Describe the size of the area, the number of sites, and the proportion of a population affected by an effect.
	Context Describe whether the extent, duration, or frequency will conform or contrast with established (baseline) conditions (is it the biggest, longest effect ever?)

As described in Table 1 (a), above.

- The Quality of Effects can be **Positive, Neutral** or **Negative/Adverse.**
- The Significance of Effects are described in Table 1 (a), above, under seven generalised degrees, which are described in EPA (2022) Table 3.4 as follows:

1) **Imperceptible:** An impact capable of measurement but without noticeable consequences.

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2) **Not Significant:** An effect which causes noticeable changes in the character of the environment but without significant consequences.
3) **Slight:** An impact which causes noticeable changes in the character of the environment without affecting its sensitivities.
4) **Moderate:** An impact that alters the character of the environment in a manner consistent with existing and emerging trends.
5) **Significant:** An impact, which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
6) **Very Significant:** An effect which, by its character, magnitude, duration or intensity, significantly alters most of a sensitive aspect of the environment.
7) **Profound:** An impact which obliterates sensitive characteristics.

- As shown in Table 1 (a), the Extent and Context of the Effect must also be described.

Table 1 (b) - Criteria and Terminology to be Used in Description of Effects: Probability & Duration of Effects (EPA, 2022, Table 3.4 continued)

Describing the Probability of Effects Descriptions of effects should establish how likely it is that the predicted effects will occur so that the CA can take a view of the balance of risk over advantage when making a decision.	**Likely Effects** The effects that can reasonably be expected to occur because of the planned project if all mitigation measures are properly implemented.
	Unlikely Effects The effects that can reasonably be expected not to occur because of the planned project if all mitigation measures are properly implemented.
Describing the Duration and Frequency of Effects 'Duration' is a concept that can have different meanings for different topics – in the absence of specific definitions for different topics the following definitions may be useful.	**Momentary Effects** Effects lasting from seconds to minutes.
	Brief Effects Effects lasting less than a day.
	Temporary Effects Effects lasting less than a year.
	Short-term Effects Effects lasting one to seven years.
	Medium-term Effects Effects lasting seven to fifteen years.
	Long-term Effects Effects lasting fifteen to sixty years.
	Permanent Effects Effects lasting over sixty years.
	Reversible Effects Effects that can be undone, for example through remediation or restoration.
	Frequency of Effects Describe how often the effect will occur (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually).

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As described in Table 1 (b), above, EPA (2022) requires statements on the Probability, Duration and Frequency of Effects.

Table 1 (c) - Criteria and Terminology to be Used in Description of Effects: Types of Effects (EPA, 2022, Table 3.4 continued)

Describing the Types of Effects	**Indirect Effects (a.k.a. Secondary or Off-site Effects)** Effects on the environment, which are not a direct result of the project, often produced away from the project site or because of a complex pathway.
	Cumulative Effects The addition of many minor or insignificant effects, including effects of other projects, to create larger, more significant effects.
	'Do-nothing Effects' The environment as it would be in the future should the subject project not be carried out.
	'Worst-case' Effects The effects arising from a project in the case where mitigation measures substantially fail.
	Indeterminable Effects When the full consequences of a change in the environment cannot be described.
	Irreversible Effects When the character, distinctiveness, diversity or reproductive capacity of an environment is permanently lost.
	Residual Effects The degree of environmental change that will occur after the proposed mitigation measures have taken effect.
	Synergistic Effects Where the resultant effect is of greater significance than the sum of its constituents (e.g. combination of SOx and NOx to produce smog).

As described in Table 1 (c), above, EPA (2022) requires a professional interpretation Describing the Types of Effects. Examples of the Types of Effects include, as follows:

- Indirect
- Cumulative
- Do Nothing
- Worst Case
- Indeterminable
- Irreversible
- Residual
- Synergistic

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3. Significance of Effects

Using the definitions for the degree of impact significance outlined above, the methodology for combining project information was presented in EPA (2022), after SNH (2018), as their Figure 3.5 and is reproduced here as **Plate 1**.

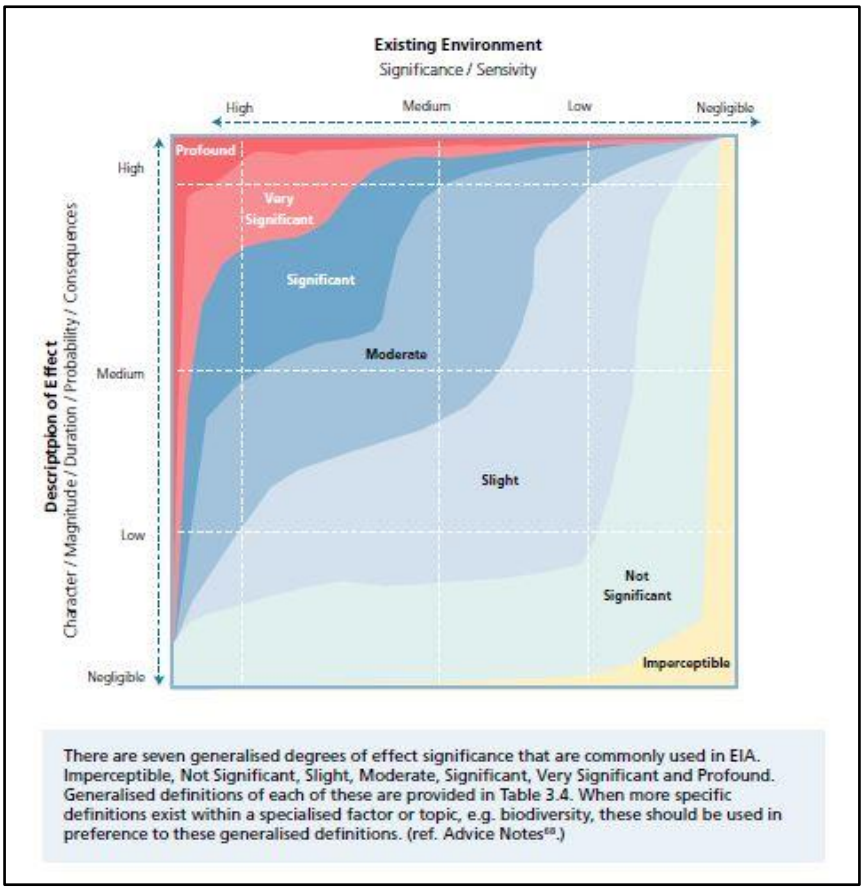

Plate 1 - EPA's Chart Showing 'Indicative' Typical Classifications of the Significance of Effects (EPA, 2022) as adapted from SNH (2018).

4. Hydrological and Hydrogeological Impact Assessment

The assessment of impacts within this chapter is carried out with respect to the hydrogeological and hydrological environment. Within this chapter, potential impacts are considered to be effects of the proposed development's resultant changes to the environment.

Criteria for assessing importance of site attributes and their magnitude of importance were evaluated using NRA Guidelines (NRA, 2008) [as prescribed in 'Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements' (IGI, 2013)]. NRA rating criteria uses the same significance terminology as the EPA. However, the NRA & IGI Guidance suggest intermediate steps to justify using that terminology, as follows:

- **Step 1:** Quantify the Importance of a feature for hydrology and hydrogeology.
- **Step 2:** Estimate the Magnitude of the impact on the feature from the proposed development.
- **Step 3:** Determine the Significance of the impact on the feature from the matrix based on the Importance of the feature and the Magnitude of the impact.

IGI (2013) and NRA (2008) tables of significance to this study are presented here as Table 2These frameworks for assessment have been applied in the EIA relating to Water and Geology.

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STEP 1:

The Criteria for Rating Site Importance of Hydrological Features (NRA, 2008) is presented in Table 2.

Table 2 Criteria for Rating Site Importance of Hydrological Features (NRA, 2008)

Importance of Attribute	Criteria	Example
Extremely High	Attribute has a high quality, or value on an international scale.	• River, wetland or surface water body ecosystem protected by EU legislation, e.g. 'European sites' designated under the Habitats Regulations or 'Salmonid waters' designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations
Very High	Attribute has a high quality or value on a regional or national scale.	• River, wetland or surface water body ecosystem protected by national legislation – NHA status • Regionally important potable water source supplying > 2,500 homes • Quality Class A (Biotic Index Q4, Q5) • Floodplain protecting more than 50 residential or commercial properties from flooding • Nationally important amenity site for wide range of leisure activities
High	**Attribute has a high quality or value on a local scale.**	• Salmon fishery • Locally important potable water source supplying > 1000 homes • **Quality Class B (Biotic Index Q3-Q4)** • Floodplain protecting between 5 and 50 residential or commercial properties from flooding • Locally important amenity site for wide range of leisure activities
Medium	Attribute has a medium quality or value on a local scale.	• Coarse fishery • Local potable water source supplying >50 homes • Quality Class C (Biotic Index Q3, Q2-3) • Floodplain protecting between 1 and 5 residential or commercial properties from flooding
Low	Attribute has a low quality or value on a local scale.	• Locally important amenity site for small range of leisure activities • Local potable water source supplying <50 homes • Quality Class D (Biotic Index Q2, Q1) • Floodplain protecting 1 residential or commercial property from flooding • Amenity site used by small numbers of local people

The application of the NRA's (2008) criteria (Table 2) to the site under consideration enables an 'Importance Attribute' conclusion, as follows:

- With reference to hydrology, the surface water network (lakes) to the north and south of the site are deemed to be attributes of '**Extremely High'** importance rating because both Lough Mask and Lough Corrib are SACs and SPAs. The site is immediately downstream of Lough Mask, waters leaving the site have a direct hydrological connection to Lough Corrib and the eastern boundary of the site is the Cong Canal, which connects both lakes. In addition to the SAC and SPA designations conferring an '**Extremely High'** importance, the fact that the site is mapped as part of the Lough Corrib catchment and that Lough Corrib is a PWS source adds a 'Very High' importance rating. However, the **'Extremely High'** rating is adopted in the Impact Assessment.

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The Criteria for Rating Site Importance of Hydrogeological Features (IGI, 2013) is presented in Table 3.

Table 3 Criteria for Rating Site Importance of Hydrogeological Features (IGI, 2013, Table C3)

Importance of Attribute	Criteria	Example
Extremely High	Attribute has a high quality, significance or value on an international scale.	• Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation, e.g. SAC or SPA status
Very High	Attribute has a high quality, significance or value on a regional or national scale.	• Regionally important aquifer with multiple wellfields. Groundwater supports river, wetland or surface water body ecosystem protected by national legislation – NHA status
High	**Attribute has a high quality, significance or value on a local scale.**	• **Regionally important aquifer.** Groundwater provides large proportion of base flow to local rivers Locally important potable water source supplying >1000 homes Outer source protection area for regionally important water source Inner source protection area for locally important water source
Medium	Attribute has a medium quality, significance or value on a local scale.	• Locally important aquifer. Potable water source supplying >50 homes
Low	Attribute has a low quality, significance or value on a local scale.	• Poor bedrock aquifer. Potable water source supplying < 50 homes

The application of the IGI's (2013) criteria (Table 3) to the site under consideration enables an 'Importance Attribute' conclusion, as follows:

- With reference to hydrogeology, the site and the aquifer within which it lies is deemed to be an attribute of '**Extremely High' importance rating** because it is mapped as a Regionally Important Karst Aquifer and, by virtue of base flow contributions, it is associated with Conservation Objective Lakes (Lough Corrib SAC and SPA and Lough Carra / Mask Complex SAC and Lough Mask SPA). Again, fact that Lough Corrib is also a PWS source adds a **'Very High'** importance rating. In addition, the aquifer to the east and north east of Lough Corrib supports the highest density of NFWGS groundwater schemes. However, the site is not directly connected to the aquifer providing water to those NFGWS potable water sources, nor does it lie within the inner or outer source protection area to any **groundwater** sources public water supply.

STEP 2:
Using the Importance Criteria ratings of Table 3, the Criteria for Estimating the Magnitude of Impact on a Hydrogeology Attribute is provided in the IGI (2013) Guidance as shown in Table 4.

Table 4 Criteria for Estimating Magnitude of Impact on Hydrogeology Attribute (IGI, 2013, Table C5)

Impact Type	Magnitude	Example
Adverse	Negligible	• No measurable changes in attribute
	Small	• **Removal of small proportion of aquifer** • Changes to aquifer or unsaturated zone resulting in minor change to water supply springs and wells, river baseflow or ecosystems. Potential low risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >0.5% annually.

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	Moderate	• Removal of moderate proportion of aquifer • Changes to aquifer or unsaturated zone resulting in moderate change to existing water supply springs and wells, river baseflow or ecosystems Potential medium risk of pollution to groundwater from routine runoff Calculated risk of serious pollution incident >1% annually
	Large	• Removal of large proportion of aquifer • Changes to aquifer or unsaturated zone resulting in extensive change to existing water supply springs and wells, river baseflow or ecosystems Potential high risk of pollution to groundwater from routine runoff Calculated risk of serious pollution incident >2% annually
Beneficial	Minor	Minor enhancement of aquifer
	Moderate	Moderate enhancement of aquifer
	Major	Major enhancement of aquifer

With respect to Baseline Information and the detail of Table 4:

- The Regionally Important Karst Aquifer is mapped by the GSI as having an area of 7,062.74 km^2, which is broadly equivalent to 7,062,740,000 m^2.
- The total area of the quarry site is 67.7 ha, which is equivalent to 677,000 m2.
- The area of the site relative to the area of the aquifer is 0.01%.

The use of criteria listed in Table 4 suggests that the proposed development may have a Potential Impact of **'Adverse'**, rather than 'Beneficial' and the Magnitude of Impact on the HYDROGEOLOGY Attribute (**Regionally Important Aquifer**), could be concluded, as **'Small' b**ased on the potential for removal of a **'small proportion of aquifer'**, **'minor changes to water supply springs and wells and river baseflow**' and a **'Potential Low Risk of Pollution to Groundwater from routine runoff'.**

The conclusion on the potential Magnitude of Impact on Hydrogeology is **'Small, Adverse'**.

STEP 3:
Using the IGI's (2013) Assessment Tables, the outcomes of Tables 3 and 4 are used to rate the potential Significance of the impact on the Aquifer.

Table 5 Criteria for Rating of Significant Environmental Impacts (IGI, 2013, Table C6)

Importance of Attribute	Magnitude of Impact			
	Negligible	**Small**	Moderate	Large
Extremely High	Imperceptible	Significant	Profound	Profound
Very High	Imperceptible	Significant/Moderate	Profound/Significant	Profound
High	Imperceptible	Moderate/Slight	Significant/Moderate	Severe/Significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight/Moderate

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Using Table 5, the overall potential outcome on hydrogeological receptors, in the absence of Mitigation Measures, could be '**SIGNIFICANT**'.
The application of criteria, as outlined in Tables 1 to 5, above, to the specifics of the study area provides a framework for general screening of the likely impact to the hydrological and hydrogeological environment. The methodology involves the identification of all the potential receptors within the site boundary and surrounding environment. This information is gathered during the desk study, site walkover, site investigation and monitoring phases of the study.

Upon collation and consideration of all project information for the site and macro scale, an Impact Assessment is completed and reported under headings, as follows:

5. **Potential Impacts**
6. **Mitigation Measures**
7. **Residual Impacts**
8. **Do Nothing**
9. **Cumulative Impacts**
10. **Transboundary Impacts**
11. **Dewatering Impact Appraisal (UK Environment Agency)**
12. **SAC Protection Measures**

Refer to the Main Body of the EIAR for the detail of the Impact Assessment specific to the site under consideration.

A description of the UK Environment Agency's Dewatering Impact Appraisal is provided separately in the next Appendix.

Appendix 8.8 Dewatering Impact Appraisal Methodology

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In addition to the application of Irish Guidelines as outlined in EPA (2022) and NRA (2008), and in the absence of Irish Guidance specifically focussed on quarries and hydrogeology, the work presented in this EIAR Section has also applied UK practical guidance as published by the UK Environment Agency (the public body equivalent of the Irish EPA). The UK Guidance provides a 'Hydrogeological impact appraisal for dewatering abstractions' (Boak, R. et. al. (2007) and the approach is succinctly outlined by the EA as follows:

> "The methodology for hydrogeological impact appraisal (HIA) is designed to fit into the Environment Agency's abstraction licensing process. It is also designed to operate within the Environment Agency's approach to environmental risk assessment, so that the effort involved in undertaking HIA in a given situation can be matched to the risk of environmental impact associated with the dewatering. The HIA methodology can be summarised in terms of the following 14 steps:
>
> - Step 1: Establish the regional water resource status.
> - Step 2: Develop a conceptual model for the abstraction and the surrounding area.
> - Step 3: Identify all potential water features that are susceptible to flow impacts.
> - Step 4: Apportion the likely flow impacts to the water features.
> - Step 5: Allow for the mitigating effects of any discharges, to arrive at net flow impacts.
> - Step 6: Assess the significance of the net flow impacts.
> - Step 7: Define the search area for drawdown impacts.
> - Step 8: Identify all features in the search area that could be impacted by drawdown.
> - Step 9: For all these features, predict the likely drawdown impacts.
> - Step 10: Allow for the effects of measures taken to mitigate the drawdown impacts.
> - Step 11: Assess the significance of the net drawdown impacts.
> - Step 12: Assess the water quality impacts.
> - Step 13: If necessary, redesign the mitigation measures to minimise the impacts.
> - Step 14: Develop a monitoring strategy.
>
> The steps are not intended to be prescriptive, and the level of effort expended on each step can be matched to the situation. Some steps will be a formality for many applications, but it is important that the same thought-process occurs every time, to ensure consistency. The methodology depends heavily on the development of a good conceptual model of the dewatering operation and the surrounding aquifer. The steps of the methodology are followed iteratively, within a structure with three tiers, and the procedure continues until the required level of confidence is achieved. Advice is also given on how to undertake HIA in karstic aquifers and fractured crystalline rocks." Boak, R. et. al. (2007).

Hydro-G has applied the UK Environment Agency's step wise process in order to present a Step Wise assessment of the potential for impact that might arise in response to the proposed development and its interaction with the water environment and Conservation Objective sites of the region.

Appendix 8.9 OPW Hydrometric Information

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Hydrometric Stations

- Carrownagower Station = Upstream of the site on the Cong Canal (Station No. 30017)
- Cong Weir Station =downstream of the site & discharging to Lough Corrib (Station No. 30031)
- Wolf Tone Bridge, Galway City downstream of Lough Corrib as the River Corrib enters Galway Bay.

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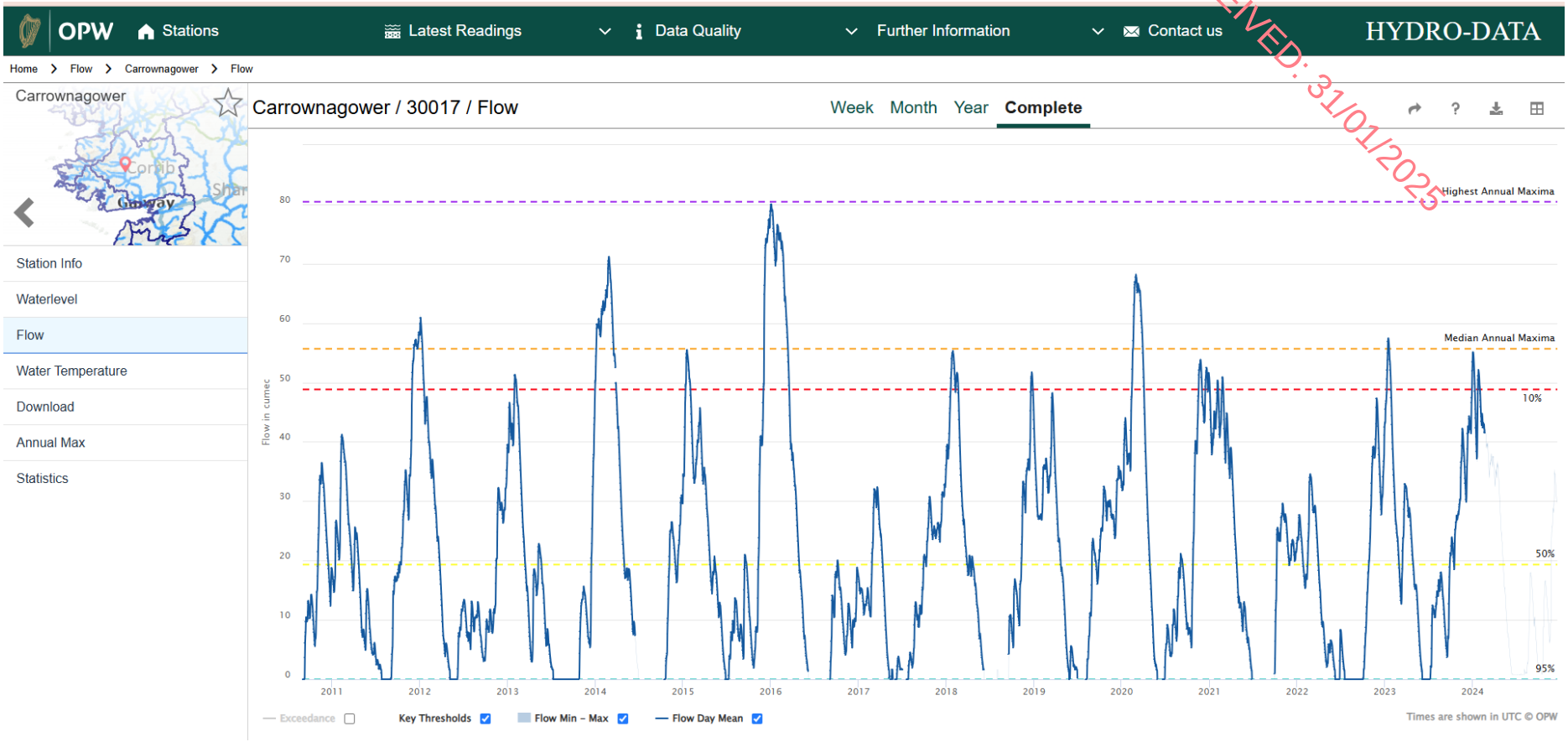

Plate A Carrownagower Station Complete Record for Flow upstream of the site on the Cong Canal (Station No. 30017). https://waterlevel.ie/hydro-data/#/overview/Flow/station/11749/Carrownagower/Flow.

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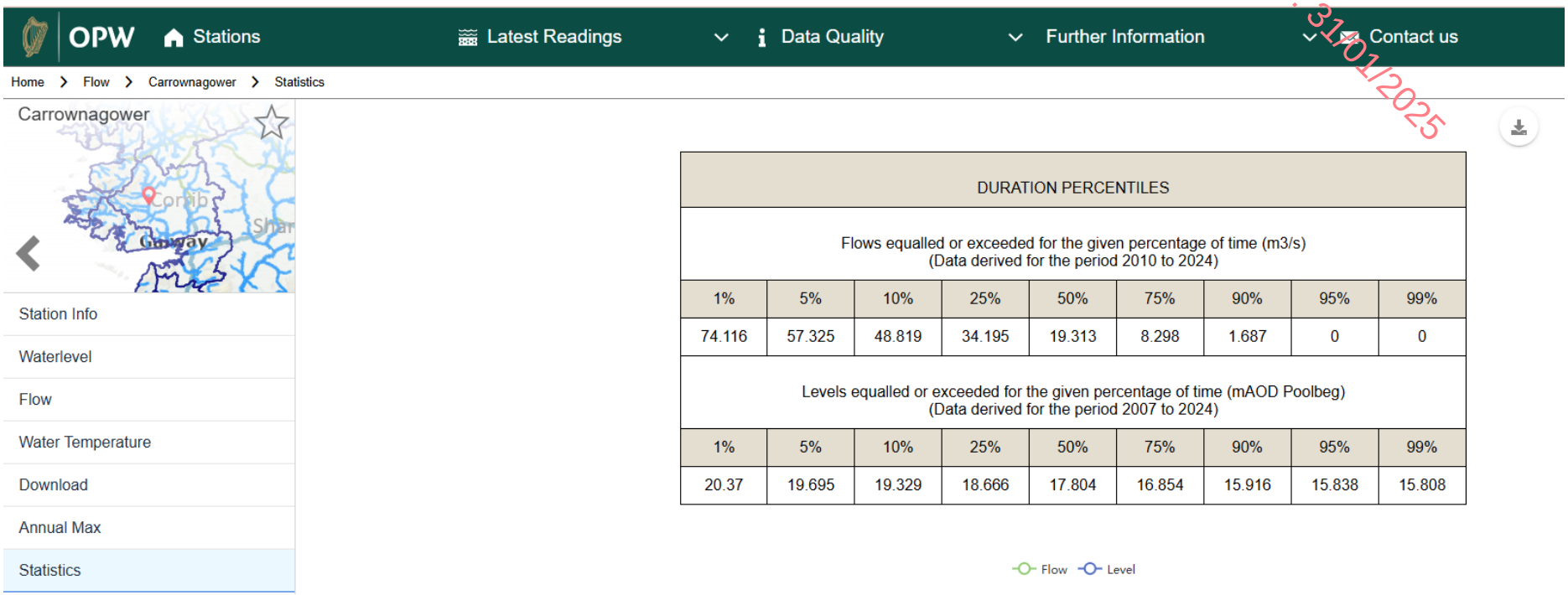

Plate B OPW Statistics for the Carrownagower Station, upstream of the site, available at https://waterlevel.ie/hydro-data/#/overview/Flow/station/11749/Carrownagower/statistic.

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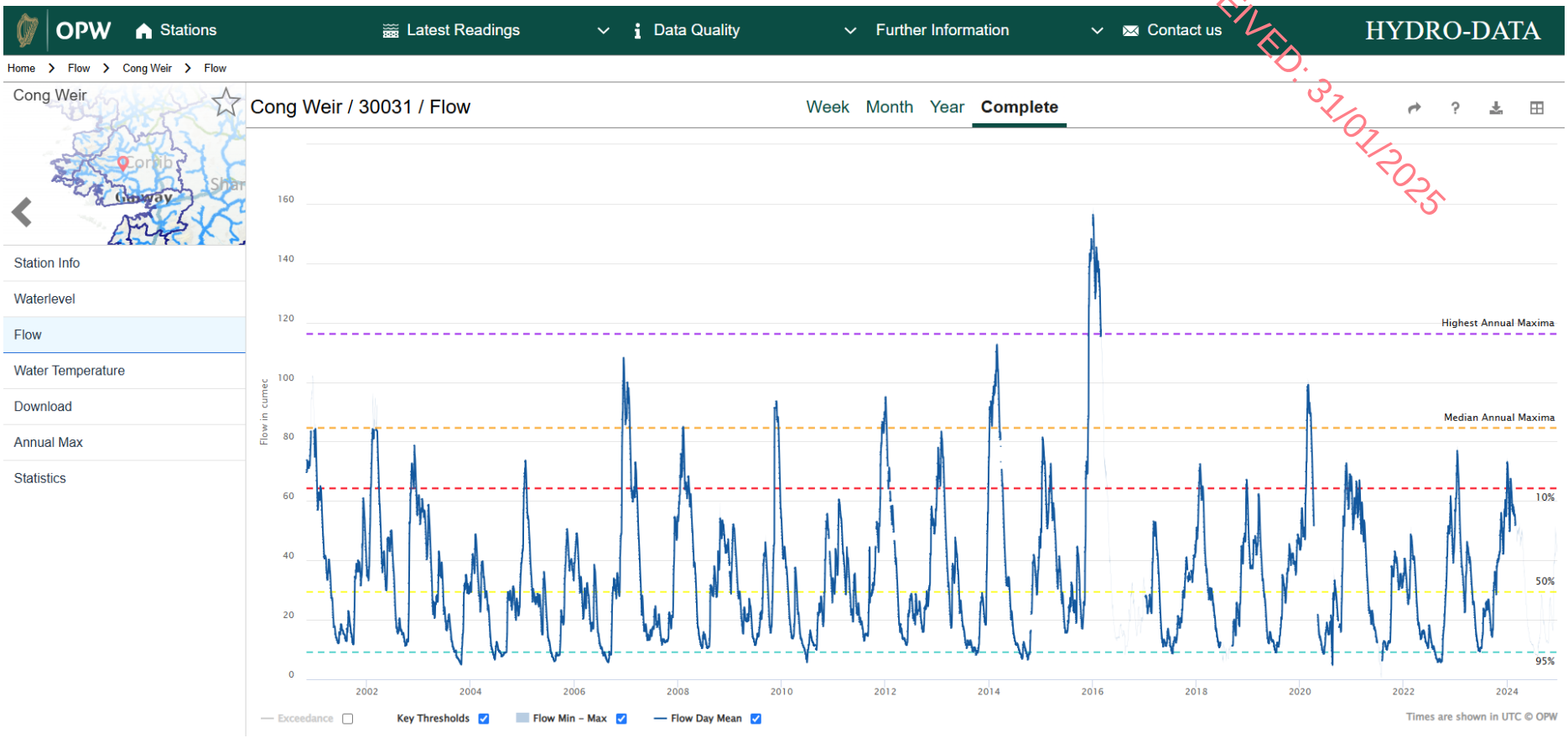

Plate C OPW Flow Data Complete Record Cong Weir 30031 Flow.
https://waterlevel.ie/hydro-data/#/overview/Flow/station/11753/Cong%20Weir/Flow.

Note that the 50 % Value, *i.e.,* flow exceeded 50% of the time is reported in the Statistic Table, overleaf, as 29.41 m3/s.

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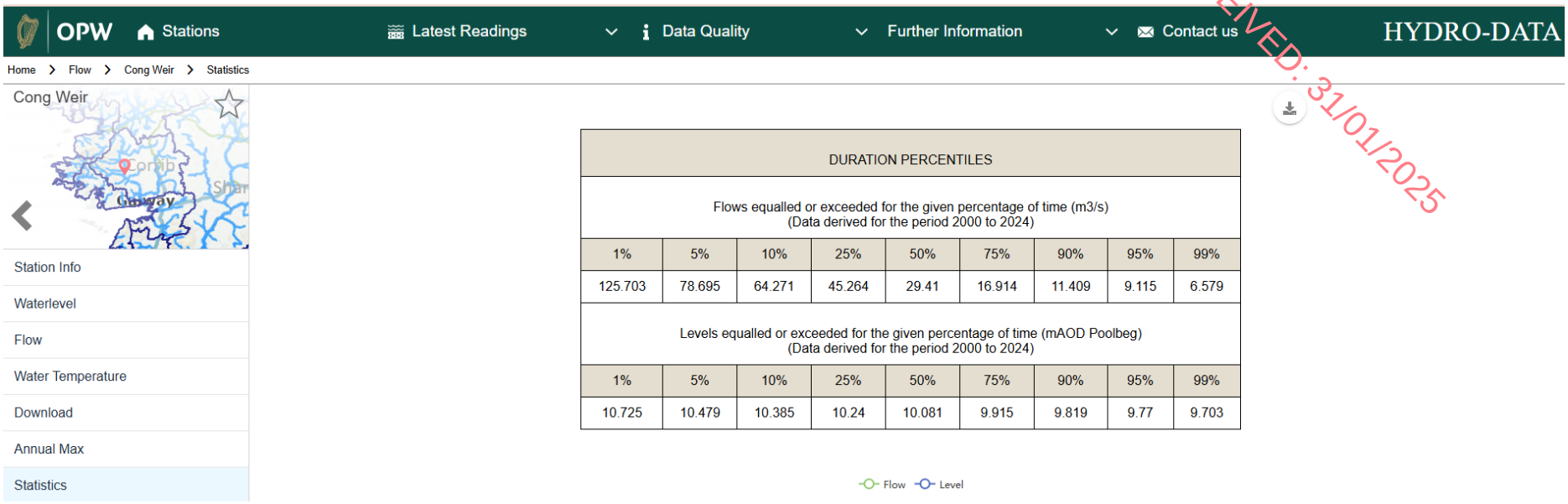

Plate D OPW Statistics for the Cong Weir available at https://waterlevel.ie/hydro-data/#/overview/Flow/station/11753/Cong%20Weir/statistic.

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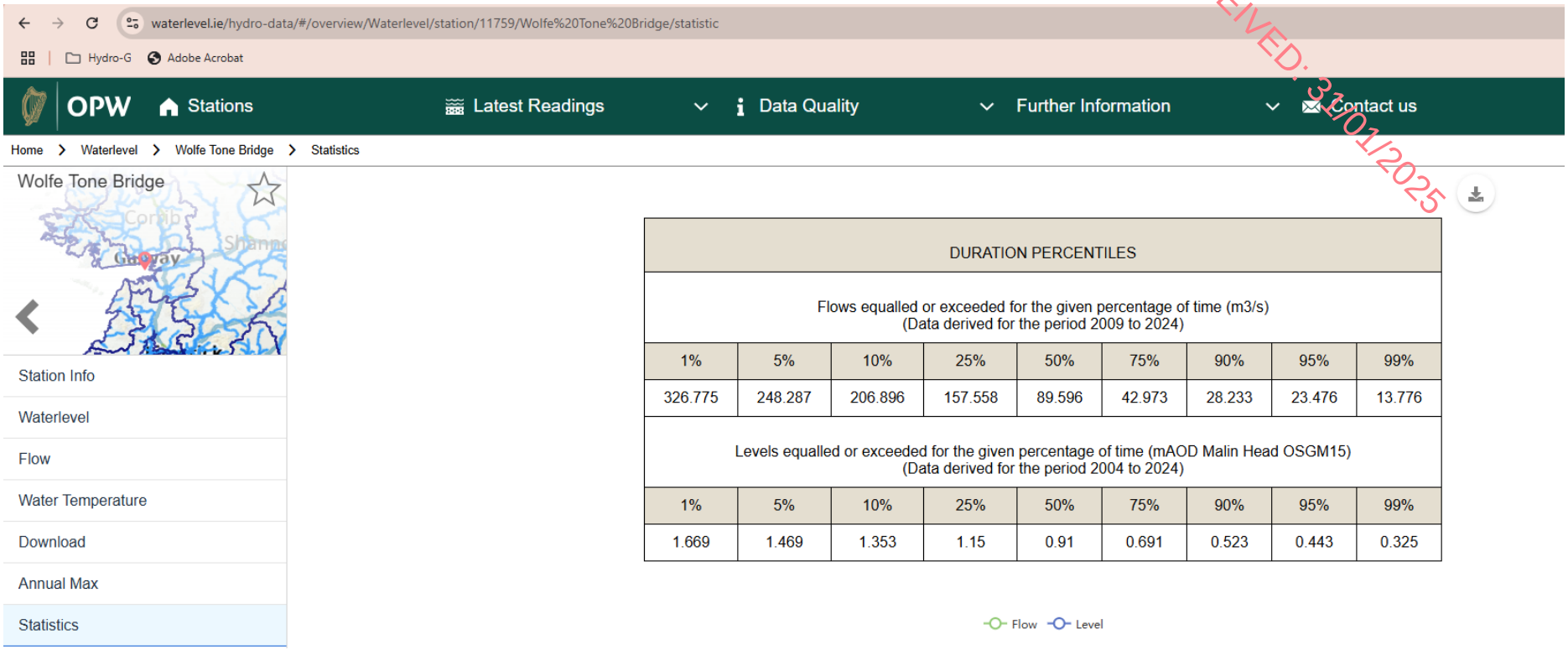

Plate E OPW Statistics for Wolf Tone Bridge available at

https://waterlevel.ie/hydro-data/#/overview/Waterlevel/station/11759/Wolfe%20Tone%20Bridge/statistic.

Appendix 8.10 McGraths Quarry (ESP, 2006)

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Karst features and other Geological Information for the site and local area have previously been described by Dr. John Campbell in his report on McGrath's quarry (ESP, 2006). The full report is presented here.

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CONG QUARRY,
Co. MAYO

HYDROGEOLOGICAL REPORT

Prepared for:

Mc Grath Quarries Group,
Cong,
Co. Mayo.

Prepared by:

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Date: May2006
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Revision: 0

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CONG QUARRY,
CO. MAYO

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1.0 SUMMARY

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The site lies on an isthmus between Lough Mask and Lough Corrib and is located on south facing slopes of elevated ground (up to 32 metres above Ordnance datum). The isthmus forms a ridge of higher ground between Lough Corrib some 2 kilometres to the south of the site and Lough Mask some 3.5 kilometres to the North West.

At Cong, the largest recharge for the Limestone aquifer is considered to be the regional through flow from Lough Mask within chartered underground conduits. There are very rapid flow rates within these conduits indicating an aquifer with minimal storage and almost infinite permeability.

The Carboniferous Limestone is a virtually impermeable material in its unfractured state, however it is commonly fractured and these fractures allow groundwater storage and flows. The existing information indicates that flow rates in the North- South Joints are twice as fast as theEast-West trending joints.

The available regional information indicates that the groundwater levels in the isthmus between Lough Mask and Cong is between 12 and 20 m.OD. This largely complies with the groundwater monitoring undertaken at the site.

The regional groundwater system is controlled by an efficient system of drainage conduits and the impact of quarrying on the surrounding water table and surface water features is minimal.

Based on the existing information it is recommended that the following monitoring 1s undertaken.

1. The existing monitoring wells installed around the quarry should be monitored for water level, ph, temperature, electric conductivity and suspended solids on a monthly basis.

2. The discharge from the settlement tanks should also be monitored as above.

3. Periodic site visits to observe the nature of any karst features encountered.

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2.0 INTRODUCTION

The McGrath Quarries Group currently operate the Quarry at Cong, Co. Mayo and under present planning regulations have planning permission to remove rock across the site area as shown on the enclosed Figure 3.

Earth Science Partnership Ltd (ESP) have been instructed by McGrath Quarries Group to undertake continuing hydrogeological assessment of the quarry and this report includes details on investigations which have been ongoing since 2001. The investigations were instigated followinga meeting with the Western Regional Fisheries Board on the 26[1] March 2001. (see Appendix F).

This report presents the results of a study of existing information available on the topography, geomorphology, geology, hydrology and groundwater regime in the vicinity of the site. The report also discusses the hydrogeological processes active and the impact of the quarry operationson the hydrogeological regime.

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3.1 DESK STUDY AND FIELDWORK

3.2 Sources of Existing Information

The following sources of information have been consulted.

- Geological Survey of Ireland (GSI)- geological sheet no. 95 dated 1869, 1 inch series. Well abstraction data and aqufer classification.
- Geological Memoir to accompany above map.
- Ordnance Survey oflreland 1:50:000 series. Dated 1993.
- On the formation of the Rock basin of Lough Corrib. Geological Magazine November 1886. G.H. Kinahan.
- D.P Drew and D.Daly. Geological Society oflreland. Report Series RS 93/9 dated 1993
- D.P. Drew. Trinity College Dublin. August 1983. Unpublished.
- The Western Regional Fisheries Board. Letter dated 18th December 2000.

3.3 Site Visits

The site was first visited by a hydrogeologist on the 19th February 2000 and a further visit was made on the 26 and 27th March 2001 to inspect the topography, geology and geomorphology of the area and a number of the water features outside the site boundary.

Further regular inspections have been made by ESP since this period. Drilling investigations were undertaken between the 19th and 25th of February 2004 under the full time supervision of a geologist.

3.3 Fieldwork

In order to obtain further information on base flow and to install permanent groundwater monitoring stations 4 No 1OOmm diameter rotary openholes (BH A,B,C,D) were constructed to depths of between 50 and 90 metres depth between the 19th and 25th February 2004.

Falling and rising head permeability tests were undertaken in the boreholes at selected intervals.

A 50mm diameter groundwater monitoring well comprising slotted plastic pipe with a gravel surround, bentonite seals and a lockable vandal proof cover, was installed in the four boreholes in order to monitor for groundwater.

The exploratory holes were supervised and logged by an engineering geologist in accordance with 885930:1999. Descriptions and depths of the strata encountered are presented on the Drillhole records in Appendix A and the results of permeability tests in Appendix B.

The locations of the exploratory holes are presented on Figure 3

3.4 Liaison with Relevant Authorities

A meeting with the Western Regional Fisheries Board was held on the 26th March 2001 and relevant features of the hydrogeology and quarrying operations discussed. Notes on the meeting were circulated to all parties concerned. The notes of the meeting are presented in Appendix A.

Further informal liason meetings have been held since this time.

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4.1 SITE DESCRIPTION

4.2 Location

The site is located to the north west of the village of Cong and to the north of the R346. The existing quarry is centred on Irish National Grid Reference of M140 560 and a site location plan is presented as Figure 1.

4.3 Topography

The site lies on an isthmus between Lough Mask and Lough Corrib and is located on south facing slopes of elevated ground (up to 32 metres above Ordnance datum). The isthmus forms a ridge of higher ground between Lough Corrib some 2 kilometres to the south of the site and Lough Mask some 3.5 kilometres to the North West.

Lough Corrib whose ordinary surface level is 8.50 (m.OD) or 6 metres above the mean sea level in Galway Bay is, in its southern part, shallow and studded over with islands; while in its northern part it is usually deep, one location about half way between Inishmicarteer and Cong being 46 metres deep.

The surface of Lough Mask whose waters are deeper than Lough Corrib, is at a level of 19.5 (m.OD). The deepest hole in Lough Mask has been recorded as 58 metres deep. The deepest recorded points of Lough Corrib and Mask are indicated to be within 1 metre of each other whichsupports the interpretation that the Loughs were formed at the same time and by similar denudingagents. (Ref G.H. Kinahan)

A site survey provided by the client indicates that the deepest point of the quarry is at 10 mOD and the existing quarry faces have 3m wide benches with sub vertical faces between 8 to 15 metres high.

4.4 History

Prior to quarrying the site was dominated by bare crags of limestone with a flat limestone pavement, which was characterised by a regular system of clints and grikes. An extract from the old Ordnance Survey map included in Figure 3 indicates the pre-quarrying layout.

The canal which is located some 300metres to the west of the quarry was constructed between 1845 and 1855 in a natural hollow to connect the Loughs. It is understood that it was proposedthat the canal should be navigable but after £30,000 had been spent on the work it was abandoned, as the rock was found to be so cavernous it was considered that it could never be water tight. However the connection to Cong was eventually completed.

Quarrying at the site has taken place since the early 1950's.

5.1 GEOLOGY

5.2 Regional Geological Setting

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The published geological sheet for the area (sheet 95 dated 1869) indicates the site to be underlain by Carboniferous Limestone. The Geological Society of Ireland (GSI) has classified this strata as Dinantian pure bedded limestones.

An extract from this map is presented in Figure 2 and Figure 7 shows an inferred geological cross section.

The outcrop of the unconformable boundary of the limestone with the underlying older impermeable Silurian (Llandovery beds) lies some 2 kilometres to the south of the site. The presence of this west- east trending boundary and the synclinal nature of the bedding forces underground water flowing from the north to the surface at Cong, rather than the subterranean flow continuing to the shores of Lough Corrib.

The strata exposed in the quarry comprise dark blue and grey, fresh, thickly bedded, strong, coarse to medium grained limestone (calcarenite) with occasional shale partings and fossils. The beds are typically 1 to 1.50 metres thick though beds some 0.30m thick and some 2 metres thick do exist in the quarry.

Karstification (solution weathering) is common to a depth of typically 2 metres below existing ground level. Vertical solution features are rare in the quarry faces although there is occasional widening of vertical joints, which are infilled. In the north east face of the quarry there is an enlarged bedding parting which has apparently been effected by solution widening to produce a space some 0.10 to 0.50m wide which has subsequently been infilled with red sediments. This would indicate that the solution process due to groundwater passing through the system is now redundant.

The dip of the bedding is near horizontal with an overall competent in the quarry being of the order of 1 to 5 degrees to the east and south east with no apparent tectonic deformation or faulting. The bedrock south of the R346 has reversed bedding with dips indicated to be 5 to 10 degrees to the north. This slight synclinal structure in this area may have assisted in the development of springs in this area.

The structure of the strata is dominated by a series of parallel near vertical joints, the principal systems running N 5 degrees E while subordinate joints trend east to west. Joint spacing averages 1 to 1.50 metres although in some areas it is as narrow as 0.50 metres. As a result the rocks at the original ground surface often appear to be detached slabs but their tops and sides are rounded and furrowed from the effects of weathering. Iron orange-brown staining of the joints which is indicative of former or present water flow is rare in the exposed faces.

5.3 Karstification

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Chemical solution by percolating rainwater is common in the Carboniferous Limestone and tends to be concentrated along the existing discontinuities, e.g. joints and bedding planes, with the resulting cavity pattern often following the discontinuity geometry of the original rock. (For example most of the open fissures and caverns are concentrated along the N 5degrees E trend).This solution and widening of joints is termed karstification. Chemical solution initially enlarges the discontinuities, with features generally developing in the unsaturated (vadose) zone above the groundwater table, and forming voids which can migrate upwards through any superficial or bedrock cover (eg. Pollahunipa near the south east boundary of the site). The collapse featuresat the surface occur when the water levels in the saturated limestone voids falls as it drains andleaves the overlying commonly cohesive cover saturated. Rapid drawdown then takes placewithin the superficials which leads to the washing out of fines and the subsequent collapse of thematerial into the limestone void. Such an effect can lead to blockages and choking of the karstsystem with ponds left at the surface.

It is likely that several periods of karstification may have occurred in the vicinity of the quarry associated with various phases of tectonic uplift and subsequent erosion. Each successive period of karstification will imprint its pattern of karst over the existing palaeokarst and even over fault patterns. The critical feature of this is that the pattern of karstification within the bedrock will not necessarily be related to the present day topography and groundwater and that cavities developed in a previous unsaturated zone may now be located below the present groundwaterlevel. The last major period of karstification occurred towards the end of the last Ice Age, approximately 10,000 years ago.

Limestone solution is usually a fairly slow process by human timescales, however the erosion and removal of the infill of the cavities and the generation of collapse features at the ground surface may occur on a more rapid timescale. Karst infill may be eroded either by the infiltrationof surface water, whether from natural sources such as rainfall or from human induced sources such as drainage measures, or by the backing up of groundwater within the karst system itself. The mobility of the infill materials will depend on the flow rates of the water passing through the infilled cavity, which in tum is controlled by the location and elevation of the outlet of the karstsystem.

There are numerous surface karst features to the south of the quarry the closest of which are indicated on the map presented in Figure 3.

6 HYDROGEOLOGY

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6.1 Conceptual Hydrogeological Model

The karst nature of the limestone will have a major influence on the flow of groundwater in the limestone bedrock. Figure 7 indicates the various types of flow through a limestone aquifer.

It is considered that the groundwater flows in the limestone bedrock in the vicinity of Cong quarry is controlled by a number of mechanisms as follows:

- mass groundwater flow down the regional hydraulic gradient towards Lough Carra and Mask
- conduit flow within karst enlarged existing fractures,
- diffuse flow within non-widened fractures in the limestone rock mass,
- lateral fracture flows within the weathered, top part of the limestone.

At Cong, the largest recharge for the aquifer is considered to be the regional through flow within the limestone which flows southwards originating from the water bodies to the north. Studies by others (Ref Drew) have indicated that there is no evidence for large scale leakage of water from the shore of the main body of Lough Mask. However the area to the east of northern Castle Lake is highly karstified to well below present sea level. Groundwater flow is considered to be initially eastward from Castle Lake then due south to Cong.

Groundwater levels for some distance inland appear to be controlled by storage in Castle Lake. The extent to which Castle Lake controls groundwater levels is considerably greater in winter than in summer. Under winter conditions groundwater levels vary by some 2 metres only over the area and the lake and regional groundwater levels are effectively united. Under summer conditions groundwater gradients are steeper (4 metres drop across the area) and the zone controlled by inflow from Castle Lake. Under winter conditions line recharge occurs from the canal to the groundwater but in the summer conditions there seems to be no discernible relationship between the canal and the groundwater.

The available information from dye test results indicates that mean groundwater flow rates between Lough Mask and Cong are of the order of 12 cm/sec. Within primary flow conduits, groundwater velocity could well be several m/sec. This is very rapid even for a karst system which suggests flow in open conduits at a steady gradient. Such rapid flow rates indicate an aquifer with minimal storage and almost infinite permeability.

The Carboniferous Limestone is a virtually impermeable material in its unfractured state, however it is commonly fractured and these fractures allow groundwater storage and flows. Groundwater movement is predominately along bedding planes although the main concentrationsof flow appear to be controlled by the enlarged joints (eg the stream at the base of Pigeon Hole). The existing information indicates that flow rates in the North- South Joints are twice as fast as the East-West trending joints.

The main controls on Groundwater South of Lough Mask are shown in Figure 6.

The available regional information indicates that the groundwater levels in the isthmus between Lough Mask and Cong is between 12 and 20 m.OD. This largely complies with the groundwater monitoring undertaken at the site.

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The construction of the Cong canal lowered the winter level of Lough Mask by some 2 metres and causes surface flow to take place between the lakes via the canal when the water level in Lough Mask exceeds 17mOD. Prior to this the underground routes transmitted all of the inter-lake discharge. At present the Cong canal is dry for an average of 90 days per year and duringthis period the Cong springs discharge about 17m3/s.

6.2 Aquifer Classification and Abstractions

Enquiries to the Geological survey of Ireland (GSI) indicate that the limestone under the site is classified as regionally important karstified aquifer unit.with conduit flow. (see Appendix C). The aquifer has not yet been classified in terms of vunerability but is likely to be of high vunerabilty.

The well search for the area indicates there are no licensed wells within influencing distance of the site.

Direct percolation will provide a source for the groundwater in the aquifer with an estimated effective rainfall of the order of 1OOOmm available for percolation or run off on unquarried areas. However within the quarry itself and in areas of roads and hardstanding this will be potentially increased or reduced respectively.

6.3 Groundwater levels under the site

Monitoring of the boreholes has taken place from February 2004 to January 2006 as presented in Appendix D.

The wells in the boreholes have been sealed with bentonite at depths of greater then lOm (see borehole records for details). This was in order to seal of the fracture zone flow and to try and detect variations in base flow. However the boreholes did not encounter any solution features andthe tight nature of the bedrock has resulted in groundwater levels rising to mainly static levels.

Groundwater levels in Boreholes A and D have steadily risen to stabilise at a level of 25 mod (ie 0.8m below ground level). Both boreholes show little response to seasonal changes althoughBorehole D has shown some variation and there was a drop of 2.7 m during August 2005. Thisgroundwater chemistry data also indicates there is little response to rainfall events and it is concluded that there is little groundwater movement in these boreholes.

Groundwater levels in Boreholes B and C have steadily risen to stabilise at a level of some 10 mod. Both boreholes show little response to seasonal changes.

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6.4 Groundwater quality under the site

Chemical testing of water samples has been undertaken from the boreholes and a summary of the laboratory test results are presented in Appendix E. The groundwater in the boreholes is of neutral to alkaline ph. There is little significant variation in results as indicated below.

Temperature – ranges from 8.5 to 12 degrees C.
Oxygen – ranges from 20 to 87 %
Conductivity -ranges from 81 to 584 us
COD is less than 10 mg/1
BOD ranges from <1 to 4.54
Suspended solids (tested on one occasion) <4 to 66 mg/1
Total Phosphorous ranges from <0.01 to 0.12
Ammonium (tested on one occasion) 0.04 to 0.218 mg/1
Turbidity (tested on one occasion) 7.88 to 20.

Most of the results for the above parameters show a decline in concentration with time which again indicates that there is little influx of fresh groundwater to change the chemistry.

6.5 Permeability

The Carboniferous Limestone is a virtually impermeable material in its unfractured state. Permeability of the rock matrix is generally low in the order of 10-15mls. However it is commonly fractured and these fractures allow groundwater storage and flows. Groundwatermovement is predominately along bedding planes although the main concentrations of flow appear to be controlled by the enlarged joints. From studies (ref Daly et al) undertaken in the area the indications are that flow rates in the North- South Joints are twice as fast as the East-Westtrending joints.

Permeability testing by falling head and rising head methods has been undertaken in the recent drillholes and the calculations are presented in Appendix B and the ranges are summarised below.

BH A K ranges from 4.08 x 10-7 to 7.98 x 10-8 *mis*

BH B K ranges from 2.12 x 10-8 to 6.66 x 10-9 *mis*

BH C K ranges from 4.54 x 10-9 to 5.99 x 10-10 *mis*

BH D K ranges from 7.95 x 10-5 to 9.85 x 10-9 *mis*

These results confirm that the bedrock mass is impermeable and where open conduits are present these dominate groundwater flow.

6.6 Flow in the Unsaturated Zone of the Limestone

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Within the overlying unsaturated zone, flows are more complex. Recharge within this zone is dominated by surface precipitation and percolation. The dominant flow is in conduits of karst enlarged cavities in the bedrock. These conduits are not present in the quarry walls and the rock mass itself is relatively impermeable and only limited groundwater flows are reported from the quarry walls indicating the impermeable nature of the rock mass.

The orientation of the conduits correlate with the discontinuities in the bedrock so that groundwater recharge will flow down solution widened joints. Whilst within these joints the groundwater has no real flow direction and in effect drains vertically downwards until it intercepts a bedding plane. The dominant lateral flow direction will therefore be along the bedding, i.e. to the east or south east. It is this mechanism that may account for reversals of flow which can occur in this area (eg. the surface water bodies in the village of Cong.)

On the east side of the quarry leakage from the canal discharges into the quarry in the winter months. The zone of leakage is confined to a particular horizon in the quarry face which illustrates the affect of flow along the bedding.

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7.1 SURFACE AND UNDERGROUND WATER FEATURES

There are a number of potentially sensitive water features within influencing distance of the site as discussed below (see also Figure 3 for locations.)

7.2 Underground water flows

Significant research of the hydrogeology of the area has been undertaken by the Geological Survey of Ireland and the work relevant to the area is summarised below.

The most important hydrogeological characteristic of the Cong area is the fact that the greatest part of the outflow from Lough Mask passes subterraneously through the isthmus to emerge from a series of large springs in Cong.

Concentrations of flow occur in bedding planes but there at least two major conduit flowpaths formed by enlarged joints either side of the quarry site. Flow rates vary but seasonally average 250-600m/h, the rates of flow generally increasing from north to south presumably in part due to the increased hydraulic gradient. Experiments in water tracing suggest that residence time for a tracer is about tent times the initial transit time for the tracer- both this fact and the rapid flow rates indicate an aquifer with minimal storage and almost infinite permeability.

Velocity measurements and water chemistry suggest that water flux takes place in the uppermost 10-15m of limestone although karstification extends to a depth of at least 50m (25m below sea level) on the isthmus.

7.3 Pollyahunipa and other associated ponds

This pond is located 50 metres south west of the quarry and is located at an approximate level of 12mOD. The pond appears to be spring fed and it is understood that it reduces in level during drought periods.

Borehole B has been drilled uphill of Pollyahunipa to a depth of 70m (-51 mod). No groundwater was encountered during drilling which took place over 2 days. No voids or areas of karstification were encountered during the drilling. Water level has risen and stabilsed at a depthof approximately 10.6 m below the ground surface..

The existing information indicates that the spring is fed from an underground flowpath to the west which then continues south to the estuary at Lough Corrib.

Based on the existing information it is considered highly unlikely that the present quarrying activities will affect levels in Pollyahunipa and associated ponds.

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7.3 Cong Canal

Cong canal is located some 250 metres to the east of the quarry at an elevation of approximately 20 m.OD.and is therefore generally above the level of quarrying. It is understood that the canal is largely unlined . Leekage from the canal has been detected from investigations near Lough Mask and there are observable seepages from the quarry face at present.

The construction of the Cong canal (1845-55) lowered the water level of Lough Mask by some 2m and causes surface flow to take place between the lakes via the canal when the water level in Lough Mask exceeds 17m O.D. Prior to this, the underground routes transmitted all of the inter lake discharge; flows in excess of 50m3/s must have emerged from the Cong Springs. At present the Cong canal is dry for an average of 90 days per year and during this period the Cong springs discharge about 17m3/s. Water from the Cong canal recharges to groundwater (strip recharge) along its entire length and in all but the highest groundwater conditions.

7.4 Hatchery Mill Pond

The hatchery mill pond is located some 650 metres south east of the quarry and is located at a level of approximately 12 mOD. The pond is used as a hatchery for salmon.

It is understood that the group of springs feeding the pond always function and are fed by one of the major underground flowpaths from Lough Mask. The springs have been investigated by divers and found to issue from enlarged bedding planes at a depth of some 20 metres.

Based on the existing information it is considered unlikely that the present quarrying activities will affect levels in the Mill Pond.

7.5 Ellechrisasaun spring

This spring is located some 300 metres to the south of the quarry which supplies a marshland area and tributary to Lough Corrib. It is understood that the springs here dry up during low groundwater conditions. The spring discharges water from the western part of the isthmus as wellas from the Lough Mask sinks.

Based on the existing information it is considered unlikely that the present quarrying activities will affect levels at the spring.

7.6 Horse hole or Pollahopple

This feature is located some 340 metres to the south west of the quarry, is spring fed, and it is understood that the pond dries up during drought periods. This feature is fed from a spring located to the south west (see Figure 6) and is not in the water catchment area of the quarry.

Based on the existing information it is considered unlikely that the present quarrying activities will affect levels in the pond.

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7.7 The well at Pigeon Hole

It is understood that the yield from this well varies from 250 –1000 m3/day and the well is fed by the stream at the bottom of the well. From our visit to the well it appears that there is sewage pollution of the groundwater and the well is no longer in use.

7.8 Lough Corrib

Lough Corrib is located some 2 kilometres to the south of the quarry and is fed by the regional groundwater flow. It is unlikely that the effects of present or future quarrying will effect water levels in the Lough.

7.9 The Quarry Lagoon

The quarry lagoon which collects water from the quarry is located to the south east of the existing quarry. The water from the quarry is passed through a settlement tank which has the following dimensions.

Total Volume = 2022.5 m3
Max Discharge = 3m3/hour
Minimum retention time = 674 hours

The water in the tank is passed through two wiers and has an outlet chamber one of which discharges to the Cong Canal and one which returns back to the quarry. It is understood from the operators that pumping from the settlement tank is on an intermittent basis.

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8.1 POTENTIAL IMPACT ON SURFACE WATER & GROUNDWATER OF QUARRY

8.2 Groundwater flows

The impacts of quarrying in the unsaturated zone of limestone aquifers are generally only localised, in the form of increased runoff, the re-routing of groundwater within the aquifer and the reduction in groundwater storage in the aquifer in the immediate vicinity of the quarry. These effects are often considered as water management issues only and can be mitigated by the use of recharge ponds or wells to compensate for the water lost.

However if the quarrying impacts on the base flow level, substantial pumping may be required to progress the workings. Karst systems are highly efficient and therefore the impact may cover a larger area and its prediction is more complex. Simple calculations of drawdown are unlikely tobe accurate. The enclosed Figure 8 indicates the influence of karstification on limestone quarries.

With reference to Figure 8, based on the existing information it is considered that the quarry falls into scenario 3. The conclusions being that although the quarry extends below the groundwatertable the non-karst limestone is tight and of low mass permeability. Therefore even though excavation is below the groundwater table there are no sudden inflows into the quarry and no extensive drawdown despite pumping.

An appreciation of the level of the base flow (top of the saturated aquifer) and karstification is therefore critical and the boreholes installed at the quarry should be permanently monitored and assessed to quantify the effects of quarrying.

The possible impact of quarrying above the base flow levels would be if a lateral conduit which formed a significant flowpath for peak flows were to be intercepted. Based on the existing information this situation is unlikely because the main chartered flowpaths exist to the west and east of the quarry.(see Figure 3).

A number of drillholes for investigation and blasting purposes have been undertaken at the site and frequent observations of the quarry have not indicated any significant fissures or voids and therefore it is unlikely that the quarry will encounter any significant conduits. As detailed above, the impact if the excavation did intercept such a conduit would be localised only. The impact could be minimised by replacing the groundwater into the karst system as part of a water management procedure.

Limited quarrying below the base flow level could intercept the regional groundwater flow to the south. Based on the existing information this is likely to have a minimal impact on the regional base flow level.

Quarrying to levels significantly below the base flow level would be likely to require more significant dewatering measures below the base flow levels and may cause a change in the regional hydraulic gradient. This would require further assessment and investigation.

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8.3 Surface water flows

The quarry is within influencing distance of a number of surface water features located to the south and downstream of the site. From the existing information there is no evidence that thesewater features are connected to the groundwater underlying the site and hence any effect of lowering the groundwater table at the site will not affect the adjacent surface water flows.

The surface water flow into the excavations of the quarry are now accommodated by a suitably designed holding lagoon which is passed through two wiers of a settlement tank.

8.3 Surface water quality

There is no evidence that quarrying activities at the site have affected surface water quality downstream of the site. However its recommended that the suspended solids discharge from the settlement tank is monitored on a more frequent basis, ie one monthly intervals.

8.4 Groundwater quantity

There are no licensed wells within influencing distance of the site and therefore there is unlikely to be any impact on groundwater quantity.

8.5 Groundwater quality

The existing reports, by the Geological Survey of Ireland indicates that there is significant pollution of wells and springs in the area. The generally low nitrate levels and the high proportion of wells in the area with faecal bacteria indicate that contamination is due to mainly organic wastes. There are four main possible sources;

Septic tanks.
Farmyards.
Landspreading of organic wastes.
Sewage in sinking streams.

Quarrying is not considered to have a major contaminative impact on groundwater quality.

At present the practices at the quarry are very well controlled measures are undertaken by the quarry operators and the use of contamination sources eg fuel and bitumen are carefully controlled. A quality control system is being operated at the site to ensure these contaminant are carefully handled and stored.

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9.0 CONCLUSIONS

The site lies on an isthmus between Lough Mask and Lough Corrib and is located on south facing slopes of elevated ground (up to 32 metres above Ordnance datum). The isthmus forms a ridge of higher ground between Lough Corrib some 2 kilometres to the south of the site and Lough Mask some 3.5 kilometres to the North West.

At Cong, the largest recharge for the Limestone aquifer is considered to be the regional through flow from Lough Mask within chartered underground conduits. There are very rapid flow rates within these conduits indicating an aquifer with minimal storage and almost infinite permeability.

The Carboniferous Limestone is a virtually impermeable material in its unfractured state, however it is commonly fractured and these fractures allow groundwater storage and flows. The existing information indicates that flow rates in the North- South Joints are twice as fast as theEast-West trending joints.

The available regional information indicates that the groundwater levels in the isthmus between Lough Mask and Cong is between 12 and 20 m.OD. This largely complies with the groundwater monitoring undertaken at the site.

The regional groundwater system is controlled by an efficient system of drainage conduits and the impact of quarrying on the surrounding water table and surface water features is minimal.

10.0 RECOMMENDATIONS

Based on the existing information it 1s recommended that the following monitoring 1s undertaken.

1. The existing monitoring wells installed around the quarry should be monitored for water level, ph , temperature, electric conductivity and suspended solids on a monthly basis.

2. The discharge from the settlement tanks should also be monitored as above.

3. Periodic site visits to observe the nature of any karst features encountered.

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11.0 REFERENCES

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Appendix 8.11 Site Investigation Information

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Table A Hydro-G's 'Blast hole' drilling rig boreholes Drilling Record

Application Area BHs							
BH ID	Easting	Northing	2014 Ground Level (mOD)	Total Depth of BH (m bGL)	Exploration Depth Base Elevation (m OD)	Hydro-G Notes on Subsurface	Date Drilled
1	514071	756608	18.272	34	-15.728	Competent Bedrock, no cracks, no changes in drilling rig response, no moisture, no clays, no sands, no evidence of weathering or conduits, no water, Solid Pure Limestone DUST Returned.	06/08/2014
2	514129	756618	16.345	34	-17.655		06/08/2014
3	514152	756675	15.607	34	-18.393		06/08/2014
4	514161	756642	15.529	34	-18.471		07/08/2014
5	514159	756520	18.73	34	-15.27		07/08/2014
6	514062	756514	21.583	34	-12.417		07/08/2014
7	531963	756427	22.267	34	-11.733		07/08/2014
8	513951	756426	22.643	34	-11.357		07/08/2014
9	513982	756451	21.428	34	-12.572		07/08/2014
10	513922	756389	23.77	34	-10.23		07/08/2014
11	513974	756306	23.72	34	-10.28		07/08/2014
12	513980	756308	23.535	34	-10.465		07/08/2014
13	513981	756304	23.763	34	-10.237		08/08/2014
14	513982	756299	23.827	34	-10.173		08/08/2014
15	513983	756294	23.823	34	-10.177		08/08/2014
16	514112	756382	21.78	34	-12.22		08/08/2014
17	514135	756415	20.498	34	-13.502		08/08/2014
18	514117	756430	17.6	34	-16.4		08/08/2014
19	514306	756462	15.627	34	-18.373		08/08/2014
20	514353	756404	16.738	34	-17.262		08/08/2014
21	514353	756390	17.051	34	-16.949		08/08/2014
22	514369	756172	19.663	34	-14.337		01/09/2014
To the South of the Application Area BHs							
BH ID	Easting	Northing	2014 Ground Level (mOD)	Total Depth of BH (m bGL)	Exploration Depth Base Elevation (m OD)	Hydro-G Notes on Subsurface	Date Drilled
23	514459	755867	21.203	34	-12.797	Competent Bedrock, no cracks, no changes in drilling rig response, no moisture, no clays, no sands, no evidence of weathering or conduits, no water, Solid Pure Limestone DUST Returned.	01/09/2014
24	514285	755843	-5.713	34	-39.713		02/09/2014
25	514302	755876	1.602	34	-32.398		02/09/2014
26	514266	755907	-5.601	34	-39.601		02/09/2014
27	514287	755935	-5.878	34	-39.878		02/09/2014
28	514356	755950	-6.088	34	-40.088		02/09/2014
29	514353	755963	-5.642	34	-39.642		02/09/2014
30	514337	755964	-5.787	34	-39.787		02/09/2014
31	514233	756021	14.653	34	-19.347		03/09/2014
32	514227	756054	13.097	34	-20.903		03/09/2014
33	514212	756073	12.96	34	-21.04		03/09/2014
34	514234	756108	12.321	34	-21.679		03/09/2014
35	514314	756118	10.687	34	-23.313		03/09/2014
36	514321	756121	10.546	34	-23.454		03/09/2014
37	514298	756113	11.093	34	-22.907		03/09/2014
38	514199	756129	12.292	34	-21.708		03/09/2014
39	514185	756091	12.738	34	-21.262		03/09/2014
40	513995	756186	12.75	34	-21.25		04/09/2014
41	513985	756057	22	34	-12		04/09/2014
42	513866	755881	14.108	34	-19.892		04/09/2014
43	513906	755874	14.845	34	-19.155		04/09/2014

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Table B Site Borehole Details: Cored Holes

Core Hole ID	Easting	Northing	2014 Ground Level (mOD)	Total Depth of BH (m bGL)	Exploration Depth Base Elevation (m OD)	Colthurst Notes on Drilling	Date Drilled	General Location Information
A	514033	756591	19.309	202	-182.691	The limestone is a solid mass of pure product with no weathered zones or water bearing routes.	May-14	In Southern Pre-63 Area
B	514280	755825	-5.525	85.2	-90.725		May-14	In Northern Application Area on on immediate boundary.
C	514324	756160	9.476	61.2	-51.724		May-14	
D	513945	756265	12.089	64.2	-52.111		May-14	
E	514259	756503	16.632	67.2	-50.568		May-14	

Table C Site Borehole Details: Long Term Monitoring Record GW BHs

Long Term BH ID	Easting	Northing	Ground Level (mOD)	Total Depth of BH (m bGL)	Exploration Depth Base Elevation (m OD)	Date Drilled	Notes
GW1	755741	514011	19.64	50	-30.36	2006	Routine Monitoring Points
GW2	755693	514264	17.62	70	-52.38	2006	
GW3	756180	514347	22.85	90	-67.15	2006	
GW4	756722	514056	19.81	60	-40.19	2006	

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Water Quality - Three Years 2024 > 2023 > 2022

- Table 8.12 (A) = Groundwater Quality & Groundwater Levels
- Table 8.12 (B) = Discharge Quality

Discharge – One Year December 2023 – December 2024 (inclusive)*

- Table 8.12 (C) = Daily Discharge Data – 1 year
- Table 8.12 (D) = Monthly Statistics for Hourly Readings of Discharge

***Note:** With Respect to Metrics on Discharge Volumes and Physiochemical:

One complete year is presented in this Appendix - December 2023 to December 2024 (inclusive). Whilst all data are reported to Galway County Council as per the Conditions of the Section 4 Discharge Licence W/391/05_R1 (2019), ONLY A SUBSET of the data are presented here for the purpose of conciseness and to demonstrate all season's response.

Table 8.12 (A) **<u>Groundwater:</u>** Boreholes & Floor Sump Quality & Levels - **'As Conditioned W/391/05_R1' QUARTERLY Laboratory Results**
(Three Year Subset of Entire Record: 2024 > 2023 > 2022)

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		Upstream Groundwater BH1										
Sampling Point		**Cong BH1**	**Cong BH1**	**Cong BH1**	**Cong BH1**	**Cong BH1**	**Cong BH1**	**Cong BH1**	**Cong BH1**	**Cong BH1**	**Cong BH1**	**Cong BH1**
	Date	**Dec-24**	**Oct-24**	**Jul-24**	**May-24**	**Dec-23**	**Aug-23**	**Apr-23**	**Dec-22**	**Oct-22**	**Jun-22**	**Mar-22**
Conductivity @20C	uS/cm	379	379	372	387	380	316	406	84.7	381	386	381
Nitrate as NO3	mg/l	2.06	1.55	<0.44	<0.44	0.658	3	<0.44	<0.44	1.67	0.885	<0.44
pH	pH Units	7.5	7.3	7.5	7.6	7.9	8.0	7.6	7.4	7.5	7.6	7.6
Suspended Solids	mg/l	4	11	5	<2	5	2	13	<2	5	2	8
Turbidity	N.T.U.	1.5	3.9	1.2	0.3	2.5	0.6	7.3	0.5	5.9	1.4	6.5
Water level (field)	m bgl	17.4	17.8	17.8	17.7	17.4	17.2	17.9	17.9	17.6	16.9	17.4
	Lab ID	1821514	1793252	1761210	1739158	Cong BH1	1644813	1600762	1564691	1536564	1489641	1430197

		Downstream Groundwater BH4										
Sampling Point		**Cong BH4**	**Cong BH4**	**Cong BH4**	**Cong BH4**	**Cong BH4**	**Cong BH4**	**Cong BH4**	**Cong BH4**	**Cong BH4**	**Cong BH4**	**Cong BH4**
	Date	**Dec-24**	**Oct-24**	**Jul-24**	**May-24**	**Dec-23**	**Aug-23**	**Apr-23**	**Dec-22**	**Oct-22**	**Jun-22**	**Mar-22**
Conductivity @20C	uS/cm	476	449	418	453	422	313	460	311	435	420	422
Nitrate as NO3	mg/l	2.04	1.64	1.35	1.55	1.66	2.98	2.15	4.08	3.63	1.6	1.88
pH	pH Units	7.7	8.0	8.1	8.0	8.1	8.0	7.8	8.0	8.0	8.1	8.0
Suspended Solids	mg/l	4	3	4	2	7	<2	<2	5	2	<2	<2
Turbidity	N.T.U.	3.0	2.0	3.9	0.7	2.9	0.6	1.1	13.4	1.6	1.8	0.9
Water level (field)	m bgl	3.2	3.7	4	4.1	6.1	3.12	5.72	5.523	5.023	5.323	5.323
	Lab ID	1821515	1793253	1761211	1739159	1688121	1644814	1600764	1564692	1536565	1489642	1430198

		Floor Sump in South East Corner of the site = Collects All Rainfall Runoff from Entire Site & Integrates GW										
Sampling Point		**Cong Sump**	**Cong Sump**	**Cong Sump**	**Cong Sump**	**Cong Sump**	**Cong Sump**	**Cong Sump**	**Cong Sump**	**Cong Sump**	**Cong Sump**	**Cong Sump**
	Date	**Dec-24**	**Oct-24**	**Jul-24**	**May-24**	**Dec-23**	**Aug-23**	**Apr-23**	**Dec-22**	**Oct-22**	**Jun-22**	**Mar-22**
Conductivity @20C	uS/cm	308	304	310	300	291	315	280	no sample	371	352	306
Nitrate as NO3	mg/l	5.36	2.17	4.1	2.86	3.31	2.99	1.77	no sample	8.75	6.83	4.47
pH	pH Units	8.0	8.0	8.1	8.1	8.0	8.0	8.1	no sample	8.0	8.2	8.1
Suspended Solids	mg/l	<2	3	<2	<2	<2	2	<2	no sample	<2	<2	<2
Turbidity	N.T.U.	0.4	0.4	0.9	0.5	0.3	0.6	0.7	no sample	1.1	1.3	0.4
	Lab ID	1821516	1793254	1761212	1739160	1688122	1644815	1600766	no sample	1536566	1489643	1430199

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Table 8.12 (B) **<u>DISCHARGE QUALITY</u> = Three Years of 'As Conditioned W/391/05_R1' QUARTERLY Laboratory Results**
(Three Year Subset of Entire Record: 2024 > 2023 > 2022)

Cong Discharge Quarterly Monitoring as per W/391/05_R1 (2019)		Licence ELV	13/12/2024	02/10/2024	02/07/2024	01/05/2024	07/12/2023	14/08/2023	05/04/2023	20/12/2022	05/10/2022	29/06/2022	30/03/2022
Temperature	oC	not specified	8.3	13.8	16.7	13.5	9.2	12.2	12.2	15.7	15.7	10.4	10.4
pH	pH Units	6 to 9	8.0	8.0	8.1	8.2	8	8.0	7.9	8.1	8	8.2	8.1
BOD	mg/l	5	In Progress	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
COD	mg/l	20	<10	<10	5	<10	<10	<10	30	<10	11	<10	<10
Suspended Solids	mg/l	20	<2	<2	<2	<2	<2	2	<2	6	<2	<2	<2
Ammonia as N	mg/l	0.1	0.488	<0.005	0.029	0.006	0.02	0.025	<0.005	0.031	0.033	0.015	0.028
Nitrate as NO3	mg/l	10	5.49	2.2	4.07	2.77	2.68	2.98	1.87	4.01	9.22	6.53	4.41
Total Phosphorus as P	mg/l	2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.11
Orthophosphate as PO4-P	mg/l	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.017	<0.01	<0.01	<0.01	<0.01
PRO	**ug/l**	not specified	14	14	15	<10	37	<10	<10	<10	<10	<10	<10
Hydrocarbons	**ug/l**	0.5 mg/l = 5000 ug/l*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
*ELV for Hydrocarbons on Licence is mg/l but Lab reports ug/l which is the Lab unit of Measurement [Note: CLS Lab is unable to Identify a known Hydrocarbon signal in the Discharge: Persistently Reporting **Unknown Signal]		**Lab ID**	1821513	1793251	1761209	1739157	1688119	1644812	1600761	1564690	1536563	1489640	1430196

Table 8.12 (C) Daily Discharge Data – 1 year (2023 - 2024)

RECEIVED: 31/01/2025

Day	Dec-23	Jan-24	Feb-24	Mar-24	Apr-24	May-24	Jun-24	Jul-24	Aug-24	Sep-24	Oct-24	Nov-24	Dec-24		
1st	1,851	6,905	5,121	3,822		2,318	1,124	613	629	1,829	1,195	1,897	2,597		
2nd	1,966	7,374	4,981	2,996		1,853	1,007	550	724	1,893	1,006	1,742	2,058		
3rd	1,833	7,167	4,546	2,999		1,591	1,024	667	976	1,585	1,161	1,831	2,083		
4th	1,780	6,788	4,045	2,683		1,537	975	579	948	1,528	1,150	1,679	2,663		
5th	1,561	6,674	3,803	2,637		1,397	974	467	2,190	1,549	1,274	1,209	3,221		
6th	2,569	6,443	4,973	2,446		1,330	358	636	1,792	1,305	1,322	1,753	3,221		
7th	3,022	5,910	4,020	2,247	0	1,328	16	694	1,886	1,231	1,101	1,637	2,873		
8th	4,298	5,186	3,941	2,115	0	1,098	10	628	1,383	1,273	1,412	1,680	4,144		
9th	5,209	4,628	4,504	2,115	0	1,256	6	743	1,581	1,115	1,209	1,602	2,618		
10th	4,485	4,786	3,840		0	1,097	6	660	950	1,378	766	1,703	1,762		
11th	3,944	4,427	3,573		0	1,202	247	701	779	1,286	- 8	1,364	1,034		
12th	4,560	4,075	3,320		3,625	1,565	1,312	256	1,023	1,223	- 14	1,420	1,301		
13th	3,355	3,815	3,117		2,740	2,214	1,040	604	1,277	1,013	- 17	1,392	1,283		
14th	3,137	3,274	4,189		2,677	1,906	1,040	660	1,053	2,193	2,060	1,203	1,304		
15th	2,917	2,822	4,565		2,950	1,715	672	947	1,138	2,284	1,878	1,332	1,359		
16th	3,050	2,564	3,499		2,443	1,378	764	1,060	1,542	1,613	1,177	1,450	1,329		
17th	4,153	2,362	3,558		2,329	1,234	685	543	1,210	1,426	1,377	1,497	1,308		
18th	6,151	1,938	3,408		2,107	1,128	475	1,172	1,153	1,131	219	1,749	1,345		
19th	4,366	1,885	3,087		1,860	1,106	576	622	951	1,271	- 8	3,005	1,291		
20th	3,753	2,721	3,060		973	1,481	414	957	1,467	1,059	1,294	2,111	1,349		
21st	3,289	2,843	3,407		1,606	2,135	453	695	1,139	791	5,724	2,512	1,314		
22nd	3,032	5,583	3,197		1,927	1,235	939	948	294	11	2,706	2,589	1,327		
23rd	3,287	6,000	3,094		1,705	1,208	738	1,366	4,861	- 4	1,783	5,831	1,373		
24th	3,975	6,147	3,139		1,632	1,235	678	1,209	2,483	- 7	1,977	5,959	1,418		
25th	3,195	5,630	3,139		1,588	1,212	592	867	2,510	- 12	4,713	3,904	1,426		
26th	2,983	5,945	2,676		1,508	1,219	616	476	2,633	- 12	2,645	2,629	1,387		
27th	5,778	5,660	2,596		1,566	1,202	738	1,370	3,995	3,131	2,578	2,434	1,343		
28th	5,524	5,288	3,045		1,360	1,342	698	760	2,933	2,098	2,569	2,338	1,357		
29th	5,228	5,075	3,258		1,240	1,050	805	1,090	2,461	1,336	2,059	2,570	3,923		
30th	6,393	4,972			140	1,174	711	873	2,176	1,150	2,001	2,582	5,588		
31st	6,782	5,014				1,200		719	1,971		2,042		977		
	Dec-23	**Jan-24**	**Feb-24**	**Mar-24**	**Apr-24**	**May-24**	**Jun-24**	**Jul-24**	**Aug-24**	**Sep-24**	**Oct-24**	**Nov-24**	**Dec-24**	**Annual Stats (m3/d)**	
MAX	6,782	7,374	5,121	3,822	3,625	2,318	1,312	1,370	4,861	3,131	5,724	5,959	5,588	7,374	**MAX**
MIN	1,561	1,885	2,596	2,115	zero	1,050	6	256	294	zero	zero	1,203	977	zero	**MIN**
AVERAGE	3,788	4,835	3,679	2,673	1,499	1,417	656	778	1,681	1,256	1,624	2,220	1,986	2,141	**AVERAGE**
	Dec-23	**Jan-24**	**Feb-24**	**Mar-24**	**Apr-24**	**May-24**	**Jun-24**	**Jul-24**	**Aug-24**	**Sep-24**	**Oct-24**	**Nov-24**	**Dec-24**		

Table 8.12 (D) Summary Statistics for DAILY DATA RECORDS
(December 2023 – December 2024, inclusive)

RECEIVED: 31/01/2025

		Outlet Flow (m3/h)	Outlet pH	Outlet Conductivity (µs/cm)	Turbidity (NTU)
	ELV W391/05_R1	408.16	6 to 9 pH	no signifcant change	
Dec-23	Average	189.7	7.0	207.3	0.6
	Max	347.15	7.5	228.44	0.67
	Min	12.32	6.7	172.81	0.47
Jan-24	Average	203	7.36	187.5	0.6
	Max	345	7.70	220.63	1.43
	Min	0	6.94	159.38	0.37
Feb-24	Average	153.4			6.8
	Max	308.32			10.71
	Min	86.92			1.42
Mar-24	Average	108.6			10.9
	Max	206.67			12.16
	Min	58.24			9.65
Apr-24	Average	87.0	6.6	245.2	
	Max	198.06	7.23	280.94	
	Min	1.42	6.31	0	
May-24	Average	59.0	7.2	215.7	0.9
	Max	134.58	8.24	277.19	7.73
	Min	1.31	4.76	0	0.16
Jun-24	Average	27	7.3	206	1
	Max	250	8.4	301	2
	Min	0	6	148	0.2
Jul-24	Average	33	7	165	0
	Max	265	8	212	3
	Min	0	6	113.13	0.21
Aug-24	Average	70	7	117	1
	Max	263	8	120	10
	Min	0	6	114.69	0.25
Sep-24	Average	52	7	117	
	Max	218	8	120	
	Min	0	6	114.38	
Oct-24	Average	68	7	109	
	Max	272	8	120	
	Min	0	6	84.38	
Nov-24	Average	93	8	94	
	Max	270	8	108	
	Min	1.64	6.49	73.75	
Dec-24	Average	85	8	87	
	Max	346	8	108	
	Min	0	7	76	