APPENDIX 8.2

STAGE 3 FLOOD RISK ASSESSMENT REPORT

– PROPOSED DEVELOPMENT (AS AMENDED)

ENVIROLOGIC

HYDROGEOLOGICAL · HYDROLOGICAL CONSULTING

Stage 3 Flood Risk Assessment

LOCATION:	Coolpowra, Ballynaheskeragh, Cooldorragha, Sheeaunrush and Gortlusky, Co. Galway
PREPARED FOR:	Halston
PREPARED BY:	Cian O'Sullivan (MSc)
REVIEWD BY:	Colin O'Reilly PhD (Hydrology)
DATE:	17th December 2025
REFERENCE:	3064C

Contents

1 INTRODUCTION

The following flood risk assessment has been prepared by Cian O'Sullivan (MSc) and reviewed by Colin O'Reilly (PhD) of Envirologic Ltd. on behalf of Halston.

This report is intended to satisfy the requirements of Galway County Council, relating to a proposed development in the townlands of Coolpowra, Ballynaheskeragh, Cooldorragha, Gortlusky, and Sheeaunrush Co. Galway. The proposed development is being referred to as 'Project Coolpowra' and will consist of a Reserve Gas-Fired Power Generator, GIS Substation and Energy Storage System.

As per the Flood Risk Management Guidelines (2009), where flood risk may be an issue for any proposed development, a flood risk assessment (FRA) should be carried out that is appropriate to the scale and nature of the development and the risks arising. The flood risk assessment outlined herein is intended to be sufficiently detailed to quantify the risks and effects of any flooding, necessary mitigation measures, together with recommendations on how to best manage any residual risks. As per the document 'The Planning System and Flood Risk Management (2009)' the flood risk assessment will consist of the following sections:

- Site description
- Site layout
- S-P-R model; sequential approach; justification test
- Determination of flood level
- Mitigation measures
- Conclusions

Site walkover and surveying of local hydrology was performed by Envirologic in May 2024 and October 2025.

1.1 OCTOBER 2025 REVISED FLOOD RISK ASSESSMENT

A Flood Risk Assessment prepared by Envirologic (Report No.: 3064; dated 30th April 2024) accompanied planning applications to Galway County Council (Pl. Ref. 24/60845) and An Bord Pleanála (Case Ref.: PA07.320095 and PA07.320095, lodged in July 2024. The overall development is referred to as 'Project Coolpowra'. This ESS planning application was refused by Galway County Council on 30th August 2024 and the applicant has subsequently appealed this decision to An Coimisiún Pleanála (ABP-302916024). In response to third party submissions, an alternative temporary construction access road (Figure 1) is proposed. As such, Envirologic have been commissioned to update the original Stage 3 FRA with the following:

i. Measure flood risk pertaining to this temporary construction access road;
ii. Measure flood risk along the original site access route;
iii. Identify any stream crossing points required and propose suitable structures. Four Section 50 applications have been deemed necessary and are included in this report.

Figure 1 – Temporary Construction Access Road

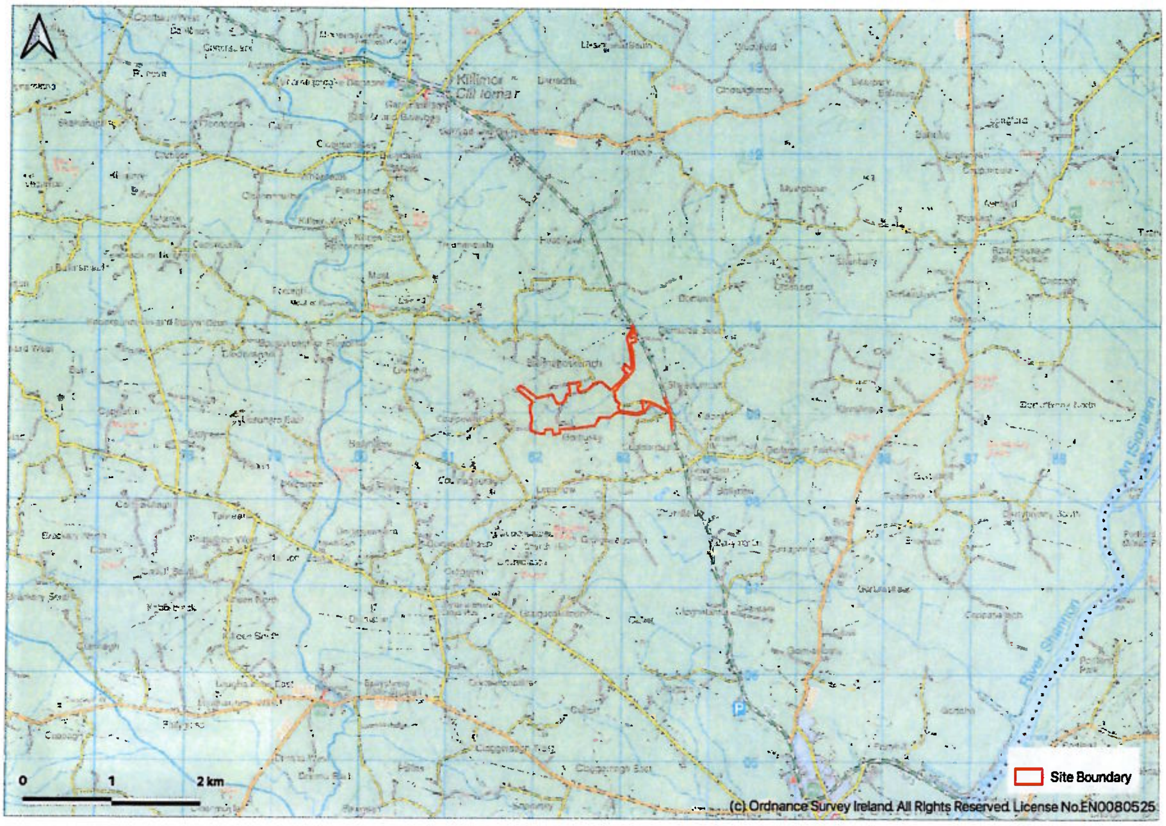
2 SITE DESCRIPTION

2.1 SITE LOCATION

The subject site is located in the townlands of Coolpowra, Ballynaheskeragh, Cooldoorragha, Gortlusky and Sheeaunrush, Co. Galway, approximately 5 km northwest of Portumna town (Figure 2). The main portion of the site is positioned 500 m west of the N65, with an internal site access road providing connection between the two.

The regional topography is considered flat to gently undulating. The 1:50,000 OS Discovery map shows that the nearest topographical feature of note in the locality is a small hummock at Churchill (91 mOD), 2 km to the south. The surrounding landscape is dominated by moderate intensity grassland agriculture.

Figure 2 - Site Location and Topography

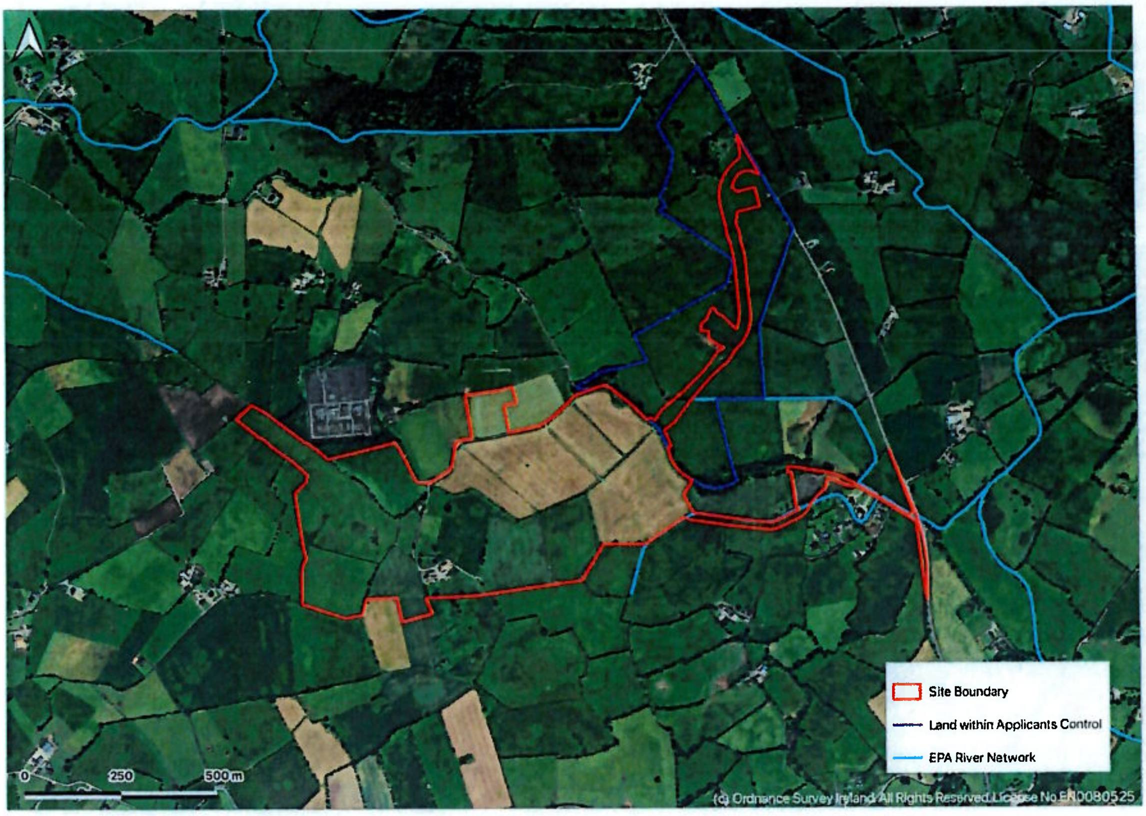


2.2 SITE LAYOUT

The proposed development site, including the alternative temporary construction access road, has an area of 45 ha. The site can be described as having an irregular shape comprised of (i) a central area which has an east-west length of 995 m and north-south width of 415 m, this area is bounded to the east by a local road; (ii) an internal access road which connects the eastern end of this central area with the N65; (iii) a 230 m northwestern spur; and (iv) the N65 to the north of the main site area. An existing 400kv GIS substation is located adjacent to the northeast boundary of the site. There is one detached house standing within the site boundary, with farmyard infrastructure present (Figure 3). It is intended to demolish existing infrastructure on the site and construct the following:

- A Reserve Gas-Fired Generator comprised of three OCGT Units;
- Upgrade and replacement of the existing 400kV AIS substation with a 400kV GIS substation;
- Alternative Technology infrastructure such as Long Duration Energy Storage (LDES) and a Synchronous Condenser.
- An alternative temporary construction access road from the N65

Figure 3 - Current Site Layout with EPA river network overlain

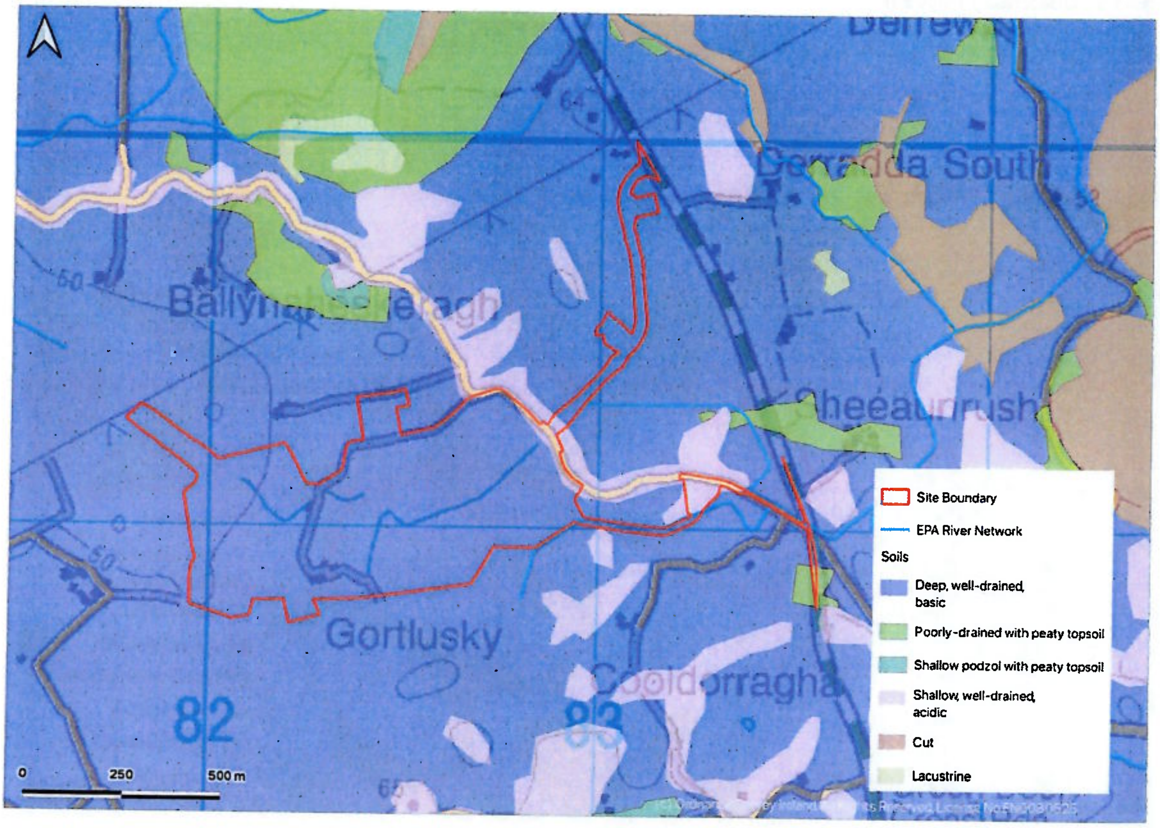


2.3 SOILS & GEOLOGY

2.3.1 Soils

Teagasc soil maps indicate that the soil within the application boundary is a uniform cover of deep, well-drained mineral soil with a basic chemical signature (Figure 4). The soil group can be described as a Grey Brown Podzolic or Brown Earth.

Figure 4 - General Soil Classification

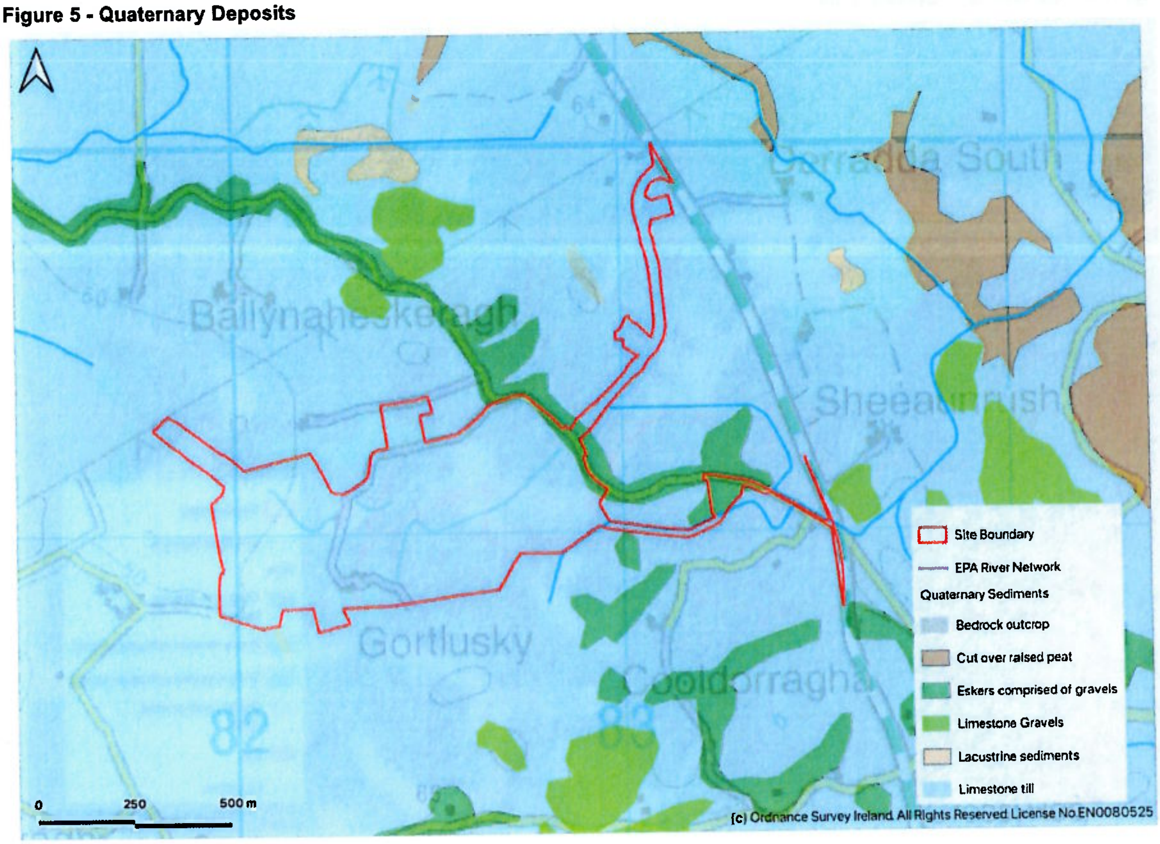


2.3.2 Quaternary Deposits

The quaternary period encompasses the last 1.6 million years and deals with the subsoils and sediments that were deposited over the bedrock described below. The Pleistocene (1.6 million years – 10,000 years ago) is commonly known as the last Ice Age, which was a period of intense glaciation separated by warmer inter-glacial periods, and it is during this period that the quaternary sediments seen today were deposited. Large amounts of ponded water were present at this stage resulting in considerable fluvioglacial sedimentation.

The majority of the site is underlain by glacial till derived from limestone. Some isolated mounds of limestone gravels are present in the area along with a graded ridge of esker sands and gravels which underlie the local road to the east (Figure 5). This combination of deposit type is characteristic of sub-glacial mechanisms resulting in well drained soils of homogenous nature.

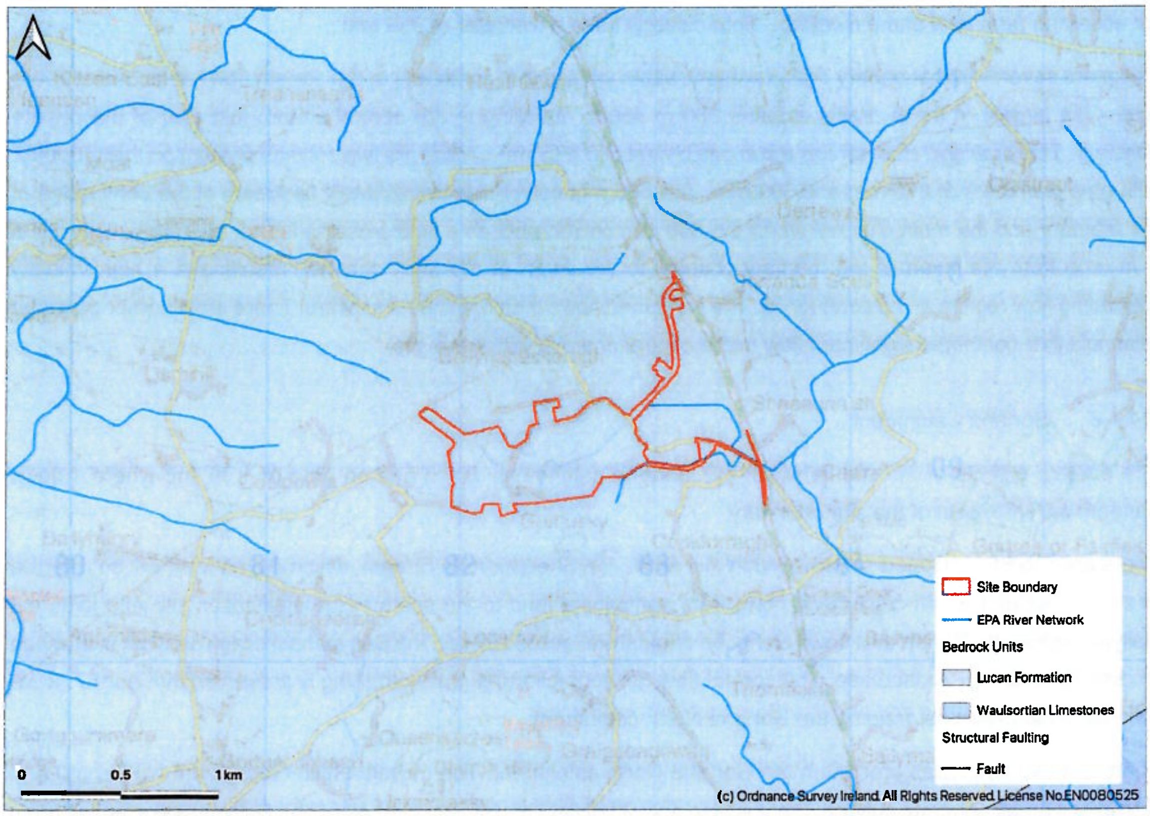
Figure 5 - Quaternary Deposits



2.3.3 Bedrock & Structural Geology

The site is underlain by the Lucan Formation. This formation consists of impure bedded limestone with shale and/or clay impurities. There are no structural geological features such as faulting mapped in the immediate vicinity of the site, as demonstrated in Figure 6.

Figure 6 - Geology of the Surrounding Area



2.4 HYDROLOGY

2.4.1 Catchment Description

The two dominant sub-catchments in the area are the Gortaha (Catchment 025B), which drains to the east, and the Kilcrow (Catchment 025C), which drains to the west. These rivers are both part of the Lower Shannon Hydrometric Area.

The EPA River Network database suggests that the divide between the Gortaha and Kilcrow river catchments lies within the site boundary, near the current Oldstreet Substation. Subsequent ground truthing and consultation of the OPW Drainage Maps indicate however that the catchment divide is just east of the main site area and that all rainfall-runoff generated on the site drains westwards, outfalling to the Kilcrow River, 2 km to the west.

2.4.1.1 Kilcrow Catchment

The drainage network serving the site is dominated by an east to west flowing central channel which itself becomes the Treananearla Stream (first order stream) a short distance downstream of the site. This central channel originates at the eastern end of the central site area, stopping just short of the local road. This catchment was delineated by topographical contours, reference to the OPW and EPA drainage network maps, and ground truthing as part of the site walkover. The catchment area contributing run-off to the downgradient site boundary has an area of 2.0 km^2 (see Figure 7).

There are two culverts in place along the central channel within the site boundary. These provide road crossings for access to farm land and a dwelling. Both culverts have a diameter of 950 mm.

There are several field boundary drains present within the site that contribute to the stream flows at its downstream end. The largest of these drains extends 950 m south, outfalling to the central stream just east of the on-site dwelling. This drainage channel has a sub-catchment of 0.675 km^2. There are two culverts present on this tributary, with pipe diameters of 650 mm and 500 mm. The 500 mm culvert lies immediately upstream of the confluence of the tributary and the main channel whilst the 650 mm culvert acts as a field crossing further upstream. There is a 1 m drop from the invert of the tributary channel to the invert of the main channel, resulting in a high velocity cascading flow regime at the confluence. The combined flows then continue westward. There are no other drainage channels that contribute significant flow to the central channel within the site.

2.4.1.2 Gortaha Catchment

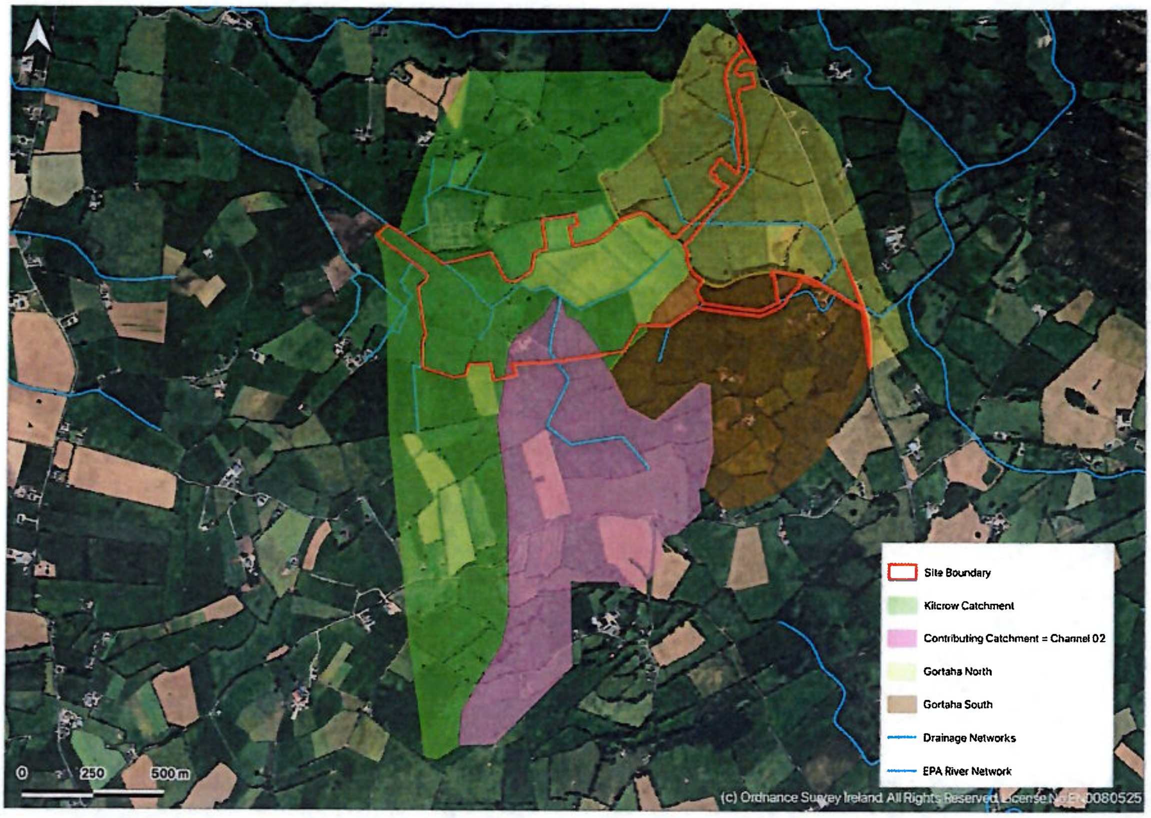
The eastern extents of the site lie within the Gortaha catchment, which has an area of 1.06 km^2 where it flows beneath the N65, east of the site boundary.

There are two EPA mapped streams within this area. The Sheeaunrush Stream, which drains what will be referred to as the Gortaha South catchment, flows from agricultural land to the south of the application site and joins the Ballynaheskeragh Stream as it flows along the original site access route. The Ballynaheskeragh network is mapped incorrectly on the EPA database. The correct flow network following groundtruthing is presented in Figure 7. It will be referred to herein as draining the Gortaha North catchment.

There are two structures present in the Gortaha North catchment. The culvert which crosses the N65 is a 0.5 m diameter circular concrete culvert. There is also one small field crossing culvert along the Ballynaheskeragh Stream which consists of a 0.3 m diameter pipe. A 0.45 m diameter circular culvert transmits water under the L8763 road and marks the confluence of the Sheeaunrush and Ballynaheskeragh streams.

There are several field boundary drains present in the Gortaha North catchment. During the site walkover it was noted that the upper reaches had no discernible flow direction, with standing water noted at multiple locations. Blockages were common, either from silted up channels or infilled areas permitting field crossings. Envirologic will present mitigation measures to regrade channels and improve conveyance alonng these field boundaries.

Figure 7 - Contributing Catchment to Local Watercourses



2.4.2 Designated Areas

Designated areas that are hydrologically connected to the site boundary are presented in Table 1. The River Shannon and Lough Derg are hydrologically connected to the site via downstream drainage. There are a number of sites associated with Lough Derg to the south, as well as the Ardgraigue Bog SAC to the north.

Table 1– Summary of Designated Sites Within a 15 km Radius of the Site

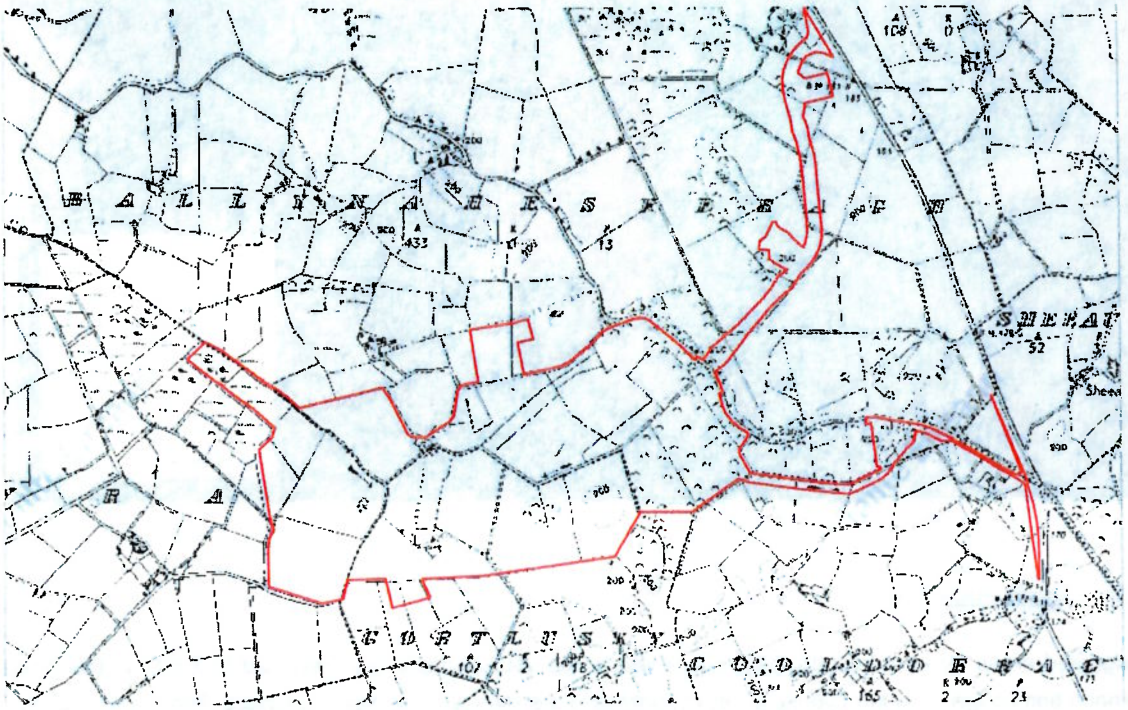
Natura 2000 Site	Site Code	Location at Closest Point to the Proposed Project
River Shannon Callows SAC	000216	5.6 km south east
Middle Shannon Callows SPA	004096	5.6 km south east
Lough Derg, North East Shore SAC	002241	8.8 km south
Lough Derg SPA	004058	8.8 km south
Baroughter Bog SAC	000231	9.1 km south-west

2.4.3 Flooding History

2.4.3.1 Historical OSI Maps

The historical 6" OSI maps (1830 -1930) show no evidence of historical flooding at the application site (Plate 1). It is noted from the historical 6" maps that flow direction on the central channel is towards the centre of the site but the flow direction from this point is unclear. It is likely that subsequent arterial drainage works deepened drains to promote a westerly flow direction.

Plate 1 - Historical 6" OSI maps (1830 – 1930)



2.4.3.2 OPW Flood Hazard Mapping

Consultation of the OPW flood hazard mapping tool shows that no previous flood events occurred within or near the site. Two flood events have been reported within 5 km of the site boundary. The nearest of these was in 1995, 3 km to the southwest where the Kilcrow River passes through Newbridge Bridge at Gortanummera. It was recommended at the time that additional drainage maintenance works be deemed a priority for the area.

2.4.4 Flood Risk Indicators

2.4.4.1 National Indicative Fluvial Mapping (NIFM)

The OPW National Indicative Fluvial Mapping (NIFM) tool shows that narrow margins flanking the Gortaha River and Kilcrow River, 200 m west and 1.7 km east of the site, respectively, are potentially at risk of fluvial flooding. The drainage channels within the application site and immediate surrounds have not been covered by the OPW NFIM programme.

2.4.5 CFRAM

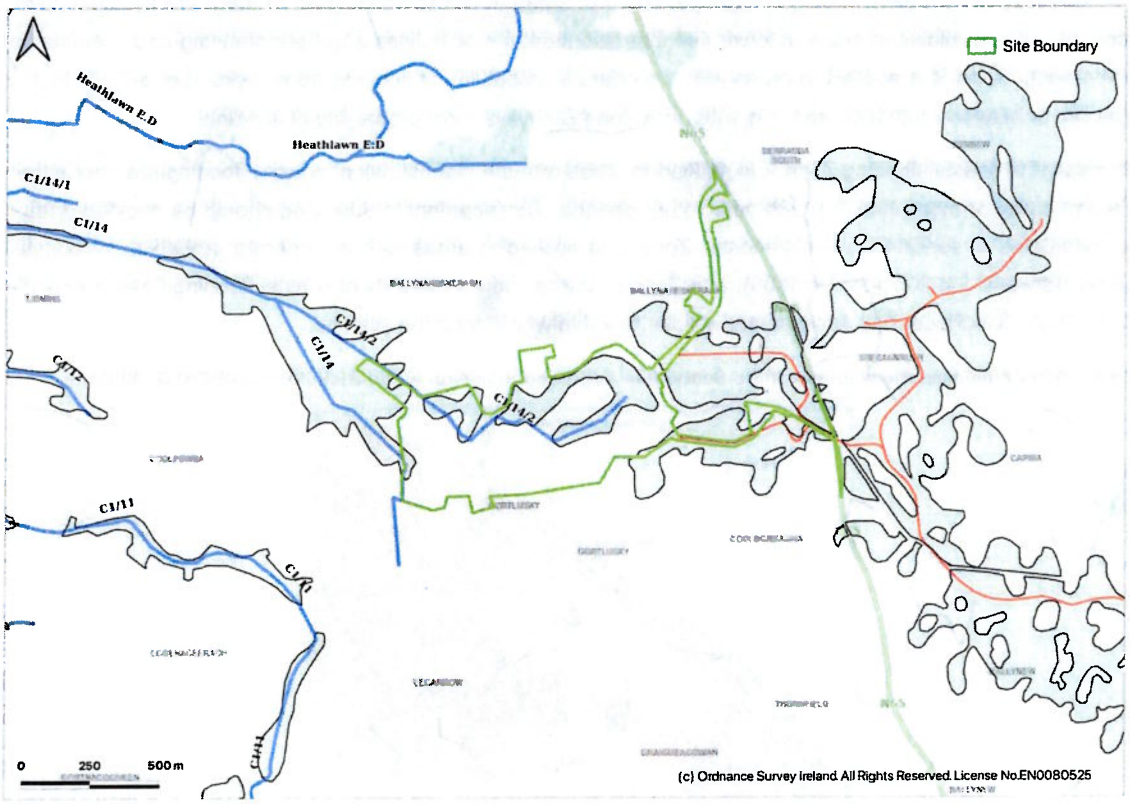
The OPW FloodInfo resource shows that neither the site nor the Kilcrow or Gortaha Rivers have been covered by detailed CFRAM hydraulic modelling.

2.4.6 Benefiting Lands

Plate 2 shows that parts of the application area lie within benefitting lands. These maps were prepared to identify areas that would benefit from land drainage schemes and typically indicate low lying land near watercourses that would be prone to flooding. The emphasis of these schemes was the improvement of agricultural land.

With respect to the application site the benefitting lands map confirms that the central west-flowing channel is maintained as part of the Killimor Arterial Drainage Scheme (Channel 14/2). Benefiting lands are also present in the Gortaha catchment. Of relevance to the application site these are either side of drainage channels that pass under both the proposed access route and the temporary construction access route. No information is available regarding their nomenclature, but they are under the local county council jurisdiction with respect to maintenance. It is noted that the OPW Drainage Map also corresponds with the drainage network layout that was groundtruthed as part of the site walkover. This is further evidence that the EPA river network is incorrect.

Plate 2 - Drainage Channels and Benefitting lands proximal to the application site



3 SEQUENTIAL TEST & VULNERABILITY MATRIX

3.1 SEQUENTIAL APPROACH

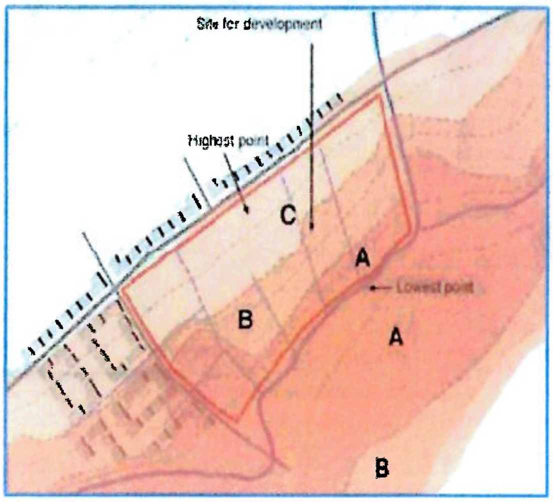
The 'Planning System and Flood Risk Management Guidelines for Planning Authorities (2009)' require the planning system at national, regional, and local levels to:

- Avoid development in areas at risk of flooding by not permitting development in flood risk areas, particularly floodplains, unless where it is fully justified that there are wider sustainability grounds for appropriate development and unless the flood risk can be managed to an acceptable level without increasing flood risk elsewhere and where possible, reducing flood risk overall.
- Adopt a sequential approach to flood risk management based on avoidance, reduction and then mitigation of flood risk as the overall framework for assessing the location of new development in the development planning processes; and
- Incorporate flood risk assessment into the process of making decisions on planning applications and planning appeals.

The sequential approach is used to assess flood risk at the site and, where there is variability, to assign appropriate zones in accordance with the Guidelines (DoEHLG, 2009). As shown in Plate 3, Zone A, applied to areas with a high probability of flooding, defines areas with the highest risk of flooding from rivers (i.e. more than 1% probability or more than 1 in 100). Development in this zone should be avoided and/or only considered in exceptional circumstances. Development should only be permitted in areas at risk of flooding when there are no alternative, reasonable sites available in areas at lower risk that also meet the objectives of proper planning and sustainable development. Zone B is applied to areas with a moderate probability of flooding from rivers. (i.e. a 0.1% to 1% probability or between 1 in 1000 and 1 in 100), with Zone C having a low probability of flooding.

With respect to coastal flooding Zone A is applied to areas with the highest risk of coastal flooding (i.e. more than 0.5% probability or more than 1 in 200 year return period). Development in this zone should be avoided and/or only considered in specified circumstances. Zone B is applied to areas with a moderate probability of coastal flooding (between 1 in 200 and 1 in 1000), with Zone C having a low probability of coastal flooding (less than 0.1% or 1 in 1000). The Flood Risk Assessment will clarify within which zone the site lies.

Plate 3 – Schematic map showing use of the Sequential Approach to assign Flood Risk Zones (DoEHLG, 2009)



3.2 VULNERABILITY MATRIX

Clause 2.16 of the Flood Management Guidelines (OPW, 2009) states: 'The classification of different land uses and types of development as highly vulnerable, less vulnerable and water-compatible is influenced primarily by the ability to manage the safety of people in flood events and the long-term implications for recovery of the function and structure of buildings.'

The Planning System and Flood Risk Management guidelines provide three vulnerability categories based on the development type. The proposed works fall into the following vulnerability categories as follows:

- **Highly vulnerable = residential, hospitals, schools, essential infrastructure, emergency service facilities.**
- Less vulnerable = buildings used for retail, warehousing, commercial, industrial and non-residential institutions.
- Water-compatible development = amenity open space, outdoor sport and recreation.

The proposed development is considered to be 'essential infrastructure' and therefore comes under 'highly vulnerable development'. Different types of development are appropriate in each of the Flood Zones, based on their vulnerability to flood risk. Hence:

- **Highly vulnerable: requires Justification test in Flood Zone A and Flood Zone B, appropriate in Flood Zone C;**
- Less vulnerable: requires Justification test in Flood Zone A; appropriate in Flood Zone B and Flood Zone C;
- Water-compatible: appropriate in Flood Zones A, B and C.

Highly vulnerable development should only be considered in zones A and B if adequate lands or sites are not available in Zone C and subject to a flood risk assessment to the appropriate level of detail to demonstrate that flood risk to and from the development can or will adequately be managed at the site.

Based on desktop information collected to this point the site is deemed to be within Flood Zone C. A conservative approach is being applied and the assessment will proceed to quantitative determination of flood levels in watercourses adjacent to the site. Unless the quantitative assessment shows the site to be in Flood Zone A or Flood Zone B then a Justification Test is not required.

3.3 S-P-R MODEL

The flood risk assessment is carried out using the source-pathway-receptor (S-P-R) model, as outlined below. The S-P-R model is used to identify the sources of flood water, the people and assets affected by potential flooding, and the pathways by which the flood water reaches those receptors.

Consideration will be given to the predominant sources, pathways and receptors in terms of the influence they have on site flooding, or the manner in which they may be impacted. The primary water sources on site are as follows:

Sources	Pathways	Receptors
Storm rainfall event (1 in 100 year)	Pluvial Flooding	Proposed Site
Kilcrow River Tributaries	Fluvial Flooding	Proposed Site Infrastructure
Gortaha River Tributaries	Road Runoff	Local Road
Runoff from upgradient lands		Third Party Lands and Property
Drainage/throughflow from upgradient lands		

Flooding mechanisms will be looked at in more detail to quantify flood risk from both the Kilcrow and Gortaha River catchments. Quantification of this risk will be achieved by firstly determining flood flows in the watercourses as they flow through/past the site.

Hydraulic modelling will then be utilised to facilitate estimation of flood levels within, and adjacent to, the site when these peak flows are passed through a series of surveyed cross sections. Mitigation measures will then be applied as appropriate.

4 SUBJECT SITE FLUVIAL FLOOD FLOW CALCULATIONS

4.1 OPW ADVICE

In selecting appropriate formulae reference has been made to an advisory response from OPW Hydrology Section and Work Package 4.2:

- For catchments between 5 km^2 and 25 km^2 the preferred equation is the 'FSU small catchments' equation. When using the small catchment equation, we generally advocate not using a pivotal site adjustment seeing as there is a very small pool of other small catchments from which to source a pivotal site.
- For catchments less than 25 km^2 we would always say that at least three methods should be explored and that the choice of the flow to be used is up to the practitioner.
- The WP4.2 report is intended to provide a further methodology for small catchment flood estimation. As far as we are concerned, it is the preferred method.
- For catchments less than 5 km^2 there is no FSU method applicable. For such 'small' catchments we would suggest that maybe the rational method or modified rational method could be used.

The catchment to the Kilcrow associated with the furthest downstream point of the site boundary has an area of 2.00 km^2. The OPW FSU method alone may therefore be deemed unsuitable for the calculation of potential flood flows in this instance. A sequence of flood flow calculations is presented below.

4.2 FLOOD FLOW CALCULATIONS: KILCROW CATCHMENT

4.2.1 OPW FSU - 7 Variable Equation

The ungauged method can be used to determine flood flows at the site using catchment characteristics, which are then corrected using a correlation against descriptors for gauged catchments. The median annual maximum flood magnitude (QMED), as outlined in the Flood Studies Update (FSU) (Nicholson & Bree 2013) is now preferred over the mean annual flood flow rate (Q_{bar}) parameter described in the Flood Studies Report (FSR) (NERC 1975). The preferred median method is less sensitive to large extreme floods and to flood measurement error in general. The estimation method for ungauged locations is based on a regression analysis relating observed QMED to physical catchment descriptors (PCDs) at gauged locations in Ireland, given by the following equation:

$$QMED_{rural} = 1.237\text{x}10^{-5} \,.\, AREA^{0.937} \,.\, BFI_{soil}^{-0.922} \,.\, SAAR^{1.306} \,.\, FARL^{2.217} \,.\, DRAIND^{0.341} \,.\, S^{0.185} \,.\, (1 + ARTDRAIN2)^{0.408}$$

The PCDs applicable to the subject site are shown in Table 2.

Table 2 - Physical Catchment Descriptors Applicable to the Subject Site

PCD	Description	Units	Value
AREA	Catchment area	km^2	2.00
SAAR	Average annual rainfall	mm	938.91
BFIsoil	Baseflow index derived from soils data		0.6908
FARL	Flood attenuation from reservoirs and lakes		1
DRAIND	Ratio of river network to catchment area	no./km^2	0.212
S_{1085}	Slope of the main stream between the 10 and 85 percentiles	m/km^2	1.034
ARTDRAIN2	Proportion of river network included in drainage schemes		0.9404
URBEXT			0
$QMED_{rural}$		m^3/s	0.198
$QMED_{urban}$		m^3/s	0.198

A principal of the FSU is the concept of a pivotal site, however no pivotal sites were considered suitable for application to such a small catchment. The return-period flood flow (Q_T) is determined by an index flood method, whereby a growth factor as determined from an EV1 distribution plot is applied. In this case:

$$Q_t = QMED \times 2.51$$

$$Q_{100} = 0.198\ m^3/s \times 2.51$$

$$Q_{100} = 0.496\ m^3/s$$

Finally, a climate change growth factor of 20 % is applied:

$$Q_{100} = 0.496 \times 1.2$$

$$\mathbf{Q_{100} = 0.596\ m^3/s}$$

Using the standard OPW FSU approach the climate adjusted Q_{1000} flow in the watercourse as it passes the downstream site boundary is equal to:

$$Q_{1000} = QMED \times 3.33$$

$$Q_{1000} = 0.198\ m^3/s \times 3.33$$

$$Q_{1000} = 0.658\ m^3/s$$

Finally, a climate change growth factor of 20% is applied:

$$Q_{1000} = 0.658 \times 1.2$$

$$\mathbf{Q_{1000} = 0.790\ m^3/s}$$

4.2.2 OPW FSU – Small Catchments

The updated Flood Studies Update (Nicholson and Bree, 2013) presents the formula suited to catchments less than 25 km^2:

$$QMED_{rural} = 2.0951\times10^{-5} \cdot AREA^{0.9245} \cdot BFIsoil^{-0.9030} \cdot SAAR^{1.2695} \cdot FARL^{2.3163} \cdot S^{0.2513}$$

The same PCDs shown in Table 2 are again applied. This equation yields a Q_{MED} value of 0.328 m^3/s. As per the OPW Guidelines a pivotal site adjustment factor is not being applied to the outcome of the small catchments equation.

In this case the Q_{100} flood flow is determined as follows:

$$QT = QMED \times \text{growth factor}$$

$$Q_{100} = 0.328\ m^3\ s^{-1} \times 2.51$$

$$Q_{100} = 0.823\ m^3\ s^{-1}$$

Finally, a climate change growth factor of 20% is applied:

$$Q_{100} = 0.823 \times 1.2$$

$$\mathbf{Q_{100} = 0.987\ m^3\ s^{-1}}$$

In this case the Q_{1000} flood flow is determined as follows:

$$Q_{1000} = QMED \times 3.33$$

$$Q_{1000} = 0.328\ m^3/s \times 3.33$$

$$Q_{1000} = 1.091\ m^3/s$$

Finally, a climate change growth factor of 20 % is applied:

$$Q_{1000} = 1.091 \times 1.2$$

$$\mathbf{Q_{1000} = 1.309\ m^3/s}$$

4.2.3 OPW FSU – 3 Variable Method

The FSU 3-variable equation was developed as part of the FSU. It was developed as a 'short cut' equation for the estimation of flow in ungauged catchments:

$$QMED = 0.000302.AREA^{0.829}.\ SAAR^{0.898}.\ BFI^{1.539}$$

$$QMED = 0.14\ m^3/s$$

Application of the relevant growth factors as per above and 20% climate change adjustment factor results in:

$$\mathbf{Q_{100} = 0.428\ m^3/s}$$

$$\mathbf{Q_{1000} = 0.568\ m^3/s}$$

4.2.4 Flood Studies Report, FSR (NERC 1974)

This is the original FSR method, with the regression coefficient for Ireland. Estimates from this equation should be treated with extreme caution. Growth factor of 1.96 was applied to determine Q_{100}. It is recommended that these equations should be used only for preliminary flood estimates.

$$QBAR = 0.0172.AREA^{0.94}.\ STMFRQ^{0.27}.\ S1085^{0.16}.\ SOIL^{1.23}.\ RSMD^{1.03}.\ (1 + LAKE)^{-0.85}$$

Table 3 - Calculations of Q_{100} – FSR Ungauged Catchments

Area, km^2	STMFRQ, jn/km^2	S_{1085}, m/km	SOIL	RSMD	LAKE	Q_{BAR} m^3/s	Q_{BAR} x 1.96 gf m^3/s	Q_{100} x 1.47 sfe m^3/s	Q_{100} x x cc (1.2), m^3/s
2.004	0.499	1.034	0.35	35.991	0	0.303	0.594	0.8745	**1.049**

Using a growth factor of 2.6 to convert from Q_{BAR} to Q_{1000}, the resulting Q_{1000} flow which includes a 20% climate change factor is estimated as **1.392** m^3/s.

4.2.5 Institute of Hydrology Report (IH)124 (1994)

Report No. 124 derives an equation to estimate flood flows for small rural catchments (less than 25 km^2). The equation has a standard factorial error (SFE) of 1.65.

$$Qbar_{rural} = 0.00108\ (AREA^{0.89} x\ SAAR^{1.17}\ x\ SOIL^{2.17})$$

Table 4 - Calculations of Q_{100} – IH124

Area, km^2	SAAR	SOIL	Q_{BAR} m^3/s	Q_{BAR} x 1.96 gf m^3/s	Q_{100} x 1.65 sfe m^3/s	Q_{100} x x cc (1.2), m^3/s
2.004	938.91	0.35	0.617	1.210	1.997	**2.396**

Without implementing the SFE (1.65), the Q_{100} rate plus 20% climate change factor was:

$$Q_{100} = 1.211\ m^3/s \times 1.2 = 1.45\ m^3/s.$$

Using a growth factor of 2.59 to convert from Q_{BAR} to Q_{1000}, the resulting Q_{1000} flow which includes a 20% climate change factor is estimated as **3.167** m³/s.

This method was developed for small catchments (< 25 km²) in the UK. Its derivation did not include any Irish catchments. The equation tends to overestimate QBAR for the smallest of the UK catchments used. This value is not comparable to results derived from other formulae.

4.2.6 Modified IH 124 (Cawley & Cunnane 2003)

Irish researchers at NUIG (Cawley & Cunnane 2003) developed a Modified Institute of Hydrology 124 methodology and formula as follows:

$$Qbar_{rural} = 0.000036\ (AREA^{0.94} \times SAAR^{1.58} \times SOIL^{1.87})$$

Table 5 - Calculations of Q_{100} – Modified IH124

Area, km²	SAAR	SOIL	Q_{BAR} m³/s	Q_{BAR} x 1.96 gf m³/s	Q_{100} x 1.65 sfe m³/s	Q_{100} x x cc (1.2), m³/s
2.00	938.9	0.35	0.483	0.947	1.563	**1.875**

Using a growth factor of 2.59 to convert from Q_{BAR} to Q_{1000}, the resulting Q_{1000} flow which includes a 20% climate change factor is estimated as **2.47** m³/s.

4.2.7 Modified Rational Method

FSU Work Package 4.2 shows that the UK only apply the Rational Method to catchments from 2 to 4 km². In Ireland this method is more commonly used to determine stormwater attenuation requirements. It is calculated using the formula:

$$QT = 2.78 \times C_v \times C_r \times I \times A$$

where:

Q_T = design peak flow, l s^{-1}

T = return period in years = 100

C_v = runoff coefficient = 0.84 (winter)

C_r = peaking/routing factor = 1.3 (arbitrary value)

A = 2.004 km²

$I_{tc,T}$ = hourly rainfall intensity for design duration of tc (hours) and return period T (years) = 29.2 mm *1.36 = 39.712 mm

t_c= time of concentration defined as the travel time from the furthest point on the catchment to the outlet (mins):

$$t_c = 0.0195 \times L^{0.77} \times S^{-0.385}$$

L = length of stream = 1600 m

S = catchment gradient, m m^{-1} = 0.001

tc = 81.6 minutes = 1.36 hours

Hence:

$$Q_{100} = 2.78 \times 0.84 \times 1.3 \times 0.0292 \times 2.004$$

$$Q_{100} = 0.348 \text{ m}^3 \text{ s}^{-1}$$

$$Q_{100} + 20\% \text{ cc} = \mathbf{0.417} \text{ m}^3 \text{ s}^{-1}$$

$$Q_{1000} + 20\% \text{ cc} = \mathbf{0.552} \text{ m}^3 \text{ s}^{-1}$$

4.2.8 Summary of Flood Flow Calculations

Results from the various flood estimation methods on the central, west-flowing stream through the main site area are summarised below in Table 6. In taking a conservative approach, the flood flow values selected for use in the hydraulic model were those calculated using the IH124 method, as these were the maximum values. The respective Q_{100} and Q_{1000} values being equal to 2.40 m^3/s and 3.16 m^3/s, respectively. These values include a 20% factor for climate change.

Table 6 - Summary of Calculated Flood Flows (includes 20% Climate Change Factor)

Methodology	Q_{100} + 20% cc (m^3/s)	Q_{1000} + 20% cc (m^3/s)
FSU Standard	0.60	0.79
FSU small catchments	0.99	1.09
FSU – 3 variable	0.43	0.57
FSR 6 – including SFE	1.04	1.39
IH124 – including SFE	**2.40**	**3.16**
Modified IH124 – including SFE	1.88	2.48
Modified rational method	0.42	0.55
Minimum	0.42	0.55
Maximum	2.40	3.16
Average (n = 7)	1.11	1.43

4.3 FLOOD FLOW CALCULATIONS: GORTAHA CATCHMENT

The above process was repeated for the flows generated in the eastern part of the site, which drain to the Gortaha catchment. The physical catchment descriptors applicable to the Gortaha Catchment are shown in Table 7, these being at the eastern extent of the site boundary, just downstream of the N65.

Table 7 - Physical Catchment Descriptors Applicable to the Subject Site

PCD	Description	Units	Value
AREA	Catchment area	km^2	1.06
SAAR	Average annual rainfall	mm	924.6
BFIsoil	Baseflow index derived from soils data		0.691
FARL	Flood attenuation from reservoirs and lakes		1
DRAIND	Ratio of river network to catchment area	no./km^2	2.455
S_{1085}	Slope of the main stream between the 10 and 85 percentiles	m/km^2	0.1
ARTDRAIN2	Proportion of river network included in drainage schemes		0.3172
URBEXT			0
$QMED_{rural}$		m^3/s	0.114
$QMED_{urban}$		m^3/s	0.115

Results from the various methods used to estimate flood flows in the Gortaha Stream are summarised below in Table 8. In taking a conservative approach, the flood flow values selected for use in the hydraulic model were those calculated using the Modified IH124 method, as this method was developed using Irish catchment characteristics. The Q_{100+cc} and $Q_{1000+cc}$ values were estimated as 1.33 m^3/s and 1.76 m^3/s, respectively.

Table 8 - Summary of Calculated Flood Flows (includes 20% Climate Change Factor)

Methodology	Q_{100} + 20% cc (m^3/s)	Q_{1000} + 20% cc (m^3/s)
FSU Standard	0.41	0.54
FSU small catchments	0.96	1.28
FSU – 3 variable	0.25	0.33
FSR 6 – including SFE	0.46	0.61
IH124 – including SFE	**1.33**	**1.76**
Modified IH124 – including SFE	1.00	1.33
Modified rational method	0.28	0.37
Minimum	0.25	0.33
Maximum	1.33	1.76
Average (n = 7)	0.67	0.88

The above flood flows apply to the catchment to the eastern extent of the site boundary. In order to estimate flood flows in the northern and southern sub-catchments in the area the flows were divided based on their respective contributing areas. This resulted in flood flow estimations of 0.75 m^3/s and 0.93 m^3/s for the Q_{100} and Q_{1000} in the Gortaha North catchment (0.57 km^2) and flows of 0.63 m^3/s and 0.83 m^3/s for the Q_{100} and Q_{1000} in the Gortaha South catchment (0.49 km^2).

4.4 PROPOSED BRIDGE CROSSINGS

In order to facilitate site layout works several new bridge crossings are required. Two new structures are proposed in the Kilcrow catchment (Figure 10) in addition to four new structures proposed in the Gortaha catchment (Figure 15). Hydraulic modelling works shall be performed to ensure these proposed bridge crossings are appropriately sized.

The bridge crossings in the Kilcrow catchment are referred to as BR1 and BR2 whilst the proposed bridge crossings in the Gortaha catchment are labelled BR3, BR4, BR5 and BR6.

Flood flows corresponding to the catchment upstream of each proposed bridge crossing were calculated using the IH124 method and the appropriate contributing catchment, and are outlined below in Table 9. In the final column a drainage factor of 1.6 has been applied to the Q_{100+cc} flood flow value, as per OPW Section 50 specifications for design flows in maintained channels.

Table 9 – Flood Flows for each proposed bridge in the Gortaha Catchment

Catchment	Bridge Reference	Area to Structure (km^2)	Q_{100} + 20% cc (m^3/s)	(Q_{100} + 20% cc) x 1.6 (m^3/s)
Kilcrow	BR1	0.80	0.96	1.54
Kilcrow	BR2	0.92	1.1	1.76
Gortaha	BR3	0.14	0.17	0.27
Gortaha	BR4	0.13	0.16	0.26
Gortaha	BR5	0.19	0.24	0.38
Gortaha	BR6	0.11	0.14	0.23

The above flood flows will inform bridge design as per OPW specifications which stipulate:

- a bridge or culvert must be capable of passing a fluvial flood flow with a 1% AEP, or 1 in 100 year flow, without significantly changing the hydraulic characteristics of the watercourse;
- a bridge must be capable of operating under the above design conditions while maintaining a freeboard of at least 300 mm;
- a culvert diameter, height and width must not be less than 900 mm in order to facilitate maintenance access and to reduce the likelihood of debris blockage.

Proposed bridge specifications are presented further in the report.

5 HYDRAULIC MODEL

5.1 MODEL CONCEPT

A site-specific hydraulic model was constructed using Flood Modeller (version 6.1), an industry standard hydraulic modelling software package for which Envirologic maintains a full license. This software package is designed to perform one dimensional (1D) hydraulic simulations for networks of natural or constructed water channels. In addition to the one-dimensional hydraulic solver the software also utilises a two-dimensional solver (2D) which models water flow and depth in situations where flood levels overtop the bank-full capacity of the surveyed channels and spill onto the adjoining floodplain. Construction of the 1D–2D linked model relies on four primary inputs summarised as follows:

- Geometric Data: Surveyed cross-sectional data of the main channel through the site boundary;
- Geometric Data: A georeferenced digital elevation model of the site and surrounding landscape to cover potential adjoining flood plain upstream and downstream of the site location;
- Upstream Boundary Conditions - Q_{100} & Q_{1000} flood flow volumes for the upstream catchment of the site;
- Inclusion of Manning Roughness Coefficient values, used to calculate frictional forces within the flood model.

5.2 MODEL BUILD – EXISTING DRAINAGE REGIME: KILCROW CATCHMENT

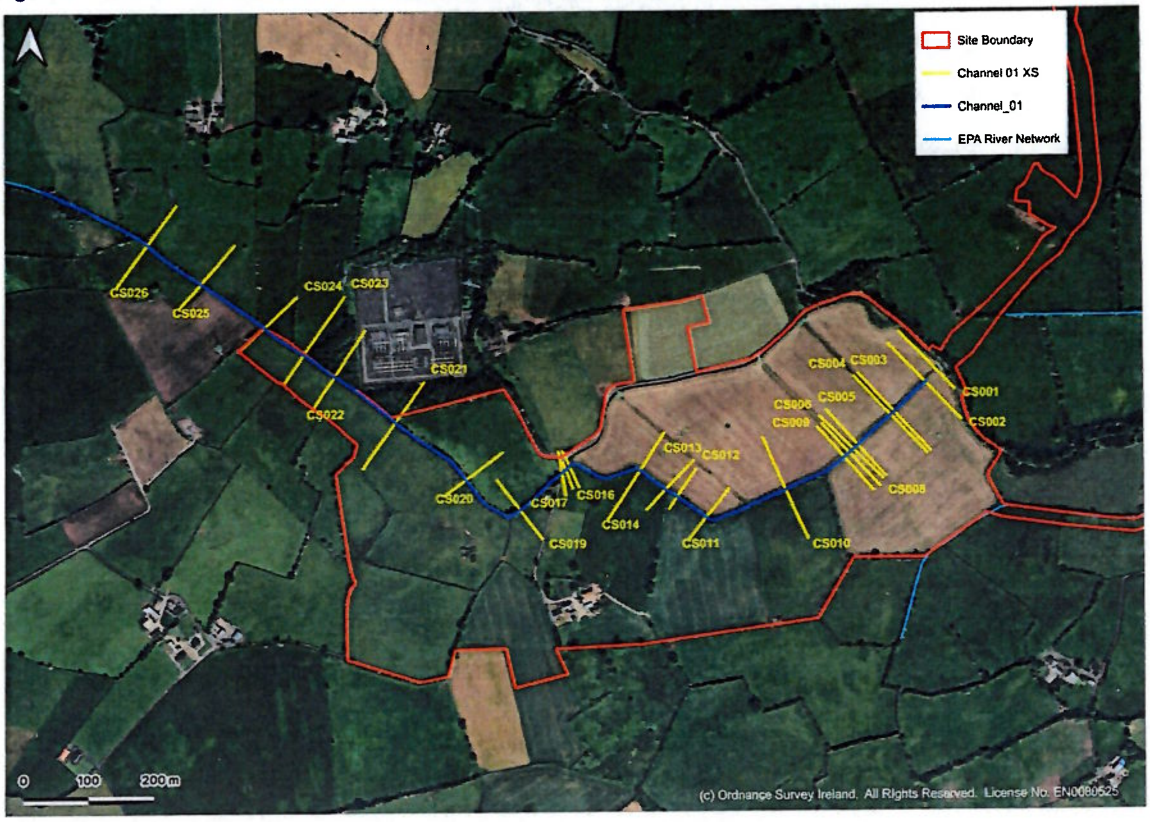
5.2.1 Cross Sections

This 1D model was compiled using twenty-six evenly spaced cross sections along the central channel within the site boundary, as shown in Figure 8. These sections were surveyed manually using Trimble RTK VRS technique. As stated previously the surface water catchment to this central channel as it passes the downgradient site boundary is 2.00 km^2.

A further 19 cross sections were surveyed within drainage ditches that run perpendicular, and outfall to the central channel within the site. Only one of these was considered as contributing flows high enough that it should be included in the flood model; this being a drainage tributary that extends 950 m south and has a catchment of approximately 0.68 km^2. Nine cross sections were surveyed along this southern drainage tributary. Accordingly, 34% of the Q_{100} and Q_{1000} flow values were attributed to this southern drainage tributary, based on its proportional area within the overall site catchment.

For reference, the model refers to the central channel as Channel_01 (Figure 8) and the southern drainage tributary as Channel_02 (Figure 9).

Figure 8 – Kilcrow Catchment: Central Channel Cross Section Locations



5.2.2 Flow Boundaries

The IH124 $Q_{1000+cc}$ flow value of 3.16 m^3/s was selected as the design flood flow through the central channel. This was introduced to the modelled central channel as inflows of 2.09 m^3/s at node CS001 and 1.06 m^3/s at node CS100. The combined flow of 3.16 m^3/s is then routed through all remaining downstream cross sections. The same modelling concept approach was applied in relation to the Q_{100} flow (2.94 m^3/s).

5.2.3 Roughness Coefficients & Gradients

A Manning's roughness coefficient of 0.03 was applied to open river channel bed sections (noted as silty/gravelly) and a value of 0.045 applied to riverbanks. The central channel (Channel 01) is noted on the OPW drainage network database as being maintained as part of the Killimor arterial drainage district. It was observed during the site visit that the channel profiles generally have steep banks and channel beds with a low hydraulic gradient, generally 0.02%. This steepened to a maximum gradient of 1.18% in the western part of the site.

5.2.4 Existing Structures

There are four structures currently in place along the modelled reaches. Culvert specifications are noted as follows:

- CS006 = Culvert field crossing along Channel 01:

    - 1 no. circular concrete culvert with an opening of 900 mm
    - Length = 6.0 m
    - Pipe crown elevation = 52.05 mOD
    - Pipe invert elevation = 51.15 mOD
    - Upstream top of wall elevation = 53.32 mOD
    - Culvert deck level = 53.21 mOD
- CS016 = Culvert crossing on Channel 01 for access road to existing dwelling:
    - 1 no. concrete culvert with an opening of 950 mm
    - Length = 7.5 m
    - Pipe crown elevation = 51.18 mOD
    - Pipe invert elevation = 50.18 mOD
    - Upstream top of wall elevation = 51.70 mOD
    - Culvert deck level = 51.87 mOD
- CS102 = Culvert crossing on Channel 02 for access between fields:
    - 1 no. concrete culvert with an opening of 650 mm
    - Length = 4.0 m
    - Pipe crown elevation = 52.95 mOD
    - Pipe invert elevation = 52.30 mOD
    - Upstream top of wall elevation = 53.31 mOD
    - Culvert deck level = 53.40 mOD
- CS110 = Culvert on Channel 02 immediately upstream of outfall to Channel 01:
    - 1 no. concrete culvert with an opening of 500 mm
    - Length = 0.5 m
    - Pipe crown elevation = 51.95 mOD
    - Pipe invert elevation = 51.45 mOD
    - Upstream top of wall elevation = 52.72 mOD
    - Culvert deck level = 52.72 mOD

5.2.5 Existing Drainage Regime: Simulations

Modelling simulations were run to represent the following scenarios:

- Validation of the model build using observed vs modelled water levels
- 1 in 100-year fluvial flood event

- 1 in 1000-year fluvial flood event

5.2.6 Simulation: Validation

Surface water levels were recorded on 1st and 2nd May 2024 as part of the topographical survey. These surveyed water levels were compared with water levels modelled by the hydraulic simulation, with results shown in Table 10. A flow of 0.2 m^3/s provided the least amount of error between the surveyed and modelled water levels and was deemed representative of flows observed on the day.

Validation results showed that the model was extremely accurate throughout the modelled reach of the central channel, with the difference generally below 60 mm. There was a slight increase in divergence of up to 200 mm at CS022 and CS023 with this being attributed to the sharp increase in hydraulic gradient towards the end of the model. Another slightly higher difference between observed and predicted water levels of 120 mm occurred immediately upstream of culvert CS016. During surveying it was noted that there was a large amount of silt and vegetation at the culvert inlet which was not accounted for in the model.

The results of the validation exercise confirm that the model is valid and accurate and is appropriate for predicting flood flows through the application site.

Table 10 - Surface Water Levels Validation

Cross Section	Surveyed Surface Water Level (mOD)	Modelled Water Level at 0.2 m^3/s (mOD)	Difference (m)
CS002	51.62	51.64	-0.02
CS003	51.60	51.63	-0.04
CS004	51.58	51.61	-0.03
CS005	51.58	51.61	-0.03
CS007	51.58	51.60	-0.02
CS008	51.58	51.60	-0.02
CS009	51.52	51.54	-0.02
CS010	51.17	51.24	-0.07
CS011	50.81	50.80	0.02
CS012	50.76	50.73	0.03
CS013	50.70	50.66	0.03
CS014	50.40	50.50	-0.12
CS015	50.37	50.48	-0.12
CS017	50.1	50.18	-0.08
CS018	49.78	49.70	0.09
CS019	48.39	48.28	0.11
CS020	45.84	45.90	-0.06
CS021	43.78	43.84	-0.06
CS022	43.18	42.96	0.22
CS023	42.82	42.63	0.19
CS024	42.45	42.45	0.00
CS025	42.31	42.38	-0.08
CS026	42.25	42.26	0.00

5.2.7 Simulation: Flood Flows

The conveyance capacity of all surveyed cross sections along the existing stream were assessed for suitability to transmit Q_{100} and Q_{1000} flood flows, with a 20% allowance included for climate change. The design flows are as follows:

- Central channel (Channel 01) Q_{100} = 1.59 m³/s
- Central channel (Channel 01) Q_{1000} = 2.10 m³/s
- Southern tributary (Channel 02) Q_{100} = 0.80 m³/s
- Southern tributary (Channel 02) Q_{1000} = 1.06 m³/s

The predicted surface water elevations from the Flood Modeller 1D simulation under steady-state conditions are presented in Table 11.

The results showed that under flood conditions waters are maintained within the central channel profile. There is surcharging upstream of the culvert at CS016 but these upstream waters remain confined within the channel profile.

Full surcharging occurs at the inlets of both culverts on the southern tributary under Q_{100} flows, these being positioned at CS102 and CS110. As proposed works involve realignment of this channel it was not deemed necessary to construct a full 1D-2D flood simulation to assess of the fate of waters that spill onto the floodplain. The southern tributary (Channel 02) was capable of safely transmitting 0.6 m³/s with the existing culverts in place.

Table 11 - Hydraulic Model Flow Simulation Outputs for existing hydraulic regime for Central Channel

Cross Section	Channel 01			
	Q_{100} Flow (m³/s)	Q_{100} fluvial flood levels (mOD)	Q_{1000} Flow (m³/s)	Q_{1000} fluvial flood levels (mOD)
CS001	1.59	52.57	2.10	52.72
CS002	1.59	52.38	2.10	52.56
CS003	1.59	52.39	2.10	52.58
CS004	1.59	52.37	2.10	52.55
CS005	1.59	52.36	2.10	52.55
CS006UP	1.59	52.28	2.10	52.43
CS006DN	1.59	52.29	2.10	52.44
CS007	1.59	52.29	2.10	52.44
CS008	1.59	52.29	2.10	52.44
CS009	1.59	52.20	2.10	52.34
CS010	1.59	51.73	2.10	51.84
CS011	1.59	51.40	2.10	51.56
CS012	2.40	51.64	3.16	51.85
CS013	2.40	51.58	3.16	51.79
CS014	2.40	51.41	3.16	51.64

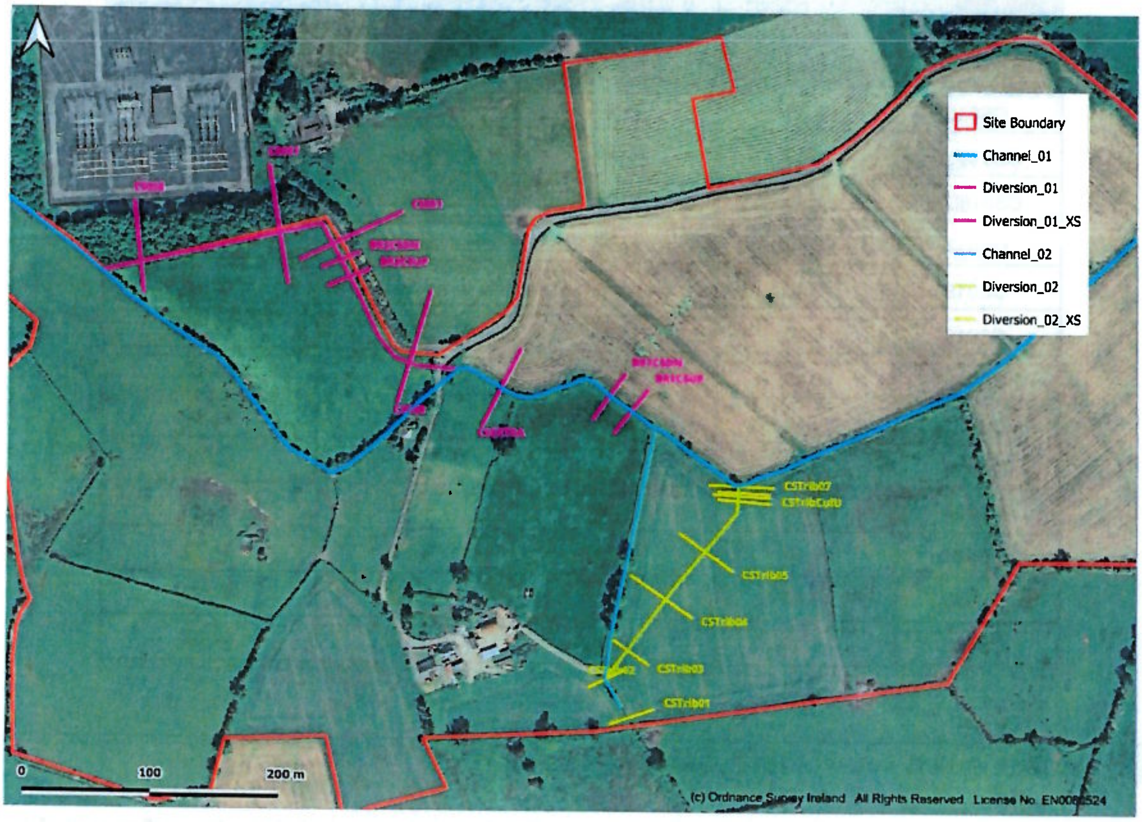
Cross Section	Channel 01			
	Q_{100} Flow (m^3/s)	Q_{100} fluvial flood levels (mOD)	Q_{1000} Flow (m^3/s)	Q_{1000} fluvial flood levels (mOD)
CS015	2.40	51.40	3.16	51.63
CS016UP	2.40	50.69	3.16	50.81
CS016DN	2.40	50.66	3.16	50.77
CS017	2.40	50.66	3.16	50.77
CS018	2.40	50.18	3.16	50.28
CS019	2.40	48.67	3.16	48.74
CS020	2.40	46.37	3.16	46.47
CS021	2.40	44.32	3.16	44.42
CS022	2.40	43.55	3.16	43.71
CS023	2.40	43.33	3.16	43.49
CS024	2.40	43.14	3.16	43.28
CS025	2.40	42.99	3.16	43.10
CS026	2.40	42.48	3.16	42.88

5.3 MODEL BUILD – REALIGNED DRAINAGE REGIME

In order to facilitate efficient site layout design the proposed development works include for the realignment of the local drainage network at two separate channel reaches, as indicated in Figure 9:

1. Realignment 01 – Channel 01. The reach between CS016 and CS020 will be diverted north and then west for 350 m. The culvert currently in place at CS016 shall be decommissioned.
2. Realignment 02 – Channel 02. The southern drainage tributary will be diverted northeastwards from where it currently flows past the on-site dwelling. The culverts currently in place at CS102 and CS110 shall be decommissioned. A new culvert will be installed to facilitate a proposed access road just before the southern tributary outfalls to the central channel.
3. Invert levels along the realigned drainage channels have been derived at the cross sections shown in Figure 9, based on a uniform bed gradient between the start and end of each realigned channel reach.

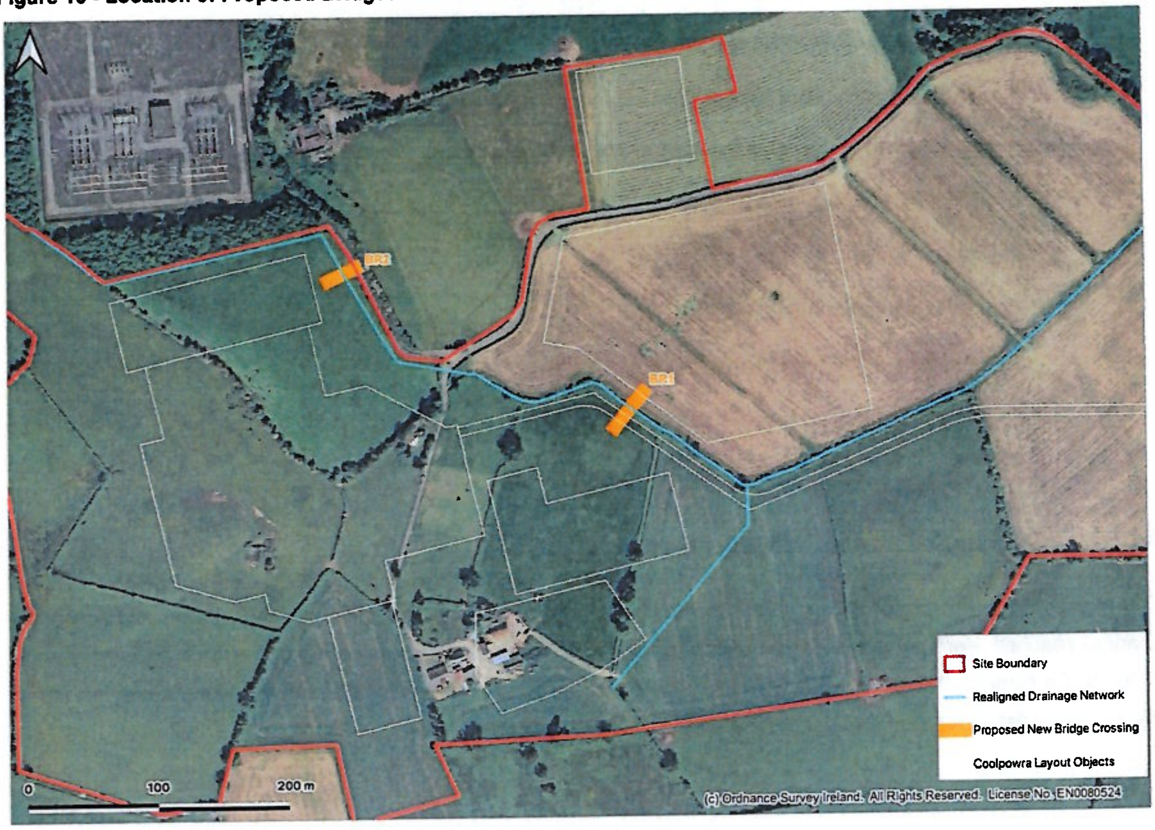
Figure 9 - Location of diverted channels and cross sections



5.4 PROPOSED STRUCTURES: KILCROW CATCHMENT

In addition to the above realignment works, two new bridges are proposed to facilitate new internal access roads, these will be installed (i) on the central channel between CS012 and CS013, and (ii) on the northern limb of Realignment 01 (BR2). Locations of the proposed bridges are shown in Figure 10.

Figure 10 - Location of Proposed Bridges: Kilcrow Catchment



The proposed replacement culvert structure will be located on Realigned Channel 02, just upstream of its confluence with Channel 01. It will have the following specifications:

- CSTribCul = New culvert upstream of confluence of Realignment 02 and Channel 01:
    - 1 no. circular concrete culvert with an opening of 1,200 mm
    - Width = 6 m
    - Pipe crown elevation = 52.45 mOD
    - Pipe invert elevation = 51.25 mOD
    - Culvert deck level = new access road elevation

The design specifications for the two new proposed bridges require a freeboard of 300 mm for the water level corresponding to the Q_{100} flow + climate change Q_{100} flow + climate change x 1.6 Drainage Factor. Each bridge structure shall consist of a precast concrete deck. Stone gabions will act as a foundation to the concrete base of the deck level, which will be set back approximately 1m from the top of the channel bank. There will be a minimum clearance of 400 mm from the top of the channel bank to the bridge soffit.

- BR1 = Proposed bridge along Channel 01 between CS012 and CS013:
    - Precast concrete bridge deck
    - Length = 6 m

    - Soffit elevation = 53.0 mOD
    - Spring elevation = Ground elevation
    - Bridge deck level = 53.5 mOD
- BR2 = Proposed bridge on northern limb of Realignment 01
    - Precast concrete bridge deck
    - Width = 6 m
    - Soffit elevation = 51.0 mOD
    - Spring elevation = Ground elevation
    - Bridge deck level = 51.5 mOD

5.4.1 Proposed Drainage Regime Flood Scenarios

The conveyance capacity of all surveyed and realigned cross sections along the existing stream and realigned channel reaches were re-assessed for suitability to transmit Q_{100} and Q_{1000} flood flows, with a 20% allowance included for climate change. The design flows are as per previous. The predicted surface water elevations from the Flood Modeller 1D-model under steady-state conditions are presented in Table 12.

Table 12 - Hydraulic Model Flow Simulation Outputs for Channel 01 with diversions 01 and 02 incorporated

Cross Section	Q_{100} Flow (m^3/s)	Q_{100} fluvial flood levels (mOD)	Q_{1000} Flow (m^3/s)	Q_{1000} fluvial flood levels (mOD)
CS001	1.59	52.57	2.10	52.72
CS002	1.59	52.38	2.10	52.56
CS003	1.59	52.39	2.10	52.58
CS004	1.59	52.37	2.10	52.55
CS005	1.59	52.37	2.10	52.55
CS006UP	1.59	52.28	2.10	52.43
CS006DN	1.59	52.29	2.10	52.44
CS007	1.59	52.29	2.10	52.44
CS008	1.59	52.29	2.10	52.44
CS009	1.59	52.20	2.10	52.34
CS010	2.40	51.93	3.16	52.08
CS011	2.40	51.74	3.16	51.90
CS012	2.40	51.75	3.16	51.92
BR1CSUP	2.40	51.70	3.16	51.87
BR1CSDN	2.40	51.69	3.16	51.86
CS013	2.40	51.68	3.16	51.85
CSEXTRA	2.40	51.40	3.16	51.53
CS014	2.40	50.87	3.16	50.98
CS050	2.40	50.80	3.16	50.92
BR2CSUP	2.40	49.66	3.16	49.63
BR2CSDN	2.40	49.81	3.16	49.89
CS051	2.40	49.07	3.16	49.12
CS057	2.40	48.09	3.16	48.19
CS058	2.40	46.89	3.16	46.99
CS020	2.40	46.37	3.16	46.47
CS021	2.40	44.32	3.16	44.42
CS022	2.40	43.55	3.16	43.71
CS023	2.40	43.33	3.16	43.49
CS024	2.40	43.14	3.16	43.28
CS025	2.40	42.99	3.16	43.10
CS026	2.40	42.48	3.16	42.88
CSTrib01	0.80	53.18	1.06	53.24
CSTrib02	0.80	52.85	1.06	52.91
CSTrib03	0.80	52.46	1.06	52.52
CSTrib04	0.80	52.09	1.06	52.26
CSTrib05	0.80	52.04	1.06	52.23
CSTribCulUp	0.80	51.94	1.06	52.09
CSTribCulDn	0.80	51.93	1.06	52.08
CSTrib06	0.80	51.93	1.06	52.08
CSTrib07	0.80	51.93	1.06	52.08

The results showed that under flood conditions waters are maintained within the re-aligned central channel and the realigned tributary to the south. There is no surcharging upstream of any of the proposed structures. As the floodwaters were contained within the 1D model it was not necessary to develop a 1D-2D linked hydraulic model.

The longitudinal profiles of Channel 01, including the realignment and proposed bridges, are shown for the Q_{100} and Q_{1000} scenarios in Plate 4 and Plate 5, respectively.

The longitudinal profiles of Channel 02, including the upgraded culvert, are shown for the Q_{100} and Q_{1000} scenarios in Plate 6 and Plate 7, respectively.

Plate 4 – Longitudinal Profile of Channel 01 with Realigned Channel under Q_{100} scenario

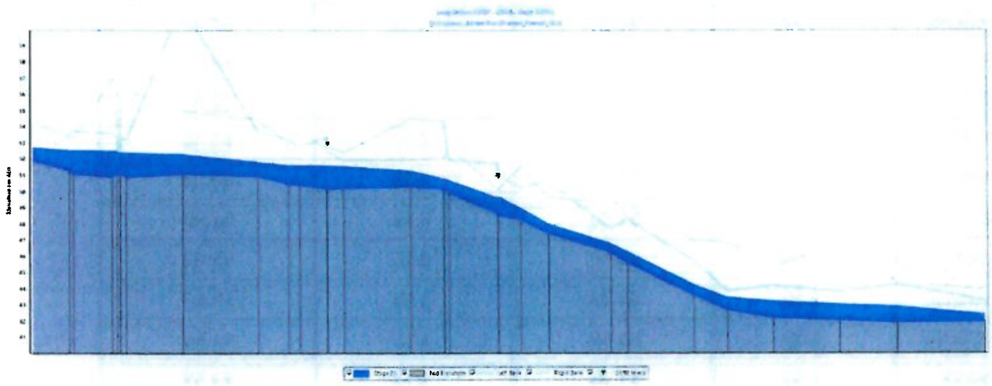


Plate 5 – Longitudinal Profile of Channel 01 with Realigned Channel under Q_{1000} scenario

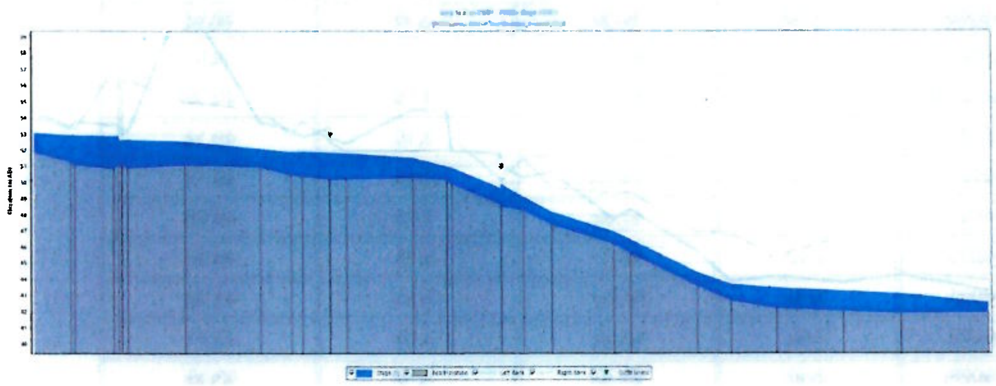


Plate 6 – Longitudinal Profile of Channel 02 with Realigned Channel under Q_{100} scenario

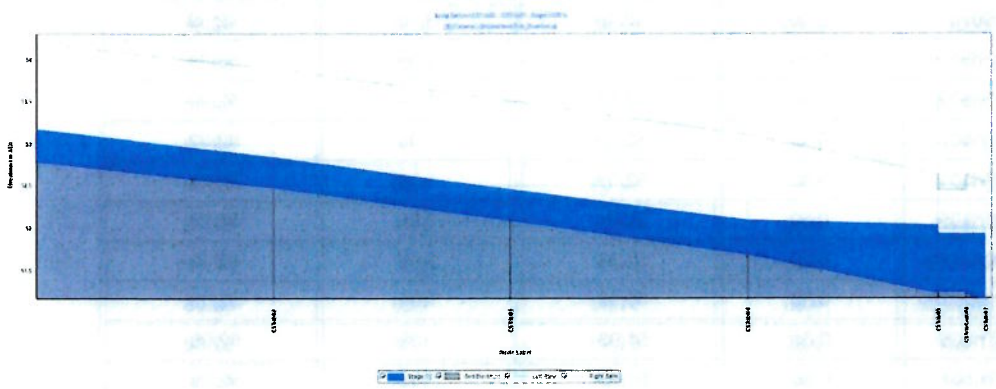
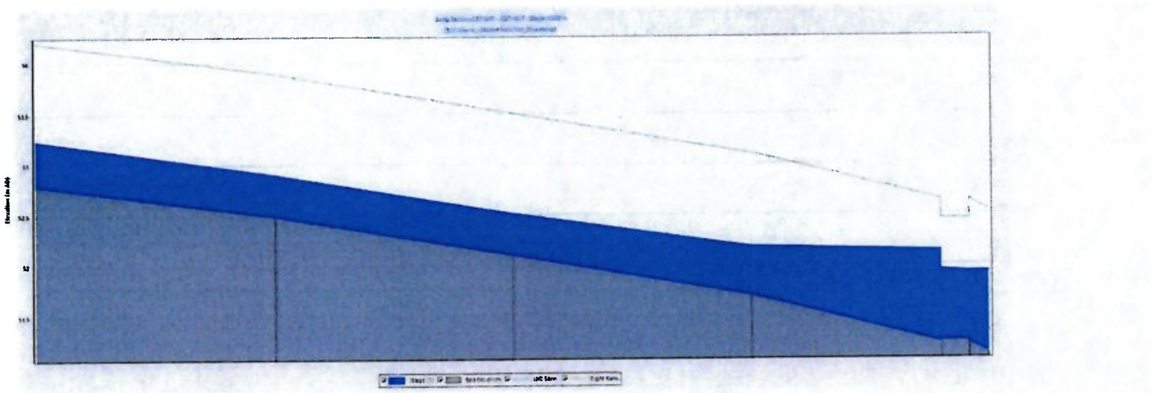


Plate 7 – Longitudinal Profile of Channel 02 with Realigned Channel under Q_{1000} scenario



5.5 MODEL BUILD: EXISTING DRAINAGE REGIME: GORTAHA CATCHMENT

The 1D model for the eastern part of the application site, which drains to the Gortaha catchment, centred around two primary watercourses. For the purposes of this study these have been referred to as the Gortaha North and the Gortaha South (indicated as CS GNo and CS GSo in node nomenclature). The 1D hydraulic model for the Gortaha catchment was compiled using forty evenly spaced cross sections surveyed along these two watercourses. Cross section locations for the Gortaha North and Gortaha South are shown in Figure 11 and Figure 12, respectively.

Figure 11 – Gortaha North Cross Sections

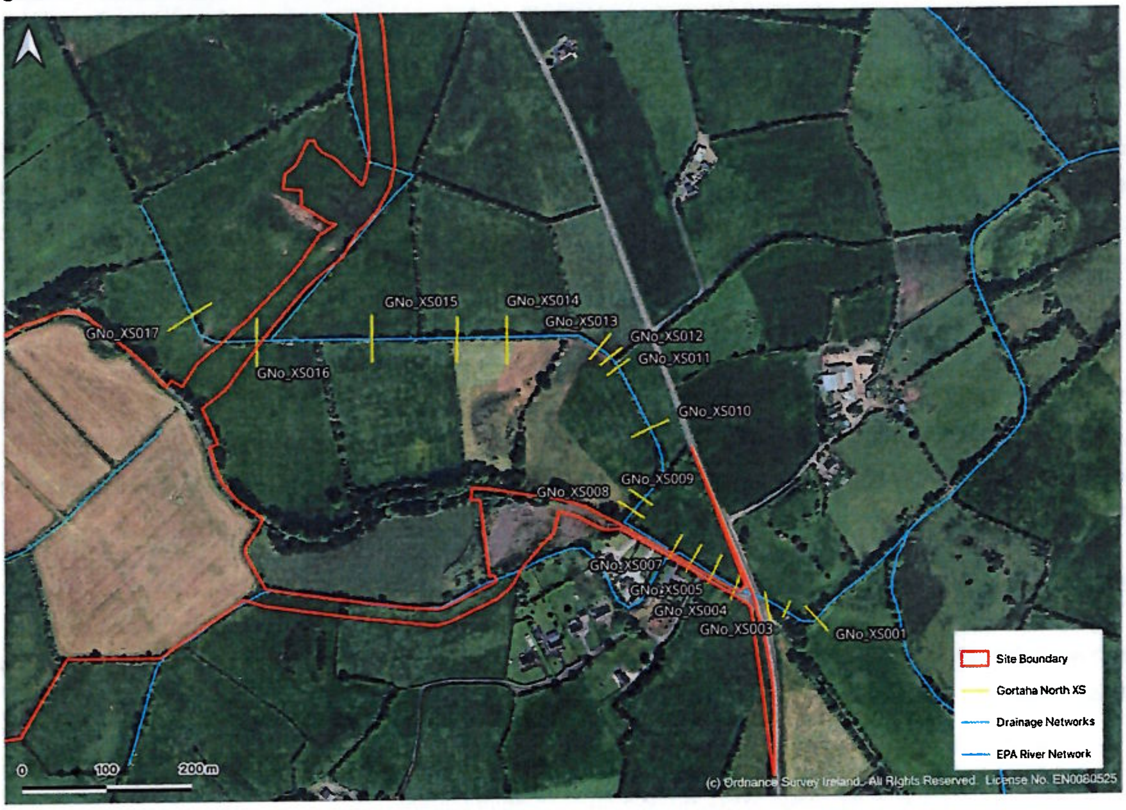


Figure 12 – Gortaha South Cross Sections

5.5.1 Flow Boundaries

The IH124 Q_{100+cc} & $Q_{1000+cc}$ flows presented previously were used as the design flood flows through each channel. The Gortaha North channel was modelled first to determine the downstream head boundary for the Gortaha South channel under flood conditions. The combined flow of 1.33 m^3/s (Q_{100+cc}) and 1.76 m^3/s ($Q_{1000+cc}$) was applied to the model downstream of the confluence.

5.5.2 Roughness Coefficients & Gradients

A Manning's roughness coefficient of 0.03 was applied to open river channel bed sections (noted as silty/gravelly) and a value of 0.045 applied to riverbanks. The channels throughout the Gortaha Catchment are characterised as having trapezoidal shape, with steep banks and flat channel bottoms. Both channels are mapped as being part of a Drainage District.

5.5.3 Existing Structures

There are three structures in place along the modelled channels in the Gortaha Catchment. Culvert specifications are as follows:

- GNo_Cul01 = Culvert crossing under the N65
    - 1 no. circular concrete culvert with an opening of 500 mm
    - Length = 42.0 m

- Upstream Pipe crown elevation = 48.45 mOD
- Upstream Pipe invert elevation = 47.95 mOD
- Downstream Pipe crown elevation = 48.30 mOD
- Downstream Pipe invert elevation = 47.80 mOD
- Upstream top of wall elevation = ground level = 49.68 mOD
- Culvert deck level (spill point) = 50.01 mOD

- GNo_Cul02 = Culvert supporting a field crossing
  - 1 no. circular concrete culvert with an opening of 300 mm
  - Length = 4.5 m
  - Upstream Pipe crown elevation = 50.25 mOD
  - Upstream Pipe invert elevation = 49.95 mOD
  - Downstream Pipe crown elevation = 50.20 mOD
  - Downstream Pipe invert elevation = 49.90 mOD
  - Upstream top of wall elevation = ground level = 50.70 mOD
  - Culvert deck level (spill point) = 50.7 mOD
- GSo_Cul01= Culvert crossing under the L8763
  - 1 no. circular concrete culvert with an opening of 450 mm
  - Length = 11.0 m
  - Upstream Pipe crown elevation = 49.03 mOD
  - Upstream Pipe invert elevation = 48.58 mOD
  - Downstream Pipe crown elevation = 48.93 mOD
  - Downstream Pipe invert elevation = 48.42 mOD
  - Upstream top of wall elevation = ground level = 49.944 mOD
  - Culvert deck level (spill point) = 49.944 mOD

5.5.4 Existing Drainage Regime: Simulations

Modelling simulations were run to represent the following scenarios:

- 1 in 100 year fluvial flood event;
- 1 in 1000 year fluvial flood event.

A validation exercise was not carried out due to the previously mentioned channel blockages in both Gortaha North and South channels. This would have resulted in water levels being returned as excessively high in the upper sections, and subsequently, excessively low in the lower sections to appropriately assess model divergence.

5.5.5 Simulation: Flood Flows

The conveyance capacity of all surveyed cross sections along the Gortaha North and South channels were assessed for suitability to transmit Q_{100} and Q_{1000} flood flows, with a 20% allowance included for climate change. As previously mentioned, the design flows are as follows:

- Gortaha North Q_{100} = 0.75 m^3/s
- Gortaha North Q_{1000} = 0.93 m^3/s
- Gortaha South Q_{100} = 0.63 m^3/s
- Gortaha South Q_{1000} = 0.83 m^3/s

The flows for each catchment merge at a confluence downstream of culvert GSo_Cul01 (culvert transmits water under the L8763) , resulting in cumulative Q_{100} and Q_{1000} flows of 1.33 m^3/s and 1.76 m^3/s, respectively. The predicted surface water elevations from the Flood Modeller 1D-model under steady-state conditions are presented for each of the Gortaha channels in Table 13 and Table 14.

Table 13 – Gortaha North Predicted Fluvial Flood Flow Elevations

Cross Section	Gortaha North			
	Q_{100} Flow (m^3/s)	Q_{100} fluvial flood levels (mOD)	Q_{1000} Flow (m^3/s)	Q_{1000} fluvial flood levels (mOD)
GNo_XS017	0.75	52.15	0.93	52.21
GNo_XS016	0.75	52.07	0.93	52.13
GNo_XS015	0.75	51.75	0.93	51.81
GNo_XS014	0.75	51.33	0.93	51.40
GNo_XS013	0.75	50.75	0.93	50.75
GNo_XS012	0.75	50.75	0.93	50.75
GNo_Cul02 us	0.75	50.75	0.93	50.75
GNo_Cul02 ds	0.75	50.75	0.93	50.75
GNo_XS011	0.75	50.20	0.93	50.26
GNo_XS010	0.75	50.08	0.93	50.15
GNo_XS009	0.75	50.06	0.93	50.08
GNo_XS008	0.75	50.06	0.93	50.08
GNo_XS007	1.33	50.06	1.76	50.08
GNo_XS006	1.33	50.06	1.76	50.08
GNo_XS005	1.33	50.06	1.76	50.08
GNo_XS004	1.33	50.06	1.76	50.08
GNo_Cul01 us	1.33	50.06	1.76	50.08
GNo_Cul01 ds	1.33	50.06	1.76	50.08

Cross Section	Gortaha North			
	Q_{100} Flow (m^3/s)	Q_{100} fluvial flood levels (mOD)	Q_{1000} Flow (m^3/s)	Q_{1000} fluvial flood levels (mOD)
GNo_XS003	1.33	48.42	1.76	48.49
GNo_XS002	1.33	48.34	1.76	48.42
GNo_XS001	1.33	48.14	1.76	48.22

Table 14 – Gortaha South Predicted Fluvial Flood Flow Elevations

Cross Section	Gortaha South			
	Q_{100} Flow (m^3/s)	Q_{100} fluvial flood levels (mOD)	Q_{1000} Flow (m^3/s)	Q_{1000} fluvial flood levels (mOD)
GSo_XS015	0.63	52.97	0.83	53.02
GSo_XS014	0.63	52.79	0.83	52.86
GSo_XS013	0.63	52.45	0.83	52.52
GSo_XS012	0.63	52.15	0.83	52.23
GSo_XS011	0.63	52.13	0.83	52.22
GSo_XS010	0.63	52.13	0.83	52.21
GSo_XS009	0.63	52.10	0.83	52.18
GSo_XS008	0.63	52.07	0.83	52.15
GSo_XS007	0.63	51.98	0.83	52.05
GSo_XS006	0.63	51.73	0.83	51.80
GSo_XS005	0.63	51.29	0.83	51.36
GSo_XS004	0.63	50.85	0.83	50.87
GSo_XS003	0.63	50.21	0.83	50.28
GSo_XS002	0.63	50.09	0.83	50.28
GSo_XS001	0.63	50.06	0.83	50.08
GSo_Cul01 us	0.63	50.06	0.83	50.08
GSo_Cul01 ds	0.63	50.06	0.83	50.08
GNo_XS007	Head Boundary	50.06	Head Boundary	50.08

The results showed that under flood conditions, the culverts in the Gortaha North catchment surcharge and increase water levels upstream. Spill points linked to the deck level or field crossing level of each culvert were inserted to permit the flow of surcharge waters over the top of the structure and into the section immediately downstream of the culvert outlet. In the case of the GNo_Cul01 the deck level of the field crossing was lower than that of the left and right bank elevation, resulting in flood waters being maintained within channel bounds. No flood zones were therefore returned at GNo_Cul01.

At GNo_Cul02, significant culvert surcharge occurs. A spill level of 50.01 mOD, relating to the N65 road level downstream of the culvert was applied. As a result flood levels were predicted to rise to 50.06 mOD and 50.08 mOD immediately upstream of this structure for the Q_{100} and Q_{1000} flood event respectively. As flood waters exceeded bank elevation at this point, it was necessary to complete a linked 1D-2D hydraulic model to evaluate the fate of flood waters and their respective depths. This is described in more detail below.

Longitudinal profiles for Gortaha North and South channels are presented below as Plate 8 and Plate 9.

Plate 8 – Gortaha North Longitudinal Profile (Q_{100} = green line; Q_{1000} = blue line)

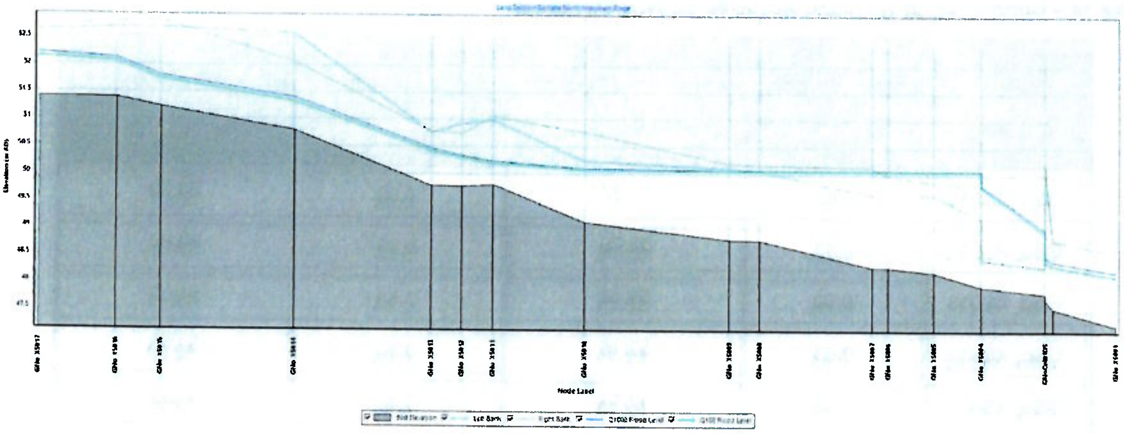
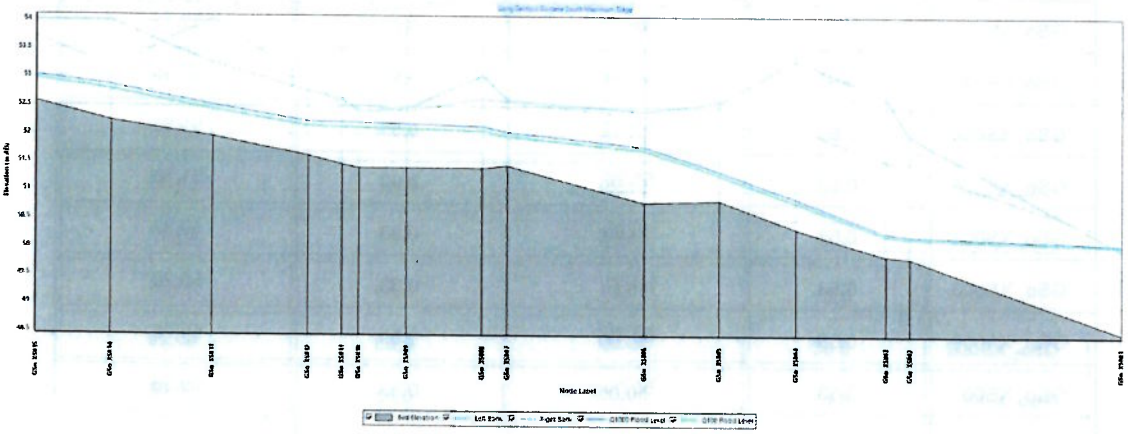


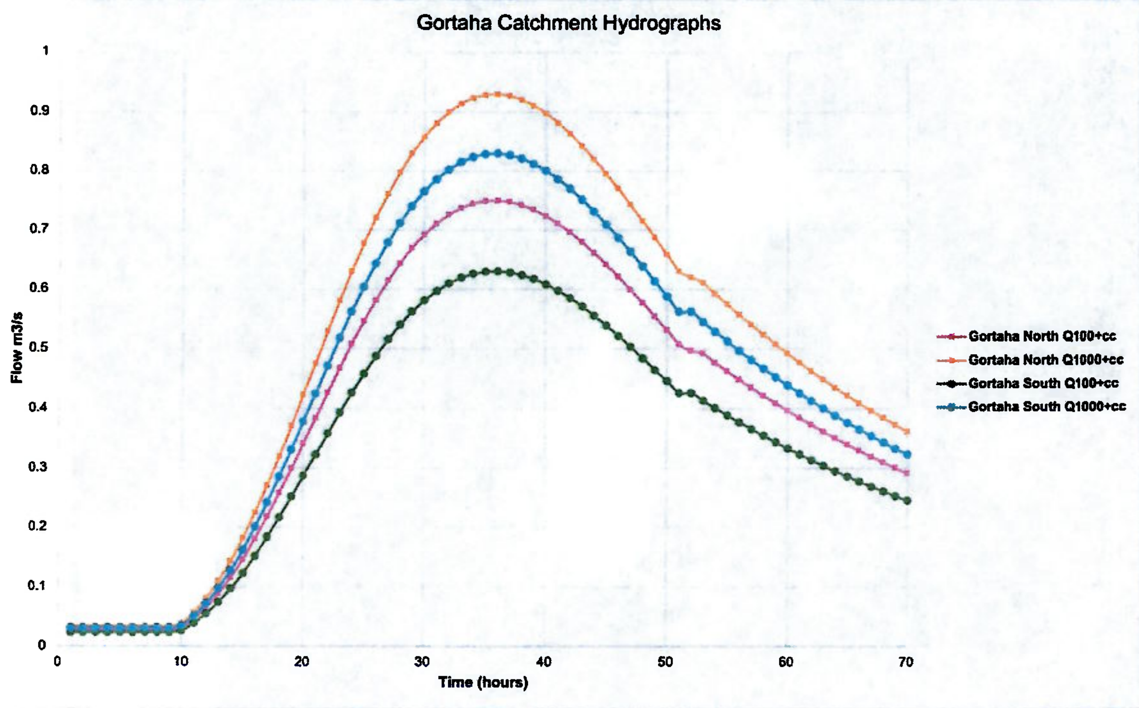
Plate 9 – Gortaha South Longitudinal Profile (Q_{100} = green line; Q_{1000} = blue line)



5.5.6 Simulation: 1D-2D Linked Hydraulic Model

A Digital Terrain Model with 0.25 m accuracy was acquired to investigate the fate of flood waters as they surcharge at section GNo_Cul01, which is the structure crossing the N65 road. Seventy-hour hydrographs for each channel and flood flow scenario were developed and are shown in Graph 1. Time to peak characteristics have been derived from the FSU portal and are representative of how 'flashy' the rainfall-runoff response is in each catchment.

Graph 1 – Hydrographs for each catchment and flood flow scenario



5.5.7 2D Flood Extents: Gortaha Catchment

The 1D model showed that under the current scenario flood waters surcharge upstream of the N65 culvert crossing (GNo_Cul01) to a maximum elevation of 50.06 mOD (Q_{100}) and 50.08 mOD (Q_{1000}).

Flood Modeller Pro was used to run a 1D-2D linked model simulation to view how the floodplain expands and contracts as the hydrograph progresses. The animation showed that in the initial stages the field upstream and north of the N65 culvert becomes inundated, as it lies lower than the N65 to the east. As flood water elevations continue to rise the floodplain expands across agricultural lands to the south, before finally spilling over the N65 at a low point on the road approximately 100 m south of the culvert. Floodwaters then continue to flow downstream (eastwards) from the N65.

Maximum flood water depths and extents are outlined in Figure 13 and Figure 14. Flood depths and extents are broadly similar for both the Q_{100} and Q_{1000} flood scenarios. Flood depths along the N65 vary from 0.1 m depth to 0.60 m depth, with the greater depths occurring on the southern side of the junction with the L8763. There is a 17 m long x 3 m wide portion of road extending north of the junction between the N65 and L8763 junction that has a maximum flood depth of 0.32 m. Flood depths along the submerged part of the L8763 do not exceed 0.3 m depth under both flow regimes.

The flood maps show that fluvial flood waters do not pose any risk to residential properties in the vicinity.

Figure 13 – Q_{100} Maximum Flood Depths and Extents

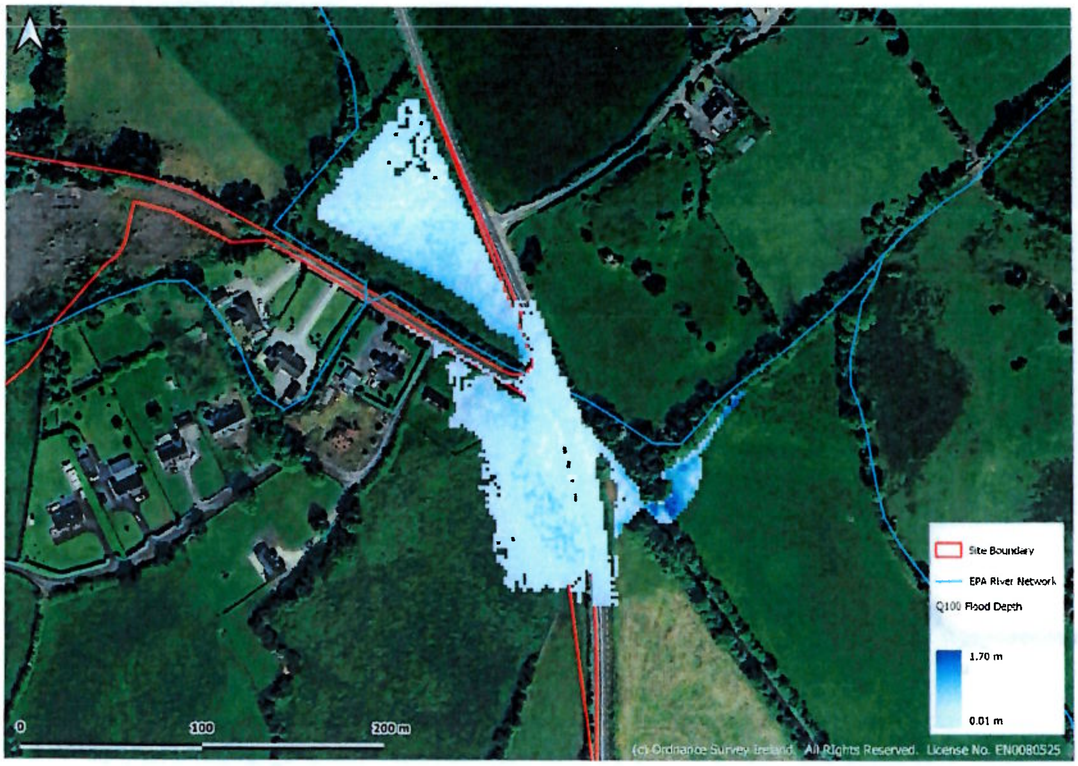
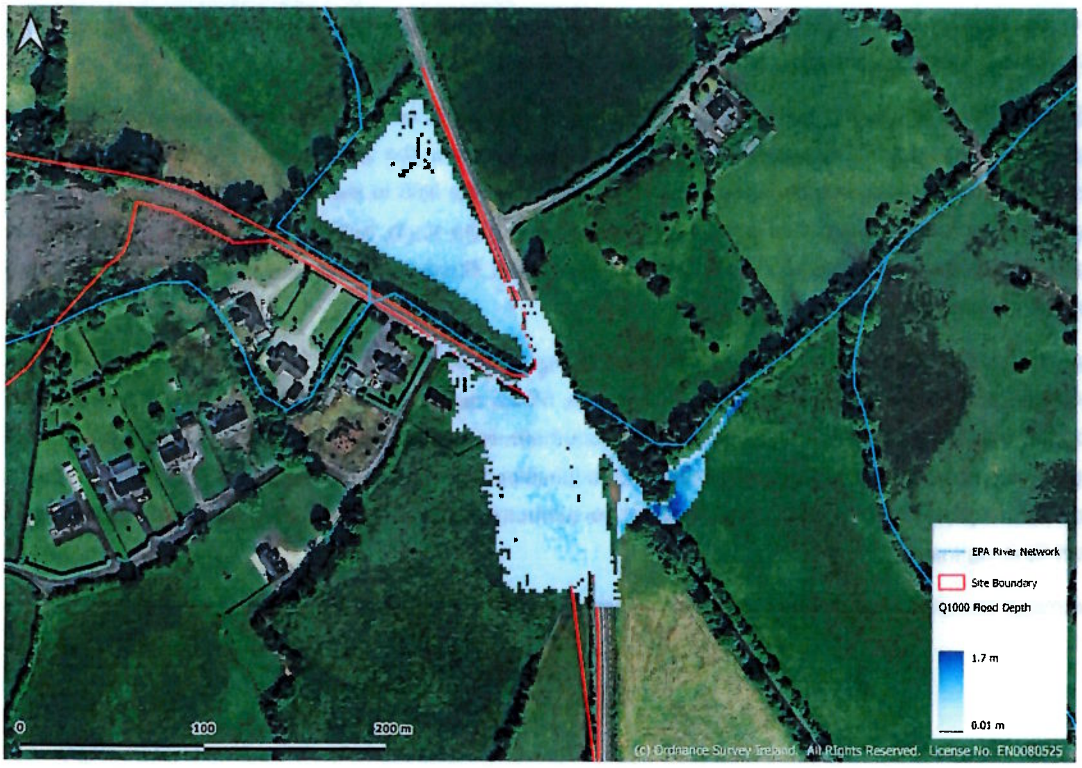


Figure 14 – Q_{1000} Maximum Flood Depths and Extents

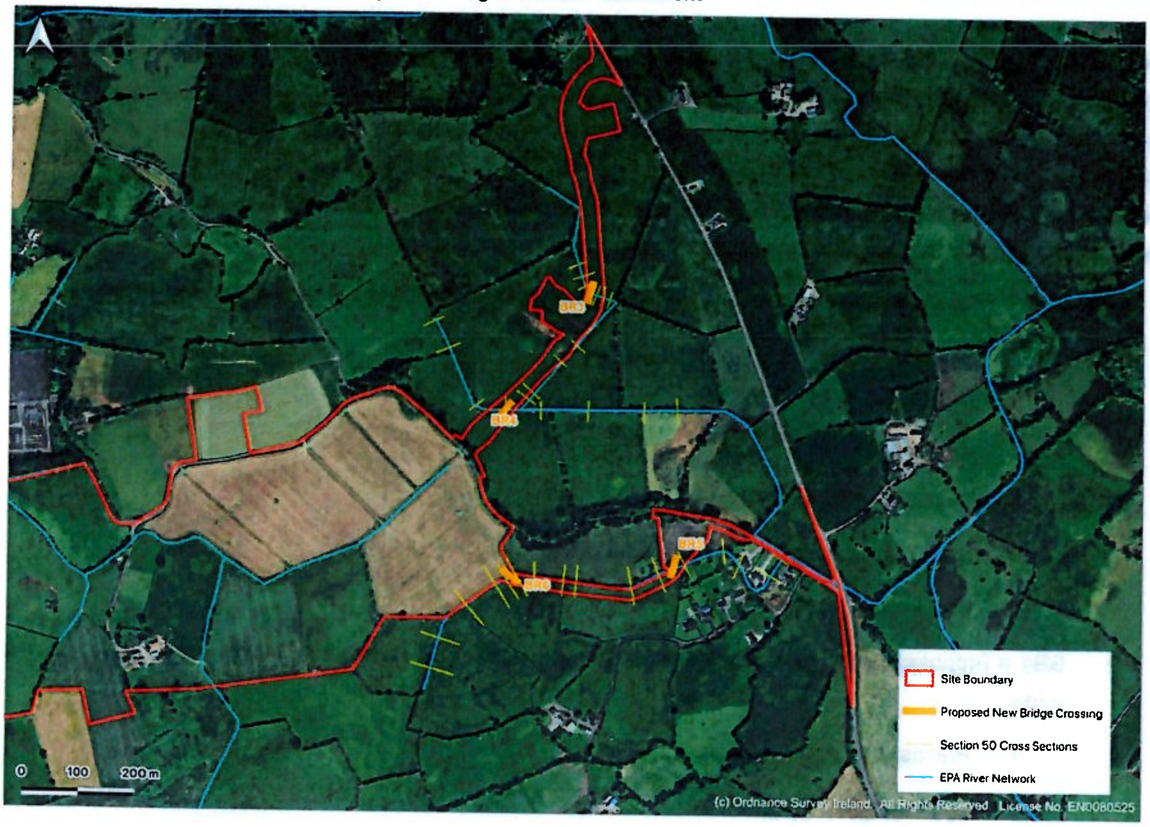


5.6 GORTAHA CATCHMENT: PROPOSED STRUCTURES

The design specifications for the four new proposed bridges in the eastern part of the application site require a freeboard of 300 mm for the water level corresponding to the Q_{100} flow + climate change x 1.6 Drainage Factor. It is proposed that each bridge structure shall consist of a precast concrete deck. Stone gabions will act as a foundation to the concrete base of the deck level, which will be set back approximately 1m from the top of the channel bank. There will be a minimum clearance of 400 mm from the top of the channel bank to the bridge soffit. Proposed bridge crossing locations are shown in Figure 15.

- BR3 = Proposed bridge crossing the Gortaha North channel to facilitate temporary construction access route
  - Precast concrete bridge deck
  - Span Length = 8 m
  - Soffit elevation = 53.02 mOD
  - Spring elevation = Ground elevation (53.02 mOD)
  - Bridge deck level = 53.52 mOD
- BR4 = Proposed bridge crossing the Gortaha North channel to facilitate temporary construction access route
  - Precast concrete bridge deck
  - Span Length = 10 m
  - Soffit elevation = 52.8 mOD
  - Spring elevation = Ground elevation (52.8 mOD)
  - Bridge deck level = 53.3 mOD
- BR5 = Proposed bridge crossing the Gortaha South channel to facilitate primary access route
  - Precast concrete bridge deck
  - Span Length = 10 m
  - Soffit elevation = 52.20 mOD
  - Spring elevation = Ground elevation (52.20 mOD)
  - Bridge deck level = 52.70 mOD
- BR6 = Proposed bridge crossing the Gortaha South channel to facilitate primary access route
  - Precast concrete bridge deck
  - Span Length = 9 m
  - Soffit elevation = 52.49 mOD
  - Spring elevation = Ground elevation (52.49 mOD)
  - Bridge deck level = 52.79 mOD

Figure 15 – Location of Proposed Bridge Crossings: Gortaha Catchment



6 MITIGATION

6.1 BRIDGE CROSSINGS: OPW SECTION 50

A total of six bridge crossings are required to facilitate the proposed development, with two of these in the west-flowing Kilcrow catchment, and the remaining four in the east flowing Gortaha catchment. As all of the six proposed bridge crossings are over channel maintained as part of an arterial drainage scheme or drainage district permission must be sought from the OPW by way of a Section 50 application. This is typically implied as a Condition of Planning. The proposed bridges have been designed to meet OPW criteria, i.e. that a where a channel is maintained as part of an arterial drainage scheme the opening must be capable of transmitting the Q_{100} plus 20% climate change factor plus a 1.6 drainage factor.

As outlined in detail above all six bridge crossings have been designed to satisfy OPW criteria.

6.2 EMERGENCY ACCESS AND EGRESS

There are multiple access and egress points to the site (see Figure 3).

The primary route is via the N65 and L8763. Under flood conditions there is a 17 m long x 3 m wide portion of road extending north of the junction between the N65 and L8763 junction that has a maximum flood depth of 0.32 m. Flood depths along the submerged part of the L8763 do not exceed 0.3 m depth under both flow regimes. Hence there is passage for access/egress of emergency vehicles to the site under floods conditions providing such a vehicle can pass through water depth of 320 mm. This is generally considered acceptable.

In the event that the N65/L8763 route is impassable there are two alternative routes for access/egress of emergency vehicles:

- the temporary construction access road which is entirely in Flood Zonne C;
- via the northern end of the L8763 which reconnects to the N65 and which is entirely in Flood Zone C.

6.3 FINISHED FLOOR LEVELS

In order to minimise potential flood risk at the development minimum finished floor level of any new building shall satisfy the 300 mm freeboard requirement above Q_{1000} flood levels, which have been adjusted for climate change.

Finished floor levels of specified proposed buildings and associated structures were assessed to see if this criteria was satisfied, through a comparison with the $Q_{1000+cc}$ at the nearest adjacent cross section. The structure numbers correspond with those shown in Halston Drawing No. CPA-HAL-MP-XX-DR-PL-1000. This analysis is presented in Table 15 which shows that:

- proposed FFL at structures numbered 3, 4, 5 and 6 needs to be raised 70 mm, from 51.15 mOD to 51.22 mOD;
- proposed FFL at structure numbered 22 needs to be raised 220 mm, from 51.00 mOD to 51.22 mOD.

Proposed FFL at all other structures are appropriate and satisfy the requirements of the Flood Risk Guidelines (2009).

Table 15 – Analysis of Proposed Finished Floor Levels

Item Number	Building/Item	Proposed FFL. mOD	Adjacent Cross Section	Q_{1000} + cc Flood Level	Amend Proposed FFL. mOD
1	400 kV Substation	49.65	CS057	48.19	
2	AIS 400 kV	50.25/53.00	Br2CSUp	49.63	
3	Transformers (OCGT)	51.15	CS050	50.92	51.22
4	House Transformers	51.15	CS050	50.92	51.22
5	OCGT Building	51.15	CS050	50.92	51.22
6	Admin./Control Building	51.15	CS050	50.92	51.22
9	Emergency Generators	51.50	CS050	50.92	
10	Firewater Pumphouse	51.50	CS050	50.92	
11	Fire Water Tanks	51.50	CS050	50.92	
12	Workshop & Storage	51.50	CS050	50.92	
13	Fuel Polishing Unit	51.50	CS050	50.92	
14	Fuel Storage Tanks	51.50	CS050	50.92	
15	Fuel Unloading	51.50	CS050	50.92	
19	IPP Building	53.15	Br1CSDn	51.86	
20	Transformer	53.00	Br1CSDn	51.86	
21	Temporary Construction Compound	53.50	Br1CSUp	51.87	

Item Number	Building/Item	Proposed FFL, mOD	Adjacent Cross Section	Q_{1000} + cc Flood Level	Amend Proposed FFL, mOD
22	Gas Heater Compound	51.00	CS050	50.92	51.22
24	AGI Compound	54.50	Br1CSDn	51.86	
26	ESB Rural Supply	53.15	CS010	52.08	

6.4 STREAM REALIGNMENT METHOD STATEMENT

6.4.1 Introduction

The following method statement shall be made available to Galway County Council, National Parks and Wildlife Service, and Inland Fisheries Ireland for review prior to works commencing.

The method statement intends to describe programme of works relating to two drainage channel diversions and the subsequent infilling of existing drainage channels, outlining in broad terms the manner in which the different aspects of the work will be undertaken. These works are required to accommodate development works as part of Project Coolpowra.

The aim of this programme of works are as follows:

a. Excavate proposed realignment channels;

b. Decommission redundant stretches and structures;

c. Construction of two bridges along Channel 01

d. Installation of a new culvert on Channel 02;

e. Maximise potential for development of ecological habitat in the recommissioned channels. This will include suitability for fish passage, and provision of areas suitable for spawning;

f. Minimise the amount of damage to existing habitat when diverting flow from channel currently in use to new channel reach.

6.4.2 Cleaning Original Channels

The banks and bed of the original channel are heavily overgrown and require cleaning. This is necessary to ensure the cross-sectional area provides adequate conveyance capacity to transmit flood flows. All vegetation and excess silt in the original channel will be removed using an excavator.

It is acknowledged that there will be a temporary adverse impact to habitat associated with the removal of this vegetation. Once new vegetation is established, the longer-term impact will be positive.

6.4.3 Channel 01 Realigned Section Invert Levels

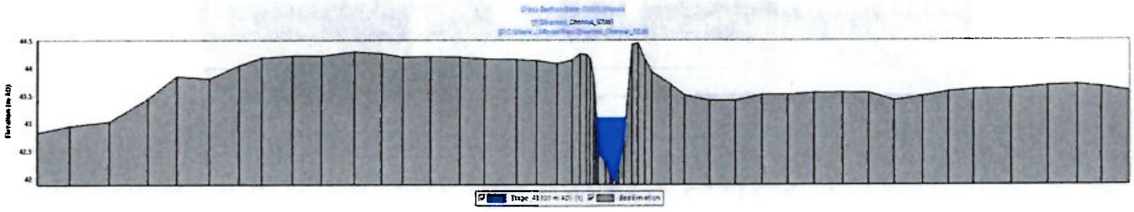
The gradient for the realigned channel in Channel 01 is 1.4%. Proposed inverts for each cross section along this reach are shown in Table 16.

Table 16 – Proposed Invert Levels on Specified Sections on Channel 01 Realigned Reach

Cross Section	Proposed Invert Elevation (mOD)
CS014	53.18
CS050	52.85
BRCSUP	52.46
BR2CSDN	52.09
CS051	52.04
CS057	51.94
CS058	51.93
CS020	51.93

The realigned Channel 01 will have a general cross section profile as shown in Plate 10.

Plate 10 – Proposed cross section dimensions in realigned section of Channel 01



6.4.4 Channel 02 Realigned Section Invert Levels

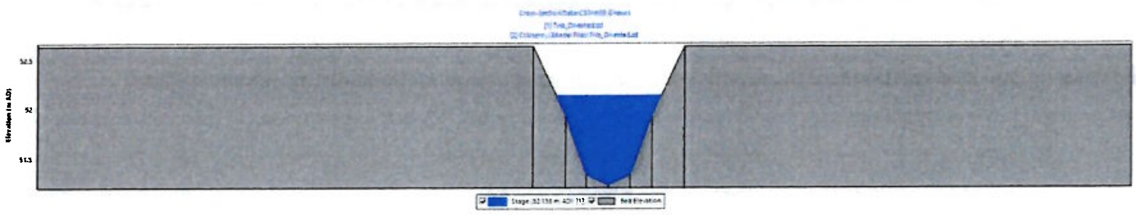
Proposed inverts for each cross section along Channel 02 reach are shown in Table 17.

Table 17 – Proposed Invert Levels on Specified Sections on Channel 01 Realigned Reach

Cross Section	Proposed Invert Elevation (mOD)
CSTrib01	52.80
CSTrib02	52.49
CSTrib03	52.10
CSTrib04	51.70
CSTrib05	51.25
CSTribCulUP	51.25
CSTribCulDN	51.25
CSTrib07	51.24

The realigned Channel 02 will have a general cross section profile as shown in Plate 11.

Plate 11 – Proposed cross section dimensions in realigned section of Channel 02

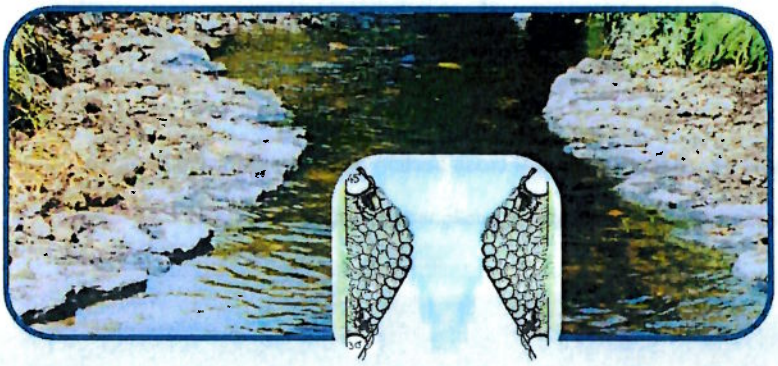


6.4.5 General Channel Modifications

The gradient across the Channel 01 route is moderate to high which means there is potential for introducing oxygen to the stream by way of cascades and turbulent zones. Velocity, and turbulence, can be increased slightly at minor narrowed sections in a low flow channel, as per Plate 12.

Rows of larger stones/boulders will be placed on the stream bed in flatter sections to create riffles. Where possible, the channel will be deepened on the outer side of any bends to create pools.

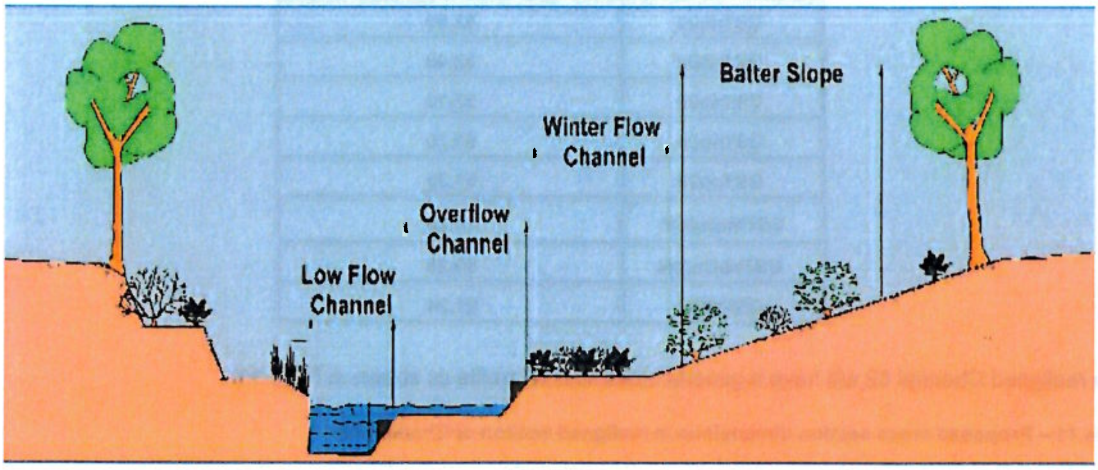
Plate 12 – Narrow river channel in low flow (IFI & OPW, 2010)



6.4.6 Channel Cross Sections

The width of the river channel will be reduced from the river bed to a height of 300 mm. This reduced width will be around 0.5 – 1.0 m. This has the effect of maintaining higher velocities in the wetted channel during normal and low flow regimes. The upper section of the profile will be wider, to provide a conveyance capacity capable of transmitting flood flows. A schematic is presented in Plate 13.

Plate 13 – Schematic of stream cross sectional profile (ERFB, 2011)



The inside of any channel bends will be landscaped with sloping marginal benches, as shown in Plate .

Plate 14 – Example of stepped bend of river bend

6.4.7 Channel Bank Vegetation

Any excavated soils will be stockpiled temporarily and used to cap the banks of the rehabilitated channel. This will promote establishment of vegetation.

The rehabilitated channel bank will be planted with native species that can be controlled/maintained to ensure conveyance capacity of channel is not significantly reduced by overgrowth in future. Grass and juvenile, native trees are deemed suitable. Trees will provide cover to pooled sections of the river channel. Bank gradients should be such that no bank failure or slippages will occur in future.

6.4.8 Channel Opening

Works on the diverted channels will commence from the downstream end. Once the diverted channels and structures are fully complete, the existing channels can then be diverted and sealed off from any flow and infilled. Upon flow entering the diverted channels, a cofferdam should be placed at the downstream end of each diverted channel to trap excess sediment and prevent it entering the watercourses downstream of the site. Straw bales can be placed at increments along each diverted channel to trap sediment. Sediment removal can occur periodically over the first number of weeks following flow entering the diverted channels.

6.4.9 Hydrocarbons

Hydrocarbon spill kits will be on-site during works. Any fuels and lubricants will be stored in bunded compounds. Refuelling will be carried out safely and securely away from the river environs. Machinery will be fully inspected prior to, and during, the course of works for suitability. Support vehicles will remain on the tarmac / hard-core roadway.

6.4.10 Timing of Works

All works within the river channel shall be carried out between the months of August to September, to coincide with low stream flows and to avoid interference with spawning runs.

Bank maintenance works on existing sections, primarily involving the removal of scrub, should take place between October and March.

Following opening of the diverted channels, water flow will be maintained in the existing channels for a minimum period of 24 hours, to facilitate downstream migration of any insects/fish.

6.4.11 Invasive Species

Standard precautionary measures to be practiced for protection against risk of invasive species. Any machinery, including excavator and dumper will be cleaned with a pressure washer prior to arriving on site, and upon leaving site.

7 JUSTIFICATION TEST

Flood flow simulations were performed using a hydraulic model of the channels within the application site that drain westwards towards the Kilcrow River and eastwards towards the Gortaha River. The use of 1D-2D hydraulic modelling has enabled any identified flood zones to be accurately delineated. The results of these simulations showed that Flood Zones A/B/C are currently present within the application site boundary. Under these circumstances the sequential approach and vulnerability matrix require that development, deemed to be highly vulnerable, must pass the Justification Test.

7.1 DEVELOPMENT MANAGEMENT JUSTIFICATION TEST

The Development Management Justification Test is used at the planning stage where it is intended to develop land at moderate or high risk of flooding for uses or development vulnerable to flooding that would generally be inappropriate for that land. It is an assessment of whether a development proposal within an area at risk of flooding meets specific criteria for proper planning and sustainable development and demonstrates that it will not be subject to unacceptable risk, nor will it increase flood risk elsewhere. Demonstration that the proposed development on the application site passes the Justification Test for Development Management is shown in Table 18.

Table 18 – Requirements of Part 1 of the Justification Test

	Requirement	Site Specific Response
	Part 1	
	The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of the flood risk guidelines.	According to the Galway County Development Plan 2022 – 2028 the application area is not zoned. The area can be described as rural with agricultural lands dominating and with linear ribbon development along the L8763. The zoning objective for Rural Areas (RA) is to protect and promote in a balanced way, the development of agriculture, forestry and rural-related enterprise, biodiversity, the rural landscape and the built and cultural heritage. Residential development is permitted within RA, subject to compliance with the Rural Settlement Strategy.
	Part 2	
(i)	The development proposed will not increase flood risk elsewhere and, if possible, will reduce overall flood risk.	Flood Zones A and B were recorded at the junction between the N65 and L8763 due to the presence of an undersized culvert. There is no planned development upstream of this culvert that would increase flood flow rates and flood levels at this junction. There are no plans to raise road levels in this area so there will be no loss of floodplain as a result of the development, ensuring no loss of storage or increased risk to downstream receptors.
(ii)	The development proposal includes measures to minimise flood risk to people, property and the economy and the environment as far as reasonably possible.	The measures included in the flood risk assessment include raising of the finished floor levels to 300 mm above the nearest modelled flood level for the Q_{1000} scenario, adjusted for climate change. The proposed bridges are proposed to be clear span, limiting interaction with the channel bed and having minimal effect on the conveyance capacity of stream networks during flood events.
(iii)	The development proposal includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures of the design, implementation and funding of any future flood risk management measures and provisions for emergency services access.	The proposed works will not remove any existing flood plain storage. No surface water flow pathways will be severed. Any hardstanding run-off will be attenuated on site to reduce the peak flow during flood events. The maximum depth of flooding that an emergency vehicles has to pass through at the N65 and L8763 junction is 320 mm which is considered passable. In the event that it is impassable there are alternative routes (i) where the L8763 reconnects to the N65 at its northern end and (ii) along the temporary construction route, both of which are in Flood Zone C. Following the provision of the alternative temporary construction access road, all vehicles associated with site development works will pass through Flood Zone C.
(iv)	The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to development of good urban design and vibrant and active streetscapes.	The proposed development satisfies the requirements of the Flood Risk Guidelines (2009) and the Galway County Development Plan 2022 – 2028.

8 SUMMARY

Development works are proposed at a site in Coolpowra, Portumna, Co.Galway. The development consists of an upgrade and replacement of the existing 500kV AIS substation with a 400kV GIS substation, a reserve Gas-Fired Generator comprised of three OCGT Units and various alternative technology infrastructure.

Following groundtruthing it was confirmed that the proposed development site lies within two distinct catchments, the Kilcrow and the Gortaha. The majority of site run-off will drain westwards to the Kilcrow River. That area of the site draining to the Kilcrow River does so via a central channel that runs through the site from the eastern to the western boundary. This channel is maintained as part of the Killimor Arterial Drainage Scheme with the result that many of the cross sections are deep and narrow. The surface water catchment to the downstream boundary on the western part of the site is 2.0 km^2. Multiple field boundary drainage channels outfall to this central channel, with one in particular noted as having a significant flow contribution to the overall site run-off.

The eastern part of the site which drains to the Gortaha River is characterised by two main channels, the Ballynaheskeragh and Sheeaunrush Streams. These two streams merge upstream of the N65, from which they continue eastwards and enter join the Gortaha River. The Gortaha Catchment has an overall area of 1.06 km^2 to where the eastern site boundary meets the N65.

A thorough desktop study confirmed that there are no indicators of historical flooding at the site nor is the site deemed to be within an area at risk of fluvial, pluvial or groundwater flooding.

Given the small catchment sizes the IH124 method was selected to estimate flood flows in within local watercourses. Suitable adjustment factors, growth factors and climate change factors (+20%) were applied and the resultant Q_{100} and Q_{1000} flows were used as the inflow to 1D and 1D-2D linked hydraulic models.

A 1D-hydraulic model was compiled using site-specific data. Evenly spaced cross sections were surveyed along the central channel throughout the site and a tributary which extends to the south. The surveyed cross sections extended approximately 400 m downstream of the application site boundary for the Kilcrow simulation and 200 m downstream for the Gortaha simulation.

The conveyance capacity of all surveyed cross sections in the Kilcrow Catchment (central channel = Channel 01; southern tributary = Channel 02), were assessed for suitability to transmit Q_{100} and Q_{1000} flood flows, with a 20% allowance included for climate change. The simulation output showed that under Q_{1000} conditions the existing culverts at CS006 and CS016 are vulnerable to surcharge, but floodwaters are maintained within the upstream bank profile. Under the proposed development works, the culvert at CS016 is to be decommissioned following the proposed channel diversion upstream of the CS016 culvert.

Two culverts on the southern tributary surcharged, resulting in bank overtopping. The more southerly of these culverts is to be decommissioned while the culvert at the northern end of Channel 02 shall be upgraded.

The modelled reaches are to be re-aligned in two locations to facilitate efficient site layout. Two new bridge crossings are also proposed. Detailed design specifications are included for new bridge structures and the cross sections and longitudinal profiles of the realigned channel reaches. Additional mitigation measures are outlined to enhance habitat quality and biodiversity in the new channel reaches.

Following incorporation of the culvert upgrade, two channel realignments, and two new bridge structures modelling showed that that there will be no surcharge of flood water outside of the stream channel under Q_{1000} conditions, with a climate change factor included. Therefore, it can be confirmed that that part of the application site positioned in the Kilcrow Catchment is currently in Flood Zone C and will remain in Flood Zone C following proposed works (i.e. not at risk of flooding). The proposed works will not result in an increased flood risk within the site or downstream.

The conveyance capacity of all surveyed cross sections in the Gortaha Catchment (Gortaha North and Gortaha South) were assessed for suitability to transmit Q_{100} and Q_{1000} flood flows, with a 20% allowance included for climate change. The simulation output showed that under Q_{100} and Q_{1000} flood flows, out of bank flooding was recorded at the inlet to the culvert that flows under the N65. This resulted in flood waters exceeding both the left and right bank and inundating lands proximal to the culvert. Whilst there was no risk noted to residential properties, flood depths of up to 0.6 m along the N65 were predicted.

The maximum depth of flooding that an emergency vehicles has to pass through at the N65 and L8763 junction is 320 mm which is considered passable. In the event that it is impassable there are alternative routes (i) where the L8763 reconnects to the N65 at its northern end and (ii) along the temporary construction route, both of which are in Flood Zone C.

No flooding was recorded along the alternative temporary construction road, therefore it is located in Flood Zone C.

Subject to the proposed works being carried out in accordance with the specifications presented in this assessment, it can be concluded that the proposed development will not have a negative impact, in terms of flood risk, on the local drainage network, on local private property, or to the surrounding environment and human health.

Permission for the proposed bridges shall be sought from the OPW by way of Section 50 license applications.

9 REFERENCES

Cunnane and Lynn. 1975. Flood estimation following the Flood Studies Report. DoEHLG, 2009.

The Planning System and Flood Risk Management. Department of Environment, Heritage and Local Government, Dublin.

ERFB, 2011. *Requirements for the protection of fisheries habitat during construction and development works at river sites.* Eastern Regional Fisheries Board.

FSR. 1975. Flood Studies Report (in five volumes). NERC, London.

Gardiner, M.J., Radford, T, 1980. Soil associations of Ireland and their land use potential. National Soil Survey of Ireland.

IFI, OPW, 2010. *The Environmental River Enhancement Programme.* Inland Fisheries Ireland and Office of Public Works.

Institute of Hydrology. 1993. Flood Studies Report (in five volumes), 3rd binding. Institute of Hydrology, Wallingford.

Nicholson, O. and Bree, T. 2013. The Flood Studies Update - What are the improvements since the 1975 Flood Studies Report. National Hydrology Conference 2013.

OPW, 2009. Report of the Flood Policy Review Group. Office of Public Works, Dublin.

OPW, 2012. The National preliminary flood risk assessment (pfra): Designation of the areas of further assessment. Office of Public Works, Dublin, March 2012.

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This report refers, within the limitations stated, to the condition of the site(s) at the time of the inspections. No warranty is given as to the possibility of future changes in the condition of the sites(s). The report is based on a visual site inspection and the physical investigation as detailed. Envirologic take no responsibility for conditions that have not been revealed due to lack of access. Whilst every effort has been made to interpret the conditions observed, such information is only indicative, and liability cannot be accepted for its lack of accuracy in representing geological/hydrological/hydrogeological conditions.

APPENDIX 8.3

WATER FRAMEWORK DIRECTIVE ASSESSMENT REPORT

– PROPOSED DEVELOPMENT (AS AMENDED)

ENVIROLOGIC

HYDROGEOLOGICAL · HYDROLOGICAL CONSULTING

Project Coolpowra
Water Framework Directive Assessment Report

LOCATION:	Coolpowra, Ballyneheskeragh, Cooldorragha, Gortlusky and Sheeaunrush Co. Galway
PREPARED FOR:	Halston
PREPARED BY:	Cian O'Sullivan (MSc); Callum Walsh
REVIEWD BY:	Colin O'Reilly PhD (Hydrology)
DATE:	18th December 2025
REFERENCE:	3064

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Contents

1 INTRODUCTION

1.1 BRIEF

The following Water Framework Directive Assessment Report has been prepared by Cian O'Sullivan (MEngSc) of Envirologic Ltd. on behalf of Halston, in relation to proposed development works at Coolpowra, Ballynaheskeragh, Cooldorragha, Gortlusky and Sheeaunrush Co. Galway.

This report is intended to satisfy the requirements of Galway County Council, relating to a proposed development in the townlands of Coolpowra, Ballynaheskeragh, Cooldorragha, Gortlusky and Sheeaunrush, Co. Galway. The proposed development is being referred to as 'Project Coolpowra' and will consist of a Reserve Gas-Fired Power Generator, GIS Substation and Energy Storage System.

Component parts of the proposed development are detailed elsewhere in the EIAR.

The purpose of this WFD assessment is to determine whether the proposed development has the potential to:

(i) result in a deterioration in the status of any river waterbody or groundwater body,

(ii) compromise WFD objectives and the achievement of at least good surface water or groundwater status, or restoration to High Status waters where required by the River Basin Management Plan 2022 - 2027 (DoEHLG, 2024) and the associated Water Action Plan (2024).

This assessment will identify any water bodies that could potentially be impacted upon, prescribe any mitigation measures required and assess any residual impacts of the development. The potential impacts to a range of designated sites in the region are also assessed.

The WFD Assessment Report is intended to supplement a wider and more detailed assessment of potential impacts that the development may have on ecological, hydrological and hydrogeological receptors as set out in the accompanying EIAR. This WFD Assessment Report has been completed with full consideration of the report detailing the AA Screening for the application.

1.2 STATEMENT OF AUTHORITY

The WFD Assessment has been prepared by Cian O'Sullivan of Envirologic Ltd. Cian has an undergraduate degree in Earth Sciences and a master's degree in civil engineering titled Water Waste and Environmental Engineering. He was the recipient of the Michael Mac Carthaigh research project award for his work on hydrological modelling in various climate change scenarios. This was awarded by the School of Civil Engineering, UCD. He has four year's professional and field based experience working in the field of Hydrology. Cian is an active member of the International Association of Hydrogeologists (Irish Group).

The WFD Assessment has been reviewed by Dr. Colin O'Reilly of Envirologic Ltd. Dr. Colin O'Reilly has a doctorate degree in soil systems and hydrology, awarded by the Centre for Water Resources Research, School of Architecture, Landscape and Civil Engineering, UCD, while a recipient of a Teagasc Walsh Fellowship. He has over 20 years of professional and field-based experience.

Since 2010 Colin has been the managing director of Envirologic, which has key competencies in hydrogeology and hydrology with expertise in flood risk assessments in addition to assessment of quarries and industrial facilities across a range of diverse hydrogeological conditions across Ireland. Colin is a current and active member of Engineers Ireland and International Association of Hydrogeologists (Irish Group).

Envirologic have compiled, or participated in the compilation of WFD assessments for bedrock quarry extensions in coastal and inland settings, meat processing plants and energy facilities.

1.3 WATER FRAMEWORK DIRECTIVE

The EU Water Framework Directive (2000/60/EC), as amended by Directives 2008/105/EC, 2013/39/EU and 2014/101/EU ('WFD'), was established to protect and, where necessary, restore water bodies in order to reach at least Good Status and to prevent deterioration. The Directive was transposed in Ireland by the European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003) and subsequent other associated legislation referred to as the Surface Water Regulations (2009, as amended), the Groundwater Regulations (2010, as amended) and the Water Abstraction and Impoundments Regulations (2024).

The WFD requires that all member states protect and improve water quality in all waters, with the aim of achieving at least good status by 2027. Good status refers to both hydromorphological, physical, chemical, ecological and quantitative characteristics of water bodies, be they surface water or groundwater. The potential for any new development to impact upon the status of waterbodies and achievement of WFD objectives must be considered.

The WFD is implemented through the River Basin Management Plans (RBMP) which comprises a six-yearly cycle of planning, action and review. RBMPs include details identifying river basin districts, water bodies, protected areas, pressures and risks, monitoring and environmental objectives. In Ireland the first RBMP covered the period from 2010 to 2015 with a second cycle plan covering the period from 2018 to 2021. The current plan covering the period 2022 to 2027 was published on 4 September 2024 with an associated Water Action Plan 2024.

The key objectives of the River Basin Management Plan (2022 - 2027) include:

- Ensure full compliance with relevant EU legislation;
- Prevent deterioration;
- Meet the water standards and objectives for designated protected areas;
- Protect high-status waters;
- Implement targeted actions and pilot schemes in focus sub-catchments aimed at (i) targeting water bodies close to meeting their objective and (ii) addressing more complex issues that will build knowledge for future cycles.

More details are available at https://www.gov.ie/en/policy-information/8da54-river-basin-management-plan-2022-2027/.

1.4 RIVER BASIN PLAN, PROGRAMMES OF MEASURES & PRIORITY AREAS FOR ACTION

In September 2024 the Department of Housing, Local Government and Heritage launched The Water Action Plan 2024 and its launch stated that the "River Basin Management Plan for Ireland sets out the measures that are necessary to protect and restore water quality in Ireland. The overall aim of the plan is to ensure that our natural waters are sustainably managed and that freshwater resources are protected so as to maintain and improve Ireland's water environment. The principal causes of the decline in Ireland's water quality are the increasing loss into water of polluting phosphorus and nitrogen from farmland, inadequately treated waste water and physical impacts on water bodies, due to river barriers, and drainage of lands and rivers".

The Water Action Plan (WAP) 2024 is available at https://www.gov.ie/en/policy-information/8da54-river-basin-management-plan-2022-2027/ and Appendix 2 sets out the Programme of Measures with an associated excel spreadsheet.

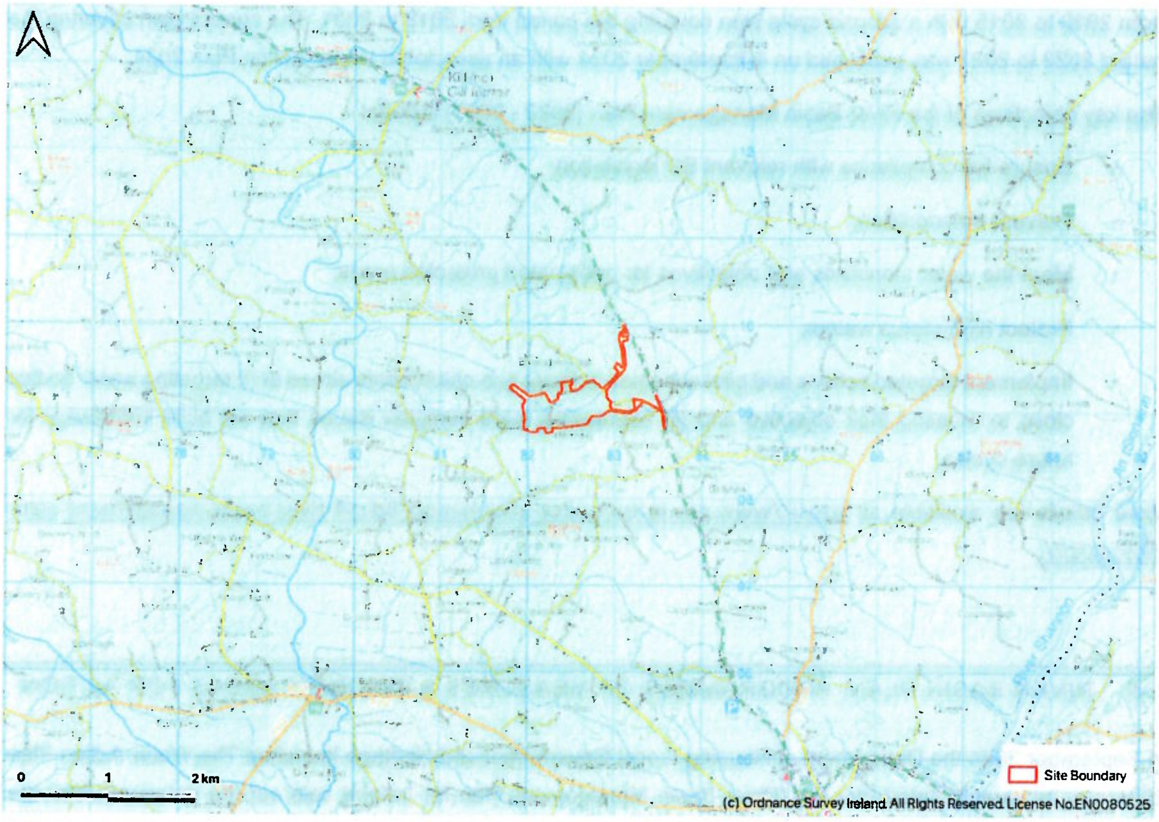
2 SITE LOCATION & ENVIRONMENTAL SETTING

2.1 SITE LOCATION

The subject site is located in the townlands of Coolpowra, Ballynaheskeragh, Cooldorragha, Gortlusky and Sheeaunrush Co. Galway, approximately 5 km northwest of Portumna town (Figure 1). The main portion of the site is positioned 500 m west of the N65, with an internal site access road providing connection between the two.

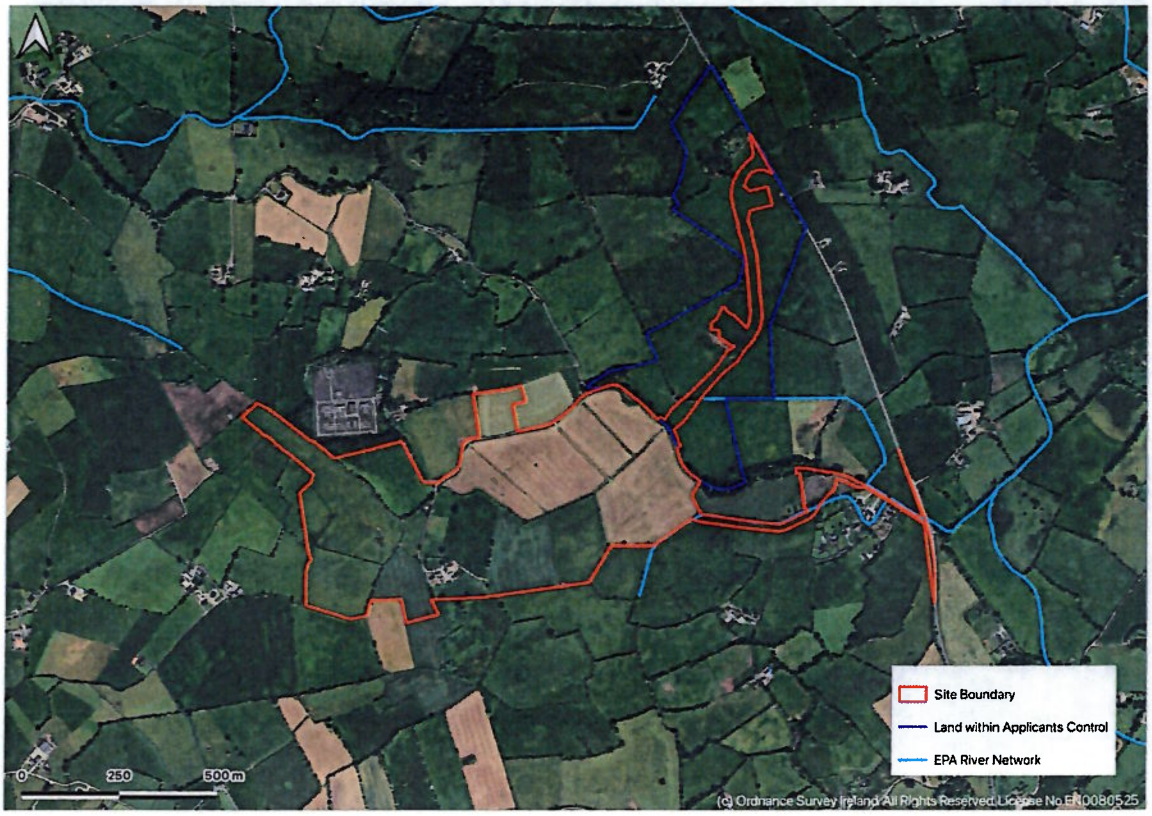
The regional topography is considered flat to gently undulating. The 1:50,000 OS Discovery map shows that the nearest topographical feature of note in the locality is a small hummock at Churchill (91 mOD), 2 km to the south. The surrounding landscape is dominated by moderate intensity grassland agriculture.

Figure 1 - Site Location and Topography



2.2 SITE LAYOUT

The proposed development site has an area of c.42 ha. The site can be described as having an irregular shape comprised of (i) a central area which has an east-west length of 995 m and north-south width of 415 m. This area is bounded to the east by a local road, (ii) an internal access road which connects the eastern end of this central area with the N65, (iii) a 230 m northwestern spur, and (iv) a temporary construction access route which connects to the N65. An existing 400kv GIS substation is located adjacent to the northern site boundary. There is one detached house standing within the site boundary, with attached farmyard infrastructure (Figure 2).

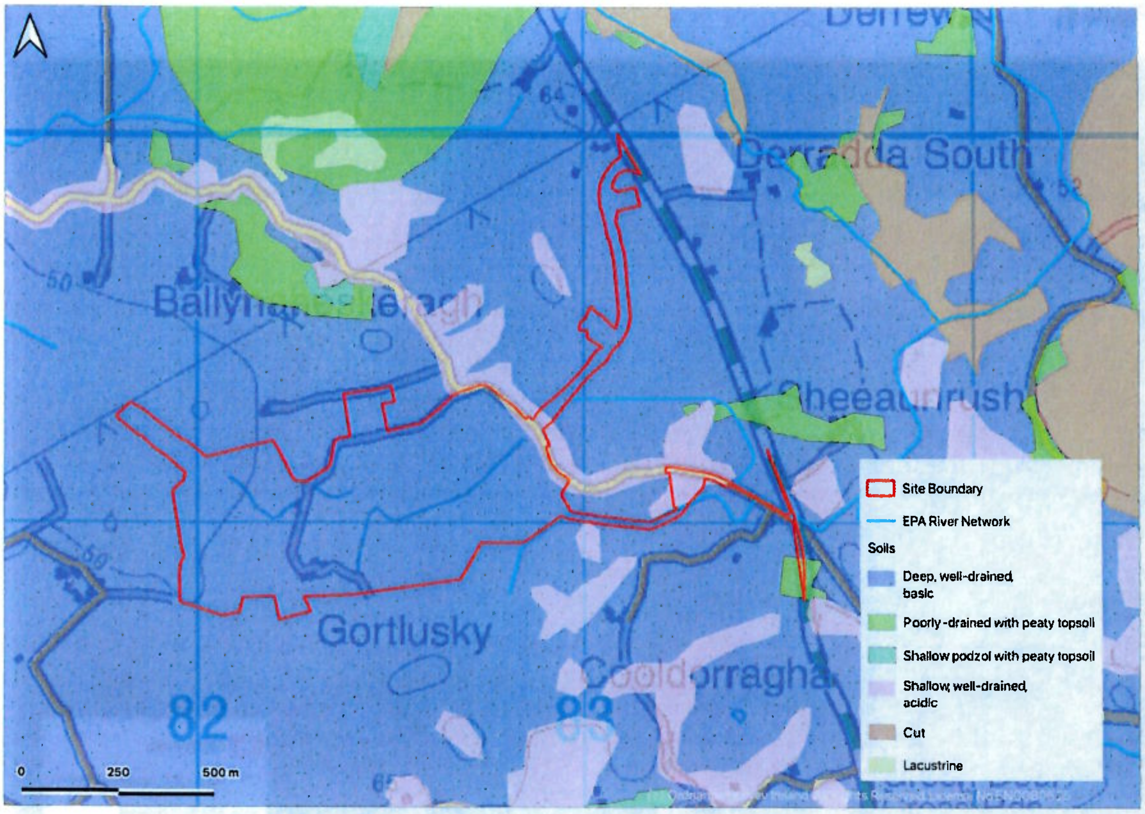


2.3 SOILS & GEOLOGY

2.3.1 Soils

Teagasc soil maps indicate that the soil within the application boundary is a uniform cover of deep, well-drained mineral soil with a basic chemical signature (Figure 3). The soil group can be described as a Grey Brown Podzolic or Brown Earth.

Figure 3 - General Soil Classification

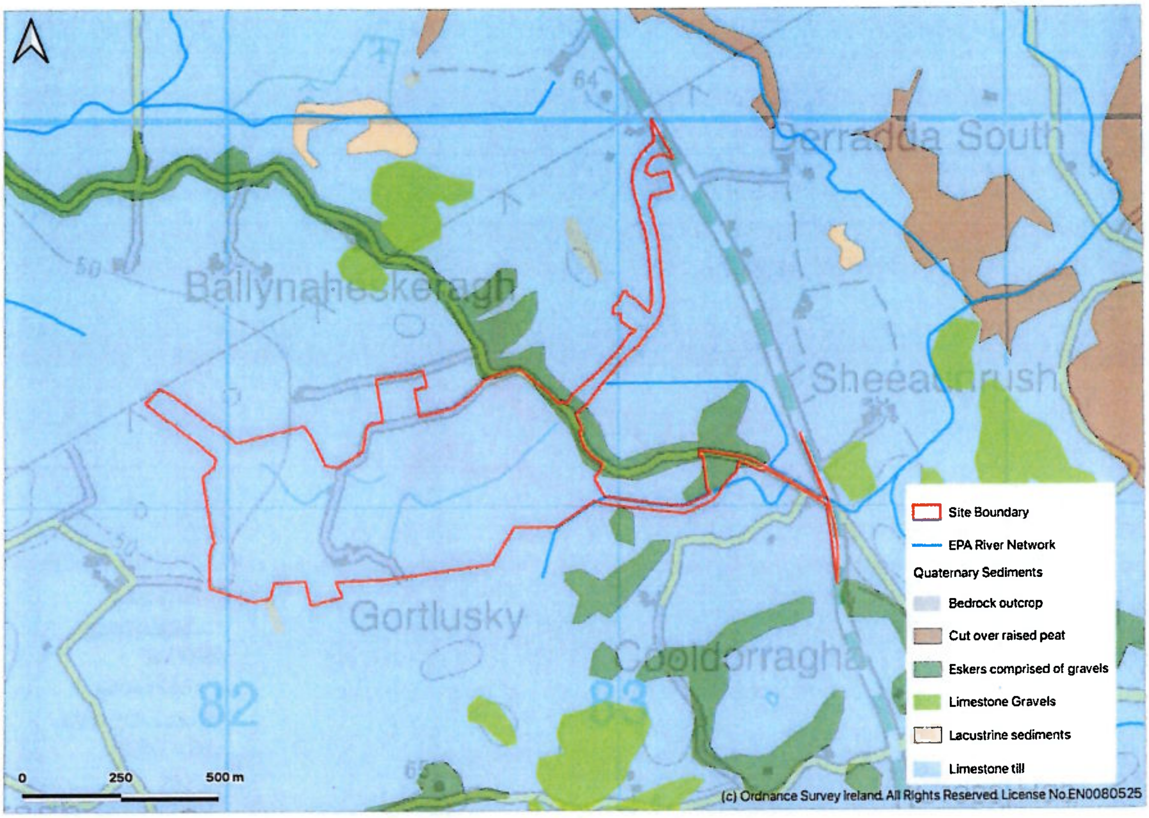


2.3.2 Quaternary Deposits

The quaternary period encompasses the last 1.6 million years and deals with the subsoils and sediments that were deposited over the bedrock described below. The Pleistocene (1.6 million years – 10,000 years ago) is commonly known as the last Ice Age, which was a period of intense glaciation separated by warmer inter-glacial periods, and it is during this period that the quaternary sediments seen today were deposited. Large amounts of ponded water were present at this stage resulting in considerable fluvioglacial sedimentation.

The majority of the site is underlain by glacial till derived from limestone. Some isolated mounds of limestone gravels are present in the area along with a graded ridge of esker sands and gravels which underlie the local road to the east (Figure 4). This combination of deposit type is characteristic of sub-glacial mechanisms resulting in well drained soils of homogenous nature.

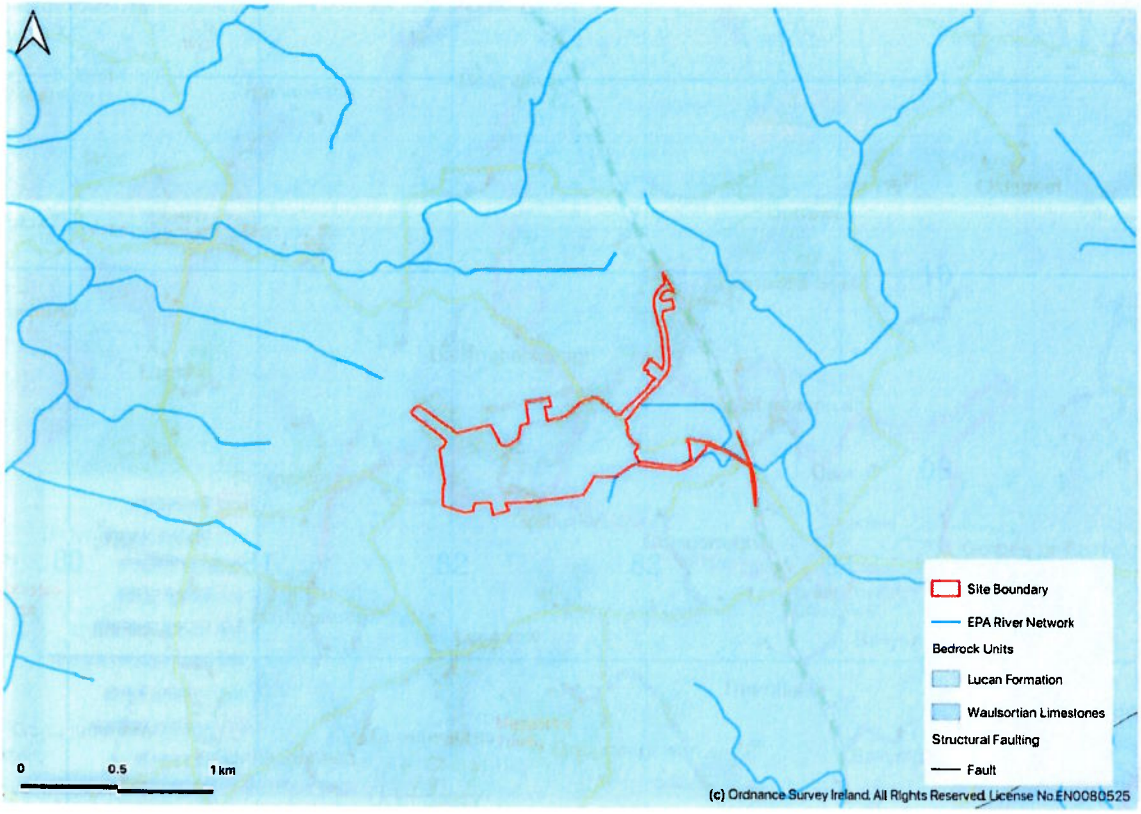
Figure 4 - Quaternary Deposits



2.3.3 Bedrock & Structural Geology

The site is underlain by the Lucan Formation, characterised as Dinantian Upper Impure Limestones. This formation consists of impure bedded limestone with shale and/or clay impurities. There are no structural geological features such as faulting mapped in the immediate vicinity of the site, as demonstrated in Figure 5.

Figure 5 – Bedrock Geology



2.4 HYDROLOGY

2.4.1 WFD Catchments

The site is bisected by a boundary separating two WFD catchments, these being Hydrometric Area 25C (Lower Shannon) to the west and Hydrometric Area 25B (Lower Shannon) to the east.

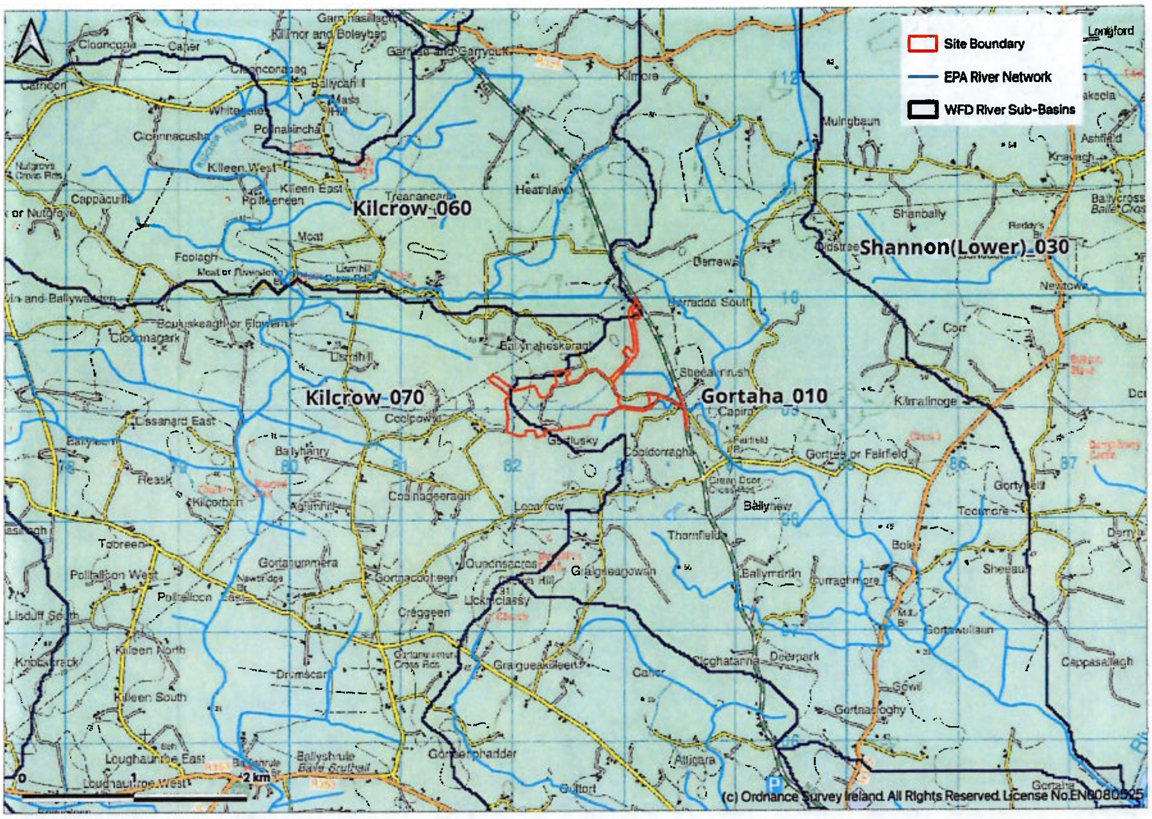
2.4.2 WFD Sub-Catchments

At the WFD sub-catchment scale the same boundary also separates two management areas as follows, Sub-Catchment Kilcrow_SC_010 to the west (Sub-Catchment ID: 25C_12) and Sub-Catchment Shannon (Lower)_SC_050 to the east (Sub-Catchment ID: 25B_4).

2.4.3 WFD Sub-Basins

At the WFD sub-basin scale the same boundary also separates two management areas as follows, Sub-Basin Kilcrow_070 to the west (Sub-Basin ID: IE_SH_25K010700) and Sub-Basin Gortaha_010 to the east (Sub-Basin ID: IE_SH_25G560730), as shown in Figure 6.

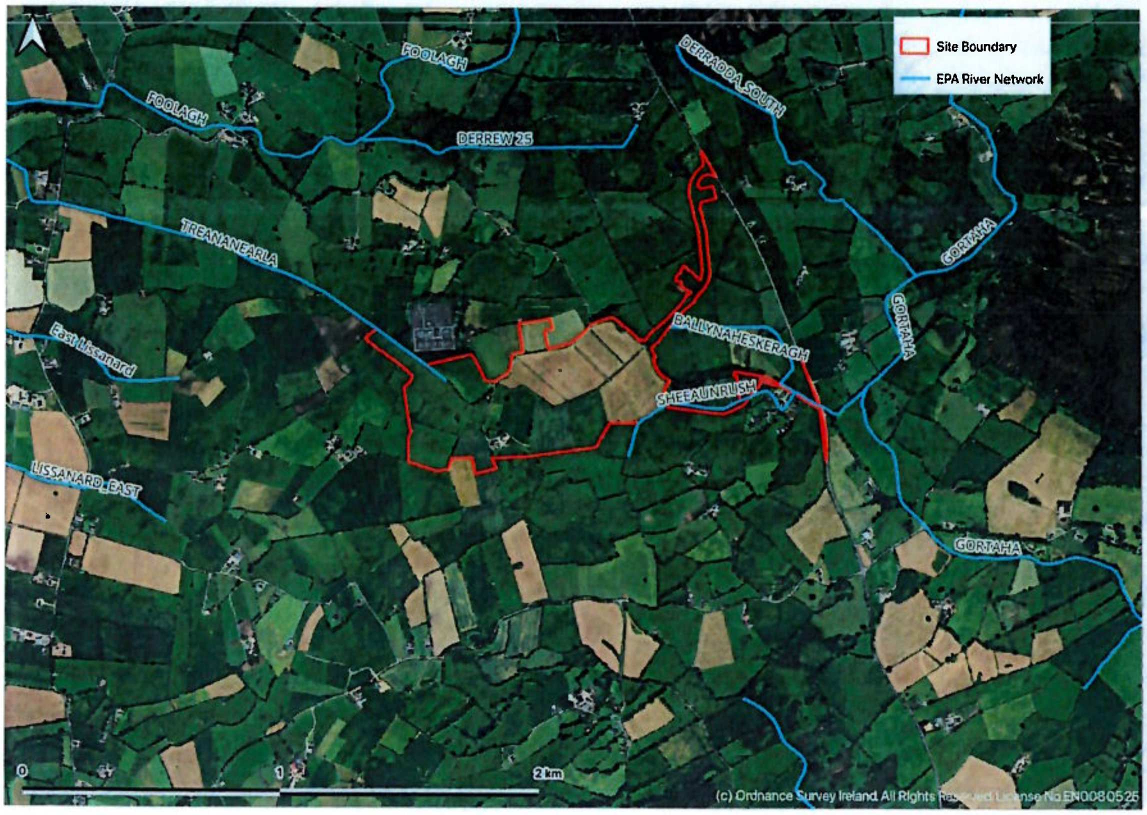
Figure 6 – WFD River Sub-Basins



The EPA mapping portal suggests that the hydrological divide between these sub-basins lies within the site boundary, near the current Oldhill Substation. However, subsequent ground truthing by Envirologic and consultation of the OPW Drainage Maps indicate that the catchment divide lies to the east of the main body of the application site and that all rainfall-runoff generated on the main development area will drains westwards, ultimately outfalling to the Kilcrow River system, 2 km to the west.

In this report the catchment that drains to the east will be referred to as the Gortaha catchment, based on the local river that rainfall-runoff generated on the access routes ultimately drains to (Figure 7).

Figure 7 – Mapped EPA River Network



2.4.4 Western (Kilcrow) Catchment Description

The drainage network serving the site is dominated by an east to west flowing central channel which itself becomes the Treananearla Stream (first order stream) a short distance downstream of the site. This central channel originates at the eastern end of the central site area, stopping just short of the local road L8763. This catchment was delineated by Envirologic using analysis of Digital Elevation Model (DEM) topographical contours, ground truthing as part of the site walkover, and reference to the OPW and EPA drainage network maps. The catchment area contributing run-off to the downgradient site boundary has an area of 2.0 km^2 (Figure 8).

There are two 950 mm diameter culverts in place along the central channel within the site boundary. These provide road crossings for access to farm land and a dwelling.

There are several field boundary drains present within the site that contribute to the runoff at its downstream end. The largest of these drains extends 950 m south, outfalling to the central stream just east of the on-site dwelling. This drainage channel has a sub-catchment of 0.675 km^2. There are two culverts present on this tributary, with pipe diameters of 650 mm and 500 mm. The 500 mm culvert lies immediately upstream of the confluence of the tributary and the main channel whilst the 650 mm culvert acts as a field crossing further upstream. There is a 1 m drop from the invert of the tributary channel to the invert of the main channel, resulting in a high velocity cascading flow regime at the confluence. The combined flows then continue westward. There are no other drainage channels that contribute significant flow to the central channel within the site.

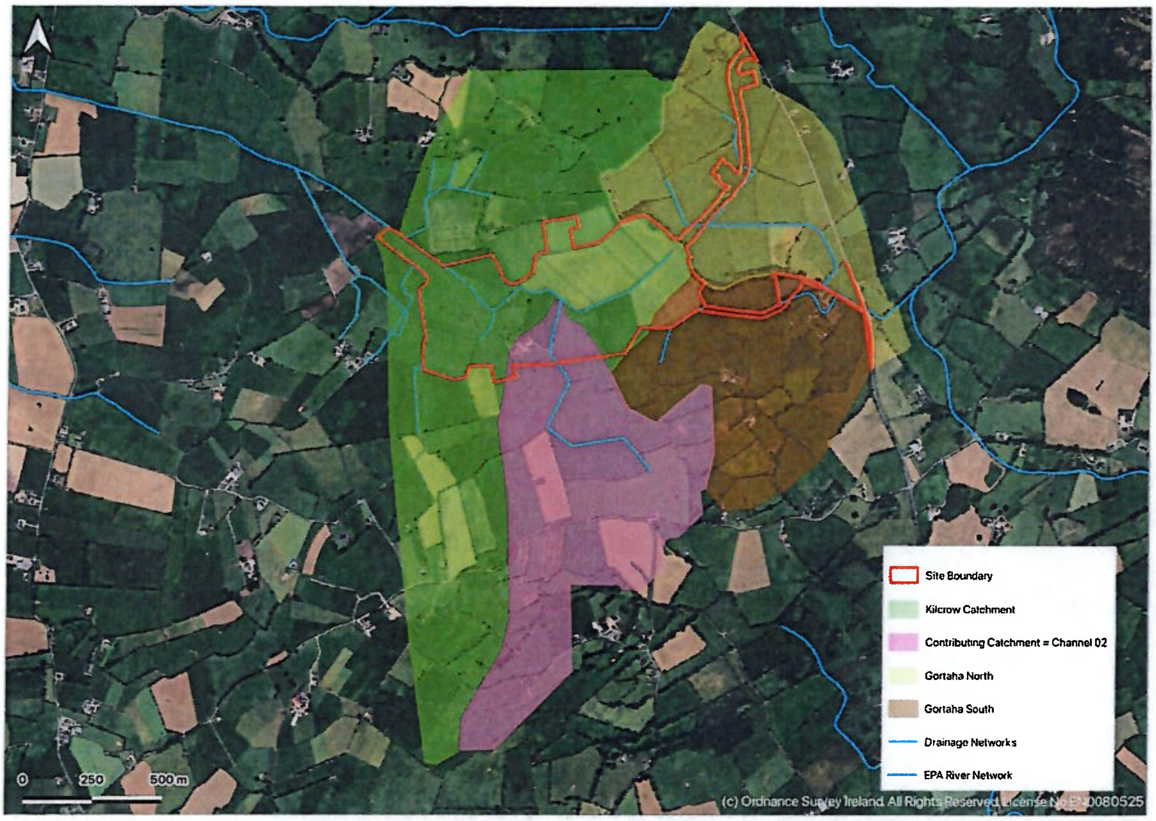
2.4.4.1 Eastern (Gortaha) Catchment Description

Rainfall runoff generated on the areas proposed for the site access route and temporary construction access route drains eastwards towards the Gortaha River.

There are two mapped EPA watercourses that flow eastwards. The Sheeaunrush stream, which will be referred to herein as draining the Gortaha South catchment, flows from agricultural land to the south of the site boundary and joins the Ballynaheskeragh Stream as it passes along the original site access route. The mapped Ballynaheskeragh Stream route is incorrect on the EPA database. The correct channel routing is presented in Figure 8 and will be referred to herein as draining the Gortaha North catchment. There are two culverts present in the Gortaha North catchment. The culvert which services the N65 is a 0.5 m diameter circular culvert. There is one additional field crossing culvert along the Ballynaheskeragh Stream measuring 0.3 m in diameter. A 0.45 m diameter circular culvert transmits water under L8763 road and acts as the confluence between the Sheeaunrush and Ballynaheskeragh streams.

There are several field boundary drains present in the Gortaha North catchment. During the site walkover it was noted that the upper reaches had no discernible flow direction, with standing water noted at multiple locations. Blockages were common, either from silted up channels or infilled areas permitting field crossings. Envirologic will present mitigation measures to regrade channels, improving conveyance through these field boundaries.

Figure 8 - Contributing Catchment to Site Run-off.



2.5 HYDROGEOLOGY

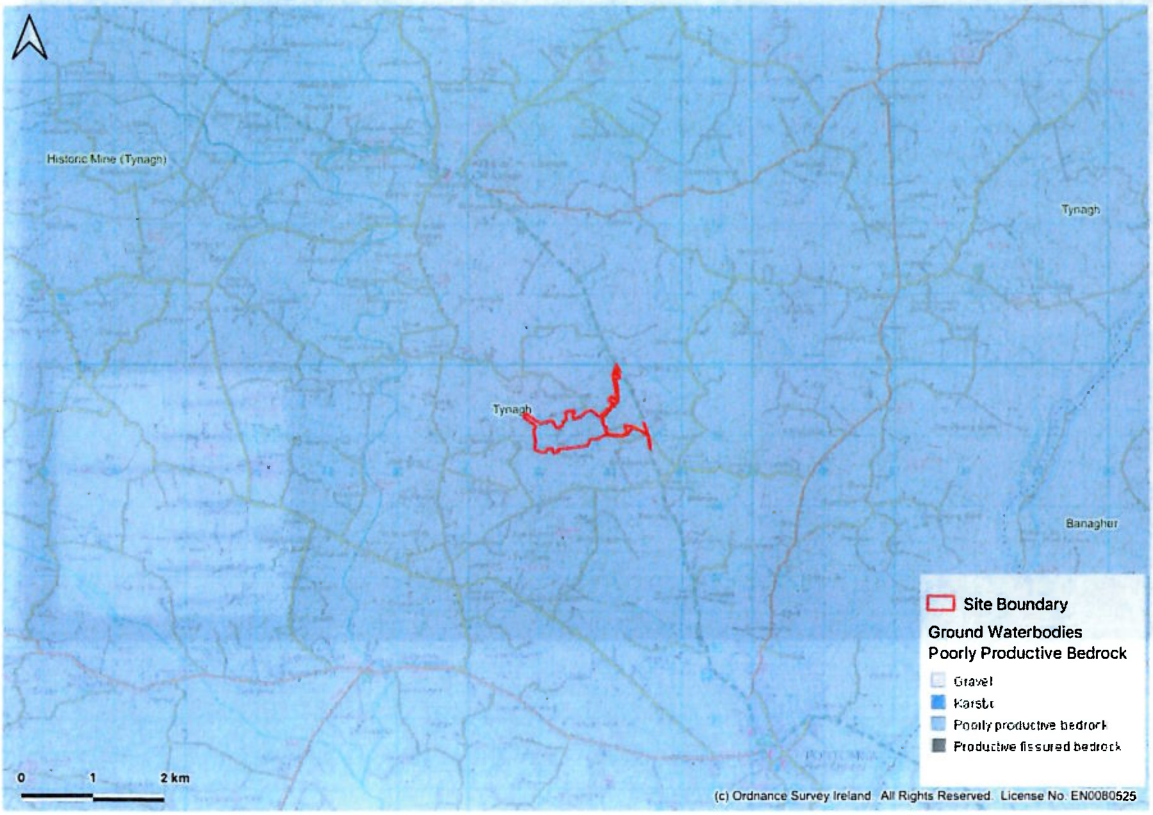
2.5.1 Aquifer Classification

The Lucan Formation is considered to be a locally important aquifer, consisting of bedrock which is moderately productive only in local zones (LI). This type of aquifer is considered to have a limited and relatively poorly connected network of fractures, fissures and joints, giving a low fissure permeability which tends to decrease further with depth. A shallow zone of high permeability may exist within the top few metres of weathered rock. Higher permeability may occur along fault zones, with these zones able to provide larger 'locally important' supplies of water. Due to the low permeability and storage capacity the aquifer has a low recharge acceptance.

2.5.2 WFD Groundwater Body

With respect to groundwater underlying the site, the Groundwater Body (GWB) underlying the site is the Tynagh GWB (IE_SH_G_236) (Figure 9). This GWB is shaped roughly like an upside-down triangle, and elevations range from 30 mOD along the shore of Lough Derg to 378 mOD at Cappaghbaun Mountain in the southwest of the GWB. The topography ranges from mountainous in areas underlain by sandstones and mudstones of Devonian origin to flat lying areas underlain by impure limestones. Associated river flow directions are predominantly southwards and eastwards towards Lough Derg and the River Shannon. Due to shallow groundwater flow in this aquifer the groundwater and surface water interaction is high and closely linked. Springs are located close to breaks of slope where groundwater intercepts the surface.

Figure 9 – WFD Groundwater Bodies Map



The GWB report (GSI, 2004) states that within the Dinantian Lower Impure Limestones, transmissivities are likely to be in the range 2-20 m^2/d, with most values at the lower end of the range. The lower impure limestone aquifers are more than several hundred metres thick. However, the effective flowing thickness of these aquifers is usually 15 m, this thickness comprising a weathered zone of a few metres and a connected fracture zone below this.

A recharge coefficient of 60% is applied to the application site, though a recharge cap of 200 mm is applied at the bedrock head.

2.5.3 Groundwater Vulnerability

Groundwater vulnerability is a measure of the risk that a potential groundwater contamination event may have on the ground water beneath. It is a measure of how vulnerable groundwater is to a potential contamination event. The vulnerability of groundwater is a function of the nature of the underlying soil cover, the presence and nature of the subsoil, the nature of strata, and the thickness of overburden above the water table.

The vulnerability categories, and methods for determination, are presented in Groundwater Protection Schemes (1999). The guidelines state that 'as all groundwater is hydrologically connected to the land surface, it is the effectiveness of this connection that determines the relative vulnerability to contamination. Groundwater that readily and quickly receives water (and contaminants) from the land surface is considered to be more vulnerable than groundwater that receives water (and contaminants) more slowly and in lower quantities. The travel time, attenuation capacity and quantity of contaminants are a function of the following natural geological and hydrogeological attributes of any area:

1. the subsoils that overlie groundwater;
2. the type of recharge - whether point or diffuse;
3. the thickness of the unsaturated zone through which the contaminant moves.

The GSI have assigned main body of the application site as having a groundwater vulnerability of Moderate (M).

2.5.4 Source Protection Area

There are two source protection areas for groundwater drinking water supply sources within close proximity to the site boundary. Both of these Group Water Schemes (GWS) are managed by the National Federeation of Grouo Water Schemes (NFWGS).The Oldthort GWS (IE_GSI_ZOC_30) is located 3 km to the south and the Killeen/Poulatoon GWS is located 4.3 km to the south west.

The Oldthort GWS is potentially downstream of the site boundary in terms of groundwater flow direction.

3 WFD WATERBODIES STATUS & RISK

3.1 WFD SURFACE WATER BODIES

WFD surface water body status and risk for local streams and sub-catchments are summarised in Table 1.

Table 1 – Summary of WFD River Waterbody Status & Risk

WFD Surface Waterbody	GORTAHA_010	KILCROW_070
WFD Sub-Catchment	25B_4 Shannon(lower)_SC_050	25C_12 Kilcrow_SC_010
Risk Status (2nd Cycle)	Not At Risk	At Risk
Risk Status (3rd Cycle)	Review	At Risk
Overall Status (2013-2018)	Good	Moderate
Overall Status (2016-2021)	Moderate	Moderate
Overall Status (2019-2024)	Moderate	Poor
Significant Pressures (3rd Cycle)	None	Anthropogenic Pressures

The EPA characterisation Report entitled WFD Cycle 2 Catchment Lower Shannon Sub-catchment Shannon Lower_SC_050 (EPA, 2018) provides an evaluation of priority sub-catchment Information as follows on the Gortaha_010:

- The Gortaha_010 is *Not at Risk*, due to Good status and/or no pressures.

The EPA characterisation Report entitled WFD Cycle 2 Catchment Lower Shannon Sub-catchment Kilcrow_SC_010 (EPA, 2019) provides an evaluation of priority sub-catchment issues as follows:

- The Kilcrow_070 river is at Moderate status, the invertebrate community indicate Good status but the fish community indicate Moderate status. There are no apparent significant pressures. Further work is needed to investigate the cause of the fish status failure.

3.2 WFD GROUNDWATER BODIES

WFD groundwater body status and risk are summarised in Table 2.

Table 2 – Summary of WFD Ground Waterbody Status & Risk

WFD Groundwater Body	Tynagh
Risk Status (2nd Cycle)	Not at Risk
Risk Status (3rd Cycle)	Not at Risk
Overall Status (2013-2018)	Good
Overall Status (2016-2021)	Good
Overall Status (2019-2024)	Good

There are two groundwater monitoring points within the GWB, these being at Whitegate (GWIE_SH_G_23603000005) and Scariff (GWIE_SH_G_23603000003). These are mapped by the EPA as being approximately 24 km southeast of the site boundary.

4 DESIGNATED SITES

The site itself is not located within any Special Area of Conservation (SAC), Special Protection Area (SPA), Natural Heritage Area (NHA) or proposed Natural Heritage Area (pNHA). The closest Conservation Objective (CO) features are outlined below.

4.1 NATURE CONSERVATION DESIGNATIONS

Figure 10 shows that, with respect to designations, none of the watercourses in the vicinity of the site are designated areas. However, the KILCROW_070 and GORTAHA_010 waterbodies contribute to the River Shannon system, which is mapped as part of the Lough Derg Northeast Shore SAC (002241) and further downstream the Lower Shannon SAC (Site Code: 002165). There is also a Statutory Instrument associated with the Lower River Shannon SAC.

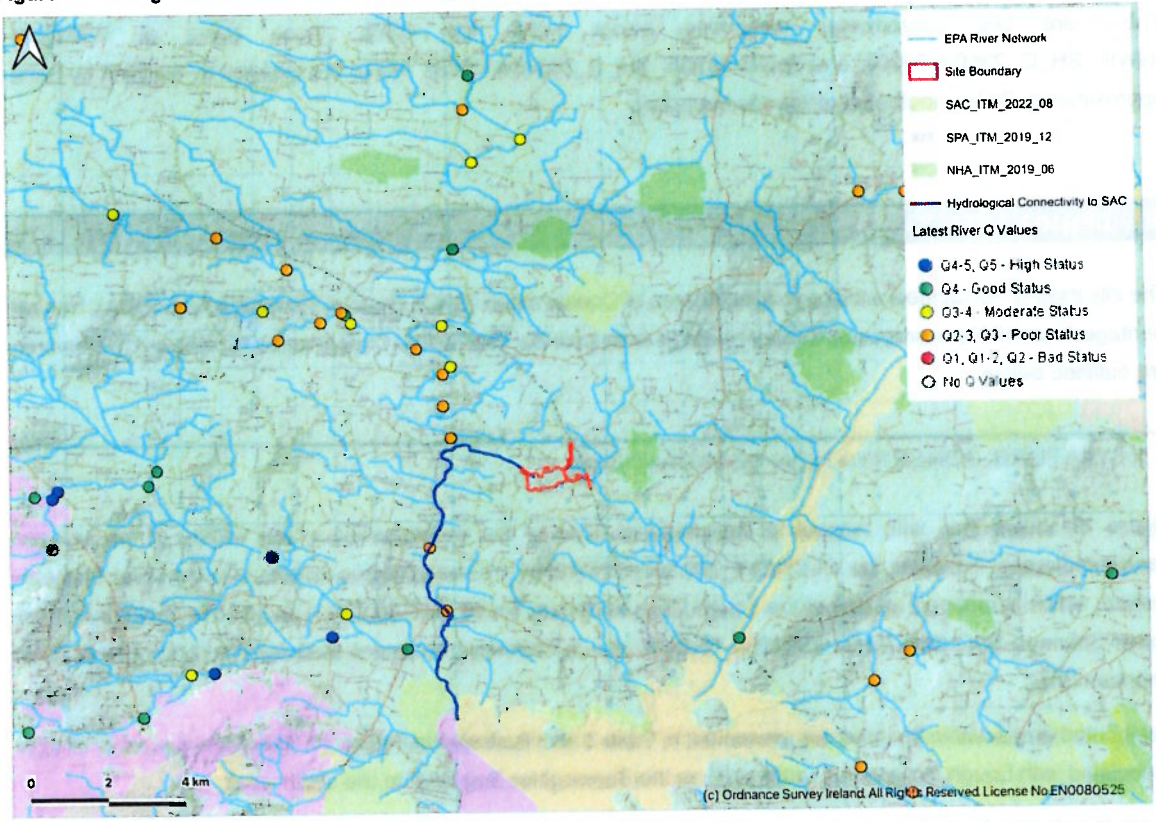
Designated areas within the area are presented in Table 3 and illustrated in Figure 10. There are a number of sites associated with Lough Derg to the south such as the Barroughter Bog SAC to the south west.

There is potential for hydrological connectivity between the application site and Lough Derg and Lower Shannon designated areas via the Kilcrow and Gortaha river networks. The Gortaha River flows into the River Shannon upstream of Lough Derg while the Kilcrow flows directly into Lough Derg. The main part of the application site drains westwards towards the Kilcrow River; this route of hydrological connectivity is shown in Figure 10.

Table 3 – Summary of Designated Sites Within a 15 km Radius of the Site

Natura 2000 Site	Site Code	Location at Closest Point to the Proposed Project
River Shannon Callows SAC	000216	5.6 km south east
Middle Shannon Callows SPA	004096	5.6 km south east
Lough Derg, North East Shore SAC	002241	8.8 km south
Lough Derg SPA	004058	8.8 km south
Baroughter Bog SAC	000231	9.1 km south-west

Figure 10 – Designated Areas & Latest Q-Ratings



4.2 BATHING WATER

Bathing waters identified under the Bathing Water Regulations (2008) are applicable to surface waters where the local authority expects a large number of people to bathe. A bathing waters location is mapped at Portumna (IESHBWL25_191a_0100) and achieved excellent water quality in 2024.

4.3 NUTRIENT SENSITIVE AREA

Nutrient Sensitive Areas (NSA) comprise Nitrate Vulnerable Zones and polluted waters designated under the Nitrates Directive (91/676/EEC and areas designated as sensitive areas under the Urban Wastewater Treatment Directive (UWWTD)(91/271/EEC). Sensitive areas under the UWWTD are water bodies affected by eutrophication associated with elevated nitrate concentrations and act as an indication that action is required to prevent further pollution caused by nutrients.

The nearest nutrient sensitive area downstream of the site boundary is Lough Derg, which is under nutrient pressure from urban waste water inputs. The Nenagh River flows into the eastern side of Lough Derg which is also a nutrient sensitive area due to an urban wastewater treatment agglomeration.

4.4 SHELLFISH AREAS

The Shellfish Waters Directive (2006/113/EC) aims to protect or improve shellfish waters in order to support shellfish life and growth.

There are no shellfish protected area sites within the vicinity of the proposed development. The closest shellfish protected area is at the Shannon Estuary, between Kiloher Head to Leck point and Corlis Point to Beal Point.

4.5 DRINKING WATER PROTECTION AREAS

Lough Derg is the closest DWPA to the site boundary. All GWB's are considered as Drinking Water Protection Areas (DWPA). The Tynagh GWB that underlies the site contain seven mapped public drinking water supply sources or source protection zones. The nearest Irish Water source protection zones to groundwater supply sources are locates at Scariff and Whitegate at the southern extent of Lough Derg.

EPA envision mapping presents DWPA information, as shown in Table 4.

Table 4 – Drinking Water Protection Area (DWPA) information

Name	Drinking Protection Type	EU Priority Area (PA) Type	EU PA Code
Derg TN	Lake Waterbody	Article 7 Abstraction for Drinking Water	IEPA1_SH_25_191a
Tynagh GWB	Groundwater	Article 7 Abstraction for Drinking Water	IEPA1_SH_G_236

5 WFD SCREENING

5.1 SURFACE WATER BODIES

As described previously, rainfall-runoff generated on the application site currently drains to the Kilcrow_070 and Gortaha_010. The River Shannon and Lough Derg are to be screened appropriately given their proximity to the site boundary.

5.2 GROUNDWATER BODIES

As described above, the GWB underlying the site boundary is the Tynagh (IE_SH_G_236).

5.3 TRANSITIONAL WATERS

There are no transitional waters or coastal waters to be included in the screening assessment.

5.4 PROTECTED AREAS

Five protected areas and designated sites have been highlighted as being potentially hydrologically connected to the downstream site boundary. A Natura Impact Statement including Appropriate Assessment was compiled by Moore Group – Environmental Services (dated 29th May 2024) and accompanied the recent application.

With respect to Barroughter Bog SAC (000231), Moore Group state that:

- *'Barroughter Bog SAC (Site Code 000231) lies close to the Kilcrow River, 5.3 km to the southwest. The Kilcrow River runs along the eastern edge of the SAC boundary before it outfalls into Lough Derg. Given the location of the SAC in relation to the proposed development and the nature of the qualifying interests for which it is designated (terrestrial habitats) no viable source-pathway-receptor links are identified and therefore no potential for significant effects to this European site, and it is screened out.'*

With respect to Lough Derg North East Shore SAC (002241) and Lough Derg (Shannon) SPA (004058), the Kilcrow_070 (Treananearla Stream) provides connectivity with the application site. Considering the proposed works involve stream realignment, as outlined in the Flood Risk Assessment compiled by Envirologic (dated: 30th April 2024), Moore Group state that:

- *'The potential for significant adverse effects on the Lough Derg North-east Shore SAC (Site Code 002241) and the Lough Derg (Shannon) SPA (Site Code 004058) is uncertain in the absence of control of potential pollution of surface water during construction. The project will require the implementation of management measures to avoid potential adverse effects on the Lough Derg North-east Shore SAC and the Lough Derg (Shannon) SPA and as such Stage 2 AA is required.'*

With respect to the Gortaha_010 catchment, there are no stream realignments proposed. The construction of four bridges to facilitate site access will not involve instream construction works. Mitigation measures to reduce sediment mobilisation whilst construction operations are taking place in around the proposed bridge locations have been outlined in the Flood Risk Assessment provided by Envirologic (dated: 30th April 2024) and the Natura Impact Statement provide by Moore Group (dated: 29th May 2024). Moore Group state that:

- *'A drainage ditch which runs under the L8763 local road close to its junction with the N65 drains a small section of the southeast of the site which has connectivity to a watercourse which enters the River Shannon north of Portumna, and thus has connectivity with the River Shannon Callows SAC (Site Code 000216) and Middle Shannon Callows SPA (Site Code 004096), 4.6km to the southeast. However, there are no works proposed that will have any impact on this drainage ditch and in the absence of a pathway and connectivity, these two sites are screened out at this stage of the assessment.'*

5.5 DRINKING WATER

Envirologic analysis with respect to connectivity of the site boundary to any Drinking Water Sources or Drinking Water Protection Areas, is noted in Table 5.

Table 5 – Drinking Water Abstractions

Name	EU PA Code	Envirologic Screening Note
Derg TN	IEPA1_SH_25_191a	The site boundary is sufficiently proximal to the Derg TN to be screened in.
Tynagh GWB	IEPA1_SH_G_236	There is an onsite well located within the site boundary that will be used for operational purposes.

It is concluded here that the proposed development is sufficiently proximal to Lough Derg, an EU Priority Area Type Article 7 Abstraction for Drinking Water, to be screed in. The site is significantly remote from any NFGWS Group Scheme Source Protection Areas. The impact and subsequent mitigation measures relating to the Derg TN will be screened in and investigated further.

6 WATER FRAMEWORK DIRECTIVE SCREENING SUMMARY

A summary of the WFD screening exercise is presented in Table 6.

Table 6 - Water Framework Directive Screening Summary

Feature Type	WFD Classification	Feature Name/ID	Included in Screening (Y/N)	Justification
Surface Water Body	River	Gortaha_010 [IE_SH_25G560730] in Sub Catchment Shannon[Lower]_SC_050	Y	The Gortaha_010 surface waterbody flows through the eastern portion of the site. Development works will take place proximally to the watercourse, along with four bridge crossings during the construction phase. It is therefore screened in.
	River	Kilcrow_070 [IE_SG_25K010700] in Sub Catchment Kilcrow_SC_010	Y	The Kilcrow_070 surface waterbody flows through the western portion of the site boundary. Development works will take place proximally to the watercourse, along with two bridge crossings and realignment works during the construction phase. It is therefore screened in.
	River	River Shannon [IE_SH_25S012350]	Y	The River Shannon is located 5.6 km downstream of the site boundary. It is therefore screened in.
	Lake	Lough Derg [IE_SH_25_191a]	Y	Lough Derg is located 8.8 km downstream of the site boundary. It is therefore screened in.
Groundwater Body	Groundwater	Tynagh [IE_SG_G_236]	Y	The Tynagh GWB has been screened in as it directly underlies the site boundary.

Transitional Water Body	Transitional	River Shannon and River Fergus Estuaries [IE_SH_060_0800]	N	Transitional waters associated with the River Shannon and River Fergus are considered too distant from the application site and are therefore screened out.
Coastal Water Body	Coastal	Mouth of the River Shannon [SH_060_0000]	N	Coastal waters downstream of Limerick City are considered too distant from the site and are therefore screened out.
Protected Area	Designated Site	River Shannon Callows SAC (000216)	Y	Distance of hydrological connectivity between the site boundary and the River Shannon Callows SAC is 5.6 km. This is considered sufficiently close to the site to be screened in.
		Middle Shannon Callows SPA (004096)	Y	Distance of hydrological connectivity between the site boundary and the Middle Shannon Callows SPA is 5.6 km. This is considered sufficiently close to the site and is screened in.
		Baroughter Bog SAC (000231)	N	Distance between the site boundary and the Baroughter Bog SAC is 9.1 km. This is considered sufficiently distant from the site boundary and is screened out. It is understood to be fed by groundwaters that flow beneath the application site.
		Lough Derg, North East Shore SAC (002241)	Y	Distance of hydrological connectivity between the site boundary and the River Shannon Callows SAC is 8.8 km. This is considered sufficiently distant from the site boundary and is screened in.
		Lough Derg SPA (004058)	Y	Distance of hydrological connectivity between the site boundary and the River Shannon Callows SAC is 8.8 km. This is considered sufficiently distant from the site boundary and is screened in.
	Bathing Water	Portumna	Y	Distance of hydrological connectivity between the site boundary and Portumna Bathing Area is 9.3 km. This is considered sufficiently distant from the site boundary and is screened in.

	Nutrient Sensitive Area	Lough Derg (Lake)	N	There will no nutrients managed or imported/exported to/from the application site.
	Shellfish	Shannon Estuary	N	The shellfish waters downstream of the site boundary are considered too distant from the site to be affected by the proposed development.
	EU Priority Area (PA) Type Article 7 Abstraction for Drinking Water	Derg TN	Y	Lough Derg is hydrologically connected 8.8 km downstream from the site boundary and is considered to be an EU PA.
		Tynagh GWB	Y	The site boundary is located within this GWB. However, the site boundary is not within any mapped Zones of Contribution or Source Protection Areas of any Water Supply Sources. A quantitative assessment will be carried out to assess the Tynagh GWB recharge rates and how the proposed development will interact with the GWB from an abstraction aspect.
	Source Protection Area	Oldthort GWS	Y	This GWS is located sufficiently close to the site boundary, and is potentially downstream in terms of groundwater flow direction.
		Killeen/Poulatoon GWS	N	This GWS is located sufficiently close to the site boundary. However is not located downstream in terms of groundwater flow direction from the site boundary.

7 WFD COMPLIANCE ASSESSMENT

7.1 PROPOSED DEVELOPMENT

The project relates to the proposed development titled 'Project Coolpowra' which intends to develop grid-connected energy support projects on lands in the townlands of Coolpowra, Cooldorragha, Ballynaheskeragh, Gortlusky and Sheeaunrush, County Galway. The proposed development is designed to increase security of supply and keep the electricity grid stable and reliable in the face of growing demand. The development includes different flexible technologies, which were chosen to compliment and support the integration of further renewable generation technologies.

It is intended to demolish an existing dwelling and farmhouse on the site and construct the following:

- A Reserve Gas-Fired Generator comprised of three OCGT Units;
- Upgrade and replacement of the existing 400kV AIS substation with a 400kV GIS substation;
- Alternative Technology infrastructure such as Long Duration Energy Storage (LDES) and a Synchronous Condenser.

Each of the above proposed developments relates to a separate planning application. To facilitate development the following will also be included in the planning application:

- An alternative temporary construction access road from the N65

The proposed site layout is highlighted in Figure 11. There is an existing groundwater extraction well located to the east of the existing dwelling. This well was drilled in the 1960's to a depth of approximately 30 m below ground level and was used as a potable water supply for dwelling and surrounding farm buildings. It is proposed to retain this well and use it as the primary source of water for site operations. Specific required water supply quantities will be assessed in this report. Rising mains water supply pipes at the well shall supply the proposed fire hydrants located across the application site boundary, three fire water tanks and the operational facilities. All surface water generated on hardstanding will be directed towards the fire water retention tank and the two settlement ponds before entering the Kilcrow_070 watercourse.

Figure 11 – Proposed Site Layout

7.2 POTENTIAL EFFECTS

7.2.1 Construction Phase (Unmitigated)

7.2.1.1 River Water Bodies: Qualitative Impacts

Sediment Loss

In an unmitigated scenario there is potential for sediment-laden waters from exposed subsoils to enter the Kilcrow and Gortaha watercourses.

Hydrocarbon Loss

In an unmitigated scenario there is potential for leakages and spillages of hydrocarbons from construction traffic to enter the Kilcrow and Gortaha watercourses.

Substrate Quality

In an unmitigated scenario, there is potential for stream realignment construction phase works to negatively impact surface water quality. Mitigation and substrate improvement measures have been presented in the method statement contained in Chapter 6 of the Flood Risk Assessment.

7.2.1.2 River Water Bodies: Qualitative Impacts

There will no alteration of surface water catchment boundaries during the construction phase.

7.2.1.3 Groundwater Body: Qualitative Impacts

There is a potential impact to groundwater quality with the use of machinery and equipment during the construction with possible loss/spillage of hydrocarbons to the environment, where they may enter the underlying groundwater body. The quantity of hydrocarbons present in machinery and plant is relatively minor, however, and the potential risk and severity associated with construction phase activities is therefore deemed low.

7.2.1.4 Groundwater Bodies: Quantitative Impacts

There will be no significant groundwater abstractions or discharges to groundwater during the construction phase.

7.2.2 Operational Phase (Unmitigated)

7.2.2.1 River Water Bodies: Qualitative Impacts

Sediment Loss

In an unmitigated scenario there is potential for sediment-laden waters to enter the Kilcrow and Gortaha watercourses from trafficked areas or exposed overburden.

Hydrocarbon Loss

In an unmitigated scenario there is potential for hydrocarbons from employee vehicles and haulage vehicles to enter the Kilcrow and Gortaha watercourses.

Stream Gradient and Substrate Quality

In an unmitigated scenario, there is potential for the realigned stream to negatively impact stream substrate quality Mitigation and substrate improvement measures have been presented in the method statement contained in Chapter 6 of the Flood Risk Assessment.

7.2.2.2 Groundwater Body: Qualitative Impacts

There is a potential impact to groundwater quality with the use of machinery and equipment during the operational phase with possible loss/spillage of hydrocarbons to the environment, where they may enter the underlying groundwater body. The quantity of hydrocarbons present in machinery and plant is relatively minor, however, and the potential risk and severity associated with construction phase activities is therefore deemed low.

7.2.2.3 River Water Bodies: Quantitative Impacts

In its greenfield condition, i.e. prior to any development, the site boundary sat within the Kilcrow and Gortaha catchments. Commencement and progression of the proposed development will not result in any alterations to existing surface water catchment boundaries, i.e. there will no alteration to areas contributing to run-off for either catchment. There will be no transfer of surface waters across existing catchment boundaries.

Surface waters released from proposed settlements ponds ensure that discharge rates are equal to or below pre-development greenfield run-off rates. Excess waters will be stored in SuDS devices accordingly.

7.2.2.4 Groundwater Bodies: Quantitative Impacts

It is a usual part of an impact assessment to complete a GWB and aquifer scale hydrogeological quantitative impact assessment. As previously discussed, there is one groundwater well present within the site boundary. This well will be used in the following capacity:

Processing: A limited volume of wash water will arise during annual maintenance. This will arise as water from washing the gas turbine compressors and will contain some detergent. The volume of wastewater generated will be approximately 5 m^3 per event (i.e., 1 m^3 per GT). The requirement for washing will be very low and it is anticipated that this will occur on average once per year generating 5 m^3 of effluent (maximum twice per annum – 10 m^3). The washdown will be performed using a dilute detergent "soap" such as Turbotech 950 (SDS attached) or similar manufacturer approved product. The effluent arising from the process will be contained and drained to an Intermediate Bulk Container (IBC). The wastewater will be transported off site by a permitted contractor and will be disposed of at a licensed facility.

Potable Use: Approximately 15-20 operatives, employed over three shifts are related to the operation of the Energy Storage Facility and GIS compounds. Taking a conservative approach at 22 litres per day per operative, the highest demand required across the entire development will be 0.44 m^3 per day.

Applying a conservative approach and combining the two GW requirements mentioned above, the maximum daily requirement for water on site will be 5.44 m^3 Table 7 and Table 8 provide an assessment of how operating procedures interacts with the Tynagh GWB.

Table 7 – Quantitative analysis of flows in groundwater bodies

Key areas		
GSI assigned area for Tynagh GWB	km^2	824
GSI assigned area for Tynagh GWB	m^2	824,000,000
GWB Annual Average Rainfall/Recharge Rates		
GSI Effective Rainfall	mm/yr	531
GSI Groundwater Recharge	mm/yr	319
GSI Groundwater Recharge Cap	mm/yr	200
GSI GWB Groundwater Recharge Rate	m/yr	0.2
Recharge to WFD GWB		
Average daily groundwater recharge to Tynagh GWB	m^3/yr	164,800,000
Average daily groundwater recharge to Tynagh GWB	m^3/d	451,506
Development Abstraction		
Future anticipated maximum daily GW abstraction from the development	m^3/d	5.44
Annual abstraction	m^3/yr	1,985
Envirologic Calculation		
Proportion of development abstraction volume as % of Tynagh GWB annual recharge to bedrock aquifer	%	0.0012

EPA Register of all other abstractions from Tynagh GWB	m^3/yr	123,370
Existing abstractions + proposed development abstraction as a percentage of available groundwater in the Tynagh GWB	%	0.075

With reference to the GW5 (WFD Irl, 2004) evaluation criteria reproduced as Table 8, the preliminary 'Groundwater Body' quantitative test results of Table 8 suggests that the volume of groundwater being abstracted at the proposed development might account for only 0.075% of the annual average recharge to the GWB. It is taken that the calculated % is in the <2% bracket according to GW5 criteria, resulting in a conclusion of '**No Potential Impact**'.

Table 8 - Groundwater Thresholds for rivers and large lakes (Table 4, GW5 Guidance Document: Guidance on Abstractions; WFD Working Group, 2004).

	Average Specific Yield or Storage of GW Screening Unit	
Groundwater Abstraction vs Average Recharge	**Low Storage (< 5%)**	**High Storage (>=10%)**
>30%, i.e. if groundwater abstraction is greater than 30% of long-term recharge	High Potential Impact	High Potential Impact
	High Potential Impact	Moderate Potential Impact
10 – 20%	Moderate Potential Impact	Low Potential Impact
2 – 10%	Low Potential Impact	Low Potential Impact
< 2%	**No Potential Impact**	No Potential Impact

8 MITIGATION

The potential negative effects to the WFD Surface Waterbodies and Groundwater Bodies in terms of quantitative and quantitative status have been outlined above. Where required the following measures will be implemented to mitigate against the potential effects. Mitigation measures have been proposed in the following documents submitted with the planning application:

- '*Coolpowra EIAR Volume 2: Section 8.5 Mitigation Measures*' prepared by Halston;
- '*Project Coolpowra Natura Impact Statement: Section 3.5 Mitigation Measures*' prepared by Moore Group Environmental Services;
- '*Stage 3 Flood Risk Assessment: Section 6*' prepared by Envirologic.

Mitigation measures for each associated potential effect during the construction and operational phases are listed in Table 9 and Table 10, respectively. Measures to mitigate against unplanned events are outlined in Table 11.

Table 9 – Mitigation Measures: Construction Phase

	POTENTIAL IMPACT			MITIGATION MEASURES	RESIDUAL EFFECT FOLLOWING MITIGATION	
Scenarios where impacts may arise	Activity	Attribute	Character of Potential Impact	Description of Mitigation	Significance or quality of Effect	Probability
Construction Phase	Contamination from spills or leaks of fuel/oil and hazardous substances stored onsite	Groundwater Bodies: Tynagh GWB Surface Water Bodies: Kilcrow_070 Gortaha_010 Lough Derg River Shannon	Deterioration in groundwater and surface water quality Moderate Impact	Construction compounds will be located at least 30 m from any surface watercourses within the site boundary. Dedicated area of hard standing for material deliveries separated a minimum of 10m from adjacent watercourses. Concrete will be mixed off–site and imported to the site. Dedicated area of hard standing for vehicle washout. Specific areas for oil storage and refueling, separated a minimum of 10m from adjacent watercourses and comply with legislation, including providing bunds which contain 110% of on-site fuel storage capacity. Use spill kits, fill point drip trays, bunded pallets and secondary containment units. Enclosed and secured site and fuel storage areas will be secondarily secured. Develop a Construction Waste Management Plan. Develop a site-specific Incident Response Plan.	Imperceptible	Unlikely

				Works involving the use of chemicals which are potentially harmful to the aquatic environment will be undertaken in a contained or lined area. Excavation and disposal off-site of contaminated soils (where required). Good housekeeping (daily site clean-ups, use of disposal bins, etc.) on the project site, and the proper use, storage and disposal of many substances used on construction sites, such as lubricants, fuels and oils and their containers can prevent soil contamination.		
Construction Phase	Realignment of part of the Treananearla Stream. Construction of 6 bridge crossings over surface watercourses	Surface Waters: Kilcrow_070 Lough Derg	Deterioration of Surface water quality from sediment input disrupting sensitive riverine and lacustrine habitats Moderate Impact	Realignment of the water channel will be undertaken at the start of development work. Works will be sequenced, i.e. the new channel will be dug in accordance with an agreed specification and best practice, and the water will be rediverted. The redundant channel (once isolated from the downstream watercourse) will then be infilled. As the stream is a part of an arterial drainage scheme, OPW will be consulted in advance of the proposed works. A method statement will be developed and agreed with all stakeholders. Silt fencing and other controls will be installed to prevent any impact on the downstream receptor.	Imperceptible	Unlikely
Construction Phase	Earthworks have the potential to result in overland run-off of sediment laden water to watercourses	Surface Waters: Kilcrow_070 Gortaha_010 Lough Derg River Shannon	Deterioration of Surface Water quality from sediment input disrupting sensitive riverine and lacustrine habitats	Minimisation of exposed ground and soil stockpiles, through careful earthworks design. Minimising the time that ground is exposed and excavations are open through careful construction programming. Stockpiles will be located away from watercourses, limited in height to 3m (topsoil) and the surface smoothed. Silt fences will be placed around the stockpiles where required to limit the potential for rainfall to wash fines into the drainage system (GIS compound	Imperceptible	Unlikely

			Moderate Impact	area). These comprise a technical filter fabric positioned as a fence around the exposed soil and sediment to catch fines within the runoff and reduce the input of fine sediment to the drainage system. Stockpiles which may be present for some time will be covered or seeded. Areas around infrastructure will be landscaped and restored with topsoil and revegetated as soon as possible. Track drainage, designed to prevent the interception of large volumes of water, will be porous and act as soak ways thereby minimising any direct discharge to watercourses. Wheel washing activities will be conducted in designated areas, with runoff waters being conducted to soak ways constructed according to best practice. Use of buffer zones, silt traps and settlement ponds to avoid sediment reaching watercourses		
Construction Phase	Contamination of groundwater by concrete, cement paste or grout	Groundwater Bodies: Tynagh GWB	Deterioration of groundwater quality Moderate Impact	A suitable casing will be used where wet concrete is proposed to ensure protection of groundwater until concrete has set.	Imperceptible	Unlikely
Construction Phase	Increased vulnerability of the aquifer as a result of soil removal	Groundwater Bodies: Tynagh GWB	Deterioration of groundwater quality. Moderate Impact	Land disturbance is expected to be minimised and quickly re-stabilised during the construction. Due to the limited soil and superficial cover present onsite, it is not thought that large quantities of soils and superficial deposits will be moved during construction. During construction, areas where the bedrock aquifer is exposed should be protected from surface activities through utilisation of appropriate surface coverings.	Imperceptible	Unlikely

Table 10 – Mitigation Measures: Operational Phase

	POTENTIAL IMPACT			MITIGATION MEASURES	RESIDUAL EFFECT FOLLOWING MITIGATION	
Scenarios where impacts may arise	**Activity**	**Attribute**	**Character of Potential Impact**	**Description of Mitigation**	**Significance or quality of Effect**	**Probability**
Operational Phase	Contamination from spills or leaks of fuel/oil and hazardous substances stored onsite	Groundwater Bodies: Tynagh GWB Surface Water Bodies: Kilcrow_070 Gortaha_010 Lough Derg River Shannon	Deterioration in groundwater and surface water quality. Moderate Impact	Dedicated indoor chemical storage areas within the three projects are provided for the storage of chemicals. The secondary fuel and other oils will be stored in bunds. Specific areas for oil storage and refueling are provided and are separated from local drainage. Secondary containment (bunding) is designed to comply with best practice – the greater of (a)110% of the largest tank or drum within the bund or 25% of the total volume of substance within the bund. Bunds floor fall to internal sump areas which will allow bunds to be emptied via pump only. Bund sumps will have impermeable surfaces Pumps will either be permanently fitted in sumps / bunds (submersible) or dry mounted at bund wall height with suction lift (self-priming). Mobile pumps will also be used for smaller bunded structures as and when required.	Imperceptible	Unlikely

ENVIROLOGIC

				Site drainage networks are designed in consideration of SUDS principles. Stormwater moving through 'dirty' site areas (e.g., parking, deliveries) to pass through oil interceptor prior to being infiltrated. Spill kits, fill point drip trays, bunded pallets and secondary containment units provided will be provided across all projects. Enclosed and secured site and fuel storage areas will be secondarily secured. A site-specific Incident Response Plan will be put in place for each project. Works involving the use of chemicals which are potentially harmful to the aquatic environment will be undertaken in a contained or lined area. All roads are designed to drain to the filter drains running parallel with the proposed access road and shown on the drainage drawings. This system shall allow runoff to filter down through the stone media providing filtering and delay and storage action. This stone shall be wrapped in a permeable membrane allowing runoff to infiltrate into the surrounding soils thus providing reduction action.		
Operational Phase	Contamination of waters due to leaks/spills from pipework and storage plant/tanks	Groundwater Bodies: Tynagh GWB Surface Water Bodies: Kilcrow_070 Gortaha_010 Lough Derg River Shannon	Deterioration in groundwater and surface water quality. Moderate Impact	Engineered controls included within the design to contain and recover spills. Water-efficient techniques will be used at source where possible to maximise reuse. Water will be recycled within the process from which it issues. The drainage system is designed to ensure separation and isolation of 'contaminated' surface water with 'uncontaminated' surface water. In order to ensure that uncontaminated surface drains are not mixing with possibly contaminated surface drains, risk areas will be discharged into a separate system. Small areas that have the potential for causing contamination of surface drain water are separated from the overall surface water drainage.	Imperceptible	Unlikely

				Appropriate surfacing and containment or drainage facilities for all operational areas are designed taking into consideration collection capacities, surface thicknesses, strength/reinforcement, falls, materials of construction, permeability, resistance to chemical attack, and inspection and maintenance procedures. Bunded (secondary containment) is provided for all storage tanks – site areas where tanks located fully bunded. Interceptors containing oil contaminated rainwater will be contained before being exported off-site for suitable disposal. The application for EPA licensing (IE License) associated with Project 1 will be progressed and put in place in advance of operation.		
Operational Phase	Use of settlement ponds	Surface Waters: Kilcrow_070 Gortaha_010 Lough Derg River Shannon	Removal and entrapment of particulate matter entrained in site waters. Moderate Impact	Surface water generated on hard standing will pass through multiple settlement ponds. This feature will clarify waters prior to them entering surface watercourses.	Imperceptible	Unlikely
Operational Phase	Cleaning of settlement ponds	Surface Waters: Kilcrow_070 Gortaha_010 Lough Derg River Shannon	Improves efficiency of settlement ponds and capacity. Moderate Impact	Particulate matter captured in settlement ponds to be transferred to landscaped perimeter bunds.	Imperceptible	Unlikely

			Mobilisation and migration of suspended solids			
Operational Phase	Use of wheel wash	Surface Waters: Kilcrow_070 Gortaha_010 Lough Derg River Shannon	Removal and entrapment of particulate matter attached to vehicles. Positive Impact	Positive impact so no mitigation required.	Positive	Unlikely
Operational Phase	Wheelwash maintenance	Surface Waters: Kilcrow_070 Gortaha_010 Lough Derg River Shannon	Improves of wheel wash Mobilisation and migration of suspended solids. Moderate Impact	The wheel wash is to be maintained in accordance with manufacturer's specifications.	Imperceptible	Unlikely
Operational Phase	Use & maintenance of hydrocarbon interceptors	Surface Waters: Kilcrow_070 Gortaha_010 Lough Derg River Shannon	Entrapment of hydrocarbons lost during movement of site waters. Positive Impact	Positive impact so no mitigation required. Oil that accumulates within hydrocarbon interceptors shall be regularly removed by an appropriately licensed contractor. The hydrocarbon interceptors shall be appropriately maintained in accordance with the manufacturer's specifications.	Positive	Unlikely

ENVIROLOGIC

Operational Phase	Monitoring	Groundwater Bodies: Tynagh GWB Surface Water Bodies: Kilcrow_070 Gortaha_010 Lough Derg River Shannon	Monitoring of surface water quality, groundwater quality Positive Impact	Regular visual monitoring of the settlement lagoons will continue as per present to ensure no visual oil or fuel contamination. Hydrocarbons are monitored regularly in on-site groundwaters and nearby surface waters. Monitoring will continue as per current regime.	Imperceptible	Unlikely
Operational Phase	Abstraction	Groundwater Bodies: Tynagh GWB Oldthort GWS	Dewatering of Groundwater Body	As specified in Table 7 and Table 8, the operational requirement of Project Coolpowra accounts for only 0.075% of the annual average recharge to the Tynagh GWB	Imperceptible	Unlikely

Table 11 – Mitigation Measures: Unplanned Scenarios

Scenarios where impacts may arise	POTENTIAL IMPACT			MITIGATION MEASURES	RESIDUAL EFFECT FOLLOWING MITIGATION	
	Activity	**Attribute**	**Character of Potential Impact**	**Description of Mitigation**	**Significance or quality of Effect**	**Probability**
Unplanned Scenario	Major Spillage	Groundwater Bodies: Tynagh GWB Surface Water Bodies: Kilcrow_070 Gortaha_010 Lough Derg River Shannon	Hydrocarbon contamination. Significant impact.	All runoff generated on potentially at-risk areas pass through a hydrocarbon interceptor prior to leaving the site. The outlet of the hydrocarbon interceptor will be fitted with a shutoff valve to facilitate manual containment of a significant spill. A contained spillage will be disposed of appropriately by a licensed contractor. Potentially harmful chemicals stored on site (e.g. lubricants) to be stored under cover on bund trays.	Imperceptible	Unlikely
	Intense Rainfall Events	Surface Water Bodies: Kilcrow_070 Gortaha_010	On-site & off-site flooding. Significant impact.	The flood risk assessment submitted as part of the planning application has adopted a conservative approach which incorporates the Q_{100} and Q_{1000} flood event. An allowance for climate change has also been included in the flood flow calculations for each catchment. There is no increased risk to downstream receptors as a result of the proposed development.	Imperceptible	Unlikely

9 SUMMARY

The proposed development, as outlined in this document, is necessary to increase security of energy supply and to keep the electricity grid stable and reliable in the face of growing demand. The development includes different flexible technologies, which were chosen to compliment and support the integration of further renewable generation technologies.

It is intended to demolish an existing dwelling and farmhouse on the site and construct the following:

- A Reserve Gas-Fired Generator comprised of three OCGT Units;
- Upgrade and replacement of the existing 400kV AIS substation with a 400kV GIS substation;
- Alternative Technology infrastructure such as Long Duration Energy Storage (LDES) and a Synchronous Condenser.

The predicted status change from proximal surface waterbodies and underlying groundwater bodies, arising from potential quantitative and qualitative impacts during the construction and operational phases of the proposed development are outlined in Table 12.

It is confirmed that the proposed development, along with its predicted abstraction volume, will not propagate a change to current WFD status of the Tynagh GWB or local surface waterbodies. Proposed stream realignment will improve hydrogeomorphology in the Kilcrow River network, creating potential new spawning grounds. The sub-catchment report (EPA, 2019) states that the Kilcrow_070 is at Moderate status, which contradicts the EPA maps portal which infers that current status in the Kilcrow_070 is Poor.

Table 12 – Potential Impacts to Qualitative and Quantitative Status of WFD Water Bodies

WFD Water Body	Tynagh GWB	Kilcrow_070	Gortaha_010
Current Overall WFD Status	Good	Poor	Moderate
Predicted Overall WFD Status	Good	Poor	Moderate

Predicted status change to the receiving watercourses and local sub-catchments, arising from quantitative and qualitative impacts during the construction, operational and restoration stages of the proposed development is outlined in Table 12, which concludes no potential to change the current Status. Both 'Risk Status' associated with the River Shannon (Shannon[Lower]_SC_050) were under review at the time of writing this report, hence are not assessed for predicted change to WFD status.

In In summary, the proposed development:

- Will not cause deterioration to any flowing surface water body, transitional water body or coastal waterbody.
- Will not impact any mapped or reported Drinking Water Area, Bathing Water, Shellfish Water or any other site.
- Will not cause a deterioration in the mapped 'Good' status of the underlying Tynagh GWB.
- Will not jeopardise the objectives to maintain the current status of the Tynagh GWB, the Gortaha_010 waterbody, the Kilcrow_070 waterbody, Lough Derg, or the River Shannon.

- Will not jeopardise the condition or protections provided to any downgradient designated site, or their future enhancement.
- Does not present any potential for impediment to the Programme of Measures associated with the River Basin Management Plan 2022 – 2027 or the Water Action Plan (WAP) 2024. The site boundary is not within any mapped Zones of Contribution or Source Protection Areas of any Water Supply Sources.
- Similarly, there are no High Status Objective sites connected to the development site.
- Is compliant with the requirements of the Water Framework Directive (2000/60/EC).