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REPORT ISSUE FORM

Hydrological investigation

in response to item No. 4c

of An Bord Pleanála's

Request for Further Information

for a proposed Outdoor Theatre

at Lanesborough,

Co. Longford.

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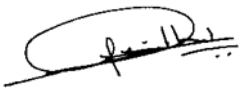
Signed on behalf of Aqua Geoservices		**Signed on behalf of the client***	

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LIST OF ABBREVIATIONS

The following abbreviations are used in this report:

Acronym	Definition
AEP	Annual Exceedance Probability
a.OD	Above Ordnance Datum
ABP	An Bord Pleanála
AGS	Aqua GeoServices Ltd.
CSM	Conceptual Site Model
CFRAMS	Catchment Flood Risk Assessment and Management Study
CDP	County Development Plan
dBMA	De Blacam and Meagher Architects Ltd.
DPBL	Dinantian Pure Bedded Limestone
EFG	European Federation of Geologists
EIAR	Environmental Impact Assessment Report
ESB	Electricity Supply Board
EurGeol	European Geologist
FONRCE	Fearon O'Neill Rooney Consulting Engineers
GSI	Geological Survey Ireland
GWB	Groundwater Body
ha	Hectare
IGI	Institute of Geologists of Ireland
IAH	International Association of Hydrogeologists
NHA	Natural Heritage Area
NIFM	National Indicative Fluvial Maps
NPWS	National Parks and Wildlife Service
pNHA	Proposed Natural Heritage Area
Rkc	Regionally Important Karstified Aquifer dominated by conduit flow
SAC	Special Area of Conservation
SPA	Special Protection Area
SPR	Source–Pathway–Receptor
SFRA	Strategic Flood Risk Assessment
TPH	Total Petroleum Hydrocarbons
WI	Waterways Ireland
WNW	West-North-West

I. INTRODUCTION

I.1 Background

Longford County Council are seeking planning permission from An Bord Pleanála (**ABP**) to construct a 500-seat outdoor amphitheatre in Lanesborough, Co. Longford (**ABP Case No. 318314** received 20/10/23).

The proposed development is to be located in the Commons North Lime quarry, which is a disused quarry currently used as a depot by Longford County Council.

Given the limited land take required for the redevelopment (0.618Ha), an Environmental Impact Assessment Report (**EIAR**) is not required.

I.2 Scope of Appointment

Aqua GeoServices Ltd. (**AGS**) were appointed by de Blacam and Meagher Architects (**dBMA**), on behalf of their client Longford County Council, to respond to item No. 4.(c) of a request for further information received from ABP on the 15/05/2024 as follows: "Detailed consideration of any potential hydrological connectivity between the proposed site and limestone and lake habitats in the vicinity".

This report presents the findings of our desk study, which was complemented by four site visits carried out during varied hydrological conditions.

I.3 Statement of Authority

Aqua Geoservices Ltd. (AGS) are a specialist geological, hydrogeological and hydrological practice, which delivers a wide range of environmental and water-related consultancy services to both the private and public sectors across Ireland but also abroad.

AGS was established in 2012, and our office is located in Wicklow Town, Co. Wicklow. Our core areas of expertise and experience include hydrogeology and hydrology. We routinely complete impact assessments for hydrology and hydrogeology for a large variety of project types.

This report was prepared by Bruno Teillard, a highly experienced hydrogeologist holding a French M.Sc. in Hydrogeology (with Distinction) with over 27 years of professional experience in Ireland and internationally. His professional certifications include:

- Professional Geologist (PGeo) with the Institute of Geologists of Ireland (**IGI**) since 2004
- European Geologist (EurGeol) with the European Federation of Geologists (**EFG**) since 2005

Mr. Teillard is also a member of the International Association of Hydrogeologists (**IAH**), a professional member of the Irish Association of Economic Geology, an associate member of the Geological Society (NI Regional Group), and is part of the panel of independent hydrogeologists approved to work on Irish Water projects.

Bruno has provided advisory services on water related environmental and planning issues to both public and private sector bodies. His specialist area of expertise is water resource management , hydrological assessment and environmental impact assessment (with respects to soil, geology and water).

II. DESCRIPTION OF THE PROPOSED DEVELOPMENT

II.1 Site Description and Location

The project is proposed to take place on an area of land of approximately 6,180m^2 on the outskirts of Lanesborough, in Co. Longford (Figure 1). The proposed site lies within the perimeter of a former lime quarry, which currently serves as a depot for Longford County Council.

The disused quarry can be directly accessed from the N63 via a tarmac road. The quarry faces are located to the easternmost portion of the site beyond which lies the Rathcline road. The quarry floor mostly consists of bare ground with a hardcore layer consisting of gravels, but a hollow ground is located to the South. It is surrounded by woodland to the West and South and by a mix of residences and pasture lands to the North.

II.2 Proposed Development

The proposed development will consist of the redevelopment of the old lime quarry into an outdoor theatre. It will comprise of:

- Permanent 12 level tiered seating (500 seats) in a landscaped embankment;
- Stage with canvas canopy and steel support structure;
- Temporary public 'porta-loos' including 1 no. accessible 'porta-loo'. These toilets will be removed off site after events. There will therefore be no requirement for connection to a sewer line or for an existing wastewater treatment system.
- 1 no. 20 foot container (14 sqm) modified for equipment storage.
- 1 no. 20 foot container (14 sqm) modified to contain function services (temporary bar, first aid room).
- 1 no. Sound booth (7 sqm).
- Site lighting.
- Associated landscaping and ancillary site.

III. BASELINE SETTING

III.1 Topography

Locally the topography is orientated to the West-North-West, i.e. toward Lough Ree (Figure 1). Locally, the elevation ranges from c. 50m above Ordnance Datum (a.OD) on the heights of Common North Townland, down to c.47m a.OD along the Rathcline road down and c. 37m a.OD on the hard standing area of the quarry floor.

The road leading to the quarry as well as the woodland trail road appear to create a minor embankment and are slightly above the surrounding grounds.

The Limestone pavement on Lough Ree lies at c. 36.8m a.OD sloping down to c. 35m a.OD along the shoreline.

III.2 Rainfall

Hydrometeorological information was sourced from Met Eireann. The most relevant rainfall station for the area is located at Mountdillon in Co. Roscommon. This rainfall station lies at an elevation of 49m a.OD and is situated c. 6km to the North of the site.The 30-year average monthly rainfall is presented in table II.3.1 below and compared to the monthly rainfall to date in 2025.

Month	30 year monthly rainfall average for the period 1981 - 2010 (in mm/month)	Monthly rainfall 2025 (in mm/month)
January	101.2	58.3
February	77.7	84.1
March	85.9	38.3
April	64.8	109.2
May	66.1	
June	72.7	
July	68.2	
August	82.8	
September*	79.0	
October	106.2	
November	99.5	
December	106.0	
Yearly Total	**1,010.1**	

Table III.1.1 – 30-year monthly and annual average rainfall at Mount Dillon Rainfall station.

III.3 Hydrology and Catchment

The proposed development lies within the Upper Shannon 26E catchment of Hydrometric Area 26. The proposed development site lies within the local Shannon Upper sub-catchment (Shannon[Upper]_SC_090). As shown in Figure 2, the surface water catchment divide located only 280m upgradient from the site.

III.4 Drainage pre-construction phase

The nearest surface water receptor is Lough Ree, which is located c. 90m down hydraulic gradient from the proposed site and is the only water feature draining the local area.

There are no other surface waterbody (i.e. brook, stream or river) and/or drainage channel in the area (mapped or identified during the site visits). The lack of surface water features in this area generally reflects a high degree of recharge to the underlying bedrock aquifer.

No direct discharge was identified from the proposed site area to Lough Ree during the walkover surveys, which were conducted during different weather conditions on the 24/03/25, 25/03/25, 16/04/25 and on the 08/05/25.

Both the access road to the former quarry area (orientated in an East-West direction) and the woodland trail (orientated in a North-Southerly trending direction) have been raised (Photographs 1 and 2) above the surrounding natural ground.

Photograph 1 – Access road to the former quarry (view Eastward, dated 16/04/25) – Please note the water ponding on the tarmac and the sloping ground on each side of the road.

Photograph 2 – Woodland trail (view Northward, dated 24/03/25) – Please note the sloping ground on either side of the trail (Quarry to the right-hand side)

Based on the observation made on site and the information obtained to date[1], it is inferred that the former quarry has been excavated in a roughly circular shape below the natural ground level to the West.

Overtime, it is assumed that the site has been raised to a level of c. 37m a.OD, possibly to remain above high-water levels from the lake during severe flooding events. This seem to have been carried out using compacted hardcore and stones, which have been partially tarmacked on top of the access roads. Given its North-South trending direction, the nature trail (Figure 2) appears to be acting as an embankment/dam around the Western perimeter of the site.

Photograph 3 –Sump located within the central part of the proposed outdoor theatre where surface water generated on site is ponding during heavy rainfall (24/03/25).

[1] Refer to dBMA Drawing No. A3 dated March 2003 in Appendix

As a result, storm water runoff generated within the proposed site drains toward the deepest part of the excavation, which is centrally located around the Eastern quarry face. Once there, it tends to become a perched water feature, that slowly percolates down to the shallow groundwater (as observed on the 24th and 25th of March 2025 and on the 16th of April 2025). The slow percolation rate may be either a reflection of harder, less fractured, limestone bedrock found at depth and/or that the fractures and cracks from the limestone bedrock have been filled in with fine sediments overtime.

III.5 Drainage post-construction phase

The outdoor theatre will be built on a reprofiled ground

III.5 Water levels of Lough Ree

The water level on Lough Ree is managed by the Electricity Supply Board (**ESB**) through the operation of the sluices at the outlet of the lake at Athlone[2]. The control works at Athlone consist of a 170m long overflow weir (crest level of 37.40m a.OD) and 15 sluice gates. These latter are operated by Waterways Ireland (**WI**) under the instructions of the ESB. The sluice gates would be closed during flood periods to reduce the flooding of vast tracts of agricultural lands downstream. Given the low gradient of the River Shannon, the discharge over the Athlone weir during flood periods is affected by backwater from the confluence of the River Suck and the main channel just downstream of Shannon bridge"[3].

Photograph 4 – The control works in Athlone (23/05/25). Please note the waterways canal to the left, the sluice gates and 170m long overflow weir (background).

There are no active gauging stations in the vicinity of the site (all three water level stations in Lanesborough being inactive[4]). Based on the information obtained from the Office of Public Works for the nearest gauging station (Derry Bay (Station No. 26093), the water level of Lough Ree for the period 2002 – 20th of May 2025 ranged from 34.08m a.OD (30/04/06) up to a recorded maximum of 36.9m a.OD (02/01/16 i.e. during the stormy Winter of 2015 – 2016) and with an average of c. 35.20m a.OD[5].

Based on Chart III.5.1 below, which illustrates the water level data, the Median Annual Maxima at the Derrybay station was of c. 36.1m a.OD, which is below the bottom of the disused quarry floor (based on topographical data provided to date). There are however maxima that are well above the bottom level of the former quarry.

[2] Source: Shannon Flood risk State agency Co-ordination Working Group (https://rivershannongroup.ie/management-of-water-levels).
[3] Source: River Shannon, Flood of Winter 1999/2000 by ESB International (dated November 2000).
[4] Source: EPA website.
[5] Source: OPW website, https://waterlevel.ie/hydro-data

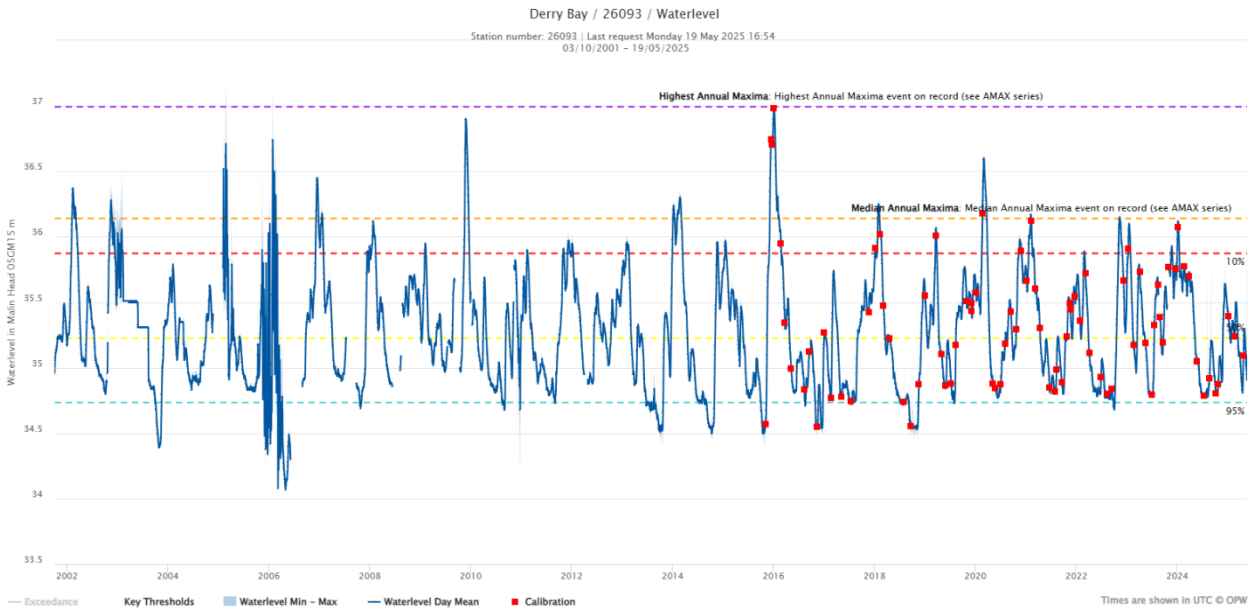


Chart III.5.1 – Lough Ree Water levels at Derrybay, Co. Longford (2002 to 19/05/25).

III.6 Flood Risk

The Geological survey of Ireland (**GSI**) Groundwater flood data maps were also consulted as part of this project. These comprised the Groundwater Flooding Probability Maps, the Historic Flooding maps and the SAR Seasonal Flood Maps (period 2015 – 2021), which did not return any flooding of the site.

The Ordnance survey 6" and 25" maps were also consulted as these can provide evidence of historical flooding but did not return any historical or anecdotal incidences of flooding within or adjacent to the former quarry.

The Office of Public Works (**OPW**) flood maps website (www.floodinfo.ie) was consulted on relation to available historical and modelled information on flooding incidences or occurrences in the vicinity of the proposed Outdoor Theatre.

Given the environmental background of the site, the main potential sources of flooding would be related to fluvial flooding only.

Pluvial flooding is discounted as there are no drainage systems surrounding the site area and tidal flooding is not relevant given the location of the site in the midlands (no influence from the ocean).

The OPW flood hazard maps did not record any flooding event at or in the vicinity of the proposed site area.

The past Flood Event Extents mapping was centred onto Lanesborough and did not extend to the South where the proposed site is located.

The Catchment Flood Risk Assessment and Management Study (**CFRAMS**) maps were consulted from the OPW website. These maps were produced from a number of sources and by applying different pluvial and fluvial models.

Figure 3 shows the modelled flood extent of land that might be inundated under different severe flood event scenarios. This mapping indicates that the site (marked with a red dot on the maps) is within a flooding area for what is considered:

- an Annual Exceedance Probability (**AEP**) of 0.1% (a 1 in 1000-year flood event) for the Present-Day Map (**Figure 3A**).

- a medium AEP of 1% (**Figure 3B**) and a Low AEP of 0.1% for the Mid-Range Future Scenario Map[6].
- a medium AEP of 1% (**Figure 3C**) and a Low AEP of 0.1% for the High-End Future Scenario Map[7].

The Maps from the Longford County Development Plan (**CPD**) were also consulted and showed that the site falls within Flood Zone A for medium and low probability events, corresponding to AEPs of 1% and 0.1% respectively.

A detailed Level 1/2 *Site-Specific Flood Risk Assessment* for the proposed development was prepared by Fearon O'Neill Rooney Consulting Engineers (**FONRCE**) in May 2025. This assessment reviewed the OPW CFRAMS, the National Indicative Fluvial Maps, and the Longford County Development Plan predictive flood maps. The assessment confirmed that the site falls within **Flood Zone A**, with modelled flood extents covering all or part of the quarry floor during both present-day and future climate change scenarios.

The model also shows that the access road to the woodland trail would be submerged under these conditions.

There is a history of flooding reported by the OPW in the wider area, notably during the winter of 1999/2000 and again on 30 November 2009. However, no direct photographic evidence of flooding specifically on the site was identified in the consultant's report, likely due to the resolution and coverage of available records.

Given the indirect hydraulic continuity between the groundwater beneath the quarry floor and the surface water level of Lough Ree, there is the potential for the quarry base, as it currently stands, to be at least partially flooded should a severe flood event occur during the construction phase.

The Flood Risk Assessment report carried by FONRCE concluded that "Although the site lies within Flood Zone A, the proposed outdoor theatre is consistent with local planning objectives, falls within the 'Less Vulnerable' category of land use, and will not significantly increase flood risk on or off site. It meets all three criteria of the Development Management Justification Test and should therefore be deemed appropriate in accordance with national flood risk policy".

III.7 Soil and Subsoil

Where present, the soil within the landholding area has been described as the Burren association (Unit No.0360a): this consists of a thin layer of rendzinas, which are generally well drained shallow soils with high lime content (as derived from limestone). Toward the shoreline and where present, the soil beneath the woodland and pastureland areas have been described as belonging to the Elton Association (Unit No. 1000a). These are luvisols, which are well drained mineral (basic) soils[8].

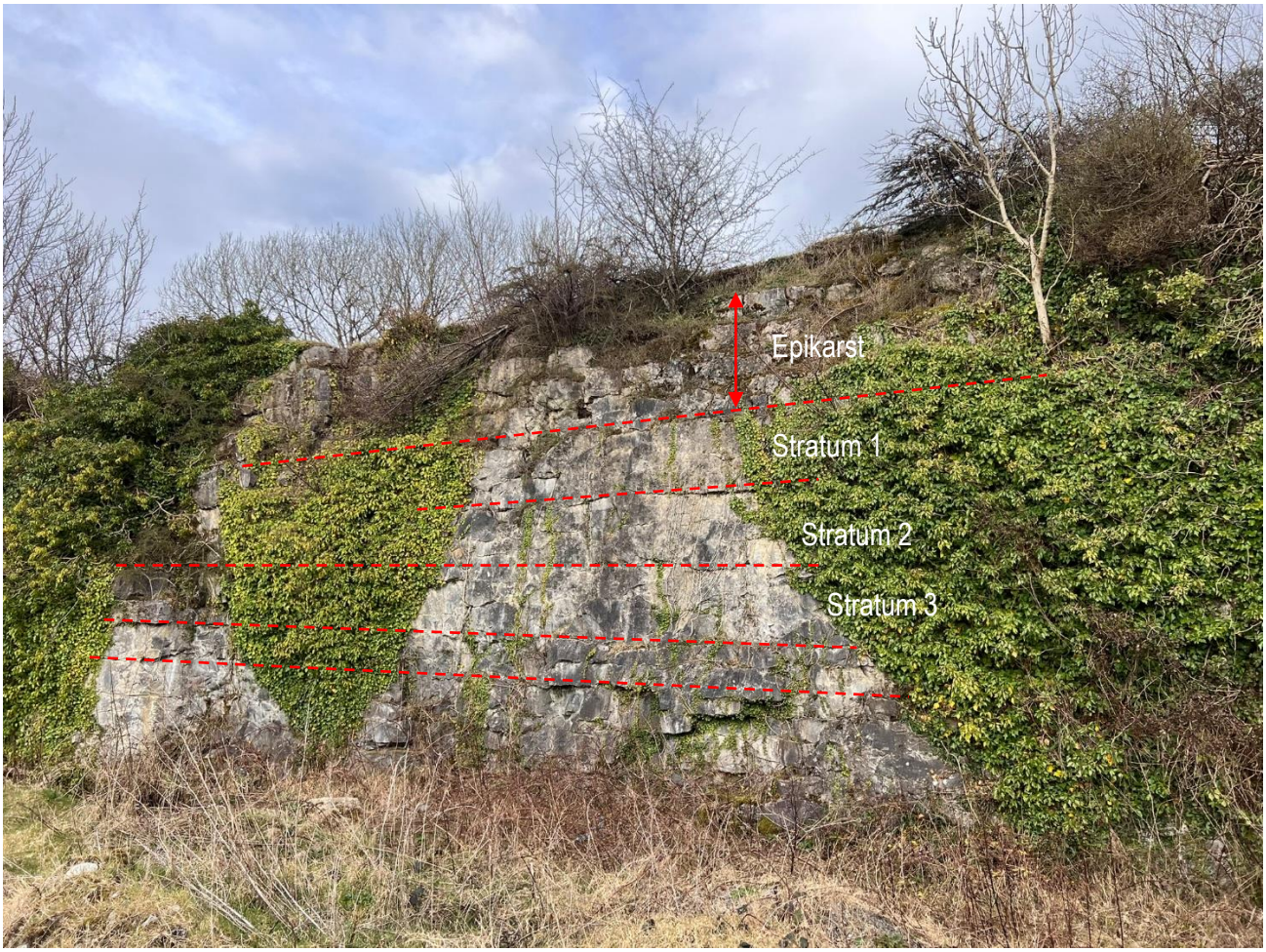
The GSI webviewer does not indicate the presence of subsoils within the site and its surrounding areas as it is described as "karstified bedrock outcrop or subcrop", which is consistent with our findings during the site visits. Toward the shoreline, the GSI indicate the presence of Lacustrine sediments, but based on our walkover survey, this would be more consistent with material encountered beneath the lake.

III.8 Bedrock Geology

Limestones of Carboniferous Age (c. 359.2 Mya to 298.9 Mya) cover the bulk of the landscape surrounding the shores of Lough Ree (Cf. **Figure 4**). The GSI has mapped the bedrock beneath the proposed site and its surrounding area as belonging to the Visean Limestones (undifferentiated) rock Formation (GSI code: CDVIS).

Based on the visual observations made on the faces of the disused quarry, the bedrock consists of an epikarst (uppermost layers of the limestone where solutional enlargements of joints and bedding planes is greatest) underlain by a series of beddings of various thicknesses (Cf. **Photograph 5**).

[6] The Mid-Range Future Scenario Map refers to modelled extents that take in the potential effects of climate change (increase in rainfall of 20% and sea level rise of 500mm).
[7] The High-End Future Scenario Map refers to modelled extents that take in the potential effects of climate change (increase in rainfall of 30% and sea level rise of 1,000mm).
[8] Source: EPA online viewer.



Photograph 5 – Eastern face of the former quarry. Please note the epikarst layer at the very top, i.e. where the bedrock is more weathered. The photograph also shows that the strata were deposited in a well-defined almost horizontal bedding. Each bed may represent a change in deposition conditions.

There are no structural features (presence of faults, syncline, anticline etc.) mapped within the site and its vicinity. This would reflect the poor exposure and the lack of variation in the rock lithology. Locally, the dip of bedding was recorded as being of 3 degrees to the NNW, which is consistent with the mapping information from the GSI for the area (2º).

Based on visual observations on the quarry faces (Cf. **Photograph 6**), it is likely that the fracturing of the upper part of the quarry works has been enhanced by blasting activities that took place in the quarry in the mid-1950's.

Photograph 6 – Leftover mark (where the ivy stem is growing) of a 2" drill hole that may have been drilled to install explosive (probably blasting gelatin otherwise known as "gelignite") for blasting the rock.

III.9 Limestone Pavements

There are no known major karstic features (doline, karstic spring etc.) mapped on the GSI website in the area. However, limestone pavement occurs sporadically along the lake shore, where the upper part of the bedrock is exposed. These limestone pavement features are prevalent in the shoreline to the West of the site area.

Photograph 7 – Small solutional hollows (Kamenitza types of Karren), which is formed in flat or gently sloping surfaces (25/03/25). Please note the rainwater accumulating in these hollows, contributing to further chemical weathering overtime.

Photograph 8 – Limestone pavement outcropping near the entrance to the Woodland trail (24/05/25).

As can be seen in Photographs 7 to 9, there is quite a variety of different pavement types.

Photograph 9 – Limestone pavement (Clint-Grike Karren) with Lough Ree in the background. The blocks of limestones are exposed after erosion and consist of solid flat-topped pieces of limestone (clint). Water has enlarged/deepened the fissures and/or cracks (grikes) that formed between the clints as a result of chemical weathering (dissolution) along joints in the Limestone. Please note the rainwater ponding in the hollows (16/04/25).

III.10 Bedrock Hydrogeology

The bedrock aquifer underlying the site is the Visean Limestones (undifferentiated) rock Formation, which forms part of the Dinantian Pure Bedded Limestone (**DPBL**). The DPBL covers a surface area of 7,062.74km^2. The following table summarises the characteristics of the bedrock aquifer underlying the site area and the general area as shown in **Figure 05**.

Unit name	Aquifer Category	Aquifer characteristics (based on GSI description of the groundwater body)
Visean limestone (undifferentiated) Formation (**CDVIS**) The bedrock aquifer beneath the site is within the Funshinagh Groundwater Body (EU Code: IE_SH_G_091).	Regionally Important karstified Aquifer dominated by conduit flow (**Rk$_c$**).	Conduit Karstification is widespread in this aquifer. Both point and diffuse recharge occur in this GWB. Swallow holes and collapsed features provide the means for point recharge, diffuse recharge will occur over the entire GWB via rainfall percolating directly through the epikarst (due to the lack of subsoil). As a result, groundwater would show a very rapid response to recharge. The lack of surface water drainage in the vicinity of the quarry confirms that potential recharge readily percolates into the groundwater system. There is no intergranular porosity or permeability in this type of rock. The preferential flow path for rainfall is to percolate within the upper shallow, highly karstified weathered zone known as the epikarst (where present) until it reaches the water table via cracks and fissures. Where present solutionally enlarge conduits would concentrate the bulk of the groundwater flow at depth within the bedrock. As a result, groundwater flow through karst areas is extremely difficult and complex to predict.

Table III.10.1 – Summary of the bedrock aquifer at Lanesborough, Co. Longford.

III.11 Groundwater Vulnerability

The GSI has assigned a groundwater vulnerability rating of "Extreme" (X and E) within the proposed site area and surrounding lands. The shoreline has been assigned a groundwater vulnerability rating of "High", which is not consistent with the presence of outcropping limestone pavement and should be revised as "Extreme" (X – rock near or at surface).

III.12 Groundwater Recharge

The GSI have calculated an Effective Rainfall (ER) value of 557.90mm/yr and a recharge coefficient of 85% for the area of the proposed development site (GSI, 2025). There is no recharge cap for Regionally important aquifers, which implies that c. 474.20mm/yr infiltrate to the groundwater.

The surface water runoff generated on site appears to drain to the central part of the compound where it is drained by a small depression (sump) in the ground. The bottom level in this sump would be consistent with what may have been the lowest level of the original quarry floor.

III.13 Groundwater levels and flow direction

Given the proximity of the site to Lough Ree and the permeable nature of the upper part of the bedrock where exposed, it is inferred that there is a hydraulic continuity between the groundwater level beneath the site and the surface water level of Lough Ree. The groundwater flow direction is likely to follow the local topography, i.e. to be orientated to the WNW.

III.14 Sump on site

The water levels within the sump were recorded using a GPS rover surveying level and the levels are provided below where they are compared to the levels of Lough Ree.

Date	24/03/25	16/04/25	08/05/25
Previous rainfall	22.8mm between the 21/03/ and 22/03/25.	11.6mm on the day prior to site visit	Dry since the 29/04/29
Levels in the sump	36.47	36.39	Dry (36.27)
Levels in Lough Ree	35.10	34.82	35.15

Table II.11.1 – Surface water levels on site and in Lough Ree.

These levels clearly show that the water levels within the sump are consistent with ponding water and are not connected to either groundwater and surface water.

III.15 Designated Sites and Habitats.

In the Republic of Ireland, designated sites include proposed Natural Heritage Areas (**pNHA's**), Natural Heritage Areas (**NHA's**), Special Areas of Conservation (**SAC**) and Special Protection Areas (**SPA's**).

A Natura Impact Statement report[9], which was submitted as part of the planning application has identified a number of Natura 2000 sites as follows:

- Lough Ree proposed Natural Heritage Area (pNHA No. 000440)
- Lough Ree Special Area of Conservation (SAC No. 000440)
- Lough Ree Special Protection Area (SPA No. 004064)

As illustrated in Figure 7, the proposed Lime quarry Theatre is located within the Lough Ree SAC and pNHA and only c. 90m to the East of the Lough Ree SPA.

IV. CONCEPTUAL SITE MODEL

A conceptual site model (**CSM**) was developed based on a good understanding of the hydrological and hydrogeological environment, plausible sources of impact and knowledge of receptor requirements. This in turn allows possible Source Pathway Receptor (**SPR**) linkages to be identified. If no SPR linkages are identified, then there is no risk to identified receptors.

IV.1 Potential sources of contamination

Potential sources of contamination during both the construction and operational phases of the project were considered. For the purposes of assessing hydrological/ hydrogeological SPR linkages, all potential sources of

[9] Source: Natura Impact Statement, Lime Quarry Theatre, Lanesborough, Co. Longford – Flynn Furney Environmental Consultants.

contamination are considered without taking account of any measures intended to avoid or reduce harmful effects of the proposed project (mitigation measures) i.e. a worst-case scenario. Construction sources (short-term) and operational sources (long-term) are considered below.

IV.1.1 Construction Phase

It is understood that during the construction phase, drinking water supply will be provided by a connection the local watermain. The following sources of contamination are considered during the construction phase of the proposed development:

1. Release of suspended solids: Excavation and construction activities such as stockpiling material and vehicular movement of plant and machinery introduce the risk of solids being entrained in runoff. Runoff contaminated with suspended solids could add turbidity if allowed to discharge untreated into a receiving surface water body, which can block fish gills and smother spawning grounds, reduce light penetration for flora growth, promote algae and bacteria production.

   Excavation at the site will be shallow (<2m) and should be carried out during dry to mild weather conditions. As a result, the potential for encountering large volumes of groundwater during excavation is low and significant dewatering works not anticipated. Run-off will only likely contain low concentration of suspended solids and drained within the former quarry area where they should be allowed to settle.

   However there would still be the potential for perched water, groundwater seepage from the quarry faces and rainwater runoff collecting in open excavation, which will need to be dealt with through dewatering and treatment where and if necessary.

2. Release of hydrocarbons and storage: Hydrocarbons are a pollutant risk due to their inherent toxicity to all flora and fauna. They chemically repel water and do not readily dissolve in polar solvents such as water. Most hydrocarbons are light, non-aqueous phase liquids that are less dense than water. If accidentally released to water, they will therefore float on the receiving water surface.
   They:
   - adsorb onto the majority of natural solid objects they come in contact with, such as oil, vegetation and animals.
   - will burn most living organic tissue they come in contact with due to their volatile chemistry.
   - represent a nutrient supply for adapted micro-organisms. This process in turn can rapidly deplete dissolved oxygen and thus result in fish kills or mortality of water based vertebrate and invertebrate life.

   During the construction phase, vehicles and plants associated with excavation, material transport and construction activities introduce the risk of hydrocarbon spillages and leaks from fuels and oils. The risk is increased when regular refuelling is required which in turn implies the requirement of a designated refuelling area within the construction compound.

   All groundwater bodies are considered vulnerable and sensitive to hydrocarbons, especially Regionally important karstified aquifer such as the one underlying the site.

   Minor spills or leaks in soils can be efficiently addressed and remediated. However it is important to note he elevated sensitivity and enhanced connection to groundwater at the site.

3. Release of construction or cementitious materials: The construction phase of the project has the potential to result in the accidental spillage or deposition of construction waste into the surrounding environment, which could leach out toward the shallow groundwater and indirectly to Lough Ree.

   Use of wet cement is a requirement during construction. The accidental release of cementitious wastes such as concrete or cement (etc.) can result in a significant change to groundwater hydrochemistry, which could adversely impact on sensitive downstream aquatic flora and fauna. The risk of cementitious materials impacting on water quality are highest when the materials are freshly deposited and are “wet”. Run-off water from recent cemented areas will result in highly alkaline water with high pH. Once set,

the potential for chemical reaction is drastically reduced and the in-situ , set and undisturbed concrete is considered not significant

4. The proposed development has only minor earthworks, with the current stockpiles (gravels, organic material etc) from the County Council depot to be removed off site during a dry period to minimise the release of fines. These stockpiles will be removed off-site and disposed in an approved manner (depending on nature) prior to the start of any work. This will not be considered further.

These impacts could be considered as intermittent short-term events.

IV.1.2 Operational Phase

There will be no direct discharge from the proposed site development to Lough Ree.

Portaloos will be brought on site during events and removed off site after events. There will therefore be no requirement for connection to a sewer line or for an existing wastewater treatment system.

The car parking will be provided in the existing public car park adjacent to Lanesborough bridge, from which existing pedestrian footpaths provide access to the venue site and the Commons North Woodland trail. Therefore there will be no risk of release of petroleum-based products during the operational phase.

Surface water runoff generated on site will discharge into the landscaped ground. It is understood that gravel material will be used, which should enable good percolation down to the quarry floor as is currently the case pre-development.

IV.2 Assessment of Pathways

The proposed site area is relatively small in scale.

The site is underlain by Dinantian Pure Bedded Limestone from the Visean Limestones (undifferentiated) rock Formation, which is classified by the GSI as a Regionally Important karstified Aquifer dominated by conduit flow (**Rk_c**). Rainfall would percolate through the upper most weathered portion of the bedrock (epikarst), from which it will then percolate to the water table through a zone of interconnected solutionally enlarged fissures and conduits that extends approximately 30 m below this.

The epikarst has been stripped off within the quarry area, which is likely to reduce the percolation rate down to the water table within the site: this would result in perched water conditions after periods of heavy rainfalls.

Although there is **no direct hydrological linkage** between the proposed site and Lough Ree, there is **an indirect hydraulic connection** via infiltration to the water table within the karstified aquifer underlying the site. The groundwater flow direction is anticipated to follow the topography, i.e. to be orientated to the WNW. This will have the following consequences:

- Hydrocarbon contamination within the proposed development has the potential to migrate to Lough Ree by seepage to groundwater.

- Sediments generated within the former quarry area are likely to settle at the bottom and would have a low potential for off-site migration.

There is a high degree of interconnection between the surface water levels of Lough Ree and the groundwater level of this karstified aquifer. As a result, the water table is likely to rise during severe rainfall events. Although the Median Annual Maxima at the Derrybay Station, appears to remain below the bottom level of the quarry floor, there would be a potential for the water table to rise within the quarry area during extreme weather events. Works should not be authorised during such events to prevent a heightened potential for pathways to the surrounding woodland habitats to the South of the proposed outdoor theatre during construction.

IV.3 Assessment of Receptors

The receptors considered in this assessment include the following:

- Underlying Regionally Important karstic bedrock aquifer (Rk_c)
- Lough Ree and Natura 2000 sites.

IV.4 Assessment of Source-Pathway-Receptor Linkages

Table IV.4.1 below summarises the plausible pollutant linkages (SPR) considered as part of the assessment. As no potential source of contamination was identified during the operational phase, the table below only relates to the Construction Phase.

Source	Pathways	Receptors considered	Risk of Impact (unmitigated)
Leaks from construction vehicle/refuelling on site	Vertical migration through exposed bedrock. Migration toward Lough Ree via groundwater.	Limestone bedrock aquifer (Rk_c), Lough Ree and associated Natura 2000 Habitats	High risk of temporary impact.
Discharge to ground of runoff water with high pH from cement process	Indirect pathway through seepage to groundwater through the exposed bedrock.	Limestone bedrock aquifer (Rk_c), Lough Ree and associated Natura 2000 Habitats	High risk of temporary impact
Runoff containing high concentration of suspended solids	Runoff within the perimeter of the quarry is likely to settle down at the bottom of the quarry floor	Limestone bedrock aquifer (Rkc)	Low risk of temporary impact.
	Runoff on the access road leading from the car park along the Lake to the Woodland trail.	Lough Ree and Limestone Pavement	Low risk of temporary impact.

Table IV.4.1 Pollutant Linkage Assessment (without mitigation).

V. MITIGATIONS MEASURES

The following measures are proposed to prevent, reduce, or offset the potential risks identified in this assessment during the construction and operation of the proposed outdoor theatre development. These measures are designed to address potential impacts on groundwater, surface water, soil, and the adjacent designated sites, including the Lough Ree Special Area of Conservation (SAC), Special Protection Area (SPA), and proposed Natural Heritage Area (pNHA).

V.1 Timing of works (Mitigation by avoidance)

- All excavation and groundworks shall be undertaken during the period **May to end of September**, when groundwater levels in Lough Ree and the karst aquifer are typically at their lowest.

- No construction works shall be undertaken during or immediately following severe rainfall events to minimise the potential for mobilisation of sediments or pollutants and the risk of inundation of the quarry floor.

V.2 Fuels, oils, greases and hydraulic fluids

- Refuelling, servicing, and storage of fuels, oils, greases, and hydraulic fluids shall be carried out only in a **bunded impermeable refuelling area**, located **at least 100 metres from Lough Ree** and **a minimum of 25 metres from any exposed bedrock**.

- Double-skinned fuel bowsers shall be used for all mobile fuel storage and refuelling operations.

- Spill kits, absorbent materials, and oil booms shall be available on site at all times, and all site staff shall be trained in their deployment.

- All machinery shall be regularly inspected and maintained to prevent leaks. Any identified leaks shall be repaired immediately, and any contaminated materials shall be removed from site.

- All spills shall be contained, collected, and disposed of in accordance with appropriate waste regulations.

- Water contaminated by oils, fuels, greases and hydraulic fluids should be tankered off site for authorized treatment and disposal (receipts should be kept and logged for any loads disposed off-site).

V.3 Cementitious Materials and Construction Waste

- Cement, concrete, and other alkaline materials shall be stored in sealed containers in protected areas away from drainage features.

- Mixing and washout shall occur on impermeable surfaces with containment to prevent migration to the ground.

- Any wash water containing cementitious residues shall be collected in sealed containers and removed off site for authorised disposal.

- pH monitoring shall be used as an indicator of potential impacts from cementitious materials.

V.4 Sediment and Surface Water Management

The movement of vehicles to access the site can generate silts and oil contaminated water. Potential sources of silts (wheel wash areas, access roads etc.) carry a high risk of causing pollution. To reduce the pollution risk, the following measures should be implemented:

- The existing infiltration of rainfall within the quarry shall be maintained during construction.

- Measures to manage surface water and minimise sedimentation shall include:

    - Installation of silt fencing, straw bales, and sediment traps downslope of working areas.
    - Use of temporary settlement tanks or sumps to allow suspended solids to settle prior to infiltration.
    - Regular inspection and maintenance of all sediment controls.

- Stockpiles of excavated materials shall be located at least 50 m from the lake shoreline and protected from erosion.

- Any ponded water with visible sediment shall be allowed to settle or be pumped to a settlement tank before infiltration.

- No direct discharge to Lough Ree or adjacent habitats shall occur under any circumstances.

V.5 Groundwater Monitoring and Early Warning

To further manage the potential risk associated with fluctuating groundwater levels and provide an early warning system for elevated groundwater conditions, it is proposed to install a dedicated groundwater monitoring well downgradient from the proposed outdoor theatre.

- This **groundwater monitoring well** shall be installed within the footprint of the proposed development site prior to construction, subject to advance consultation and agreement with the **National Parks and Wildlife Service (NPWS)**.

- The construction of the groundwater monitoring well shall be supervised by a competent hydrogeologist and/ or water engineer to ensure that its upper section is properly sealed off and will not allow the ingress of shallow / ponding water.

- Upon completion of the groundwater monitoring post-construction, the monitoring well should be decommissioned in an approved manner.

- Continuous water level monitoring shall be undertaken during construction using an electronic dipper.

- A **High Water Alert Level** shall be set at **36.5m above Ordnance Datum (m a.OD)**. When this level is exceeded in the monitoring well, all excavation and ground-disturbing works shall be temporarily suspended, and additional protective measures shall be implemented to prevent mobilisation of sediment or contaminants. Work may only resume once groundwater levels recede below this threshold.Groundwater quality shall be sampled periodically to confirm no impact. The trigger level shall be reviewed following baseline groundwater monitoring and adjusted, if necessary, in agreement with the relevant authorities

- Monitoring data shall be reviewed regularly and shared with the relevant authorities on request.

V.6 Protection of Designated Sites

The protection of downstream European sites is **not reliant on mitigation measures** alone, as no direct hydrological linkage was identified. However, these measures will provide an additional safeguard to maintain water quality and ecological integrity.

- No discharge of surface water, wastewater, or contaminated runoff shall occur directly or indirectly to Lough Ree or adjacent habitats.

- All site staff shall be briefed on the sensitivity of the surrounding designated sites and the importance of adherence to the agreed environmental protection measures.

V.7 Groundwater and Site Monitoring and Reporting

Water quality monitoring shall be undertaken **prior to commencement, throughout the duration of construction activities, and for a minimum period of six months following completion of works** to confirm that no deterioration of groundwater or site drainage quality has occurred as a result of the proposed development.

Monitoring Locations:

- **Groundwater Monitoring Well:** Installed within the site footprint prior to construction, subject to prior agreement with the National Parks and Wildlife Service (**NPWS**).
- **Sump Water:** Any ponded water accumulating within the quarry floor during construction.

Monitoring Parameters:

- **On-site field measurements** using calibrated field monitoring equipment:

    - pH
    - Electrical Conductivity
    - Temperature
    - Dissolved Oxygen

- **Laboratory analyses:**

    - Turbidity
    - Total Suspended Solids
    - Total Petroleum Hydrocarbons (**TPH**)
    - Chloride
    - Nitrate (baseline monitoring only)

Monitoring Frequency:

- **Prior to construction:** Baseline sampling to establish reference conditions.
- **During construction:** Monthly monitoring, with additional sampling following significant rainfall events or as required by site activities.
- **Post-construction:** Monthly monitoring for a minimum of six months to confirm no residual impacts. The duration may be adjusted in consultation with the consenting authorities based on monitoring results.

Reporting:

- All monitoring results shall be recorded, reviewed, and reported to Longford County Council, An Bord Pleanála, and NPWS on request.
- Any exceedance of trigger levels or evidence of contamination shall result in immediate investigation and the implementation of appropriate remedial measures.

Given that the proposed development:

- **Will not generate any direct discharges to Lough Ree or associated habitats**,
- Is separated from the lake by a buffer of woodland and embankment features, and
- Is hydraulically connected to the lake **only via an indirect pathway through the underlying karst aquifer**,

it is not considered proportionate or necessary to establish dedicated surface water monitoring points within Lough Ree itself. Should the consenting authorities require supplementary monitoring of lake water quality, an appropriate sampling and analysis plan can be developed in consultation with the NPWS.

VI. CONCLUSIONS

This assessment was undertaken to provide a detailed consideration of any potential hydrological connectivity between the proposed development site and the adjacent limestone and lake habitats, including Lough Ree and the designated European sites in the vicinity.

A **Conceptual Site Model (CSM)** has been prepared following a comprehensive desktop review of the site and its surrounding environment, supported by multiple site inspections conducted during varying hydrological conditions. Based on this CSM, **plausible Source – Pathway - Receptor (SPR) linkages** have been identified and assessed, assuming an absence of any measures intended to avoid or reduce harmful effects of the proposed project (i.e. assuming an unmitigated worst-case scenario).

The assessment concludes that:

- The proposed development will be situated within the footprint of a disused lime quarry underlain by the **Regionally Important Karstified Aquifer (Rk_c)**. The quarry floor lies above the average water level of Lough Ree but within the historical maximum recorded levels and is confirmed by predictive flood mapping to be at risk of inundation during medium- (1% AEP) and low-probability (0.1% AEP) flood events, corresponding to Flood Zone A.

- There is **no direct hydrological connection** between the quarry floor and the adjacent lake habitats. However, there is a clear **indirect hydraulic connection** via infiltration to the karst aquifer beneath the site, which discharges to Lough Ree.
- Under extreme rainfall events, rising groundwater levels within the karstified bedrock could result in partial inundation or full inundation of the quarry floor, temporarily elevating the potential for indirect mobilisation of pollutants toward Lough Ree and associated limestone habitats **during the construction phase**.
- **Flood risk mapping, the detailed Site-Specific Flood Risk Assessment, and the classification of the site within Flood Zone A confirm the requirement for robust design, operational safeguards, and real-time monitoring of groundwater levels to manage this risk.**
- No direct discharge of surface water or foul effluent is proposed during the operational phase.
- Potential pollutant linkages during construction were assessed to pose low to high temporary risks depending on the nature of the contaminant and the pathway involved.
- Finally, **mitigation measures and an early warning groundwater monitoring system, including a defined High Water Alert Level of 36.5m a.OD, have been incorporated into the construction design and management. These measures will provide additional protection to the receiving soil and water environments and ensure that indirect pathways to Lough Ree are effectively controlled. However, the protection of downstream European sites is not reliant on these measures alone, as no direct hydrological connection has been identified.**

VII RECOMMENDATIONS

To address the identified risks and ensure that the project remains compliant with environmental protection requirements and best practice standards, the following recommendations are made:

1. **Flood Risk Management**

    - Schedule construction works predominantly during periods of low water levels on Lough Ree (May to September).
    - Avoid excavation and construction activities during or immediately after severe rainfall events to minimise flood risk and potential water ingress into the quarry floor.
    - Maintain regular monitoring of groundwater and sump water levels during construction to provide early warning of elevated groundwater conditions.

2. **Pollution Prevention and Control**

    - Confine refuelling, servicing, and maintenance of plant and equipment to a **bunded impermeable refuelling area**, located at least 100 m from Lough Ree and 25 m from any exposed bedrock. Spill response materials shall be available on site at all times.
    - Collect runoff from wheel wash areas, refuelling zones, and construction access routes for settlement and, if necessary, removal off site for authorised treatment.
    - Implement silt fencing, sediment traps, and settlement tanks in all areas where silt-laden runoff may arise, with regular inspection and maintenance.

3. **Management of Cementitious Materials**

    - Store and handle cement, concrete, and other alkaline materials in protected areas to prevent uncontrolled runoff or infiltration.
    - Prevent wash water and slurry from entering exposed bedrock or migrating indirectly to groundwater.
    - Collect and remove any cementitious wash water off site for authorised disposal.

4. Operational Controls

- Ensure portable sanitation units are removed promptly after each event and maintained in good condition.
- Retain permeable gravel surfacing to maintain infiltration capacity and reduce overland flow.

5. Water Quality Monitoring

- Baseline groundwater quality sampling shall be conducted prior to commencement of works, and periodic sampling shall be undertaken during construction phase to confirm that no adverse impacts on groundwater or indirectly connected habitats are occurring.
- All monitoring results shall be documented and made available for inspection by the relevant authorities. During the construction phase, the water quality from the sump should also be monitored.
- The parameters to be monitored shall comprise:

    - pH
    - Turbidity
    - Electrical Conductivity
    - Dissolved Oxygen
    - Temperature
    - Total Suspended Solids
    - Total Petroleum Hydrocarbons
    - Chloride
    - Nitrate (baseline monitoring only).

- Following completion of works, implement a monitoring programme for a minimum of six months to confirm no adverse impacts have occurred. Sampling shall be undertaken monthly and following significant rainfall events, including all parameters listed above.
- Any exceedance of trigger levels or evidence of contamination shall result in immediate investigation and implementation of remedial measures.
- Additional monitoring should be conducted following significant rainfall events or if inspections indicate potential pollution.

6. Inclusion in Method Statement

The mitigation measures proposed in this report are representative of standard industry environmental management practices implemented to minimise the impact of such projects on the environment. **It is recommended that these measures be included in the final version of the Method Statement for the project.**

7. Review and Emergency Preparedness

- Review and update all mitigation measures prior to commencement of works to ensure alignment with final construction methodologies and recognition of the **indirect hydraulic connection** to Lough Ree.
- Prepare and implement an **Emergency Response and Flood Contingency Plan** to address accidental spills or flooding events, including procedures for temporary suspension of works when the High-Water Alert Level is exceeded.

8. Groundwater Monitoring Well

It is recommended that a dedicated groundwater monitoring well be installed on the site, downgradient to the proposed development and prior to the commencement of construction activities. This is subject to advance consultation and agreement with the **National Parks and Wildlife Service (NPWS)**, given the location of the site within the Lough Ree SAC. This well should be designed to:

The monitoring well shall:

- Be designed with a sealed upper section to prevent ingress of shallow or ponding water.
- Be fitted with a calibrated automatic logger to enable continuous recording of groundwater levels and allow prompt response to changing conditions..
- Establish a High Water Alert Level of **36.5m a.OD**, above which excavation and other ground-disturbing works shall be temporarily suspended until water levels recede.
- Be sampled prior to works to establish a baseline dataset of groundwater levels and water quality, and periodically during construction and for at least six months post-construction to confirm no adverse impacts.

All monitoring results shall be recorded and made available to the relevant authorities upon request.

Upon completion of the groundwater monitoring post-construction, the monitoring well should be decommissioned in an approved manner.

FIGURES

Aqua GeoServices

Your Partner in Geology, Environment & Water

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Figure 1: Location Map
Ref. No. 500-24
Project: Lanesborough
Size: A4
Date: 02/07/25
Scale:

0 100 200 Metres

Legend:

Proposed site area (former lime quarry landholding)

Sources of information:

Department of Communications, Climate Action & Environment

Geological Survey Suirbhéireacht Gheolaíochta Ireland | Éireann

EPA MAPS

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Figure 2: Surface water catchments
Ref. No. 500-24
Project: Lanesborough
Size: A4
Date: 10/05/25
Scale:

0 100 200 Metres

Legend:

Proposed site area (former lime quarry)

Water catchment divide

Sources of information:

Department of Communications, Climate Action & Environment

Geological Survey Suirbhéireacht Gheolaíochta Ireland | Éireann

epa MAPS

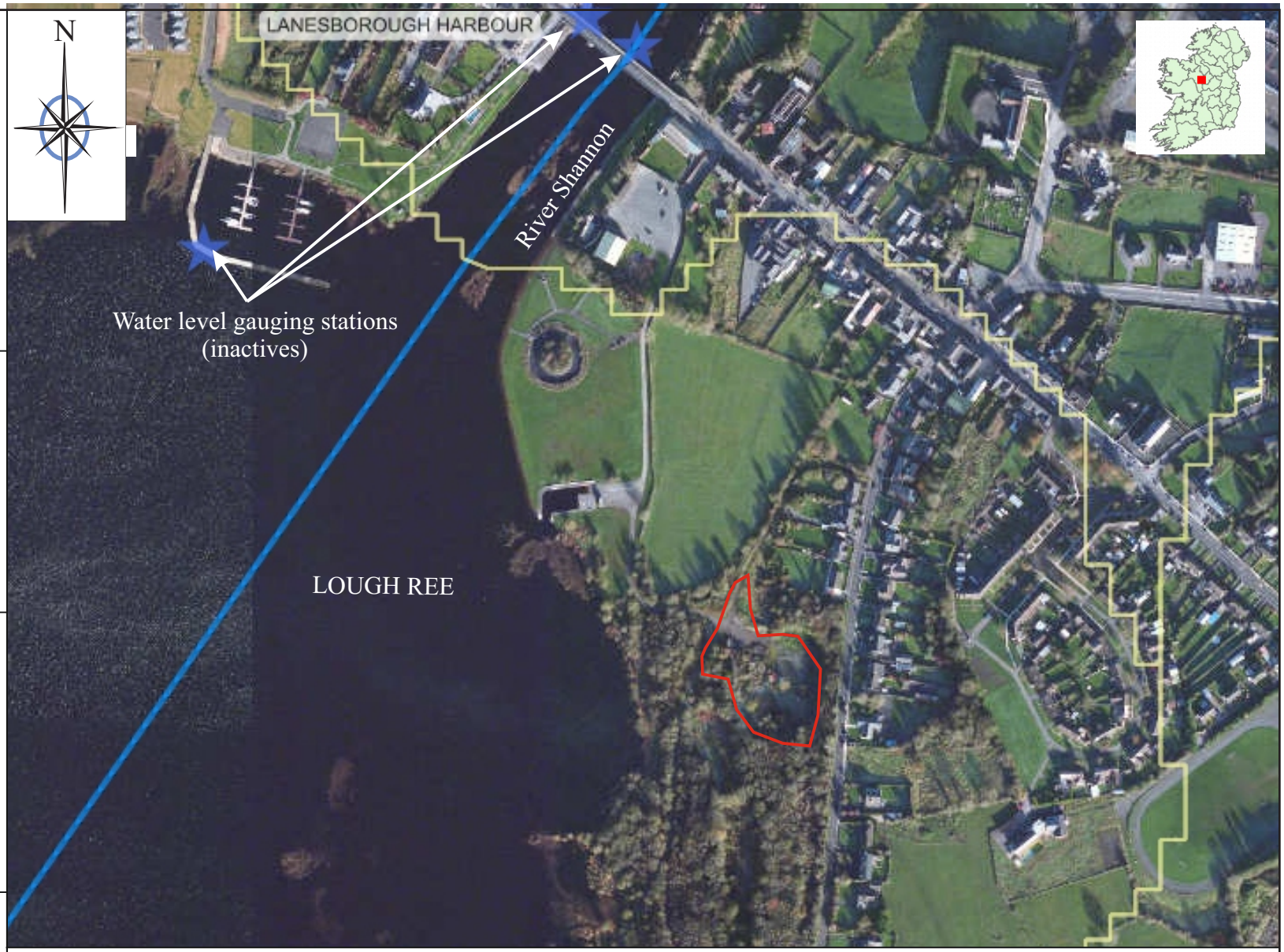
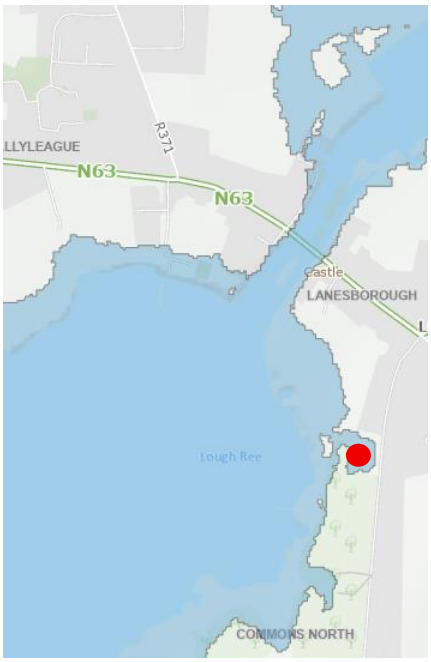


Figure 3 – Catchment Flood Risk Assessment Management Study ((CFRAMS) River Flood Extents – Source: www.floodinfo.ie/map/floodmap. The red dot indicates the location of the proposed outdoor theatre.

A – CFRAMS Present Day Low Probability (1:1000 Year Flood Event).

B – CFRAMS Mid-Range Future Scenario Medium Probability (1:100 Year Flood Event).



C – CFRAMS High-End Future Scenario Medium Probability (1:100 Year Flood Event).

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Figure 4: Bedrock Geology
Ref. No. 500-24
Project: Lanesborough
Size: A4
Date: 10/05/25
Scale:

0 150 300 **Metres**

Legend:

- Proposed site area (former lime quarry)
- Visean Limestones (undifferen--tiated)
- Bedrock outcrops

Sources of information:

Department of Communications, Climate Action & Environment

Geological Survey Suirbhéireacht Gheolaíochta Ireland | Éireann

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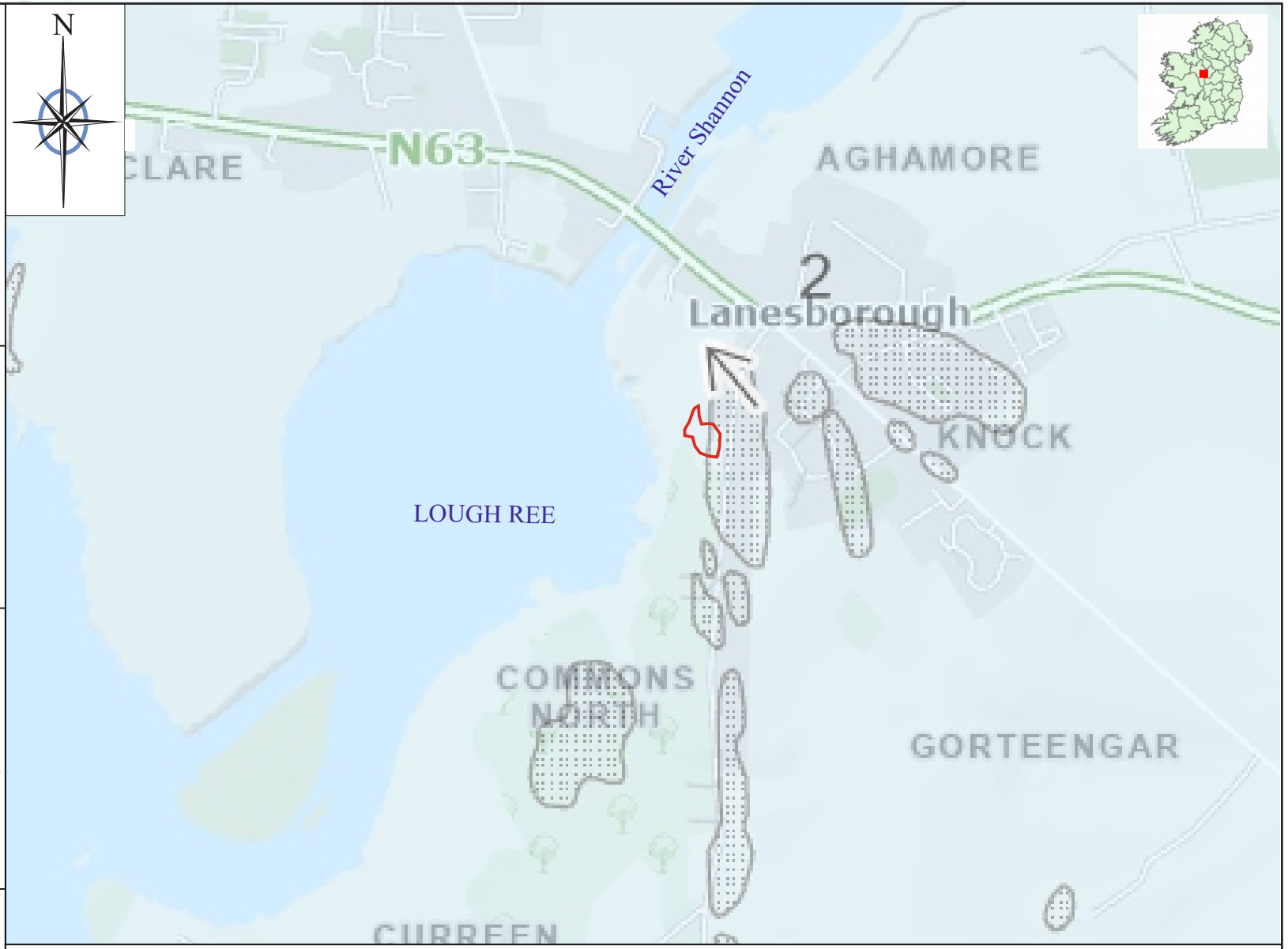

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Figure 5: Bedrock Hydrogeology
Ref. No. 500-24
Project: Lanesborough
Size: A4
Date: 02/07/25
Scale:

0 100 200 Metres

Legend:

Proposed site area (former lime quarry landholding)

Regionally Important aquifer, - Karstified (conduit) Rkc

Sources of information:

Department of Communications, Climate Action & Environment

Geological Survey Suirbhéireacht Gheolaíochta Ireland | Éireann

epa MAPS

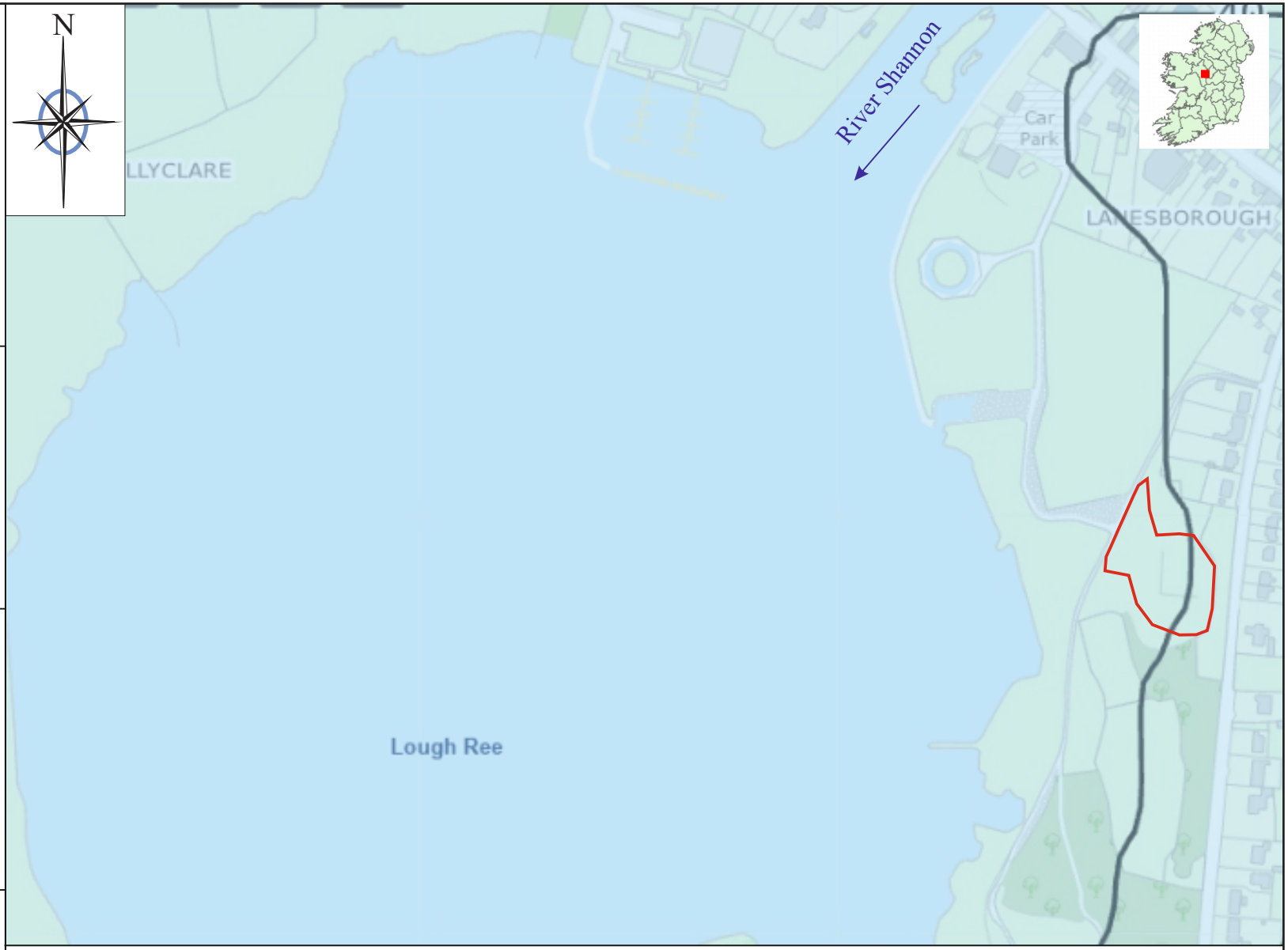

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Figure 6: Groundwater vulnerability
Ref. No. 500-24
Project: Lanesborough
Size: A4
Date: 02/07/25
Scale:

0 500 **Metres**

Legend:

- Proposed site area (former lime quarry landholding)
- Extreme (X) - Rock at or near Surface or Karst
- Extreme (E)
- High (H)

Sources of information:

Department of Communications, Climate Action & Environment

Geological Survey Suirbhéireacht Gheolaíochta Ireland | Éireann

epa MAPS

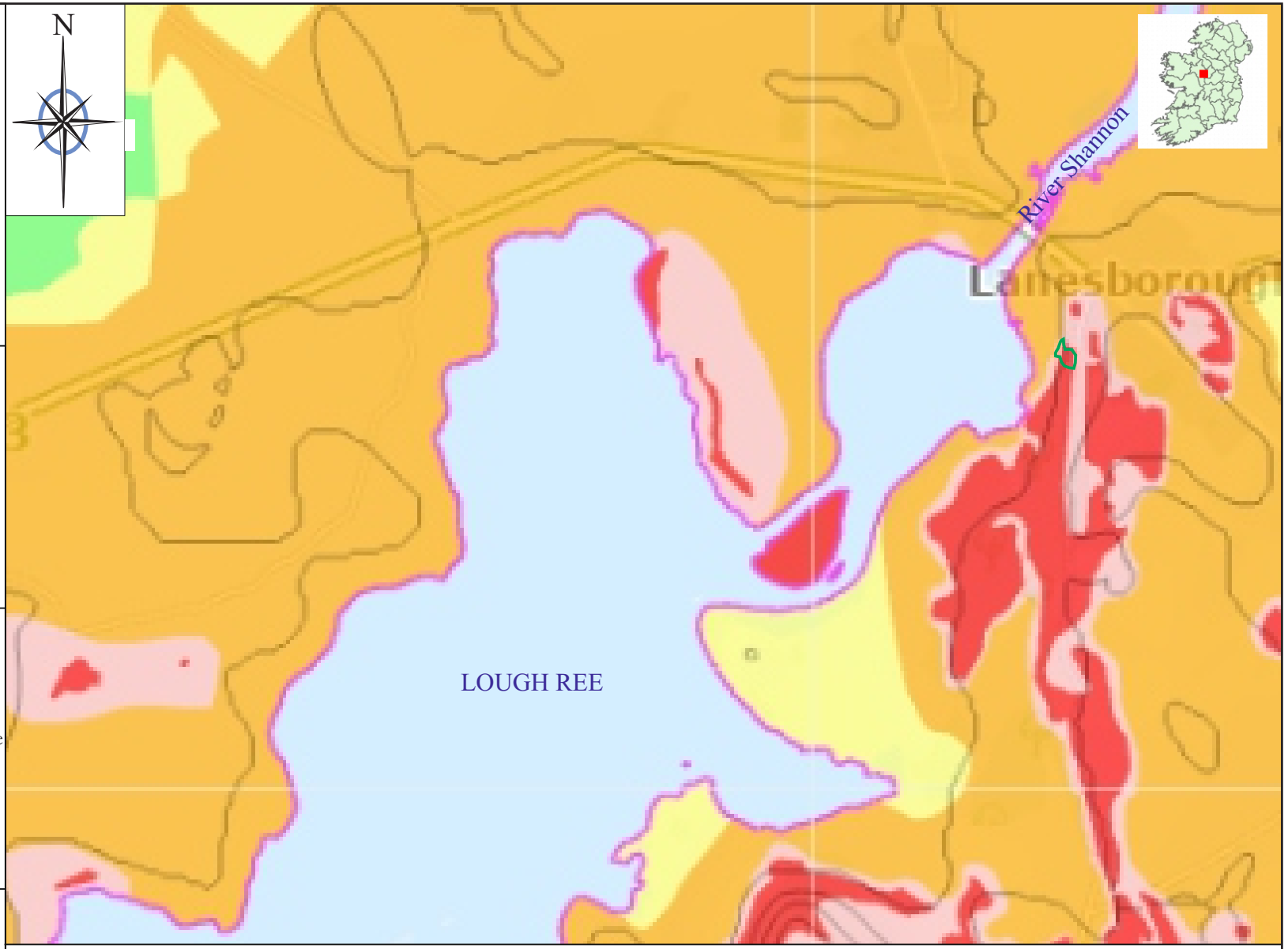

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Figure 7: Natura 2000 Sites
Ref. No. 500-24
Project: Lanesborough
Size: A4
Date: 10/05/25
Scale:

0 250 500 Metres

Legend:

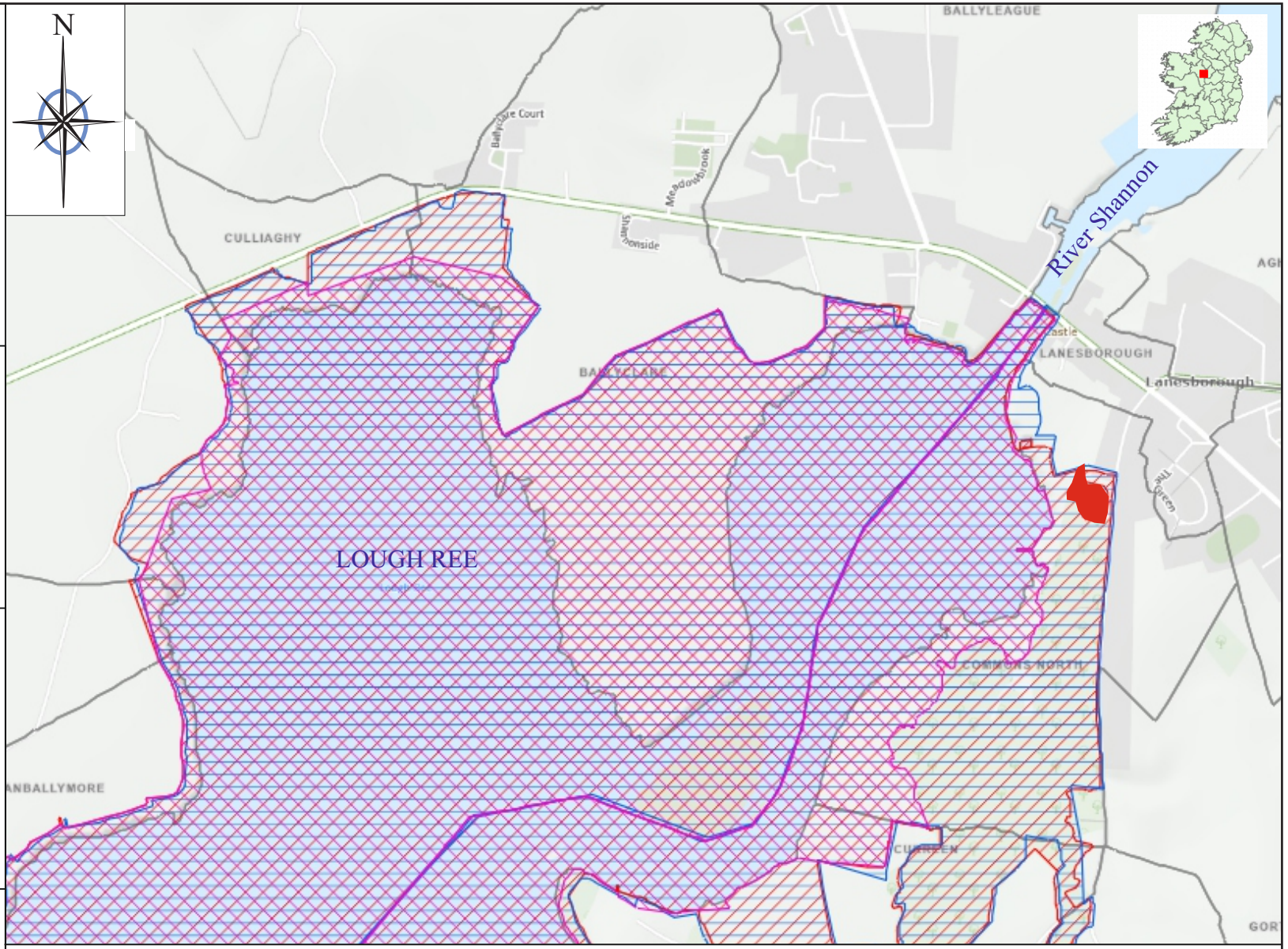
- Proposed site area
- Special Protection Areas (SPA)
- p. Natural Heritage Areas (pNHA)
- Natural heritage Areas (NHA)
- Special Area of Conservation (SAC)

Sources of information:

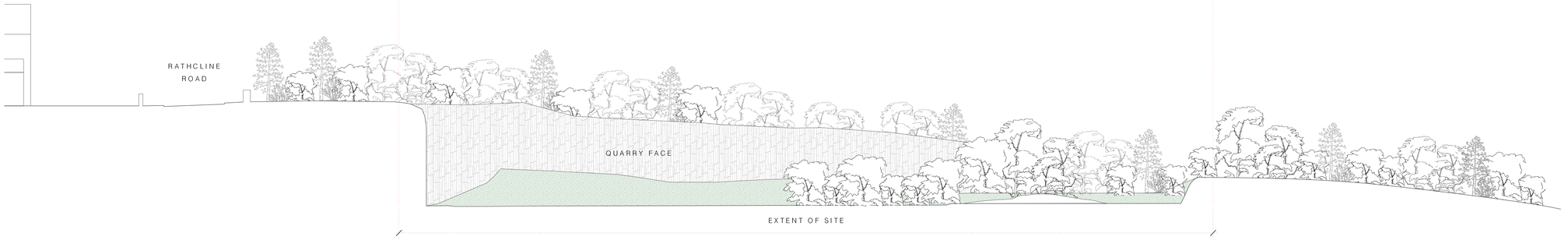
Department of Communications, Climate Action & Environment

Geological Survey Suirbhéireacht Gheolaíochta Ireland | Éireann

epa MAPS

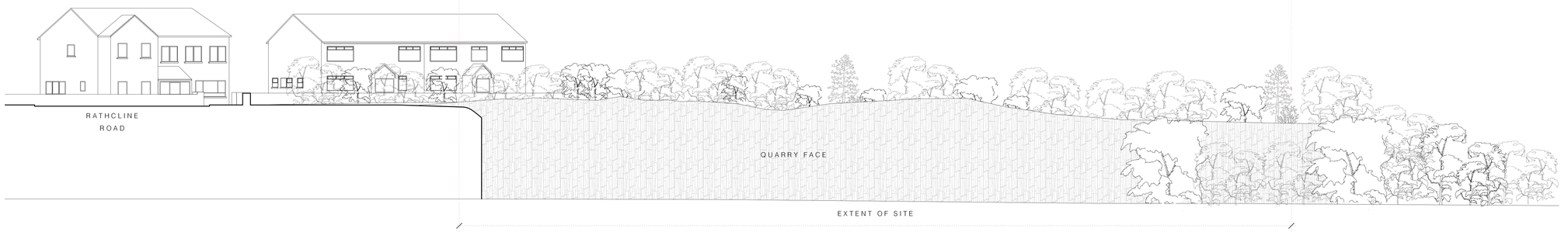


APPENDIX



01 EXISTING SECTION A A
Scale 1.200

02 EXISTING SECTION B B
Scale 1.200



03 EXISTING SECTION C C
Scale 1.200

04 KEY PLAN
Scale 1.1000

N

CLIENT:

DESIGN TEAM:
Quantity Surveyor

Structural Engineer

Services Engineer

STATUS OF DRAWING:

PART 8 APPLICATION PURPOSES ONLY

Do not scale from this drawing.
All dimensions to be taken from Architect's drawings.
Discrepencies to be referred to the Architect for clarification.

REVISIONS:

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JOB TITLE **Lanesborough Outdoor Theatre**

DRAWING TITLE **Existing Sections**

DATE **March 2023** SCALE **1:200 @ A1** JOB NO. **2129** DWG NO. **A 3** REV. **1**