CLONASLEE FLOOD RELIEF SCHEME

Environmental Impact Assessment Report
Chapter 10: Land, Soils, Geology and Hydrogeology

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10.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) identifies, describes and presents an assessment of the likely significant effects of the Proposed Scheme on Land, Soils, Geology and Hydrogeology during both the construction and operational phases of the Proposed Scheme. The assessment presented is based on the information provided in **Chapter 5 – Project Description**. The assessment presented is further informed by the following EIAR chapters:

- **Chapter 9 – Biodiversity:** Impact pathways for terrestrial biodiversity
- **Chapter 11 – Water:** Direct or indirect effects on the groundwater environment depending on the degree of interaction between surface water and groundwater
- **Chapter 15 – Material Assets: Waste- Utilities.** Reuse of soils

The scope and objectives of this assessment are to:

- Review and characterise the baseline soils, geological and hydrogeological conditions of the existing environment within the Study Area.
- Evaluate the impact of the Proposed Scheme on these attributes and establish the activities associated with the construction and operation of the Proposed Scheme.
- Identify groundwater vulnerability to assess the impacts of the Proposed Scheme on the underlying aquifers and any potential impacts on public/private water abstractions/wells.
- Consider the likely hydraulic and hydrochemical impacts that are likely to arise from the construction and operation of the Proposed Scheme.
- Address interactions with other disciplines (hydrology, ecology, waste); whether there are likely to be any indirect impacts by changes in hydrology/hydrogeology on terrestrial and aquatic habitats including annexed species that are designated and thus protected under Irish and European law.
- Identify and assess any potential impacts on any geological heritage sites or sites of geological interest.
- Identify and incorporate appropriate mitigation measures, that would prevent, reduce or remediate the identified impact.
- Conclude any residual impacts that would remain or arise from the mitigation measures identified.

10.2 Methodology

10.2.1 Legislation, Policy and Guidance

10.2.1.1 Legislation

The principal legislation relevant to this chapter is set out in the following primary legislation:

- European Union Directive on the Assessment of the Effects of Certain Public and Private Projects on the Environment (2014/52/EU)
- European Communities Environmental Objectives (Groundwater) Regulations 2010 (S.I. No. 9 of 2010)
- European Communities Environmental Objectives (Groundwater) Amendment Regulations 2016 (S.I. No. 366 of 2016); European Communities Environmental Objectives (Groundwater) (Amendment) Regulations 2022 S.I. No. 287 of 2022
- Part IV of the First Schedule of the Planning and Development Act 2000, as amended
- European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003)

- European Union (Drinking Water) Regulations 2014 (S.I. No. 122/2014)
- European Union (Drinking Water) (Amendment) Regulations (S.I. No. 464 of 2017)
- European Union Directive on the Assessment and Management of Flood Risks (2000/60/EC)
- European Union Water Framework Directive (WFD) (2000/60/EC)

In Ireland, the original Groundwater Directive (80/68/EEC) was primarily transposed into National legislation through:

- The Local Government (Water Pollution) Act, 1977 to 1990
- The Local Government (Water Pollution) Regulations, 1978 (SI No 108 of 1978)
- The Protection of Groundwater Regulations, 1999 (SI No 41 of 1999). This was repealed and replaced by the Waste-Water Discharge (Authorisation) Regulations, 2007 (SI 684 of 2007) in 2013
- The Local Government (Water Pollution) (Amendment) Regulations, 1999 (SI No 42 of 1999)

10.2.1.2 Policy

The Proposed Scheme is located in the administrative area of Laois County Council (LCC) and the policies included in the Laois County Development Plan 2021-2027 have been considered in the preparation of this chapter.

10.2.1.3 Guidance

The impact assessment has had regard to the general guidance regarding the undertaking of an EIA (as presented in **Section 1.5** and **1.6** of **Chapter 1 – Introduction)** and the following topic specific guidance in relation to land, soils, geology and hydrogeology:

- Guidance on the Management of Contaminated Land and Groundwater at EPA Licensed Sites (EPA, 2013)
- Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements, hereafter referred to as the 'Guidelines', IGI (2013) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (TII, 2009)
- Office of Public Works (OPW) (2009) The Planning System and Flood Risk Management Guidelines for Planning Authorities
- Geology in Environmental Impact Statements – A Guide (Institute of Geologists of Ireland (IGI, 2002)

10.2.2 Zone of Influence

To examine the potential impacts on adjacent soils and land, the Study Area extends outside the footprint of the Proposed Scheme to a 1 km buffer zone from the works areas. To fully examine the potential impacts on groundwater, a 2km radius from the works areas was studied which included examining two groundwater bodies (GWBs) ; the Clonaslee West GWB and the Geashill GWB which underlie the three works areas of the Scheme.

The Zone of Influence (ZoI) also covers the bedrock aquifers traversed which have value in the local area for abstraction purposes. These aquifers are addressed in the baseline section of this chapter.

10.2.3 Sources of Information to Inform the Assessment

10.2.3.1 Desktop Study

The following publicly available data sources have been used to classify the regional and local setting, which are used to support the characterisation of the land, soils, geology and hydrogeology study area:

- Environmental Protection Agency (EPA) Catchments and online resources that include Hydronet (EPA Hydronet) and HydroTool (EPA HydroTool) and GIS maps – accessed July 2024

- EPA Catchment Science and Management Unit 3rd Cycle Draft Boyne Catchment Report. Available at https://www.catchments.ie/ - accessed December 2023
- GeoHive geospatial data hub. Available at https://www.geohive.ie/. accessed July 2024
- Geological Survey of Ireland (GSI) data, maps, reports and research. Available at https://www.gsi.ie/ - accessed July 2024
- Teagasc, Irish Soil Information System http://gis.teagasc.ie/soils/map.php
- Google Maps. Available at https://www.google.ie/maps/ accessed July 2024
- Laois County Development Plan (2021-2027)
- Groundwater Flooding Data Viewer https://dcenr.maps.arcgis.com
- Catchment Flood Risk Assessment and Management Studies (CFRAM)
- National Parks & Wildlife Service maps, data, reports and research. Available at https://www.npws.ie/ - accessed December 2023
- Uisce Éireann Tullamore South and Clonaslee Water Supply Zone - Drinking Water Quality Results - https://www.water.ie/help/water-quality/results/ accessed July 2024
- GeoDirectory, Laois County Council, 2024.

10.2.4 Key Parameters for Assessment

The flood relief measures identified as part of Study Area are set out in **Table 10-1.**

Table 10-1: Study Area Works Areas

Area Name	Area Location	Defence elements
Area 1: Brittas Wood	Existing walking/access track within Brittas Woods	• Embankment • Debris trap with access slipway • Culvert remediation
Area 2: Chapel Street	Existing wall along Chapel St. at Clonaslee village	• Flood wall
Area 3: Tullamore Rd and Integrated Constructed Wetland (ICW)	500m north of Clonaslee village at Uisce Éireann treatment plant.	• Flood wall • Embankment

The specific construction methodologies for each element of the works is provided in **Chapter 5 – Project Description**.

The following key parameters were examined as those having the potential to result in likely significant effects on an identified receptor or receptor group:

- Groundwater Quality (GWQ);
- Groundwater Resources (GWR);
- Regional Geomorphology (RG);
- Quaternary Deposits (QD);
- Aggregate Resources (AR);
- Geological Heritage (GH); and
- Groundwater Dependant Terrestrial Ecosystems (GWDTE).

An overview of potential impacts considered in relation to the above parameters during the construction and operational phases is contained in **Table 10-2.**

Table 10-2: Potential Impacts considered in Assessment

Parameter	Phase*		Potential impact
	C	O	
GWQ	✓	✓	Short-term effects upon groundwater quality and groundwater recharge through the infiltration of surface run-off within or adjacent to construction areas
GWQ	✓	✓	Impact to soil and groundwater quality due to accidental spillages of chemicals/ fuel/concrete. Impact to groundwater quality (increase to groundwater vulnerability) through the reduction in overburden thickness for excavations for wall and embankment foundations and for drainage requirements
GWR	✓	✓	Increased risk of contaminants entering groundwater abstraction wells Impact on the hydrogeological environment through hydraulic impact (i.e. change in water levels, supply, flow rates and flow regime)
AR/Soil and Subsoil Reserves	✓		Loss of soil and subsoil reserves through excavation for foundations
QD	✓		Impact to soil and subsoil quality through disturbance of contaminated material. Impact to the integrity of soil and subsoil quality (settlement/ground subsidence) through construction activities i.e. embankment construction and drainage works
GH	✓		Impact to integrity of geological heritage as a result of Proposed Scheme
GWDTE	✓		Loss of or impacts to GWDTE as a result of the Proposed Scheme
RG°	✓		Impact or changes to the geomorphological characteristics of the Study Area

*C = Construction, O = Operation

°Changes to Fluvial Geomorphology is addressed in **Chapter 11** Water.

10.2.5 Assessment Criteria and Significance

The criteria for determining the significance of effects is a two-stage process that involves defining the sensitivity of the receptors and the magnitude of the potential impacts.

The significance of an impact is defined by first considering the importance of the attribute impacted and secondly the magnitude of the impact. The importance of geological and hydrogeological attributes (rating criteria) is defined in accordance with the '*Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes'* (2009) (hereafter referred to as the 'TII Guidelines'). With the exception of the exclusion of the terms 'not significant' and 'very significant', this guidance uses the same significance terminology as the EPA and includes intermediate steps for rating site importance (**Table 10-**) and magnitude of impact (**Table 10-**), and then significance of impact (**Table 10-**). For the purposes of this assessment, a rating of moderate and above is considered significant in EIA terms.

Table 10-3: Rating Criteria for Site Importance of Geology and Hydrogeology Attributes (TII, 2009)

Importance	Criteria	Typical Examples	
		Soils and Geology	Hydrogeology
Extremely High	Attribute has a high quality or value on an international scale.	–	Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation e.g. SAC or SPA status.
Very High	Attribute has a high quality or value on a regional scale.	Geological feature rare on a regional or national scale (NHA). Large existing quarry or pit Proven economically extractable mineral resource	Regionally Important Aquifer with multiple wellfields. Groundwater supports river, wetland or surface water body ecosystem protected by national legislation – NHA status. Regionally important potable water source supplying >2,500 homes. Inner source protection area for regionally important water source.
High	Attribute has a high quality or value on a local scale.	Contaminated soil on site with previous heavy industrial usage Large recent landfill site for mixed wastes Geological feature of high value on a local scale (County Geological Site) Well drained and/or highly fertility soils Moderately sized existing quarry or pit Marginally economic extractable mineral resource	Regionally Important Aquifer Groundwater provides large proportion of baseflow to local rivers Locally important potable water source supplying >1000 homes Outer source protection area for regionally important water source Inner source protection area for locally important water source
Medium	Attribute has a medium quality or value on a local scale.	Contaminated soil on site with previous light industrial usage Small recent landfill site for mixed wastes Moderately drained and/or moderate fertility soils Small existing quarry or pit Sub-economic extractable mineral resource	Locally Important Aquifer Potable water source supplying >50 homes Outer source protection area for locally important water source
Low	Attribute has a low quality or value on a local scale.	Large historical and/or recent site for construction and demolition wastes Small historical and/or recent landfill site for construction and demolition wastes Poorly drained and/or low fertility soils Uneconomically extractable mineral resource	Poor Bedrock Aquifer Potable water source supplying

Table 10-4: Rating Criteria for Magnitude of Impact on Geological and Hydrogeological Attributes (TII, 2009)

Importance	Criteria	Typical Examples **Soils & Geology**	Typical Examples **Hydrogeology**
Large Adverse	Results in loss of attribute.	Loss of high proportion of future quarry or pit reserves. Irreversible loss of high proportion of local high fertility soils. Removal of entirety of geological heritage features. Requirement to excavate / remediate entire waste site.	Removal of large proportion of aquifer. Changes to aquifer or unsaturated zone resulting in extensive change to existing water supply springs and wells, river baseflow or ecosystems. Potential high risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >2% annually.
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute.	Loss of moderate proportion of future quarry or pit reserves. Removal of part of geological heritage feature. Irreversible loss of moderate proportion of local high fertility soils. Requirement to excavate / remediate significant proportion of waste site. Requirement to excavate and replace moderate proportion of peat, organic soils and/or soft mineral soils.	Removal of moderate proportion of aquifer. Changes to aquifer or unsaturated zone resulting in moderate change to existing water supply springs and wells, river baseflow or ecosystems. Potential medium risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >1% annually.
Small Adverse	Results in minor impact on integrity of attribute of loss of small part of attribute.	Loss of small proportion of future quarry or pit reserves. Removal of small part of geological heritage feature. Irreversible loss of small proportion of local high fertility soils and/or high proportion of local low fertility soils. Requirement to excavate / remediate small proportion of waste site. Requirement to excavate and replace small proportion of peat, organic soils and/or soft mineral soils.	Removal of small proportion of aquifer. Changes to aquifer or unsaturated zone resulting in minor change to water supply springs and wells, river baseflow or ecosystems. Potential low risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >0.5% annually.
Negligible	Results in an impact on attribute but not of sufficient magnitude to affect either use or integrity.	No measurable changes in attributes.	Calculated risk of serious pollution incident <0.5% annually.
Minor Beneficial	Results in minor improvement of attribute quality.	Minor enhancement of geological heritage feature.	
Moderate Beneficial	Results in moderate improvement of attribute quality.	Moderate enhancement of geological heritage feature.	
Major Beneficial	Results in major improvement of attribute quality.	Major enhancement of geological heritage feature.	

Table 10-5: Definition of Terms Relating to the Significance of Impact Levels (EPA, 2022)

Term	Definition
Imperceptible	An effect capable of measurement but without significant consequences.
Not Significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
Slight Effects	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
Moderate Effects	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.
Significant Effects	An effect which, by its character, magnitude, duration or intensity, alters a sensitive aspect of the environment.
Very Significant	An effect which, by its character, magnitude, duration or intensity, significantly alters most of a sensitive aspect of the environment.
Profound Effects	An effect which obliterates sensitive characteristics.

The significance of the impacts on soils/geology and hydrogeology attributes are determined by correlating the importance/sensitivity of the receptor with the magnitude of the impact. The method employed for this assessment is presented in **Table 10-6**. For the purposes of this assessment, any impacts with a significance level of slight or less have been concluded to be not significant in EIA terms.

Table 10-6: Rating of Significant Environmental Impacts (TII, 2009)

	Magnitude of Potential Impact			
Importance	**Negligible**	**Small Adverse**	**Moderate Adverse**	**Large Adverse**
Extremely High	Imperceptible	Significant	Profound	Profound
Very High	Imperceptible	Significant/Moderate	Profound/Significant	Profound
High	Imperceptible	Moderate/Slight	Significant/Moderate	Profound/Significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight/Moderate

10.2.6 Data Limitations

This chapter of the EIAR was prepared using the best available information and in accordance with current best practice and relevant guidelines.

There were no data limitations or technical difficulties or otherwise encountered in the preparation of this chapter of the EIAR.

10.2.7 Consultation

A summary of the key issues raised during consultation activities undertaken to date specific to land, soils, geology and hydrogeology is presented **in Table 10-7**: Consultation Responses

7 together with how these issues were considered in the production of this EIAR chapter. Further detail is presented within **Chapter 3: Consultation**.

Table 10-7: Consultation Responses

Consultee and type of response	Comments and Issues raised	Response to issue raised and/or where considered in this chapter
Geological Survey of Ireland (GSI)-	There are no County Geological Sites (CGS); in the vicinity of the Proposed Scheme.	**Section 10.3.10** Geological Heritage Areas and Protected Sites.
	Regionally important aquifer - fissured underlies an area of scheme, groundwater vulnerability is variable	**Section 10.3.12** Aquifer Classification
	The zone of contribution of the Clonaslee Public Water Supply (PWS) is within the flood relief scheme areas. The GSI recommends that groundwater-surface water interaction be considered in relation to the public supply.	**Section 0** Public Supply
	GSI recommend the use of the groundwater viewer to identify areas of high to extreme vulnerability.	**Section 10.3.13** Aquifer Vulnerability
	Aggregate Potential can be seen via the Aggregate potential map viewer, use this to ensure that natural resources used in the scheme are from properly licensed facilities.	**Section 10.3.9** Mineral and Aggregate Resources
	GSI recommend that geohazards and flooding be taken into account when developing areas where these risks are prevalent.	**Section 10.3.8** Geohazards
	GSI request if the project goes ahead that a report with all SI works data be shared with them.	N/A
Teagasc	No Response	N/A

10.3 Description of the Existing Environment

10.3.1 Introduction

This section describes the existing conditions and important features in terms of the land, soils, geology and hydrogeology within the Study Area. The existing land, soils, geology and hydrogeology have been interpreted from a review of the publicly available information, as set out in **Section 10.2.3**, consultations and an ecological site walkover undertaken in August 2023. Please see Chapter 9 Biodiversity for details on all ecological surveys undertaken for the Proposed Scheme.

10.3.2 Previous Site Investigations

The details of previous site investigation reports and studies located within the study area that have been used in the assessment of the baseline ground conditions are presents in Table 10-8.

Table 10.8: Historic & Previous Site Investigations within the Study Area

Report Title	Year	Contractor	Location	Scope
Coolnabacky 400kV Substation Factual Report on Ground Investigation	2012	ESB International	Coolnabacky, Co. Laois	10 no. boreholes 15 no. Trial pits
Evaluation of Groundwater Resources of the Clonaslee Area Co. Offaly	1979	Geox	Clonaslee	Yield test Groundwater level monitoring

10.3.3 Topography & Regional Geomorphology

The topography within the footprint of the Proposed Scheme is relatively flat (adjacent to the River Clodiagh at Clonaslee) to gently undulating, typical of a glacial outwash plain.

Within the Study Area, regional topography slopes towards the Rivers Clodiagh and Gorragh from the local highpoint of 286mOD at Ross, within the lower Slieve Blooms, approximately 2km south of Area 1-Brittas Woods. Elevations across the proposed works areas range from 100m in the north (in the vicinity of Area 3-Tullamore Road and ICW) to 140m in the south (in the vicinity of Area 1-Brittas Woods).

The geomorphology comprises deglacial landforms represented by hummocky sand and gravel deposits (drumlins) to the northeast of the study area which are aligned in a north-east to south-west orientation. Glacial meltwater channels emerge from the high ground to the south.

10.3.4 Landuse and Landtake

10.3.4.1 Landuse

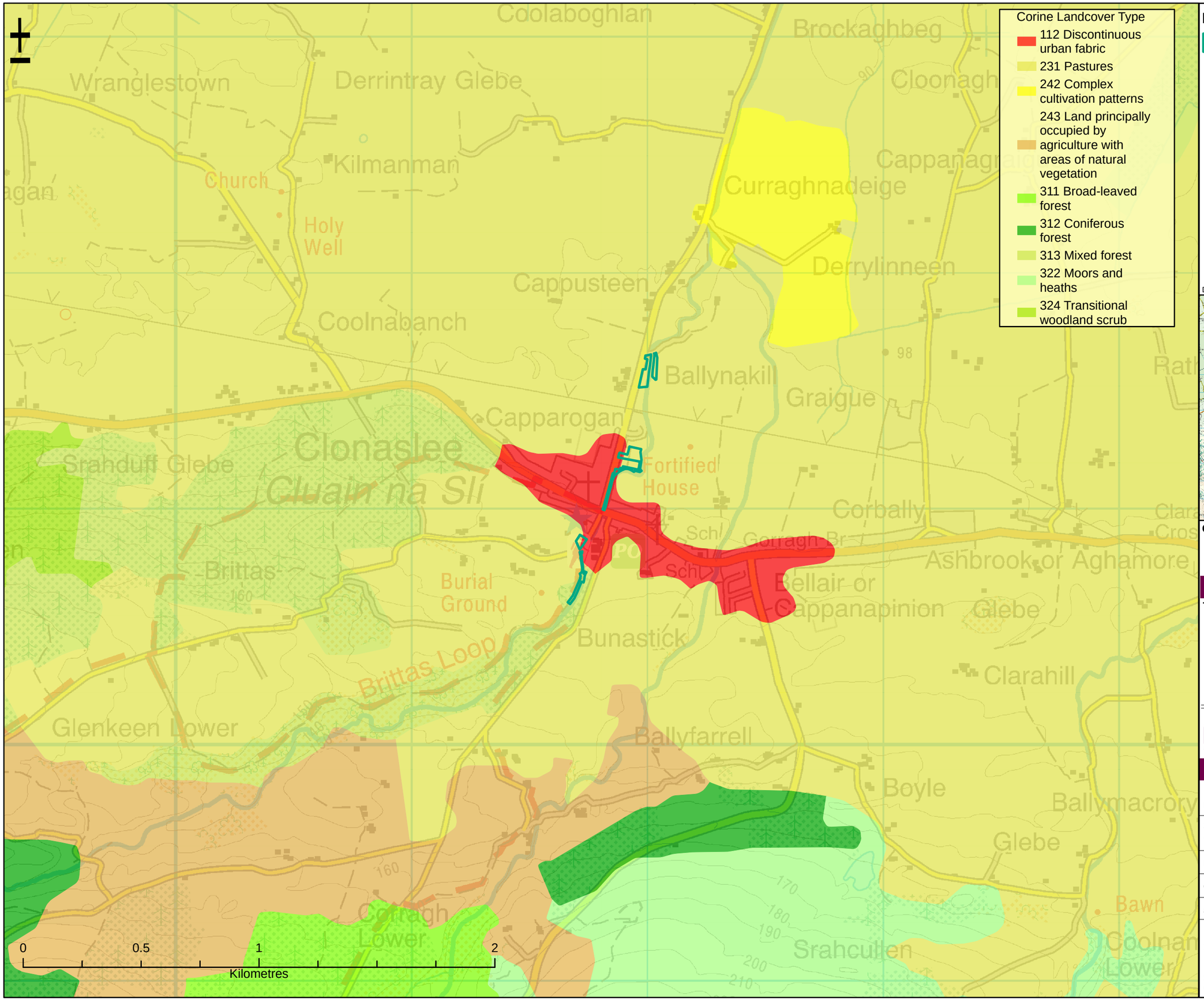
The EPA's CORINE 2018 landcover map consists of an inventory of land cover under various classes. This dataset is replicated in "Land Use" **Figure 10-2**. It shows that the landcover distribution in the centre of the Study Area is occupied by discontinuous urban fabric with artificial surfaces which is consistent with the population centre of the town of Clonaslee. The outer sections of the Study Area primarily the northern and eastern portion of the Study Area is mapped as a mixture of agricultural areas including pastures and complex cultivation patterns and the western portion of the study area and along the Clodiagh River, south of the village is mapped as being dominated by forest and semi-natural areas (corresponding to Curragh and Brittas Woods, respectively). The identified land use within each area of the Scheme are identified in Table 10-.

Table 10-9: Scheme Areas Land Use Summary

Scheme Area Name	Corine Landcover Designation	Features and land use
Area 1: Brittas Wood	• Complex cultivation patterns	• Within public amenity woodland.
Area 2: Chapel Street	• Complex cultivation patterns • Discontinuous urban fabric	• Adjacent to Clonaslee village street. • Adjacent to terrace, church and GAA grounds. • A section of works in this area is within a private property garden, currently let out for short-term holiday stays.
Area 3: Tullamore Rd and Integrated Constructed Wetland (ICW)	• Complex cultivation patterns	• Within an agricultural field. • Within grounds of Uisce Éireann wastewater treatment facility.

The construction and operation of the Proposed Scheme will directly affect 10 private properties through-way. This includes 5 no. residential properties, 2 no. residential/agricultural properties, 2 no. agricultural properties and 1 no. commercial property. The remainder of the area where works will take place consists of portions of public roads and public pathways, as well as sections of river channel (i.e., where instream works are proposed).

For impacts on residential and commercial properties in terms of short-term and permanent wayleave requirements for the construction and maintenance of the Proposed Scheme, please see **Chapter 7 Population.**



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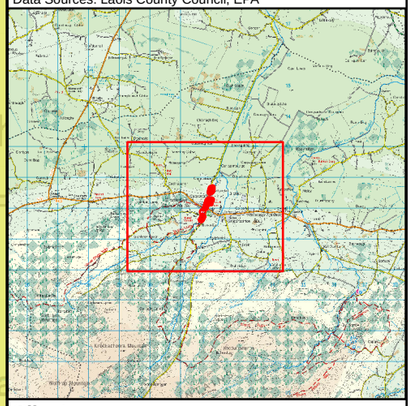
Works Area

Data Sources: Laois County Council, EPA



Client

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Figure 10-1: Land Use

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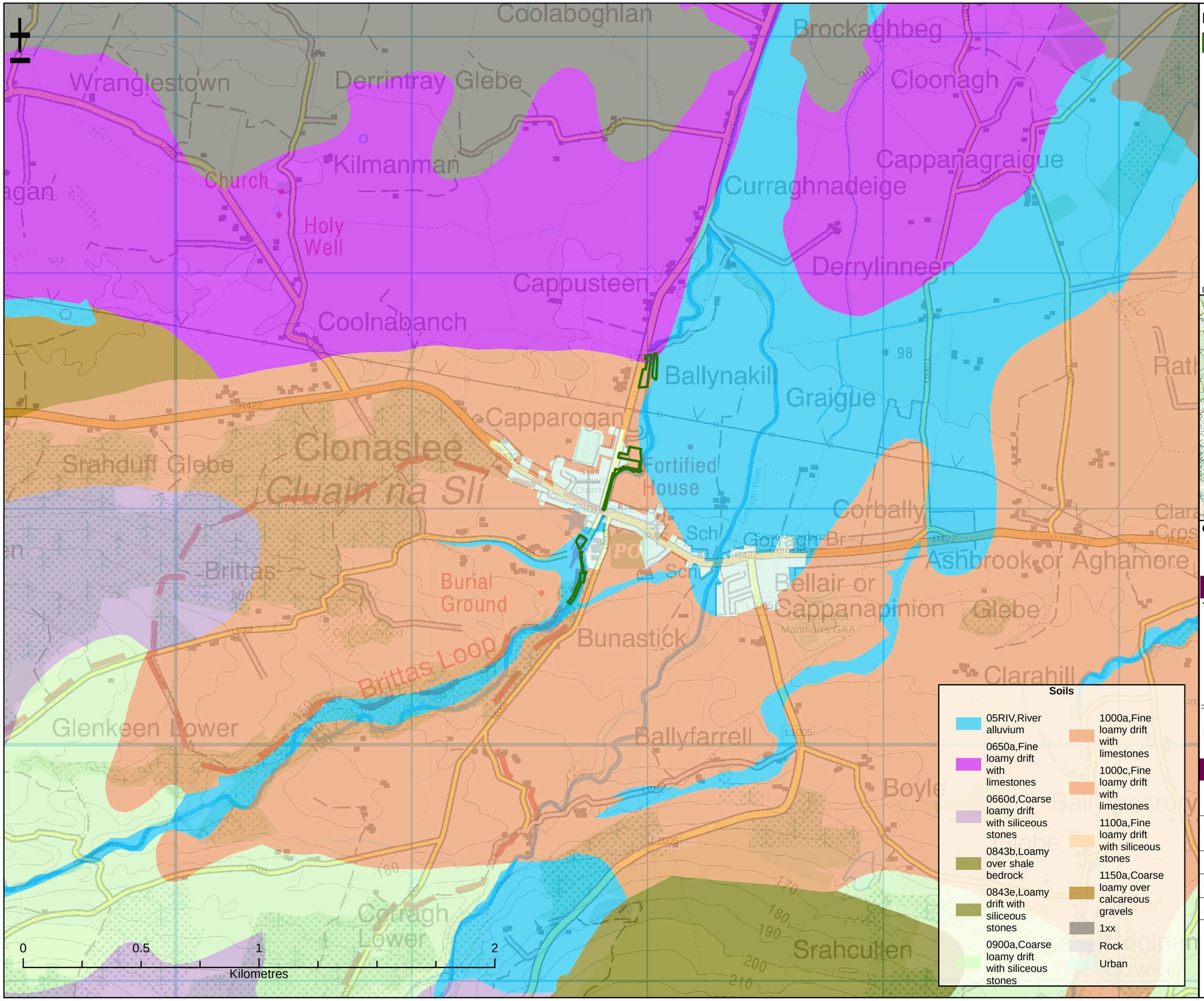
10.3.5 Quaternary Geology

10.3.5.1 Soils

The distribution of soil types present within the Study Area and their importance in terms of drainage properties and fertility is set out in **Table 10-**. The distribution of soil types across the Study Area is shown in "Teagasc Soils" (Figure 10-3).

Table 10-10: Teagasc Soil Classification within the Study Area

Soil Type	Drainage Properties	Soil Group	Location	Drainage/Fertility Importance
River alluvium	Poorly draining	Variable	Area 1- Brittas Woods Area 3- Tullamore Road and ICW (western portion) Northwest of the study are- Associated with the flood plains of Clodiagh River and River Gorragh	Low
Urban	No drainage or fertility properties	-	Area 2- Chapel Street Artificial cover in Urban/ residential/ commercial centre of Clonaslee	Low
Fine loamy drift with limestones	Well-draining	Typical Calcareous Brown Earths	Area 3- Tullamore Road and ICW East and west of the study area- outside the extent of the alluvium	High
Fine loamy drift with limestones	Shallow poorly draining	Surface water Gleys, Ground water Gleys,	North of the Study Area.	Low
Coarse loamy drift with siliceous stones	Shallow well-draining	Typical Brown Earths	South of the Study Area.	Medium



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Works Area

Data Sources: Laois County Council, EPA

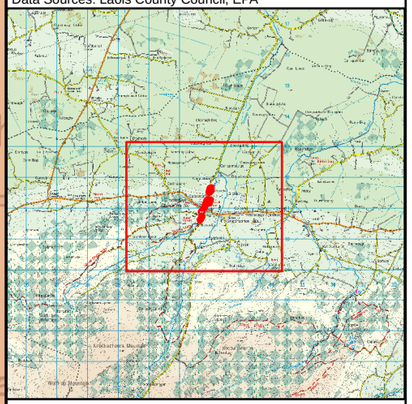

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Figure 10-2: Teagasc Soils

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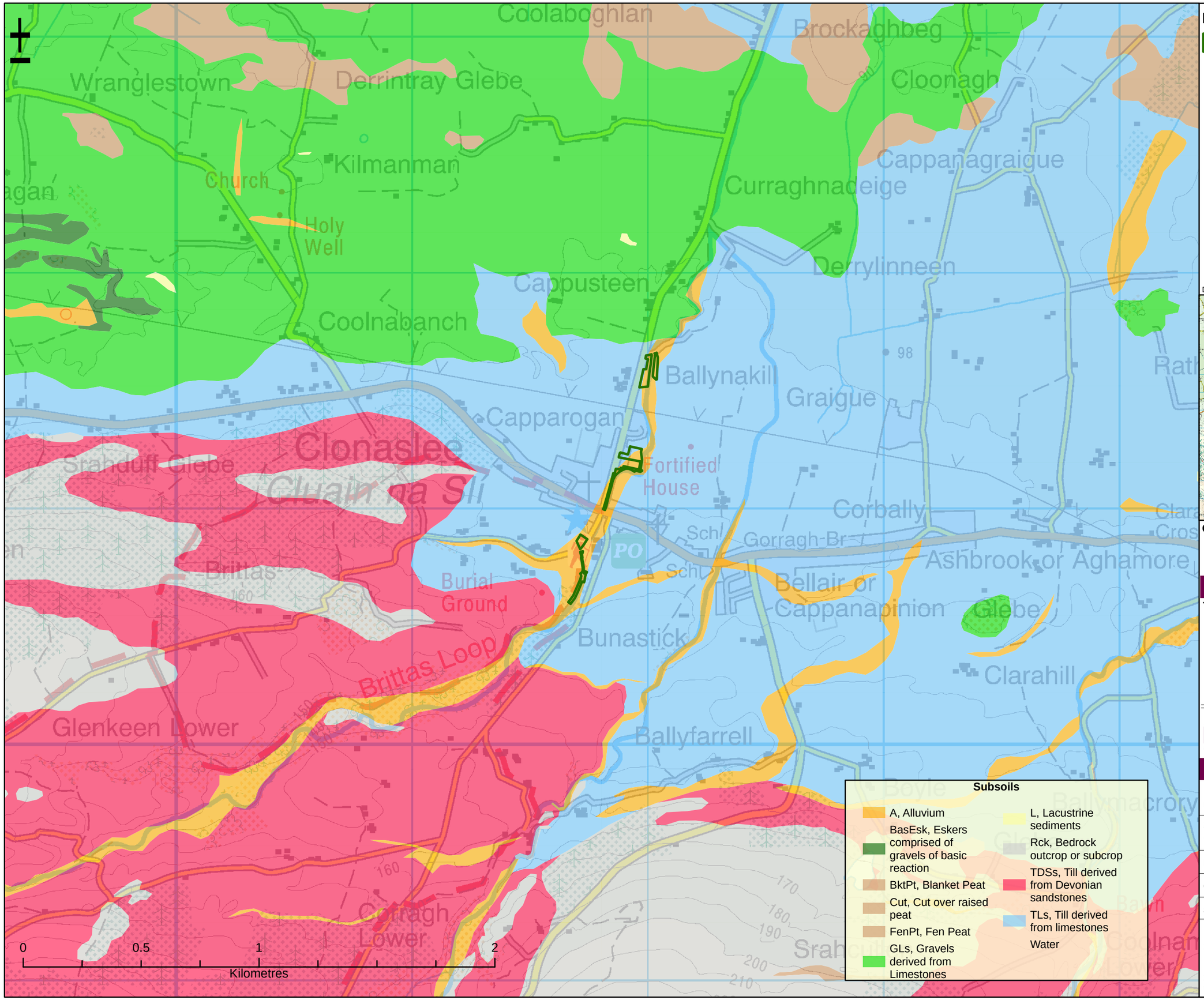
10.3.5.2 Subsoils

A review of GSI mapping indicates that the regional subsoils are varied. The dominant subsoil type within the proposed works areas is Alluvium associated with The Clodiagh River and Gorragh River. The remainder of the study area is dominated by Tills derived from either limestones (TLs) or sandstone (TDSs). Gravels derived from limestones (GLs) dominate at the northwest. The subsoil permeability in the Study Area is mapped as "Moderate" (GSI, 2024). **Table 10-11** sets out the subsoil types and locations within the Study Area.

Table 10-8: Subsoil Types within the Study Area

Soil Type	Attribute	Location
Alluvium (A)	Associated with the floodplains of the Clodiagh River and River Gorragh	Clodiagh River and River Gorragh: Area 1: Brittas Woods Western portion of Area 2– Chapel Street Eastern portion of Area 3- Tullamore Road and ICW
Tills derived from Limestone (TLs)	Limestone Till	Outside the extent of the Alluvial floodplain Eastern portion of Area 2– Chapel Street Western portion of Area 3- Tullamore Road and ICW
Tills derived from Sandstone (TDSs)	Sandstone Till	South and southwest of the study area
Gravels derived from Limestones (GLs)	Limestone Gravels	Northwest of the study area
Bedrock outcrop or subcrop (Rck)	Rock at or near surface	At the high ground in the west of the study area (Srahduff)

The subsoils underlying the study area is shown in "Subsoils" (Figure 10-4).



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Works Area

Data Sources: Laois County Council, EPA

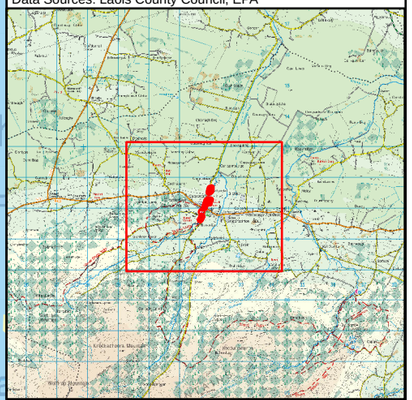

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Figure 10-3: Subsoils

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10.3.6 Bedrock Geology

The majority of the study area including Area 1- Brittas Woods and Area 2 - Chapel Street is underlain by the Clonaslee Member (Code: DUCDMT1), the top part of the Cadamstown Formation which is described as thick flaggy sandstone, thin siltstone and is the oldest bedrock unit beneath the Study Area from the Upper Devonian period (GSI, 2024).

Overlying the Clonaslee Member, a small portion of the northern study area, i.e. the southern portion of Area 3 - Tullamore Woods and ICW is mapped as the Lower Limestone Shale (Code: CDLLS) which is described as “Sandstone, mudstone & thin limestone” from the Dinantian series of the Carboniferous period (GSI, 2024).

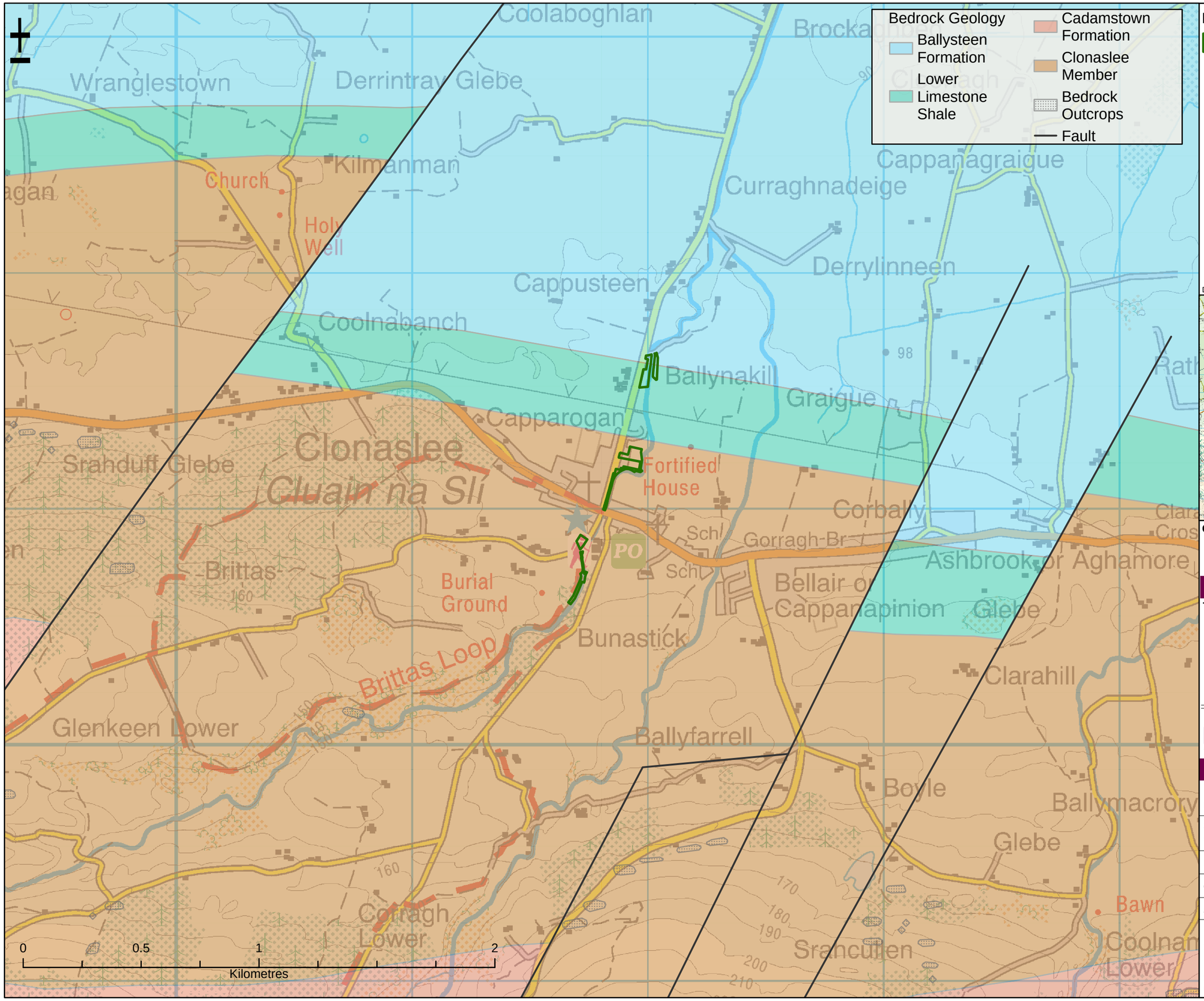
Further north, a minor portion of the study area, the northern portion of Area 3 - Tullamore Road and ICW is mapped as the Ballysteen Formation (Code: CDBALL) which is described as “Dark muddy limestone shale” (impure limestones) from the Dinantian series of the Carboniferous period (GSI, 2024).

Structural faults oriented in a south-west to north-east direction are mapped within the Clonaslee Member, Lower, Limestone Shale and Ballysteen Formation approximately 1.4km east of Area 2.

Based on GSI groundwater vulnerability and permeability mapping the depth to bedrock is expected to be at least > 8 meters below ground level (mbgl) (GSI, 2003). Depth to bedrock information from borehole drill records record a depth to bedrock of 18.3mbgl (GSI Well ref 2321SWW069) at Area 1, Brittas Woods and 19mbgl (GSI Well ref 2321SWW074) at Ballyfarrell, east of the Gorragh River. Depth to bedrock decreases towards the northwest of the study area with drilling logs recording depth to bedrock of 4.3mbgl ((GSI Well ref 2321SWW072) and 7mbl (GSI Well ref 2321SWW065) at Capparogan.

The importance of the Clonaslee Member, the Lower Limestone Shale and Ballysteen Formation in terms of their economic importance (crushed rock aggregate potential) is set out under **Section 10.3.9**.

The bedrock geology underlying the study area is shown in “Bedrock Geology” (Figure 10-5).



Legend

Works Area

Data Sources: GSI, EPA

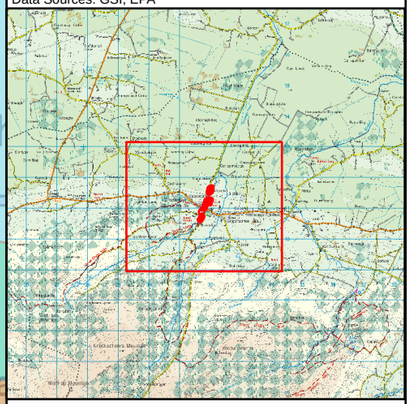


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Figure 10-4
Bedrock Geology

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10.3.7 Contaminated Land and Soil Quality

Various sources of information including historic mapping, aerial photography, Teagasc soil mapping, CORINE landcover mapping, EPA datasets and the SI information were reviewed to assess the potential for contaminated land within the Study Area.

OSI historic 6 Inch (1829-1841) and 25-inch mapping dating back to 1888-1913 records historical industry along the Clodiagh River and River Gorragh, including a saw-mill, a smithy and a corn mill (OSI, 2023). The saw mill and corn mill were located at Ballynakill, 400m east of Chapel St and the smithy 260m south of Tullamore Road (Area 3). A historic burial ground at Killyann was present approximately 150m west of Brittas Woods. The sawmill, smithy and corn mill are no longer evident on modern-day OSI mapping and Google Earth aerial imagery. However, the present day Clonaslee Water treatment plant adjacent to Brittas Woods is evident on OSI historic 6 Inch (1829-1841) as "Clonaslee Water Treatment Plant".

A review of EPA Licenced Activity sites notes an Uisce Éireann urban wastewater treatment plant (WWDA License Ref: D0386-01) located to the north of the village off the Tullamore Road. This is an Integrated Constructed Wetlands (ICW) type treatment plant. Another licensed site, named as Rosderra Farms (Portlaoise) is located approximately 1.1km east of Clonalsee which is an Integrated Pollution Control (IPC) licensed site (Reg: P0435-02). There are no historical or currently active landfill sites or waste licensed facilities within the Study Area.

From a review of historic OSI mapping and historic aerial photography (1995-2023), there has been minimal expansion of housing and commercial development into greenspace within the study area and there has been no identifiable expansion of industrial developments or infrastructure identified.

Due to the presence of made ground within the central portion of Study Area (Area 2) there is potential for residual ground contamination such as inclusions of waste components or residual chemicals to be present, however, no evidence of ground contamination has been identified within the Study Area.

An ecological walkover survey carried out in August 2023 identified the presence of the Invasive Alien Species (IAS) Japanese Knotweed in the northern portion of works Area 2 – Chapel Street. Chapter 9 Biodiversity discusses the presence of, and mechanisms for, the spread of crayfish plague in the River Clodiagh.

Overall, there is a low potential for ground contamination locally based on the current and historic land-use.

A summary of potential sources of contamination including licenced facilities, within the Study Area and their importance locally in terms of their potential as a source of contamination is presented in **Table 10-**. There are as also a number of historical quarry and pit locations located within the study area which are presented in **Table 10-**.

Table 10-9: Summary of Potential Sources of Contamination within the Study Area

Feature	Source	Location	Importance
Made/ Built Land	GSI	Area 2- Chapel Street	Medium*
IAS	Ecological Walkover Survey	Northern portion of Area 2 – Chapel Street	High
St Manaman's Cemetery	OSI, 2023; Google 2023 satellite imagery	Approx. 0.65km east of Area 2- Chapel Street	Low
Clonaslee Water Treatment Plant	OSI, 2023; Google 2023 satellite imagery	Adjacent to Brittas Woods	Low
Mahers Mills Petrol Station	Google 2023 satellite imagery	Approx. 0.68km east of Area 2- Chapel Street	Low
Texaco Service station	Google 2023 satellite imagery	Srahduff Glebe, approx. 2km west of Area 2- Chapel Street.	Low
Uisce Éireann Integrated Constructed Wetlands (ICW) UWW Treatment Centre EPA WWDA Licenced Site (Ref: D0386)	EPA 2023 Webmapping and Database	200m north of Area 3- Tullamore Road	Low

Feature	Source	Location	Importance
Rosderra Farms (Portlaoise) EPA IPC Licensed Site (Ref: P0435-02)	EPA 2023 Webmapping and Database	Approx. 1.1km east of Area 3- Tullamore Road and ICW	Low

*Importance in terms of Made ground fertility and drainage is Low as per Table 10-9.

10.3.8 Geohazards

Soft and/or unstable deposits within the Study Area consist of alluvium. Alluvial deposits are predominantly associated with the floodplains of the Clodiagh River and the Gorragh River (as described in Section 10.3.4). There are no peat soils, raised bogs, blanket bogs or fens mapped within the footprint of the Proposed Scheme however there are peaty gleys mapped approximately 1.8km north-east of Area 3 at Cappanagraigue.

The landslide susceptibility of the majority of Area 1, Area 2 and Area 3 is classified as “Low” (inferred), with a small portion of lands located 800m west of Area 2 classified as “Moderate” and “High” landslide susceptibility. There are no records of landslides held by the GSI within the Proposed Scheme footprint however, one landslide event is recorded within the Study Area occurring on April 2021, located approximately 1.1km south of the Proposed Scheme at Srahcullen. There are no seismic events recorded by the Irish National Seismic Network (INSN) within a 86km radius of the Study Area.

According to the GSI’s Groundwater Flooding Viewer there are no mapped flood extents of groundwater flooding within the Study Area.

There are no mapped rock outcrops or karst features within the Study Area. The closest karst features, which are mapped as superficial solution features “*dissolved limestone outcrop with karren*” are located approximately 5.5 km north of Area 3 at Killurin within the Allenwood Bedrock Formation. Given the nature of the underlying bedrock within the Study Area, the risk of encountering karst during sub surface excavations is considered low to minimal.

The overall potential for occurrence of geohazards within the Study Area is therefore considered to be low to minimal.

10.3.9 Mineral and Aggregate Resources

Based on a review of the GSI Spatial viewer there are a number of historical pits and quarries within the Study Area. There are no metallic or non-metallic mineral localities identified on the GSI Spatial viewer within the Study Area. **Table 10-** presents a summary of the historic gravel pits and quarries within the Study Area.

Table 10-10: Pits, Quarries and Mineral Locations identified within the Study Area

Feature	Distance from Proposed Scheme (km)	Location	Description
Historic Pit	0.49km west of Area 2	Cappusteen	-
Historic Pit	0.7km west of Area 2	Cappusteen	-
Historic Pit	1.54km north of Area 3	North Clonaslee	Early to Mid-20th Century Pit
Historic Pit	0.54km east of Area 1	Clarahill	Early to Mid-20th Century Pit
Historic Pit	0.93km east of Area 1	Aghamore	Early to Mid 20th Century Pit
Historic Quarry	1.3km south of Area 1	Srahcullen	Early to Mid 20th Century Quarry
Historic Quarry	1.98km south of Area 1	Srahcullen	-
Historic Quarry	1.9km south of Area 1	Srahcullen	Early to Mid 20th Century Quarry
Historic Sand Pit	1.56km north-east of Area 3	Cappanacraigue	-
Historic Pit	0.87km west of Area 3	Kilmanman	Early to Mid 20th Century Pit
Historic Pit	1.8km north of Area 3	Cloonagh Beg	Early to Mid 20th Century Pit

The granular aggregate potential within the Study Area is mapped as “very low” corresponding to the alluvial flood plains of the Clodiagh River and River Gorragh while a portion of lands in Area 3- Tullamore Road and ICW are mapped as having “Moderate” and “High” potential (GSI, 2024). The rest of the Study Area is unclassified with regards to granular aggregate potential.

The majority of the Study Area is mapped as “very low” in terms of potential for crushed rock aggregate within Area 1, Area 2 and Area 3, while small portions of ground in the west of Area 1- Brittas Woods are mapped as “low” and “moderate”.

The GSI Aggregate potential rating within the Study Area and its relative importance in terms of its economic importance is set out in **Table 10-**.

Table 10-11: GSI Aggregate Potential within the Study Area

GSI Aggregate Potential	Potential	Location	Importance
Crushed Rock Aggregate Potential	Very Low	Area 1- Brittas Woods Area 2- Chapel Street Area 3- Tullamore Road and ICW	Low
	Low	Area 3- Tullamore Road and ICW (northern portion)	Low
Granular Aggregate Potential	Very Low	Area 1- Brittas Woods Area 2- Chapel Street Area 3- Tullamore Road and ICW	Low

10.3.10 Geological Heritage Areas and Protected Sites.

There is one County Geological Site (CGS) mapped approximately 1.49km south of Area 1- Brittas Wood and is recorded as the Glebe Quarry (Site Code: LS013). This is an intermittently worked flagstone quarry which is of interest due to it being “*a representative site for an important, but poorly exposed part of the geology of Slieve Bloom*” (GSI, 2024).

In accordance with TII Guidelines, Geological heritage areas are considered to be attributes of High importance. The location of this Geological Heritage Area is included in the “Bedrock Geology” (Figure 10-5).

While the Glebe Quarry is located within a 2km radius of the Proposed Scheme footprint, therefore, impacts associated with geological heritage areas are not further considered in this assessment.

10.3.11 Regional Hydrogeology

The Study Area is mapped as being underlain by two groundwater bodies (GWB: the Clonaslee West GWB and the Geashill GWB.

The majority of the Study Area including Area 1 - Brittas Woods and Area 2- Chapel Street are underlain by the Clonalsee West GWB (EU Code: IE_SH_G_066) which includes the bedrock of the Clonaslee Member. The Clonaslee West GWB is described as productive fissured bedrock with recharge occurring where the overburden is less than 5m thick or where sands and gravels exist along alluvial landforms. Discharge from the Clonaslee GWB is to the rivers crossing the aquifer, and there is some evidence of springs within the lower section of the sandstones implying that recharge is being rejected by the lower permeability layers. Flow within the aquifer occurs along fractures, joints and major faults with short flow paths in upland areas (<300m) and longer flow paths in confined areas of the aquifer in the Lower Limestone shales (GSI, 2024).

The north of the Study Area including Area 3 - Tullamore Road and ICW is underlain by the Geashill GWB (EU Code: IE_SH_G_103) which includes the bedrock of the Lower Limestones Shale and the Ballysteen Formation. The Geashill GWB is described as poorly productive bedrock with diffuse recharge occurring over the GWB via rainfall through subsoils and gravels such as those associated with hummocky sand and gravel deposits northeast of Area 3. Groundwater discharges to gaining streams and rivers and to springs within the GWB. Groundwater flow paths are described as occurring primarily through fractures and faults. The Geashill GWB is also described as having limited karstic limestone (GSI, 2024).

There is no recorded groundwater flow direction across the Study Area however, groundwater will follow a subdued version of topography within the underlying GWBs; therefore, local groundwater flow direction is expected to flow from south to north towards the Clodiagh River and Gorragh River.

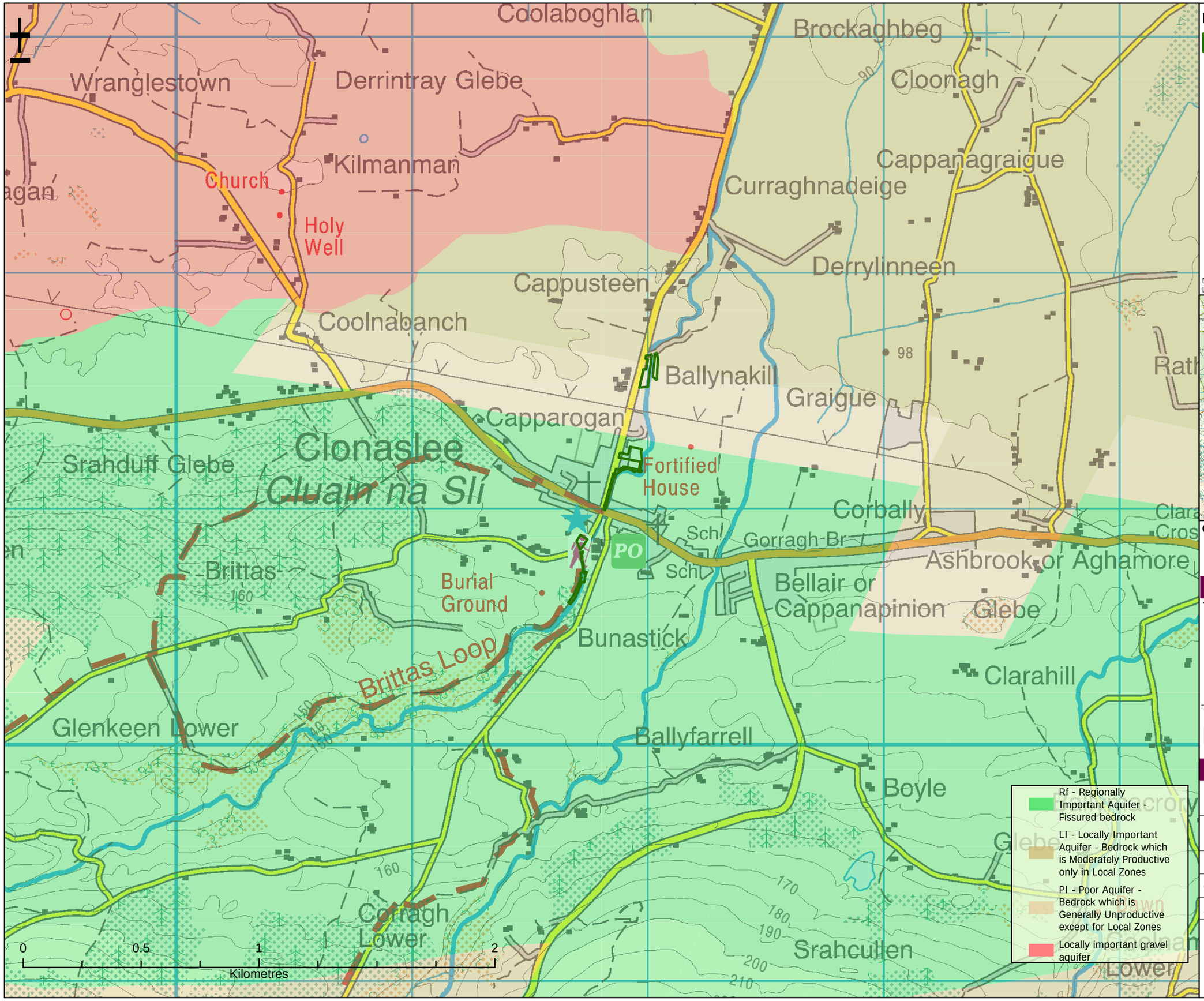
10.3.12 Aquifer Classification

The vast majority of the bedrock geology in the Study Area (encompassing Area 1 and Area 2) is classified by the GSI as a Regionally Important Aquifer (Rf) Fissured bedrock. This aquifer comprises bedrock of the Clonaslee Member i.e. the Clonaslee West GWB.

A small portion of the bedrock geology towards the north of the Study Area encompassing Area 3 comprises the bedrock of the Lower Limestone Shale which is classified as a Poor Aquifer (Pl) Bedrock which is Generally Unproductive except for Local Zones. The Ballysteen Formation forms the ground to the north of the Lower Limestone Shale and is classified as a Locally Important Aquifer (Ll) bedrock which is moderately productive only in local zones (these bedrock units comprise the Geashill GWB).

The Clonaslee Gravel Body is located approximately 1km to the northwest of Area 3, this gravel body is classified as Locally important gravel aquifers (Lg).

The aquifer types present within the study area are presented in Figure 10-6 and their importance in terms of a resource out is set in **Table 10-**.



Legend

Works Area

Rf - Regionally Important Aquifer - Fissured bedrock

LI - Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones

PI - Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones

Locally important gravel aquifer

Data Sources:
Laois County Council, GSI

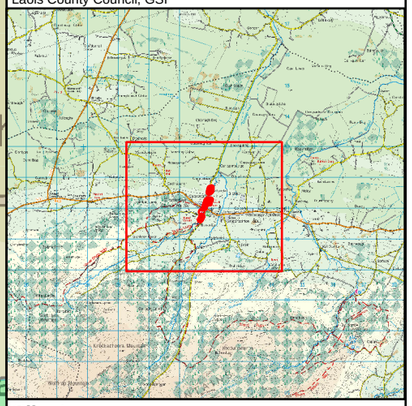


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Figure 10-5: Groundwater Aquifers

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Table 10-12: Aquifer Classification Summary

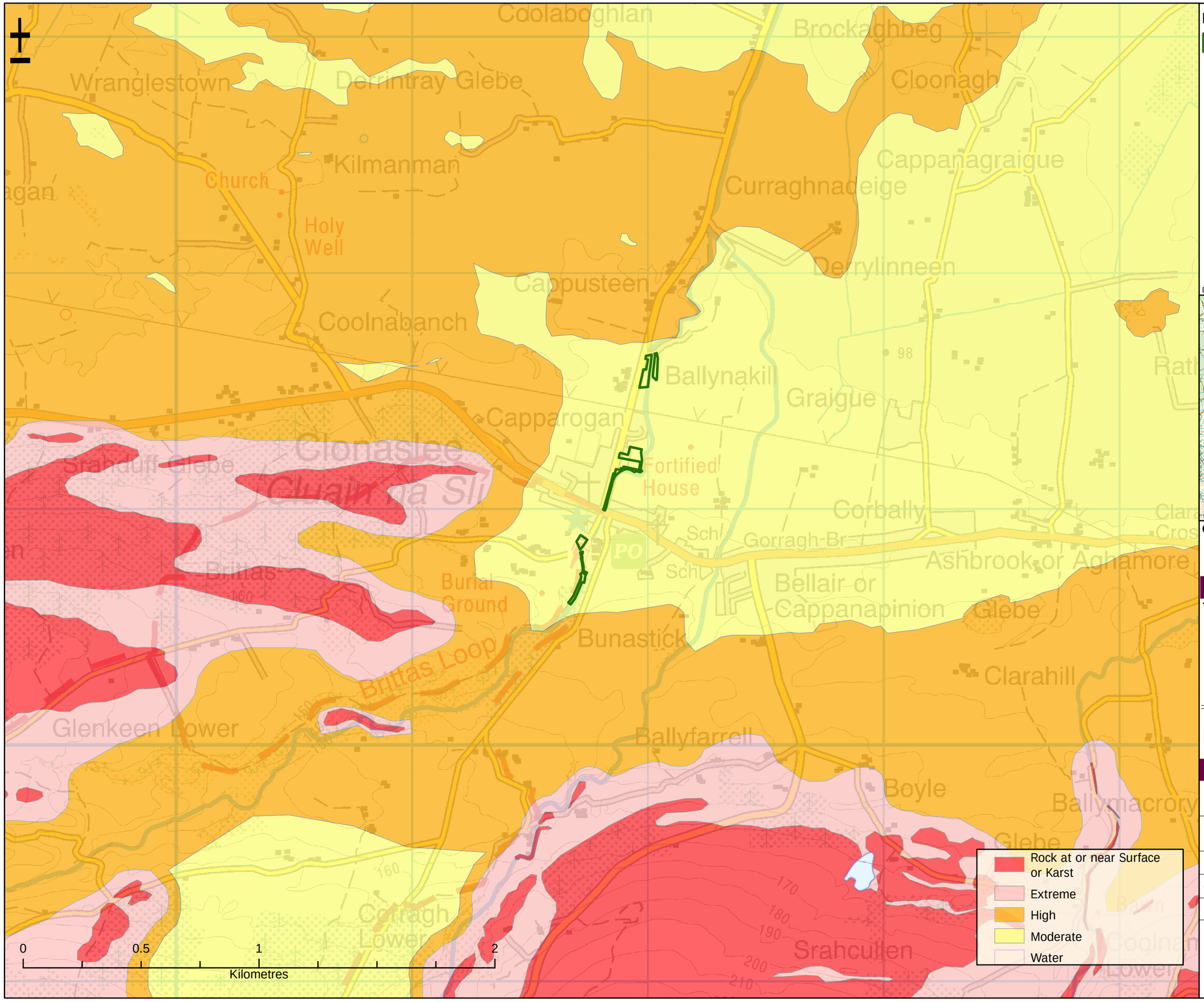
Aquifer Classification	Location	Importance
Regionally Important Aquifer (Rf)	South of the Study Area encompassing: Area 1- Brittas Woods Area 2- Chapel Street	High
Poor Aquifer (Pl) Bedrock which is Generally Unproductive except for Local Zones.	Area 3- Tullamore Road and ICW	Low
Locally Important Aquifer (Ll) bedrock which is moderately productive only in Local Zones	North of the Study Area	Medium
Locally important gravel aquifers (Lg)	Northwest of the Study Area	Medium

10.3.13 Aquifer Vulnerability

The GSI have developed a system to classify aquifer vulnerability based on the thickness and permeability of the overburden. The greater the thickness and permeability, the greater the protection to the groundwater in the underlying aquifer.

The majority of the Study Area encompassing all three proposed works areas is classified as having 'Moderate'(M) vulnerability indicating 5-10m of low permeability subsoil or >10m of moderate permeability subsoil. The south and west of the Study Area is mapped as 'High' (H) vulnerability indicating 5m-10m of moderate or low permeability subsoil or >10m of high permeability subsoil (GSI, 2003). Depth to bedrock information (Section 10.3.6) aligns with mapped vulnerability at Area 1 is Moderate (>10m moderate permeability subsoil) and at the northwest at Capparogan (7m of moderate permeability subsoil).

The vulnerability classification is presented in Table 10-16. The aquifer vulnerability classification of the study area is presented in the "Aquifer Vulnerability" (Figure 10-7).



Legend

Works Area

Data Sources: EPA

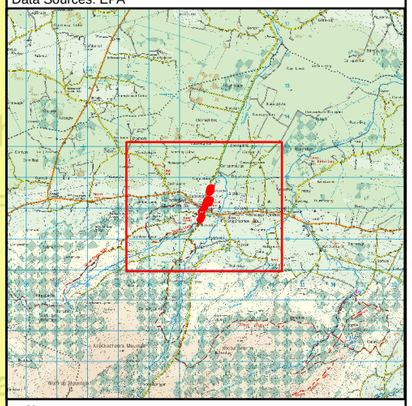


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Figure 10-6: Groundwater vulnerability

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Table 10-13: Vulnerability Classification Summary

Vulnerability Classification	Location
Moderate (M)	Northern portion of Area 1- Brittas Woods Area 2- Chapel Street Area 3- Tullamore Road and ICW Northeast of the study area
High (H)	Southern portion of Area 1- Brittas Woods South of the study area: Ballyfarrell Northwest of the study area
Extreme (E)	High ground to the west of the study area at Brittas and Srahduff
Extreme (X)	High ground to the west of the study area at Brittas and Srahduff

10.3.14 Groundwater Recharge

Due to the topographical changes across the Study Area, GSI Groundwater recharge mapping indicates variable although generally high recharge rates (between 101-550mm/year).

The ability of the bedrock to accept recharge is based generally on the permeability of the overlying subsoil and the thickness of the fissured/fractured zone of bedrock. Within the Study Area, recharge rates are highest (550mm/year) where the GSI has classified vulnerability as “high” particularly within the Sandstone Till mapped in the south and southwest of the Study Area.

Recharge rates are lower (101mm/year) in the central, residential/commercial centre of Clonaslee and in the vicinity of the Clodiagh River and Gorragh River which is attributed to the made ground restricting recharge. Recharge is capped for the Poor and Locally important aquifer at the north of the Study Area due to the fact they have low transmissivity and storage.

10.3.15 Groundwater Use and Abstractions

10.3.15.1 Domestic Wells

Data on wells in the Study Area was collected from the GSI Groundwater Data Viewer. There are 16 no. recorded groundwater wells and springs of mixed abstraction mapped within 2km of the Proposed Scheme that are underlain by the Geashill and Clonaslee West GWBs (the Study Area). The location of these wells are illustrated on the “Groundwater Wells and Springs”, Figure 10-8. The exact location of some of these wells is unknown with their locational accuracy ranging from 500m to 5km. It is possible that there are other unmapped private wells associated with farms or private properties within the Study Area that have not been recorded by the GSI. Domestic Wells are considered to be attributes of low hydrogeological importance on a local scale.

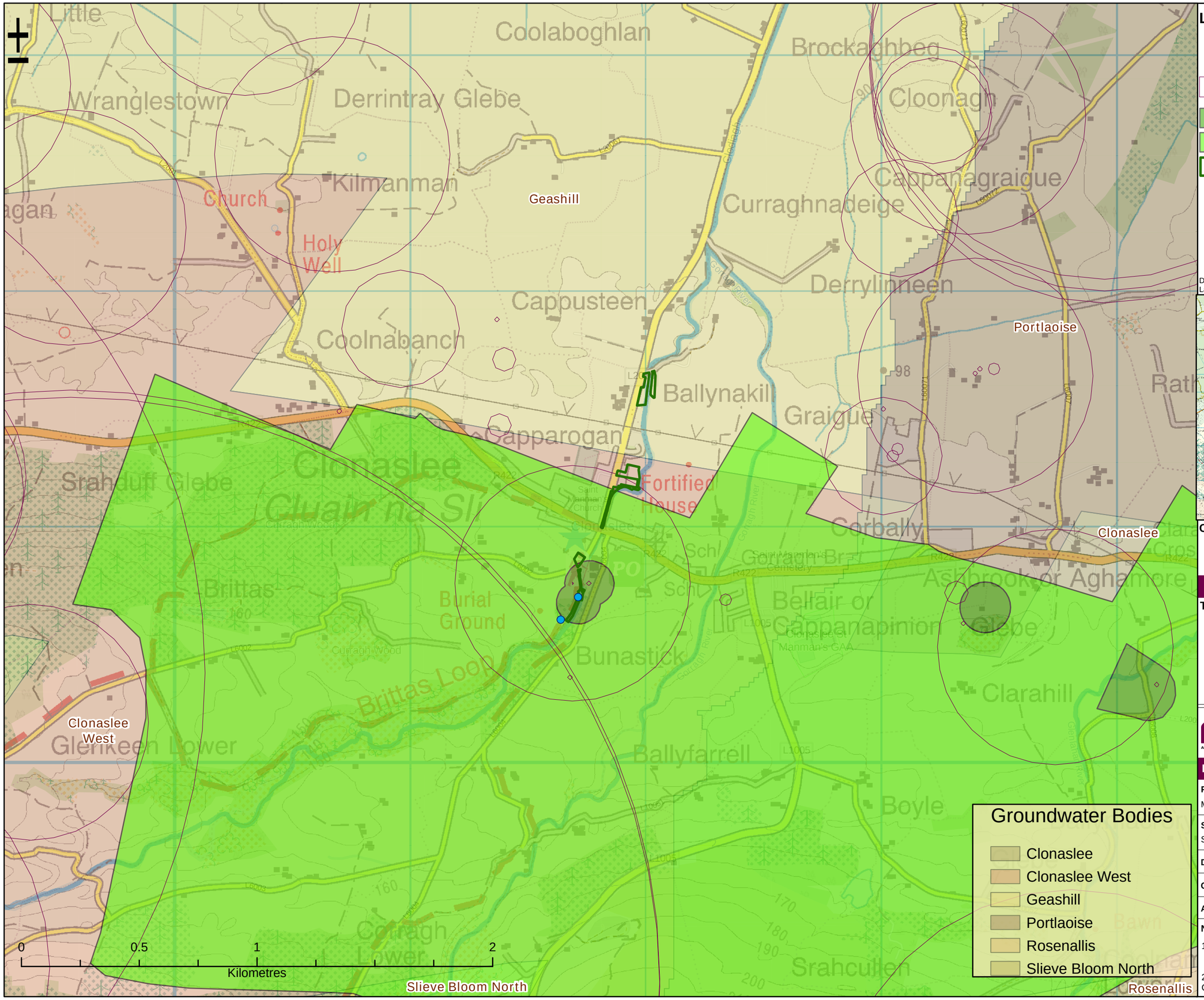
TII Guidelines state that ‘all live water supply wells within 100m of the footprint boundary will need to be assessed specifically for potential impacts on water level and quality’. None of the identified wells and springs recorded by the GSI within 100m of the Study area include private domestic wells , therefore no impact is envisaged as a result of the proposed works. The recorded GSI wells in the study area are detailed in **Table 10-.**

Table 10-14: Summary of Domestic Groundwater Wells and Springs recorded within the Study Area

GSI Well ID	Townland	Well Type	Well Use	Yield Class	Yield (m^3/day)
[1]2019NEW007	Scarroon	Borehole	-	Poor	32.7
[1]2019NEW008	Scarroon	Dug Well	-	-	-
2321SWW019	Clarahill	Dug Well	-	Moderate	43.6
2321SWW020	Graigueafulla	Borehole	-	Poor	21.8
2321SWW021	Graigueafulla	Dug Well	-	-	-
2321SWW022	Graigueafulla	Dug Well	-	Poor	21.8
[1]2321SWW023	Corbally	Borehole	-	Good	109
[1]2321SWW025	Coolnabanch	Dug Well	-	-	-

GSI Well ID	Townland	Well Type	Well Use	Yield Class	Yield (m^3/day)
2321SWW028	Cappanagraigue	Borehole	-	-	-
[1]2321SWW030	Coolnabanch	Dug Well	-	Poor	32.7
2321SWW065	Capparogan	Borehole	-	-	-
2321SWW066	Coolnabanch	Borehole	-	-	-
2321SWW071	Ballyfarrell	Borehole	-	-	-
2321SWW072	Capparogan	Borehole	-	-	-
2321SWW074	Ballyfarrell	Borehole	-	Poor	-
2321SWW076	Corbally	Borehole	Industrial	-	-

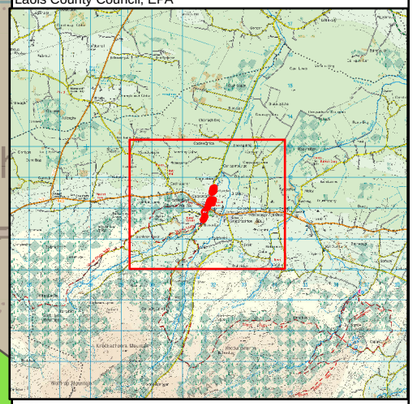
[1]Exact location unknown mapped with a locational accuracy of> 500m



Legend

- Surveyed Borehole Locations
- Groundwater Wells Springs
- SI-Inner Protection Area
- SO-Outer Protection Area
- Works Area

Data Sources: National Monuments Service, Laois County Council, EPA



Groundwater Bodies

- Clonaslee
- Clonaslee West
- Geashill
- Portlaoise
- Rosenallis
- Slieve Bloom North

Client

Laois County Council

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Title

Figure 10-7 Groundwater Wells and Springs

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10.3.15.2 Public Supply

The Public Supply Source Protection Area of the Tullamore South and Clonaslee Public Water Supply (PWS) is mapped within the southern portion of the Study Area including Area 1-Brittas Woods and Area 2- Chapel St (as illustrated on Groundwater Wells and Springs", Figure 10-8). The Tullamore South and Clonaslee PWS serves a population of approximately 4,017 and supplies on average 1,661 m^3/day of water to South Tullamore and Clonaslee and surrounding areas. The source of the supply is mainly from five boreholes – 3 no. located east of Clonalsee at Clarahill, Glebe, and Tinahinch, which lie outside of the study area and 2 no. from boreholes located in Brittas Woods (Forest and Plant boreholes) with an intake of approximately 1,300m^3/day in total and a further intake of approximately 513 m^3/day from the Clodiagh River. Groundwater from Clarahill, Glebe and Tinnahinch Boreholes are collected in the Roundhill Collection Chamber and gravity-fed to the Borehole Collection Chamber at Clonaslee WTP along with the Forest and Plant Boreholes. Raw surface water from the Clodiagh River is collected at the Surface Water Collection Chamber at the WTP.

Area 1 lies within the Inner Source Protection Area (SI) and Area 2 lies within the Outer Source Protection Area (SO) of the Forest (GSI Name 2321SWW069) and Plant (GSI Name 2321SWW075) boreholes. The location of the boreholes were identified during site walkover as being located along the embankment of Area 1 and immediately south of Area 1. The Forest borehole abstracts at the western bank of the Clodiagh River while the Plant borehole, located on the grounds of the Clonaslee Treatment Plant, is on the eastern bank. The Plant borehole has a daily abstraction rate of 393m^3/day. Groundwater located in the Inner Source Area (SI) of a locally important source are considered to be of "High" importance as it represents an attribute of high quality or value on a local scale. Groundwater located in the Outer Source Area (SO) of a locally important source are considered to be of "Medium" importance as it represents an attribute of high medium or value on a local scale.

The PWS boreholes within the study area are detailed in Table 10-18.

Table 10-15: Wells listed for Public Supply within the Study Area

GSI Well ID	Townland	Well Type	Well Use	Yield Class	Yield (m^3/day)	Location relative to the Proposed Works
[1]2321SWW001	Clonaslee	Borehole	Public Supply	-	-	300m north-east of Area 3
[1]2321SWW002	Clonaslee	Borehole	Public Supply	-	-	300m north-east of Area 3
2321SWW003	Clonagh	Borehole	Public Supply	Good	156.9	1.6km north of Area 3
2321SWW069	Clonaslee	Borehole	Public Supply	Good	393	50m north and downgradient of Area 1
2321SWW070	Brittas	Borehole	Public Supply	Excellent	600	450m south and upgradient of Area 1
2321SWW075	Clonaslee	Borehole	Public Supply	Poor	10.9	Along embankment of Area 1

[1]GSI confirms that these are mapped on the database with a locational accuracy of 1km

10.3.16 Groundwater Dependant Ecosystems (GWDTE)

Chapter 9 Biodiversity lists the Annex I of the EU Habitats Directive habitats associated with European Sites that are within or intersect with the Proposed Scheme. There are a number of EU Annex I habitats that are classified as Groundwater Dependent Terrestrial Ecosystem (GWDTE) under the Water Framework Directive. GWDTE are habitats/ species that are dependent on groundwater to maintain the environmental supporting conditions required to sustain that habitat or species. Annex I ecosystems have a "High" importance rating.

There are no Annex 1 GWDTE mapped within the footprint of the Proposed Scheme (1km). One GWDTE is mapped by the NPWS within the ZoI, located south of Clonaslee Village supported by the Clonaslee West GWB (see Table 10.10). Blanket Bogs and Alluvial forests are also found in this area. Given its distance and position upgradient of the proposed works, no loss or damage to the GWDTE is envisaged.

A summary of the GWDTE identified in the study area is presented in **Table 10-**.

Table 10-16: Summary of Annex 1 GWDTE located within the study area

Annex 1 GWDTE type	Habitat Code	Location	Associated SAC, SPA, NHA	Underlying GWB
Wet heath	4010	990m south of Area 1-Brittas Woods at Srahcullen Upgradient of the Proposed Scheme, Gorragh River Sub-basin	Slieve Bloom Mountains SAC (Site code: 000412)	Clonaslee West GWB Clonaslee GWB

10.3.17 Groundwater Quality

The WFD establishes a legal framework for the protection and management of water resources in the EU. It requires each member state to implement changes to the management of water bodies taking account of all aspects of the water cycle. Under the WFD, the GWB of the Study Area that need to be protected are:

- Clonaslee West GWB
- Geashill GWB

The WFD Quality Status and Risk Status for each GWB are summarised in **Table 10-**.

Table 10-17:WFD Groundwater quality status

Groundwater Body	Location within the Study Area	3rd Cycle Risk Status	Groundwater body status 2016-2021	Importance
Clonaslee West GWB (IE_SH_G_066)	Area 1-Brittas Woods Area 2-Chapel Street	Review	Good	High
Geashill GWB (IE_SH_G_103)	Area 3- Tullamore Road and ICW	Not at Risk	Good	High

WFD chemistry monitoring data from 2 and Cycle 3 (2010 to 2023) are defined as “Good” for the Clodiagh (Tullamore) Subcatchment Assessment includes groundwater quality data from the Clonaslee West GWB. Data from the Clonaslee West GWB includes sample results from the two PWS abstraction boreholes identified in Section 10.3.15 (Clonaslee Borehole- Forest GWIE_SH_G_06616000002 and Clonaslee Borehole- Plant GWIE_SH_G_06616000003).

Sample results from 2022 and 2023 monitoring events show an overall decrease in the concentrations of ammonia (reported below the laboratory limit of detection) for these monitoring locations from the previous monitoring events from 2010 onwards, as well as an overall decrease in the concentration of nitrite, chloride, alkalinity and coliforms while Total Organic Carbon and metals are reported at highly variable concentrations. Concentrations of Total Oxidised Nitrogen and nitrate in 2023 show an overall increase from those reported in 2010. **Chapter 11 Water** and **Appendix 11-1 Water Framework Compliance Report** discusses the WFD Status of the River Clodiagh.

Groundwater monitoring carried out as part of IPC licence compliance for Rosderra Farms (Rosderra Farms, AER 2023) identified no exceedances of the relevant limits set out in the Groundwater Regulations for the monitoring period.

Groundwater monitoring was not carried out for licencing requirements for the Uisce Éireann Integrated Constructed Wetlands (ICW) wastewater treatment facility.

10.3.18 Conceptual Site Model (Groundwater – Surface Water Interactions)

10.3.18.1 Source

The principal sources of potential groundwater risk/impact within the Study Area are diffuse sources:

- Diffuse sources will come from direct rainfall recharge percolating through the more permeable subsoil where recharge rates are high (Sandstone Till, described in **Section 10.3.14**) and where rock is at or

close to surface at the higher ground to the southeast of the Study Area (Brittas Wood, Area 1). The aquifer recharge rate within the made ground and alluvium is restricted to 20% and 22.5% of the effective rainfall (604 mm/yr) i.e. 121 mm/yr. The recharge rate increases to 60% within the well-drained tills i.e. 362mm/year.

10.3.18.2 Pathway

- Lateral groundwater flow:
  - Flow paths within the Clonaslee West GWB and the Geashill GWB are relatively short (along fractures, joints and major faults, with flow following local topography. Discharge is to rivers and springs which cross these GWBs and near the contact with the impure limestones at the north of the study area.
  - Groundwater flow will generally follow a subdued version of topography. Regional topography slopes from the high ground at the south of the Study Area towards the north, therefore local groundwater flow direction is expected to be from south to north towards the Clodiagh River and Gorragh River.
- Vertical groundwater flow:
  - The study area is underlain by moderately permeable limestone and sandstone Tills which provides a permeable downward pathway for recharge, particularly where overburden is thin (< 5m deep) and is overlain by well drained soils.
- Surface water pathways:
  - Where the subsoil is not too thick there is ingress from the groundwater to the rivers and streams indicating a close link between surface and groundwater in these locations.

10.3.18.3 Receptor

The main receptors are identified as follows and in **Table 10-**.

Table 10-18: Summary of Receptors

Receptor	Location	Key Receptor Attributes	Importance
Overburden			
Mineral Alluvium (A)	Area 1- Brittas Woods Area 3- Tullamore Road and ICW	Poorly draining soil	Low
Made/ Built Land	Area 2- Chapel Street	Made ground- no drainage properties/ restricts recharge	Low
Limestone Till (TLs)	North eastern and western portion of study area (outside extents of Alluvium)	Moderate permeability subsoil overlain by deep well drained soil	High
Sandstone Till (TDs)	South and southwest of the Study Area	Moderate permeability subsoil overlain by shallow well-drained soil	Moderate
Bedrock Aquifers			
Clonaslee Member/ Locally Important (LI) Bedrock Aquifer	Southern portion of Study Area including Area 1- Brittas Woods and Area 2- Chapel Street	Regionally Important (Rf) Aquifer	Very High
Lower Limestone Shale	Area 3- Tullamore Road and ICW	Poor (Pl) Aquifer	Low
Ballysteen Formation	Northern portion of study area	Locally Important (LI) Aquifer	Medium
Public Water Supply			
Clonaslee Wellfield PWS	Area 1- Brittas Woods	Inner Source Protection Are for a locally important water source	High
Industrial & Private Well users			

Receptor	Location	Key Receptor Attributes	Importance
Wells drilled for domestic, agricultural or Industrial purposes	Within the Study Area	This attribute has a low quality or value on a local scale.	Low
	GWDTE		
Wet heath	Approx 1km south of Area 1-Brittas Woods at Ballyfarrell part Slieve Bloom Mountains SAC (Site code: 000412)	Annex I habitat	Very High
	Surface Water Bodies		
River Clodiagh	Within the Study Area	Groundwater will discharge as baseflow to the River Clodiagh	Very High

Note: *The potential impacts to the Slieve Bloom SAC during the construction and operational phases have been considered in* ***Chapter 9: Biodiversity***

10.4 Description of the Likely Significant Effects

10.4.1 Do Nothing Scenario

In the event that the Proposed Scheme is not constructed, there would be no resulting impacts on the soils, geology, or hydrogeology within the Study Area. However, in the absence of the Proposed Scheme, the flood risk for properties and infrastructure would remain. This risk may increase in the future when considering climate change effects and projected increases in pluvial and fluvial flooding, which can result in localised and small scale cumulative negative impacts on the land, soils and groundwater environment within the Study Area. This increased flooding may result in soil erosion and instability and loss of land for future development.

10.4.2 Construction Phase

The project design and details of the activities required to construct the Proposed Scheme are provide in **Chapter 5: Project Description**. The key civil engineering works for the Proposed Scheme which will have potential for impact on the land, soils, geology and hydrogeology receiving environment during construction are summarised below:

- The undertaking of earthworks for embankments construction
- Excavation for flood wall/retaining wall/embankment/debris trap foundation construction as well as for culvert reinstatement and laying of drainage and services
- Stockpiling of clay, embankment material and other construction material
- Surfacing of Brittas Wood embankment and debris trap slipway
- The use of concrete, fuel, oils or chemicals
- Undertaking dewatering activities for instream works (for placement of the debris trap in Area 1) and for groundwater management during excavations for cut-offs below the flood defences (Flood Wall construction in Area 2).

The potential impacts on the geological and hydrogeological environment, as they relate to the above construction stage activities, are outlined in the subsequent sub-sections - **Section 10.4.2.1** to **Section 10.4.2.8**.

10.4.2.1 Importation of Construction Materials

It is anticipated that the Proposed Scheme will require the importation of approximately 1,200m³ of clay fill for both embankments, approximately 350tonnes (t) of concrete for the flood walls and approximately 120t for the Brittas Wood embankment, 374t steel bar reinforcement materials (debris trap and flood walls).
It is anticipated that topsoil will be stored for reuse with minimal quantities imported. The importation of material or by-products will involve the excavation of soil reserves from other construction schemes. **Table 10-22** sets out the estimated volumes of material required for the construction of the Proposed Scheme.

This activity has an indirect, short-term negligible effect on the geological environment during the construction phase (TII, 2009).

Table 10-22: Estimated Material Volumes required during Construction Phase of the Proposed Scheme

Area	Location	Element	Material	Volume of Material (m³)
Area 1	Brittas Loop Walk	Embankment	Fill material	456.3
		Debris Trap	Concrete (Precast & standard mx)	43.29
		Culvert	Fill material	25
Area 2	Chapel St	Flood Wall	Concrete	705
Area 3	Tullamore Rd	Embankment	Fill material	744.45
		Retaining Wall	Concrete	36.75
Total Volume (m³)				2,010.79

10.4.2.2 Embankment Settlement

The Proposed Scheme includes the construction of 2 no. new embankments with 3:1 side slopes and heights of 0.8m as flood defences along the River Clodiagh at Brittas Wood (Area 1) and Tullamore Road (Area 3).

Potential impacts with regard to embankment settlement includes settlement of the altered ground profile and slope instability during excavation and construction of the earth embankments. These elements have been considered in the geotechnical design of the Proposed Scheme, therefore It is expected that settlement will be minor and complete within the construction period.

Embankment settlement is considered to be a direct, short-term, small-adverse effect (TII, 2009).

10.4.2.3 Infiltration of Surface Runoff

Silt-laden water can arise from exposed ground and soil stockpiles during construction. Surface water runoff containing large amounts of silt could migrate into the groundwater which can cause significant pollution of water through the generation of suspended solids.

Where topsoil and other soils or construction material are to be stored on site, stockpiles with significant side slopes can create a source of sediment laden runoff. Once the slopes are built up, rainfall landing on the slope and runoff from the top of the stockpile travel can uncontrolled down the slope – potentially at high velocities – causing suspension of soil particles from the surface of the slope. Another source of runoff can arise from exposed earthwork surfaces during the excavation of overburden for foundation construction. Over compaction of soil and subsoil due to vehicles and plant tracking over areas of topsoil and subsoil to access the works causing strain to the existing subsoil structure, leading to a reduction in soil integrity and less resilience to erosion.

Short-term effects on groundwater quality can occur through the infiltration of surface runoff within or adjacent to construction areas. The impact to groundwater, via infiltration to ground is predicted to be localised to the footprint of the Proposed Scheme. Subsoil within the footprint of the proposed works is present at a sufficient depth to provide adequate attenuation and filtration, therefore, the infiltration of surface water runoff is considered to be an indirect, small adverse effect on the groundwater environment (TII, 2009).

Two boreholes which were identified as being part of the Clonaslee PWS well field, are located adjoining the western boundary of Area 1 and there is a potential for surface water runoff from construction works to enter into the boreholes. In the absence of mitigation measures the impact of runoff to the boreholes would result in a direct, small adverse effect on the receiving groundwater quality within these boreholes and the groundwater supplying the Clonaslee PWS.

Impacts of the Proposed Scheme on surface water quality are assessed in **Chapter 11: Water**.

10.4.2.4 Loss of Soil Reserve

Topsoil, and subsoil removal is an unavoidable consequence of the construction works. The removal of topsoil and subsoils during excavation works is a direct and permanent impact. It is not expected to encounter bedrock.

The flood wall construction at Chapel St will include excavation of cut off trench and placement of concrete foundation to a depth of 3mgl. The retaining wall construction at Tullamore Road will include excavation to a depth of 1.1mbgl to allow placement of the concrete base for steel reinforcement for the base of the wall. The embankments construction work will include topsoil stripping and excavation for the clay core to a suitable stratum depth, typically 1mgbl. Construction of the debris trap will require excavation of the riverbed to a depth of 1.2mbgl for placement of a of a concrete base. A minor amount of excavation will also be required at the culvert inlet for the headwall installation.

The removal of soil will result in the irreversible loss of a minor proportion of local well-draining fertile soils (sandstone Till) present beyond the extents of the alluvium floodplain of the River Clodiagh and a slightly larger proportion of poorly draining soils (alluvium associated with the flood plain of the River Clodiagh). The construction of proposed embankments, debris trap, flood wall, retaining wall and associated surface drainage and remediation of the culvert will generate approximately 7,500 m³ of subsoil.

There is estimated to be 150m of plastic pipework (Area 2 Flood Wall) required for the laying of drains and pipework which will be excavated to invert level and backfilled accordingly. Excavation requirements for the implementation of the Proposed Scheme are summarised in **Chapter 15: Material Assets: Waste and Utilities**

It is unlikely that excavated material from embankments and walls will be used elsewhere as part of the works. Excess material will be disposed of at a licenced waste disposal facility.

The attributed importance of soils within the Limestone Tills is High, as they are, in general, classified as deep well drained fertile soils. The Alluvium are classified as poorly draining, therefore their importance is considered to be Low. Loss of soil reserves is considered to be a small adverse permanent impact (TII, 2009) on the soils of the area.

10.4.2.5 Impact to Aquifers (Aquifer as a Resource and/or Increase of Aquifer Vulnerability)

The removal of soil can have an impact on aquifer vulnerability where protective overburden is removed during excavation works for foundations and trenches through increasing the aquifer's vulnerability to contamination and thereby reducing groundwater quality. Where groundwater is encountered during intrusive work, flow paths can be altered reducing an aquifer's ability to provide baseflow to GWDTE, watercourses or impact flow paths to water supplies. The majority of the Study Area encompassing all three proposed works areas is classified as having 'Moderate'(M) vulnerability. Subsoils with 'High' groundwater vulnerability underlie a small portion of the proposed works area at Area 1- Brittas Woods. There are no areas of 'Extreme' groundwater vulnerability within the footprint of the Proposed Scheme. The underlying limestone bedrock is classified as a Regionally Important Aquifer, however there will be no excavation into bedrock (excavation depths will be no more than 3 mbgl).

10.4.2.5.1 Groundwater Resources

The proposed works in Area 1 lie within the Inner Source Protection Area (SI) of the Clonaslee PWS as set out in Section 10.3.14. Given the expected depth to bedrock (18.3mbgl) limited depth of excavation for the clay core embankment foundation (1mbgl) and debris trap base (1.2mbg) and the areal extent of the excavtion, it is considered unlikely that the regional water table will be encountered. The proposed excavation works will not have an impact on the groundwater flow and dynamic levels of groundwater within the Clonaslee GWB. In addition, the most productive well in the SI, Plant borehole (GSI Name 2321SWW069) is located on the opposite bank of the River Clodiagh to the proposed embankment, therefore the River Clodiagh will likely act as a hydrological barrier against any impact to groundwater on the opposite side of the hydrological divide (River Clodiagh).

The proposed flood wall at Area 2 lies with the Outer Source Protection Area (SO) of the Clonaslee PWS. GSI 2321SWW069 is located approximately 250 north and downgradient of the southern end of the proposed flood wall. Given the expected depth to bedrock (>10m) limited depth of excavation for the

concrete foundation (3mbgl) and areal extent of the excavtion, it is considered unlikely that the regional water table will be encountered. Area 2 is located hydrogeologically downgradient of the PWS abstraction boreholes therefore no impact is envisaged.

The proposed flood wall and retaining wall at Area 3 lies outside the Source Protection Area of the Clonaslee PWS and no wells were identified within the footprint of the proposed works (100m). Given the expected depth to bedrock (>10m) limited depth of excavation (circa 1m for both the embankment clay core and retaining wall foundation) and areal extent of the excavtion, it is considered unlikely that the deeper regional water table will be encountered at Area 3.

In all three Areas, there is potential for excavation works to encounter shallow groundwater flow paths within the overburden deposits where the till/alluvium provides additional storage for the underlying bedrock aquifer. The water table is normally within 5m of the surface (GSI, 2004) and any lowering of the water table during excavation works will be a short-term effect.

Considering the above the magnitude of this effect is small adverse effect on the groundwater supplying the Clonaslee PWS.

10.4.2.5.2 Groundwater Quality

The removal of overburden means vulnerability will be locally and temporarily increased during construction. This would increase the ease at which recharge can percolate downward. The potential hazards will be associated with construction plant and activities within the area where the protective soil cover has been reduced. During the initial excavation phase, there will be no drainage installed and in the absence of adequate controls there will be potential to cause contamination where groundwater is encountered within the shallow subsurface. This is also true for the placing of fill for the embankments, where fill will be imported although there may still be the potential for untreated runoff.

Given the expected thickness of overburden within the Study Area, the natural subsoil will provide adequate attenuation and considering the areal extent of the aquifer the magnitude of this effect is negligible on the underlying aquifer.

10.4.2.6 Use of Concrete, Fuel, Oils or Chemicals (Accidental Spillage)

Construction works including the excavation of soils and the placement of concrete for the construction of the flood and retaining wall and debris trap. The concrete for the culvert pipework will be precast.

During the construction phase, the import and pouring of concrete material for foundations can result in accidental spillage and contamination of adjacent watercourses and soils. Intrusive works during construction can potentially create pathways to impact subsoils and groundwater. Localised accidental spillages of fuel, oils or chemicals on the site have the potential to contaminate the underlying soils and groundwater by exposure, dewatering, or construction related spillages resulting in a short-term, small adverse effect on soils and groundwater (TII, 2009).

Impacts of the use of cement and hydrocarbons on surface water quality during the construction phase are assessed in **Chapter 11: Water**.

10.4.2.7 Encountering Contamination

Due to the presence of made ground within the central portion of Study Area (Area 2 and Area 3), there is potential for residual ground contamination such as inclusions of waste components or residual chemicals to be present. The presence of the Invasive Alien Species (IAS) plant Japanese Knotweed in the northern portion of works Area 2 – Chapel Street, poses a threat to soil quality whose roots can penetrate the soil and alter its structure and ability to retain nutrients.

If not handled correctly, the excavation and handling of potentially contaminated made ground or contaminated soil could result in the mobilisation of contaminants which could increase the potential impacts on the quality of soil and groundwater. Depending on contaminants of concern that may be present; impacts could include leachate of contaminants to clean soils and groundwater, surface water runoff from exposed contaminated made ground as well as a risk to human health due to direct contact and from volatile or semi-volatile vapours. Potential sources of contaminants relevant to Proposed Scheme are detailed in **Section 10.3.7.**

The excavation of potentially contaminated made ground would have a slight to significant, negative effect on the soils, geology and hydrogeology of the Study Area depending on the nature of the contamination and the sensitivity of the receiving environment. Given that limited extent and depths of excavation required the potential for encountering contaminated ground is low and the resulting impact would be considered to be a short-term, small adverse effect on soils (TII, 2009). Conversely, should any waste material be encountered during construction, it will be removed to a suitably licensed facility. Assuming proper handling, this would be considered to be a **direct, permanent, minor beneficial** effect on soils by removing a potential source of contamination.

Waste Generation and excavation of waste as a result of the construction of the Proposed Scheme is addressed in **Chapter 15: Material Assets Waste-Utilities.**

10.4.2.8 In stream works

Instream works will be required at Area 1 to facilitate the placement of the concrete base in trench boxes for placement of debris trap poles in the bed of the Clodiagh River. River flow diversion and dewatering is required to facilitate placement of trench boxes and pouring of concrete, while excavations will be required from trench boxes and for reprofiling of the inlet stream bed to slope towards the remediated culvert.

Dewatering has the potential to create subsurface changes to soils and sediments that include movement and settlement of surrounding ground with the potential to alter stream bed geomorphology. Without mitigation, river-bed excavations have the potential to cause channel bed degradation, lateral erosion of banks and deposition of eroded sediments.

The receptors' importance from a hydrological perspective range is Very High (River Clodiagh). Without mitigation, this effect is a short-term, small adverse (River Clodiagh) (TII, 2009).

10.4.1 Operational Stage Impacts

10.4.1.1 Maintenance and Inspection Activities

Maintenance activities during the operational stage will involve periodic inspection of flood walls, monitoring of the newly constructed embankments to check for signs of instability or soil slippage and inspection of debris trap and remediated culvert. This work is expected to be carried out as a visual walkover, inspections and general landscaping activities. Maintenance work will be facilitated by the design of the debris trap which will be regraded and surfaced to provide an access to the debris trap for future maintenance and debris removal. There is no expected negative effect on land, soils, geology and hydrogeology as a result of such activities.

10.5 Mitigation Measures

10.5.1 Construction Phase

10.5.1.1 Importation of Construction Materials

The importation of surplus clean and inert excavated material from quarries or as a by-product from other sites will be undertaken. By-product will be subject to an Article 27 notification to the EPA in accordance with relevant waste legislation and taking account of the findings of the current EPA publication 'Guidance on Soil and Stone By-products in the context of article 27 of the EC (Waste Directive Regulations 2011 (2019)

10.5.1.2 Embankment Settlement

Soft soils will be removed during the construction of the foundation to create a stable base and a geotextile membrane placed over the formation to strengthen the foundation. To prevent a surface water and shallow groundwater flow paths destabilising the embankment a cut off ditch will be extended below the level of the embankment. Embankments will be constructed of suitable compacted materials, tamped down and the surface reinstated to ensure stability and to minimise the potential for erosion of sediments into the adjacent River Clodiagh.

10.5.1.3 Infiltration of Surface Runoff

Where stockpiling of topsoil is required, stockpiles shall be limited to heights not exceeding two metres, shall be battered back to a stable slope, and shall not be unnecessarily trafficked (TII, 2009). There will be no stockpiles within 20 m of the main channel of the River Clodiagh or any drains that connect to the river. Care will be taken in reworking this material to minimise the effects of weathering, dust generation, groundwater infiltration and generation of runoff. Construction compounds are located north of Brittas Wood works area and north of the Chapel St works area where there will be designated stockpiling areas. These locations will allow material to be delivered to central locations and is not bound by the works programmes at each works area.

To prevent suspended sediment runoff to ground and to the boreholes within Area 1, a barrier method such as a sediment barrier or silt fence will be placed on the river side of the embankment. Installation of temporary protective fencing around the boreholes, in line with the Specification and Related Documents for Ground Investigation (Engineers Ireland, 2016) may also be considered for the duration of the construction works. Ensuring that a Construction Environmental Management Plan (CEMP) is in place will mitigate any risks associated with embankment construction activities, thus reducing these impacts to an Imperceptible level. The development of a surface water management plan will mitigate any risks associated with surface water runoff and also prevent or reduce impacts to groundwater quality.

Where compaction occurs due to vehicle and truck movements remediation works will be undertaken to reinstate the ground to a condition to at least equal to that of the original surface. Vehicles will minimise tracking over natural or unfinished surfaces and will not track over reinstated soils.

Ensuring that a CEMP is in place will mitigate any risks associated with the removal of superficial deposits thus reducing these impacts to an imperceptible level.

Chapter 9: Biodiversity sets out mitigation measures for sediment control. The measures set out in **Chapter 11 Water** for limiting suspended solids from entering water will also protect groundwater. These measures pertaining to sediment control and groundwater protection are also reiterated in the **Construction Environment Management Plan (CEMP) and Chapter 20 Schedule of Environmental Commitments.**

10.5.1.4 Loss of Soil Reserves

Where possible the removal of topsoil will be avoided. Where needed (embankment footprints, debris trap access slipway and stockpiles) the topsoil will be stripped and assessed for reuse within the Proposed Scheme, ensuring appropriate handling, processing and segregation of material. It is unlikely that excavated material from embankments and walls will be used elsewhere as part of the works due to the requirement for non-porous embankment material. Excavations will be supported by use of trench boxes or other specifically designed temporary works measures.

A sediment control plan will form part of the CEMP and will be developed further by the contractor prior to the commencement of work. This plan will identify actions on site to minimise the loss of topsoils and soils and its potential for erosion such as stabilising side surfaces to prevent erosion through appropriate slope angles. Soils removed during excavations will be reinstated as soon as possible and backfilled and compacted to replicate the conditions prior to the works. Excess soil will be disposed of at a licenced waste disposal facility. **Chapter 15: Material Assets Waste - Utilities** details licenced waste facilities in County Laois that may be considered for the disposal of material and waste streams generated by the Proposed Scheme. The Waste Management Plan will address the analysis of waste arisings, methods proposed for the prevention, reuse and recycling of wastes and material handling procedures.

10.5.1.5 Impact to Aquifers (Aquifer as a Resource and/or Increase of Aquifer Vulnerability)

The mitigation measures set out above will mitigate against loss of aquifer and/or an increase in groundwater vulnerability. In addition, protection measures including fencing will be undertaken to reduce and prevent any runoff infiltrating to the PWS abstraction boreholes located within Area 1.

10.5.1.6 Use of Concrete, Fuel, Oils or Chemicals (Accidental Spillage)

Construction activities will be undertaken in strict compliance with measures set out in the OPWs Environmental Guidance: Drainage Maintenance and Construction *(2019)* and CIRIA's *Control of water pollution from construction sites*. *Guidance for consultants and contractors* (2001) to minimise the risk of transmission of hazardous substances to adjacent soils, groundwater and watercourses.

These measures will ensure soil and groundwater and adjacent watercourses remain free from pollution:

- Ensuring that all areas where liquids (including fuel) are stored, or cleaning is carried out, are located in designated impermeable areas that are isolated from the surrounding area and within a secondary containment system, e.g., by a roll-over bund, raised kerb, ramps or stepped access.
- The location of any fuel storage facilities shall be considered in the design of the construction compounds. These are to be designed in accordance with relevant guidelines and codes of best practice and will be fully bunded.
- Careful management of concrete placement and truck wash-out etc. will be enforced;
- Use of dry low strength concrete, that will set to form an impermeable barrier in order to prevent washout of cementitious material into shallow groundwater during the construction of the cut-off trench in Area 2.
- Good housekeeping at the site (daily site clean-ups, use of disposal bins, etc.) during the entire
- construction phase.
- Spill kit to be provided and to be kept close to the storage area. Staff to be trained on how to use spill kits correctly.

The CEMP will include an emergency plan to deal with accidental spillages. **Chapter 11: Water** sets out mitigation measures for concrete loss and general hydrocarbon loss controls.

10.5.1.7 Encountering Contamination

The appointed contractor will be responsible for regular testing of excavated soils to monitor the suitability of the soil for reuse. If contamination is encountered suitable measures will be put in place to avoid mobilising the contamination based on best practice for contaminated land management. Samples of ground suspected of contamination will be tested for contamination by the appointed contractor during the ground investigation. Three compounds are to be developed in the locations shown in **Figure 5-30** of **Chapter 5: Project Description**. The management of surplus excavated material or temporarily stored material at the site compounds will be determined by the classification of the material and will be stored in such a manner as to prevent disturbance of any existing contamination that may be present in the material itself or at the site compound.

After temporary storage contaminated material will be disposed of to a suitably licensed or permitted sites in accordance with the current Irish waste management legislation. **Chapter 15: Material Assets Wastes – Utilities** details licenced waste facilities in County Laois. Any dewatering required in areas of contaminated ground shall be designed by the appointed contractor to minimise the mobilisation of contaminants into the surrounding environment. Mitigation measures for waste in terms of waste segregation auditing, storage and removal are discussed further in **Chapter 15: Material Assets Wastes – Utilities.**

10.5.1.8 In stream works

In stream works will be undertaken during the normal recommended Inland Fisheries Ireland (IFI) window from July to September. This coincides with the time of year when the base flow in the river is at its lowest. It should be noted that heavy rainfall events have caused spikes in flow during these summer months in the past. In line with the IFI's Guidelines of Protection of Fisheries During Construction Works in and Adjacent to Waters, the flow management measures shall be designed to "accommodate such flood event as might reasonably be expected over the period in question".

Water will be managed by completing the excavation and construction in two halves. For the first half, water will be dammed and directed to one side of the channel using large sandbags or another suitable damming system. The excavation will be completed using trench boxes. A sump will be created within the excavation to enable pumping of any river or ground water that seeps in. This water will be passed through a suited sedimentation system before returning to the river.

The extent and area of dewatering required will be small (366m²) and local in nature over a short timeframe and is therefore not expected to result in any significant impact on groundwater levels. In order to mimic the naturally occurring substrates, river-bed reinstatement measures prior to trench box removal and re-diverting of flows over the area will be agreed with the IFI.

There will be no direct discharge of surface water from any element of the works without suitable attenuation and treatment of sediments.

10.5.2 Operational Phase

Mitigation measures, proposed for the construction phase will be implemented for maintenance operations, where relevant. OPW Guidance will be adhered to for periodic maintenance and/or repair of flood defences.

10.6 Residual Impacts

The significance of all impacts identified during the construction phase will be reduced to **Imperceptible** with the implementation of the mitigation measures outlined in **Section 10.5.1.**

The significance of all impacts identified during the operational phase will be reduced to **Imperceptible** with the implementation of the mitigation measures outlined in **Section 10.5.2.**

10.7 Significance of Effects

The effects on Soils, Geology and Hydrogeology due to the construction of the Proposed Scheme are not significant. The effects on Soils, Geology and Hydrogeology due to the operational of the Proposed Scheme are not significant.

10.8 Proposed Monitoring

10.8.1 Construction Phase

10.8.1.1 Sediment Runoff

Refer to **Chapter 11: Water** for the measures proposed for the monitoring of sediment runoff during the construction phase.

10.8.1.2 Embankment Monitoring

The appointed contractor shall monitor settlement every two to three days using settlement plates during and after embankment construction at Brittas Wood.

10.8.1.3 Waste Monitoring

Chapter 15: Material Assets- Utilities sets out monitoring controls for waste material.

10.8.1.4 Groundwater Quality and Level Monitoring

Groundwater quality and level monitoring (background groundwater levels) of the existing Clonaslee PWS Plant and Forest boreholes will be monitored prior to, during and post construction in order to establish baseline conditions and demonstrate that the design of the Proposed Scheme has not impacted on groundwater quality and flow regime.

10.8.1.5 Excavations Monitoring

Records shall be kept of all truck movements relating to the removal of site clearance vegetation, topsoil and construction soil. The records shall include quantity, nature/ type and quality of the material, and the excavation and disposal locations. Excavations shall be monitored during earthworks to ensure the stability of side slope and that excavated soils meet the Waste Acceptance Criteria (WAC) testing classifications and descriptions.

10.8.2 Operational Phase

OPW Guidance will be adhered to for ongoing inspection and monitoring of flood defences, debris trap and culvert remediation.

10.9 Interactions and Cumulative Effects

10.9.1 Interactions

The following disciplines have potential to interact with Land, Soils, Geology and Hydrogeology as follows:

- Water
- Biodiversity
- Air Quality
- Material Assets – Waste – Utilities
- Cultural Heritage

Please see **Chapter 18 Interactions and Cumulative Effects** for details on interactions between Land, Soils, Geology and Hydrogeology and these disciplines.

10.9.2 Cumulative Effects

Cumulative impacts are defined as the combination of many minor impacts creating one, larger, more significant impact (NRA, 2009 and EPA 2022). Cumulative impacts consider existing stresses on the natural environment as well as developments that are underway and in planning.

A review of the planning files for LCC, An Bord Pleanála, Department of Housing, Local Government and Heritage as well as EPA licence applications was carried out to identify the number of existing and/or approved projects were identified which could have the potential for likely significant cumulative effect.

Chapter 18 Interactions and Cumulative Effects lists the assumptions that projects must meet in order to be included in the list for assessment e.g. some projects were not listed owing to their nature and scale such as one-off housing, projects where appealed decisions were refused. The full assessment methodology is set out in **Chapter 18 Interactions and Cumulative Effects**.

10.10 Conclusion

Table 10.23 collates all the mitigation and monitoring commitments recommended in this chapter.

Table 10-19: Summary of Potential Environmental Effects, Mitigation and Monitoring Commitments

Description of Impact	Magnitude of Impact	Importance of Receptor	Pre-Mitigation Impact	Controls and Mitigation Measures	Residual effect	Significance of Effects
Importation of Construction Materials	Negligible	High	Imperceptible	Importation of surplus clean and inert excavated material from quarries or as a by-product from other sites will be undertaken.	Imperceptible	Not Significant
Embankment Construction-Settlement/Slope Instability	Small Adverse	High	Moderate/Slight	Use of geotextiles and suitable compacted materials to ensure stability and to minimise the potential for erosion, use of a cut-off ditch to prevent destabilisation by groundwater, barrier methods to prevent suspended sediment runoff Monitoring of embankment settlement.	Imperceptible	Not Significant
Infiltration of Surface Water Runoff	Small Adverse	Predominantly Low (prevalence of poorly draining alluvium).	Slight	Stockpiling to minimise the effects of weathering such as limiting heights of stockpiles, battering of sides to ensure stability, restrictions on the placement of stockpiles will not be placed within 20 m of a watercourse. Minimising dust generation, groundwater infiltration and generation of runoff. Designated stockpile locations at construction compounds.	Imperceptible	Not Significant
Loss of soil and subsoil reserves	Small Adverse	Predominantly Low (prevalence of poorly draining alluvium).	Slight	Reuse of topsoil, keeping excavations to a minimum, adherence to a soil management plan to minimise the loss of topsoils and soils and its potential for erosion such as stabilising side surfaces to prevent erosion through use of trench boxes. Reinstatement of soils removed during excavations. In areas of soft soils,, excavate and replace options are proposed in order to achieve acceptable settlement limits.	Imperceptible	Not Significant
Impact to Aquifers Groundwater Resources	Small Adverse	High	Moderate/Slight	As above for Infiltration of Surface Water Runoff and Loss of soil reserves. Preserving a 30m set back distance around PWS abstraction boreholes in the SI	Imperceptible	Not Significant
Impact to Aquifers Groundwater Quality	Negligible	High	Imperceptible	As above for Infiltration of Surface Water Runoff and Loss of soil reserves Use of raft foundations instead of sheetpiles to prevent vertical flow paths.	Imperceptible	Not Significant

Description of Impact	Magnitude of Impact	Importance of Receptor	Pre-Mitigation Impact	Controls and Mitigation Measures	Residual effect	Significance of Effects
Use of Concrete, Fuel, Oils or Chemicals (accidental spillage)	Small Adverse	Predominantly Very High (*high prevalence of deep well drained Limestone Tills)*	Moderate/Slight	Employing the measures set out in *CIRIA's Control of water pollution from construction sites. Guidance for consultants and contractors (2001)*	*Imperceptible*	Not Significant
Encountering Contamination	Small Adverse	High (for both Groundwater & Soil receptors)	Moderate/Slight	Regular testing of excavated soils, measures to avoid mobilisation of contamination during works, transportation and temporary storage. Contaminated materials will be disposed of at suitably licensed or permitted sites	*Imperceptible*	Not Significant
Removal of Waste	Minor Beneficial	High (for both Groundwater & Soil receptors)	n/a	n/a	*n/a*	Not Significant
In-Streams Works (Dewatering)	Small Adverse	Very High	Significant/Moderate	An appropriate dewatering methodology will be selected for the works (to avoid the use of sheet piles, dewatering will be undertaken by use of using a dam with trench boxes and use of submersible pumps). Dewatering will take place during low level conditions. No direct discharge of surface water from any element of the works without suitable attenuation and treatment. The culvert remediation is required to be constructed in accordance with the requirements of the OPW and IFI.	*Imperceptible*	Not Significant

10.11 Chapter References

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