Chapter 08

Lands and Soil

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8. Land and Soils

8.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) presents the Land and Soils assessment of the proposed Barnesmore Gap Greenway project (the 'proposed development' hereafter). 'Land' in the context of this chapter refers to the existing soil and geological characteristics of the receiving environment. This chapter sets out the methodology used to undertake the assessment (Section 8.3), describes the existing environment (Section 8.4), examines the predicted impacts of the proposed development (Section 8.5), proposes mitigation and monitoring measures (Section 8.6 and Section 8.7, respectively), and identifies residual effects, interactions and cumulative effects (Sections 8.8, Section **Error! Reference source not found.** and Section **Error! Reference source not found.**, respectively). This chapter should be read in conjunction with the following Chapters, and their appendices, which present related impacts arising from the proposed development.

- Chapter 4: Description of the Proposed Development,
- Chapter 5: Traffic and Transportation,
- Chapter 9: Hydrology,
- Chapter 10: Hydrogeology,
- Chapter 15: Cultural Heritage,
- Chapter 20: Interactions and Cumulative Effects,
- Chapter 21: Summary of Mitigation and Monitoring Measures.

8.2 Guidance

8.2.1 Guidance Documents

This chapter has been prepared following the guidance documents below:

- Environmental Protection Agency (EPA) (2015), *Advice Notes for Preparing Environmental Impact Statements*;
- Environmental Protection Agency (EPA) (2022), *Guidelines on the Information to be contained in Environmental Impact Assessment Reports*;
- Institute of Geologists of Ireland (IGI) (2013), *Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements*;
- Transport Infrastructure Ireland (December 2008), *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes PE-ENV-01116*;
- Transport Infrastructure Ireland (February 2023), *Environmental Planning of National Road and Greenway Projects*, *RE-ENV-07008;*
- Transport Infrastructure Ireland (November 2024), *Environmental Impact Assessment of Rural Cycleways (Offline & Greenway) – A Practical Guide PE-ENV-01109*, and;
- Transport Infrastructure Ireland (February 2025), *Rural Cycleway Design (Offline and Greenways), DN-GEO-03047.*

8.3 Methodology

8.3.1 Study Area

The proposed development extends for approximately 37km, mainly along the abandoned West Donegal rail line, connecting the towns of Donegal Town and Ballybofey/Stranorlar in Co. Donegal, including spurs and loops which provide additional connectivity and integration to surrounding amenities and active travel routes. The route traverses a mix of rural, agricultural and natural landscapes and passes through the Barnesmore Gap, a glacial valley situated in the Bluestack Mountains.

8.3.2 Survey Methodology

8.3.2.1 Site Walkover

A site walkover was carried out in September 2024 along the proposed development at both the abandoned railway corridor and the offline greenfield sections. The walkover throughout the whole development helped gaining knowledge of the site soil and geology characteristics along with the current conditions of the existing structures.

8.3.2.2 Desktop Study

The desktop study involved collecting all relevant data for the study area, particularly along the greenway alignment where feasible design options are required.

Existing information such as mapping and aerial photographs were used during initial desktop studies to plan the ground investigations to inform the baseline description of the receiving environment. Sources of historical information, geological maps and/or features had been established during the geotechnical desktop study of the area including a review of information from various previous projects and site developments. The sources of information review include:

- Geological maps, Geological Survey of Ireland (GSI) for mapping and preliminary classification of geomorphology, bedrock geology, soils and subsoils, superficial deposits, economic geology, karst features, geological heritage and landslide vulnerability (www.gsi.ie),
- Historical ordnance survey mapping information from Ordnance Survey Ireland (OSI) website, including historical maps available, OSI Historic 6” black & white and colour, OSI 6” Cassini and OSI Historic 25” (map.geohive.ie),
- EPA maps for identifying and assessing any likely landfill sites or waste facilities within the study area (https://gis.epa.ie/EPAMaps/),
- Other available mapping and imagery (e.g., Google Earth, Bing Maps and OSI) for aerial imagery and large-scale identification of surficial ground features and general topographical characteristics as well as features of the built environment or to assist in general geohazard identification and characterisations.

8.3.2.3 Ground Investigations

A ground investigation (GI) programme was carried out by Northwest Geotech Ltd (NWG) along the proposed development. The scope of this investigation was determined from analysis of existing information such as mapping and aerial photographs. The investigation utilised intrusive techniques such as cable percussion (CP) and windowless sampler (WS) boring, trial pitting (TP) and dynamic probing (DP). Both push-in and standpipe type piezometers were also placed along the peat-rich areas.

The primary objectives of the investigation were to:

- Assess the subsurface conditions, including the extent of soft ground/peat and the presence of Made Ground;
- Estimate the likely depths of bedrock;

- Evaluate the groundwater levels and investigate potential contamination across the site.

Key sections of the development, such as areas around some of the proposed structures were investigated in greater detail. Boreholes and trial pits were used to better understand overall soil conditions, while dynamic probes confirmed in-situ characteristics such as consistency/density or stiffness of the deposits. Standpipes were also installed to monitor the groundwater table.

The findings of the GI programme were reported in the unpublished Ground Investigation Report Barnesmore Gap Greenway (NWG Report No: 24-0069, Revision A02, November 2025).

8.3.3 Assessment Methodology

The potential impact of the proposed development on the soils and geology environment has been assessed by classifying the importance of the relevant attributes and quantifying the likely magnitude of impact on these attributes. The rating criteria for assessing the importance of geological features within the study area are detailed in Table 8-1 whilst the rating criteria for quantifying the magnitude of impacts are detailed in Table 8-2.

The rating of potential environmental effects on the Land and Soils is based on the assessment criteria presented in Table 8-3 which take account of both the importance of an attribute and magnitude of the potential environmental impacts of the proposed development on it. This assessment methodology is consistent with impact assessment criteria outlined in the EPA, Guidelines on the Information to be contained in Environmental Impact Assessment Reports (2022).

The impact assessment methodology is in accordance with the guidance outlined in Section 5.4 of the TII's Guidelines on Procedures for Assessment & Treatment of Geology, Hydrology & Hydrogeology for National Roads (TII, 2008). Impact categories, duration and the type/nature of impacts have been taken into account in this assessment in accordance with those guidelines.

Table 8-1 - Criteria for Rating Importance

Importance	Criteria	Typical Example
Very High	Attribute has a high quality, significance or value on a national or regional scale. Degree or extent of soil contamination is significant on a national or regional scale. Volume of peat and/or soft organic soil underlying route is significant on a national or regional scale*	Geological feature rare on a regional or national scale (NHA). Large existing quarry or pit. Proven economically extractable mineral resource.
High	Attribute has a high quality, significance or value on a local scale. Degree or extent of soil contamination is significant on a local scale. Volume of peat and/or soft organic soil underlying route is significant 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 high fertility soils. Moderately sized existing quarry or pit. Marginally economic extractable mineral resource.
Medium	Attribute has a medium quality, significance or value on a local scale. Degree or extent of soil contamination is moderate 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.

Importance	Criteria	Typical Example
	Volume of peat and/or soft organic soil underlying route is moderate on a local scale*	Sub-economic extractable mineral resource.
Low	Attribute has a low quality, significance or value on a local scale. Degree or extent of soil contamination is minor on a local scale. Volume of peat and/or soft organic soil underlying route is small 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.

* relative to the total volume of inert soil disposed of and/or recovered

Table 8-2 - Criteria for Rating the Impact Magnitude at EIAR Stage – Estimation of Magnitude of Impact on Soil/Geology Attribute

Magnitude of Impact	Criteria	Typical Example
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 feature. Requirement to excavate / remediate entire waste site. Requirement to excavate and replace high proportion of peat, organic soils and/or soft mineral soils beneath alignment.
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 beneath alignment.
Small Adverse	Results in minor impact on integrity of attribute or 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 beneath alignment.
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity.	No measurable changes in attributes.
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.

Magnitude of Impact	Criteria	Typical Example
Major Beneficial	Results in major improvement of attribute quality.	Major enhancement of geological heritage feature.

Table 8-3 - Significance of Effects

Significance	Description
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 or emerging baseline trends.
Significant	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 Effect	An effect which obliterates sensitive characteristics.

8.3.4 Difficulties Encountered

This chapter has been prepared based on the best available information and in accordance with current best practice and relevant guidelines. There were no difficulties encountered in the preparation of this chapter of the EIAR.

8.4 Receiving Environment

8.4.1 General Description

The proposed development extends from Donegal Town to Ballybofey/Stranorlar through five baseline sections:

- Abandoned Railway Corridor,
- Offline Greenfield Sections,
- Existing and New Structures,
- Town Connection Routes and Trailheads.

8.4.1.1 Abandoned Railway Corridor

The greenway route follows the abandoned West Donegal railway corridor, which was constructed in the 19th century. The corridor passes through a mix of rural, agricultural and forested areas/woodlands. It retains many of its features such as embankments, cuttings and structures including bridges and culverts (see Photograph 8-1 - Abandoned Railway Corridor through Woodlands and Photograph 8-**2Error! Reference source not found.**).

The soils along the railway corridor are predominantly composed of railway ballast and Made Ground, with underlying cohesive soft units and granular deposits of sands and gravels. While the corridor provides a stable foundation for the greenway, some areas may require remediation due to instability. The existing drainage ditches along the corridor will be cleaned and regraded to manage surface water runoff effectively to prevent erosion or undermining of the earthworks and foundations of the old railway.

Photograph 8-1 - Abandoned Railway Corridor through Woodlands

Photograph 8-2 **- Abandoned Railway Corridor through Barnesmore Gap**

8.4.1.2 Offline Greenfield Sections

In areas where the greenway diverges from the abandoned railway corridor, it passes through offline greenfield sections (see Photograph 8-3). These sections are characterised by a mix of agricultural land, peatlands and natural habitats near the SACs such as Lough Eske and Ardnamona Wood SAC and Croaghonagh Bog SAC which the proposed development runs parallel to. The soils in these areas are variable, with peat and organic cohesive units encountered in low-lying and waterlogged areas, particularly near Lough Eske, Barnesmore Gap and Lough Mourne.

Photograph 8-3 - Offline Greenfield Section near N15

8.4.1.3 Existing and New Structures

The development includes the repair and reuse of existing structures, such as underbridges, overbridges and culverts, as well as the construction of new structures where necessary (see **Error! Reference source not found.**). These structures are critical for maintaining the continuity of the proposed development and ensuring safe crossings of watercourses and roads.

Photograph 8-4 - Existing Stone Arch Bridge at River Eske Crossing

8.4.1.4 Town Connections and Trailheads

At the southern and the northern ends of the proposed development, the greenway alignment transitions mainly from abandoned railway corridor into urban environments to connect with Donegal Town and Ballybofey/Stranorlar, respectively. These connections and associated trailheads are generally located close to rivers and town localities, where the alignment approaches former railway bridges and navigates surrounding fields, estates, and development lands (see Photograph 8-5).

Photograph 8-5 - Future Trailhead Location near Biddy's O'Barnes

8.4.2 Geomorphology

The proposed development shows a diverse transition in topography and elevation. At Donegal Town, which lies near sea level on the shores of Donegal Bay, the terrain is initially flat, influenced by River Eske estuary. This area is part of a low-lying coastal plain where marine and fluvial processes played a role shaping the landscape as per Figure 8-1.

Inland the landscape begins to rise, creating a gently rolling terrain and transition into a drumlin belt. This area, just before the Barnesmore Gap, is shaped by glacial activity and is characterised by drumlins with elevations typically ranging between +25 to +100m OD (meters above Ordnance Datum). The drumlins are mainly composed of glacial till deposited by retreating glaciers formed during the last Ice Age.

To the north the Bluestack Mountains dominate the terrain which becomes steeper and more rugged. These mountains were shaped by glacial erosion which carved deep valleys between ridges. One of the most important glacial features is the Barnesmore Gap, which cuts through the mountains. The elevations at the gap ranges from +125 to +200m OD. The rocky slopes at either side of the gap rise to over +400m OD on either side of the gap. Meanwhile, the valley floor is relatively flat, with glacial features such as moraine ridges. A hummocky moraine feature is also present at the beginning of the gap.

North of Barnesmore Gap, there is a plateau around in the vicinity of Lough Mourne before the terrain descends gradually into the River Finn Valley. This valley, which is a broad, low-lying land area shaped by both glacial and fluvial processes, extends through Ballybofey/Stranorlar from west to east. Elevations across the valley vary from +20 to +100m OD. Both drumlin and moraine features, which are shown in Drawing 60701883-ACM-EGN-SW_ZZ_ZZ_ZZ-DR-EN-0804 in Volume 3 of this EIAR, are largely associated with audited geological heritage sites which are discussed in the next subsections.

8.4.3 Bedrock Geology

The study area for the proposed development comprises of a geologically diverse region, shaped by mainly sedimentary, tectonic and metamorphic processes (see Figure 8-2**Error!**

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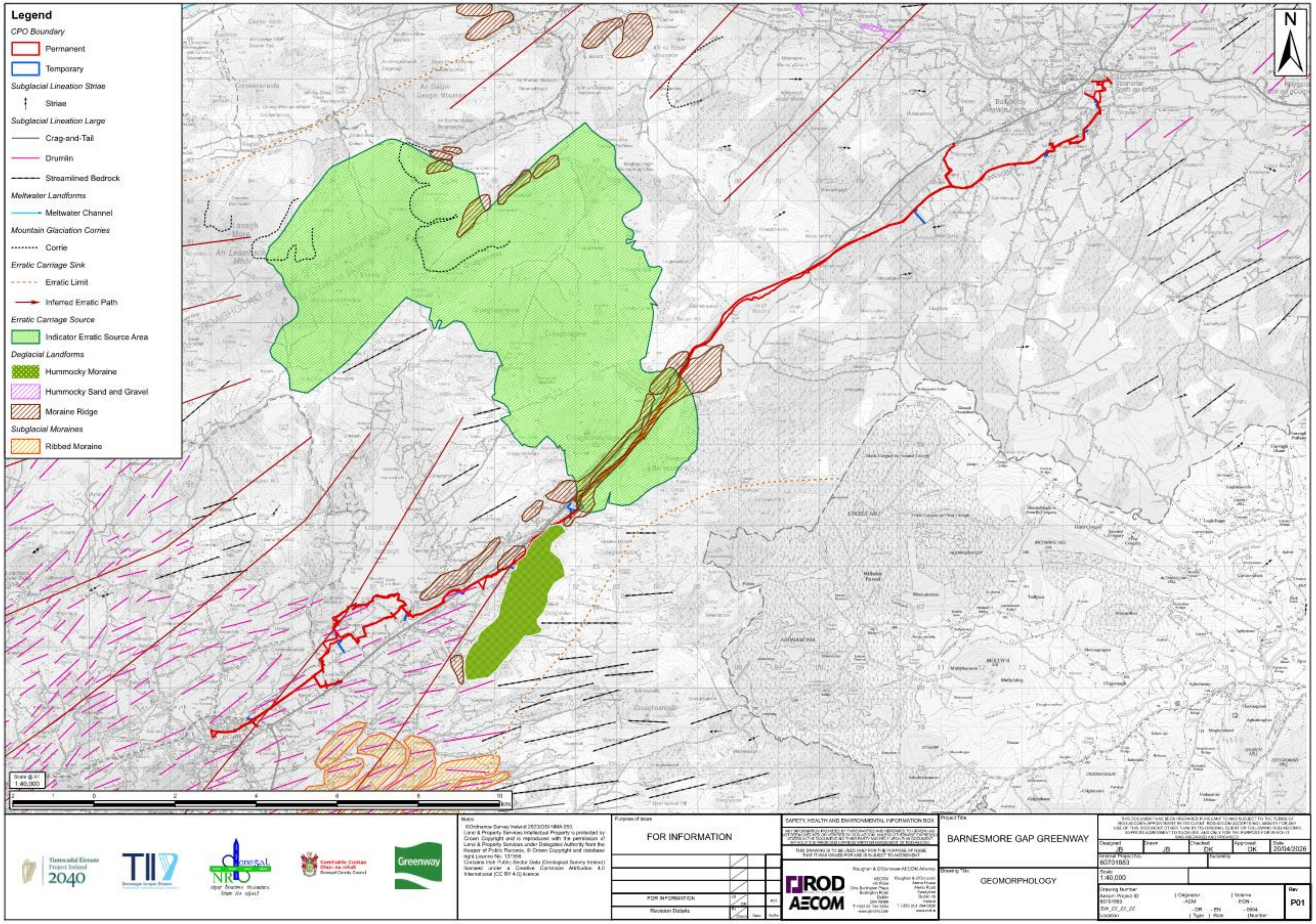

Figure 8-1 - Geomorphology Features of the Study Area (GSI maps)

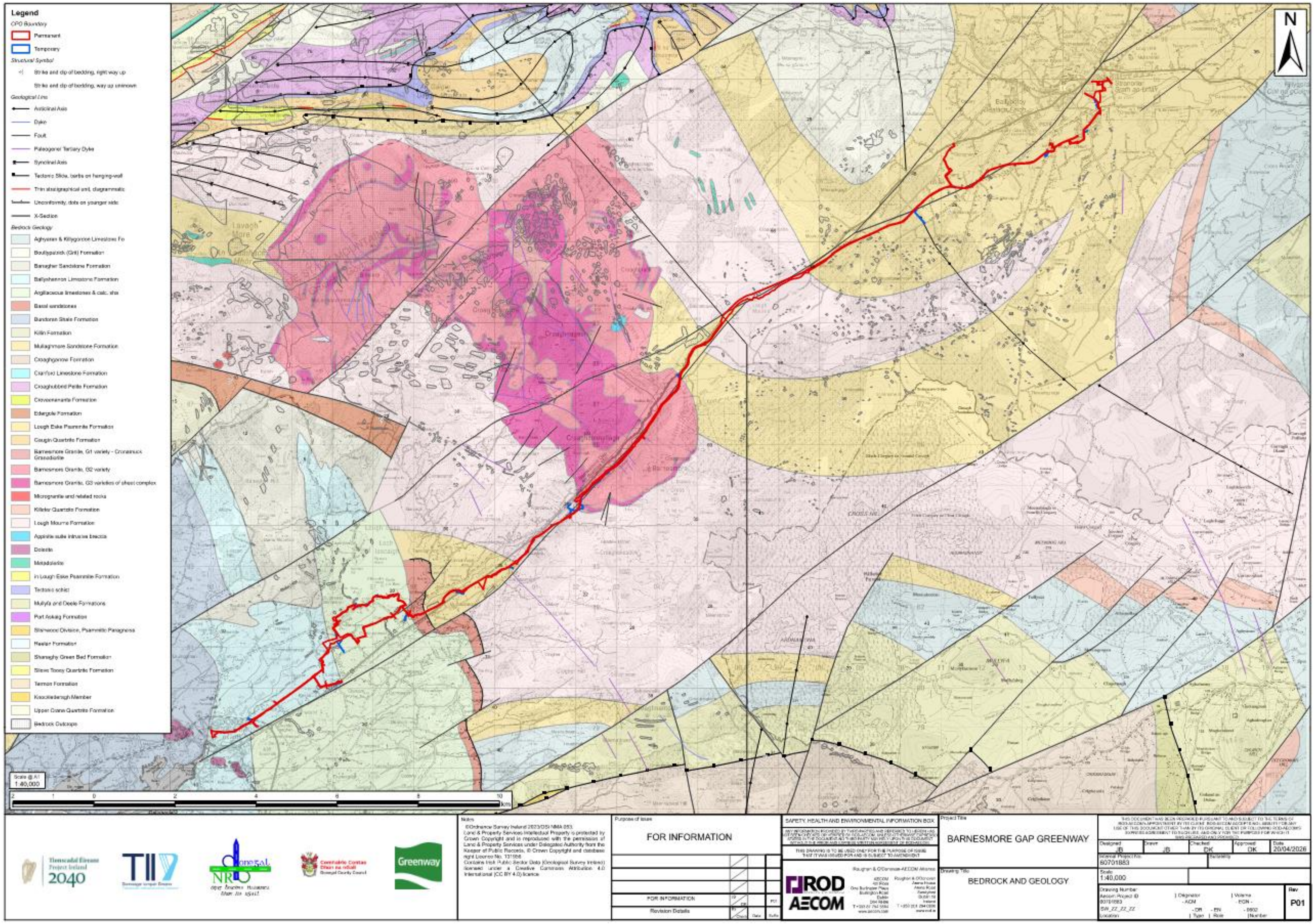

Figure 8-2 - Bedrock Geology 100k of the Study Area (GSI maps)

8.4.4 Overburden

The overburden in the study area was mainly deposited during the last Ice Age and the subsequent post-glacial period. These sediments include deposits such as glacial till, alluvium and peat, and bedrock outcrop or subcrop along with outwash gravels and boulders. In the river valleys (Eske, Lowerymore, Finn and respective tributaries) there are gravels and soft areas of alluvium and peat. Blanket peat covers the flatter mountain areas, such as around Lough Mourne (see Quaternary Geology Drawings 60701883-ACM-EGN-SW_ZZ_ZZ_ZZ-DR-EN-0810 – 0817 in Volume 3 of this EIAR).

Gravels and boulders are also present, particularly along the steep slopes and valleys of the mountains where meltwater channels are located (see **Error! Reference source not found.**).

Photograph 8-6 - Boulders and Scree Deposits in the Mountain Slopes

Made Ground is primarily composed of a mixture of clays, sands, gravel, and boulders along the abandoned railway corridor.

8.4.5 Geological Heritage

There are two geological heritage sites closely related to the proposed project according to the GSI database:

- Donegal and Inver Bays (DL011)
- Barnesmore Gap (DL002)

Donegal and Inver Bays geological heritage site features a prominent field of drumlins and ribbed moraines which are subglacial landforms created during the last Ice Age. These features are primarily composed of Quaternary deposits overlying Lower Carboniferous limestone bedrock. The site is considered one of the finest examples of ribbed moraines and associated drumlins in Ireland, making it a significant County Geological Site with potential for designation as a Geological Natural Heritage Area (NHA). This designation underscores the medium to high importance attributed to the site.

As outlined in the subsections above, the Barnesmore Gap is a deep, steep-sided glacial valley formed during the Last Ice Age. It is just over 4km long and up to 200m deep. It follows the Barnesmore Fault which is one of the major structural features of the bedrock geology of Donegal. The Gap is recommended as NHA due to its ease of accessibility and striking geomorphology. The site is therefore of high importance (see Waste Landfill Mineral Active Quarries and Geological Heritage Drawing 60701883-ACM-EGN-SW_ZZ_ZZ_ZZ-DR-EN-0807 in Volume 3 of this EIAR).

8.4.6 Mineral Observations

There are a few small, abandoned, quarry sites along the route in the vicinity of Barnesmore Gap, but no active quarries in the close vicinity of the route.

8.4.7 Karstification and Weathering of Bedrock

The GSI Groundwater database indicated four known karstic formations in the vicinity of the proposed development; two springs, one swallow hole and one enclosed depression (see Groundwater Vulnerability and Karst Landforms Drawing 60701883-ACM-EGN-SW_ZZ_ZZ_ZZ-DR-EN-0805 in Volume 3 of this EIAR). Table 8-4 below summarises the list of them with corresponding information.

Table 8-4 - Karst Formations Along the Proposed Development

Type	Historic GSI Karst Feature ID and Unique ID	Name	Coordinates
Enclosed Depression	1737NEK001 IE_GSI_Karst_40K_4179	-	X Easting (ITM): 595902.63 Y Northing (ITM): 882865.07
Swallow Hole	1737NEK002 IE_GSI_Karst_40K_448	Foxes Hole	X Easting (ITM): 595662.66 Y Northing (ITM): 881155.43
Spring	1737NEK003 IE_GSI_Karst_40K_2457	"Spa Well"	X Easting (ITM): 596122.56 Y Northing (ITM): 881165.43
Spring	1737NEK004 IE_GSI_Karst_40K_338	-	X Easting (ITM): 596462.49 Y Northing (ITM): 881215.41

Karstic formations are a type of geological feature characterised by caves, springs and other types of underground drainage resulting from the dissolution of the underlying bedrock formation. This typically occurs in areas of high rainfall with rock types vulnerable to dissolution, such as limestone.

Karstic formations are mainly spread in the vicinity of the River Eske and its tributaries based on the GSI database, as shown in **Error! Reference source not found.**. Apart from a closed depression to the north of Lougheask Demesne near Lough Eske, the rest lie beneath the proposed development. The most prominent of these is a swallow hole called "Foxes Hole" (see **Error! Reference source not found.**). It is a feature located in Ballyshannon Limestone region (see Section 8.4.2 and **Error! Reference source not found.**), characterised by calcarenite and argillaceous limestone, which typically are less prone to karstification. Although it is historically recorded as a swallow hole, it may be potentially associated with nearby faulting and varying local deposits. Historical maps indicate the presence of several quarries in the vicinity, suggesting that the area might have been subjected to quarrying or mining activities due to shallow deposits of rock. However, this condition appears to have been influenced by water following joints between watercourses. Similar conditions are present in other extraction sites around Donegal Town, where drier conditions allowed for more extensive quarrying activities.

Photograph 8-7 - A View from Foxes Hole

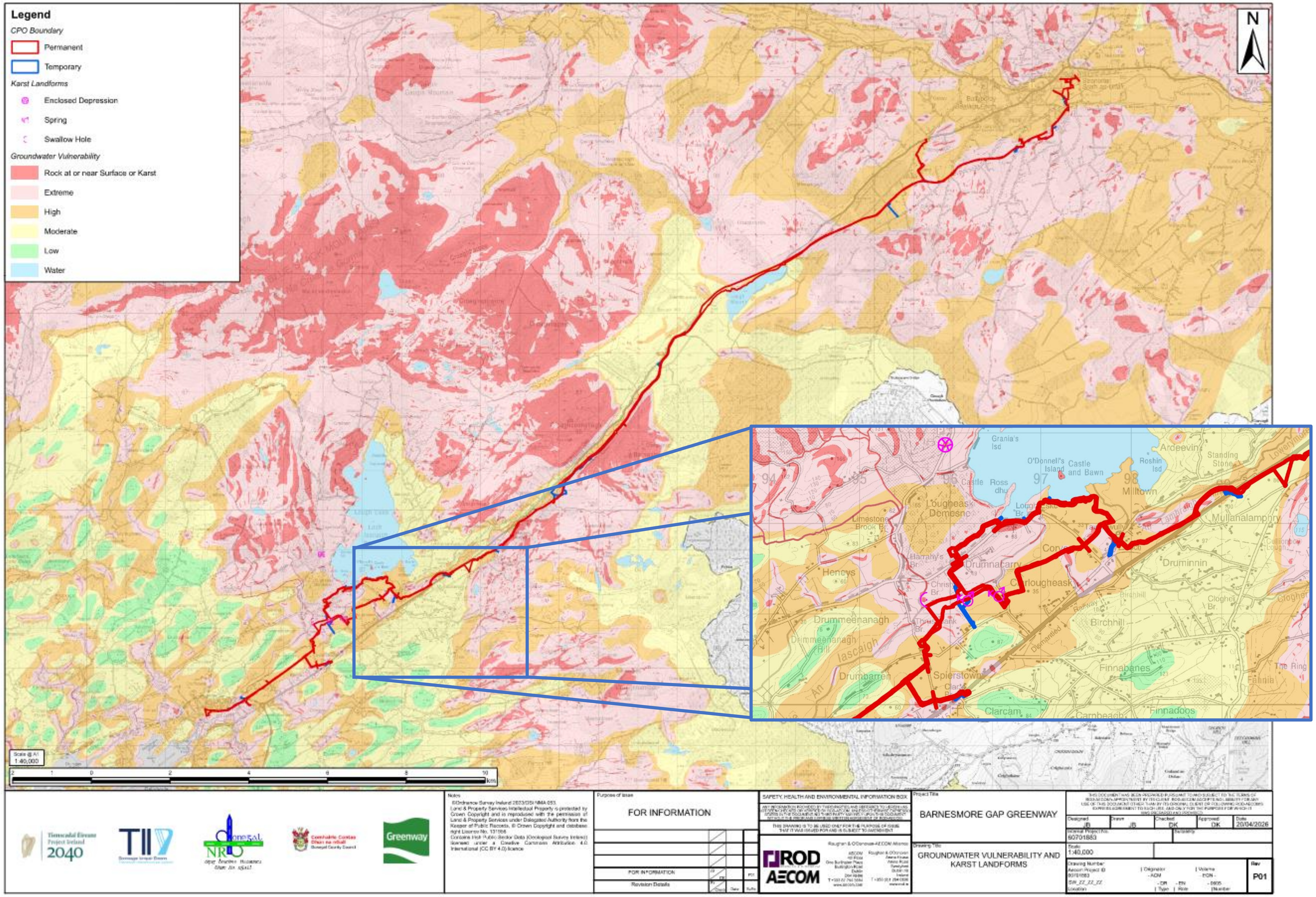

Figure 8-3 - Karst Features of the Study Area (GSI maps)

8.4.8 Existing Slope Stability

The route of the proposed development includes areas, particularly along the Barnesmore Gap, at risk of landslide/ground instability in the form of landslides, rockfalls, bog-slides and/or flows. These areas include sections where peat extends uphill beyond the railway line, unstable earthworks slopes, and adjacent mountainous terrain. Evidence of ground instability includes convex scar features, accumulation of debris at mountain bases, and large boulders that have rolled downhill with considerable energy, indicating the potential for rockfall events. **Error! Reference source not found.** and **Error! Reference source not found.** show the abandoned railway corridor located on the valley floor with mountain slopes of Barnesmore Gap. It also highlights areas of exposed rock surfaces (bedrock outcrop), and zones where debris and boulders have accumulated at the base of the slopes.

The GSI Landslides database recorded three landslide events along the proposed development, with the most recent occurrence in November 2020 (see Geohazards Drawing 60701883-ACM-EGN-SW_ZZ_ZZ_ZZ-DR-EN-0803 in Volume 3 of this EIAR). The landslide event in 2020 was caused by the construction of the nearby Meenbog Windfarm and peat flow area extended approximately 240m long and 120m wide. The incident released a significant amount of peat material into the surrounding environment, primarily impacting the Mourne Beg River and its tributaries. It also posed risks to water quality and aquatic ecosystems, particularly as the area is part of a designated SAC. Similarly, a peat flow event was trigged by the construction of a road, in 1963 within proximity of Meenbog Windfarm.

There is another event recorded at Barnesmore Gap, understood to be a rockfall incident. No apparent impact was noted.

Photograph 8-8 - Existing Slopes at Barnesmore Gap (1)

Photograph 8-9 - Existing Slopes at Barnesmore Gap (2)

8.4.8.1 Landslide/Rockfall Risk Assessment

The Barnesmore Gap presents a geotechnical hazard in terms of landslide/rockfall risk along the proposed development due to its steep glacial valley topography. The valley slopes comprise of bedrock outcrops and superficial deposits of glacial till.

A review of the GSI Landslide Database and aerial mapping/desk study indicates historical and potential instability within the Barnesmore Gap. The geomorphology of the area is indicative of potential landslide and rockfall risk in terms of shallow debris slides in till covered slopes and rockfall from bedrock outcrops.

The primary risk identified is not related to construction induced instability since no significant excavation or slope cutting is planned along the abandoned railway line situated within the Barnesmore Gap. However, the main risk stems from the potential for natural rockfall or loose scree deposits from the steep valley slopes above the greenway alignment. This poses a potential safety risk to future greenway users. An understanding of these existing conditions is fundamental to assess the need for and development of appropriate mitigation measures if they be deemed necessary, as further discussed in Section 8.6 of this EIAR.

As identified in the GSI Landslides Database, the landslide susceptibility along the Barnesmore Gap ranges from *Moderately Low to High* (see **Error! Reference source not found.**). The Moderately Low to Moderately High susceptibility sections are concentrated along the proposed development route (existing abandoned railway line), as defined by the GSI "Landslide Susceptibility Bands". However, High susceptibility regions are present in areas where the soil is thin and rock is less than a metre below the surface, or indeed exposed (RNS-Rock Near Surface). These include sections of the mountainous surface of the Barnesmore Gap mainly consisting of convex scar features having 30 to 45 degrees range and occasionally much steeper. Meanwhile, fine to coarse range grain size soils are mainly present at Moderately Low to High susceptibility regions. The predominant material is glacial till which can range from fine clays to large cobbles in a matrix of finer material (FCR-Fine to Coarse Range).

The susceptibility bands defined by GSI comprises of descriptions from Low up to High (Low, Moderately Low, Moderately High, High) based on factors including slope stability and associated topographic factors (slope steepness, orientation, etc.) discussed in National Landslide Susceptibility Mapping Project Summary (McKeon (2016)). Although mapping and bands can identify regions susceptible to landslides, they do not specify the type of susceptibility present. Landslide events may be in the form of debris slides, river terrace collapse, peat-slide or rockfall. Rockfall poses the greatest risk among other events.

Rockfall risk assessment comprises the estimation of the level of risk, deciding whether it is acceptable and exercising appropriate measures to reduce the risk when the risk level cannot be accepted (see Section 8.6.2.4). The following criteria have been identified as requiring attention: (a) maximum elevation; (b) setback distance; (c) typical gradient; and (d) runout distance. Based on these criteria, the probability of rockfall is categorised as low, moderately low, moderately high or high, which is consistent with the susceptibility bands defined by McKeon (2016). A qualitative desk study has been conducted using aerial mapping to evaluate these criteria along the Barnesmore Gap, from Ch. 12300 to 14400, where evident rockfall risk has been identified. Additionally, historical aerial photographs have been utilised to determine the change in the number of boulders that rolled downhill between 1996 and 2025. Table 8-5 summarises the preliminary risk assessment.

Table 8-5 - Preliminary Risk Assessment

Chainage From [m]	Chainage To [m]	Max. Elevation [m OD]	Typical Setback Distance [m]	Typical Gradient [%]	Boulder Runout Distance [m]	Risk Category
12300	12500	~175	~50	13	N/A*	Low
12500	12800	~200	~20	18	N/A*	Moderately Low
12800	13000	~235	~15	22	N/A*	Moderately Low
13000	13400	~300	N/A**	31	25-40	High
13400	13750	~375	N/A**	33	50-100	High
13750	14200	~425	N/A**	44	50-75	High
14200	14400	~400	N/A**	35	25-40	Moderately High

**: No boulders were identified in the aerial mapping that cross the greenway route.*

***: There is no valid setback distance since boulders cross the greenway route by the specified runout distance.*

Historical aerial imagery from 1996 to 2025 shows that areas prone to rockfall have remained relatively stable over the period. In this regard, no significant increase in the number of boulders nor any major changes in their positions on the slopes have been observed over this period of time. This may suggest that large scale rockfall events are not common in this area. However, this observation does not fully eliminate the risk as the risk has been characterised by the criteria summarised in Table 8-5 and infrequent but high energy events. The presence of boulders within the boulder runout zone confirms that rockfall risk is evident and an active geomorphological process.

<u>Conclusion:</u> The potential consequences of rockfall events can be severe, but the probability of such an event impacting the greenway is unlikely. Refer to Section 8.6 of this EIAR for more information.

8.4.9 Contaminated Soils

There is no evidence of contaminated soils posing a risk for the project as the route avoids previously developed areas such as yards and buildings or sites where vehicles and machinery/fuel tanks were stored.

8.4.10 Waste Handling/Landfill Sites

The Ballynacarrick Landfill at Ballintra, 10km south of Donegal Town, is the closest licensed waste disposal site to the proposed development as identified by EPA mapping.

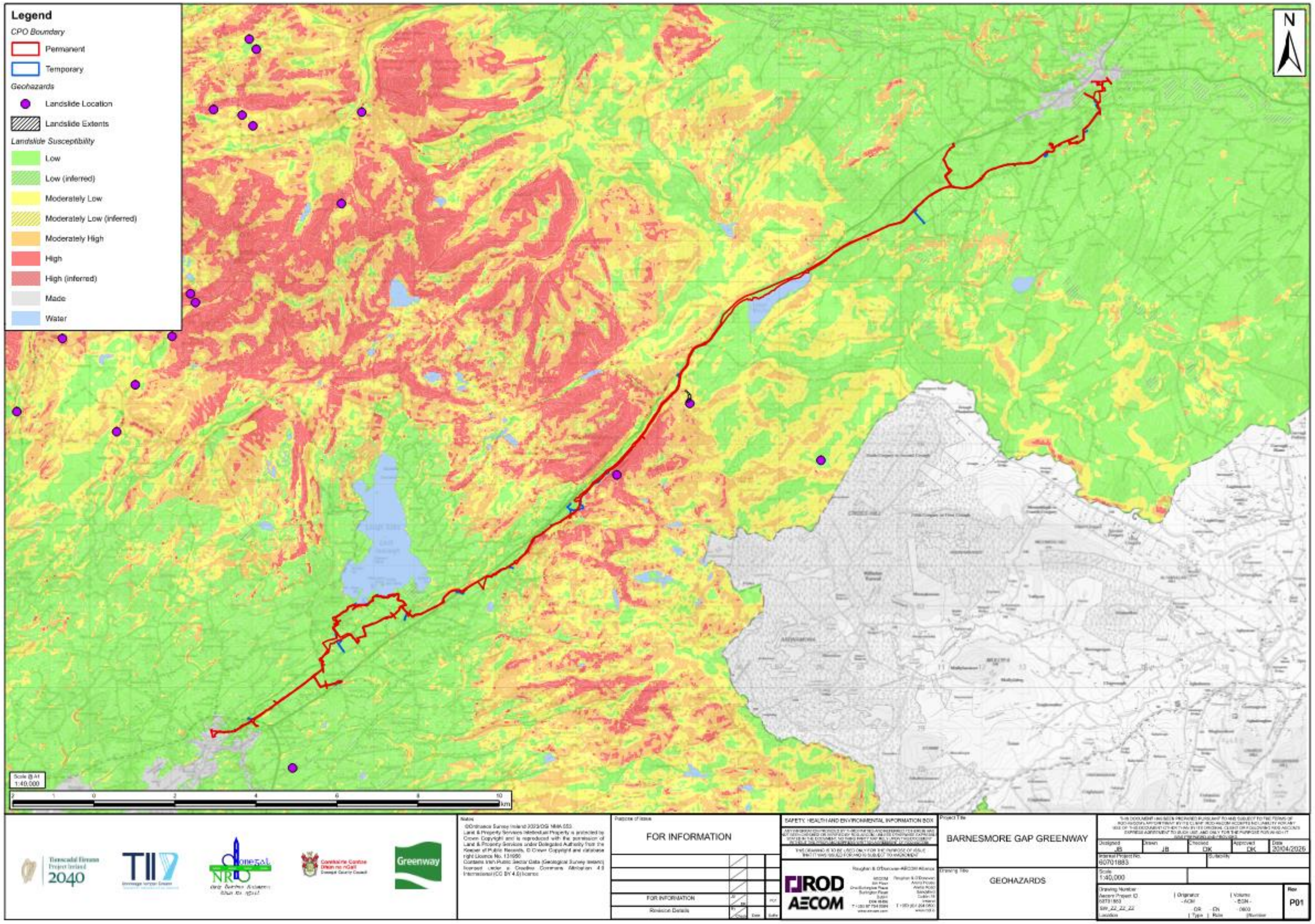

Figure 8-4 - Landslide Susceptibility of the Study Area (GSI maps)

8.5 Description of Potential Impacts

8.5.1 Do Nothing Scenario

If the proposed development is not built, it is likely that the current land uses will continue for the foreseeable future. There would be no construction related disturbance to lands or soils along the corridor. Soils and peat deposits would remain undisturbed and no earthworks, compaction or sealing would occur. The existing abandoned railway corridor would continue to deteriorate (e.g., gradual revegetation of railway, continued natural erosion) with no active management. The natural rockfall hazard within Barnesmore Gap is a preexisting geomorphological condition that is entirely independent of the proposed development. In the Do Nothing Scenario, this hazard would persist unchanged. Loose boulders and scree, exposed bedrock outcrops, and the potential for rockfall events would remain on the slopes above the abandoned railway corridor.

As a result, impacts to the Land and Soils would remain largely unchanged.

8.5.2 Potential Construction Impacts

The main characteristics of the proposed development that will impact the Land and Soils are discussed under the following subheadings in this section along with the details on construction and operation of the greenway:

- Temporary construction compounds and access points;
- Excavations and material balance, and;
- Structures

8.5.2.1 Temporary Construction Compounds and Access Points

The construction of the proposed development will require 3 no. main compounds and 27 no. temporary working areas along the route as detailed in Chapter 4: Description of the Proposed Development in Volume 2 of this EIAR. Works will be undertaken in each direction from the compounds, typically 500 to 2000m depending on the spacing of compounds in a given area. Key locations of the main compounds are given below:

- Donegal Town (Ch. 000),
- Biddy's O'Barnes (Ch. 11950),
- Stranorlar (Ch. 29980).

Each main compound will occupy approximately 4,000 to 7,300m^2, with temporary working areas typically covering 500 to 11,400m^2. The compounds will be situated adjacent to trailhead locations. Access to work locations will be from the construction compounds and/or direct access points.

Construction of the main compounds and temporary working areas will involve vegetation clearance and creation of hardstanding areas, which can lead to localised soil compaction from construction traffic. Unmitigated, this would represent a short-term, *Slight to Moderate Effect* on soil structure. The works will also expose soils to erosion during rainfall events, with potential for silt runoff into sensitive watercourses such as the River Eske and tributaries feeding Lough Mourne.

The operation of plant and machinery within the compounds will necessitate storage of fuels and oils, presenting a potential contamination risk to soils and groundwater. Their storage is likely to pose potential spill and leak risks. Unmitigated, this would be a short-term *Slight to Moderate Effect* on soil quality.

Similar to greenway pavement construction, the importation of fill material and/or other construction related products for the construction of the compounds and access tracks will have a permanent *Slight to Moderate Effect* on the source quarries.

As outlined in Chapter 4: Description of the Proposed Development in Volume 2 of this EIAR, construction compounds and access points will be cleared and reinstated. Temporary buildings, containers, parking areas and unused construction materials will be removed as appropriate.

8.5.2.2 Earthworks and Material Balance

The earthworks balance, based on design modelling, indicates a net export of material. A key optimisation strategy is to maximise the on-site reuse of excavated materials to reduce import and export volumes. Table 8-6 summarises the earthworks and material balance.

Table 8-6 - Cut/Fill Volumes

Earthworks and Material Component	Item	Volume [m^3]	Remarks
Cut/Fill	Cut	105,000	Volume estimates calculated using Autodesk Civil 3D. Comparison between proposed surface level and existing ground surfaces, with additional cut volumes calculated for capping, sub-base and pavement make-up. Surplus (Cut) material will be re-used on site for verges, earthworks side slopes and grading ancillary infrastructure
	Fill	75,000	
	Net (Cut)	30,000	
Material Import	Class 1/2 Acceptable Fill	0	All required acceptable fill will be sourced from on-site cut. Import is required for specific pavement and drainage materials
Topsoil (On site storage)	Topsoil	15,800	All topsoil will be planned for temporary stockpiling and subsequent reuse in landscaping, verges, and embankment softening

Most of the cut material will be suitable for reuse in embankment construction and it will not be necessary to import general fill material to the site. A small surplus of excavated material will be deposited in landscaped areas and on the sides of embankments with shallow gradients. Therefore, it will not be necessary to export any excavated soils from the proposed development for disposal elsewhere. Soil deposits (comprising alluvium, glacial till and gravels and cobbles) are assessed as being of *Low Importance*. These deposits are not considered rare or to have significant geological value. The main impacts on these soils will be from excavation for cutting, structure foundations and drainage channels which will result in permanent removal from these locations. Earthworks operations will expose soils to wind and water erosion during construction, and the movement of construction machinery will cause compaction in areas adjacent to the active works footprint. Additionally, the placement of fill material will result in the permanent local sealing of soils beneath the embankments. Consequently, the magnitude of impact on these soils is assessed as *Small Adverse*, and the resulting effect is considered as permanent *Not Significant to Slight Effect*, if unmitigated. Meanwhile, importing specific materials for pavement and drainage components (e.g., capping layers, sub-base, and surfacing materials) will have a permanent *Slight to Moderate Effect* on source quarries. Refer to Chapter 5: Traffic and Transportation in Volume 2 of this EIAR for details on construction traffic.

The earthworks design accounts for varying ground conditions along the route. In areas of soft ground (peat, organic materials and soft alluvium up to 3m thick), a specialised construction technique called 'floating' ('no dig') will be employed. This technique uses geogrid and geotextile materials, as well as capping on top of the sub-formation or the existing surface where possible. This is then overlain by the pavement makeup which eliminates the need for further excavation and fill operations.

Where excavation is required on parts of the existing slopes of the Barnesmore Gap comprising boulders and scree, further detailed investigation and design specifications will be required. Cross sections of the greenway alignment have been developed and reviewed to identify critical geometries and constraints. It has also been confirmed that the alignment will be subject to local centre line adjustments where it is not centred on the abandoned railway corridor in localised sections to eliminate the need for any cut/fill operations.

Table 8-7 shows where soft ground (peat and organic materials) is present in the proposed development. Please note that some of these sections are located alongside the existing abandoned railway line. In these areas, the existing railway ballast will be used as the formation level. This will be 'made good' by removing the top layer and replacing it with subbase material; no further excavation of the peat and organic materials will be required.

Table 8-7 - Soft Ground Sections

Section	Chainage [m]		Length [m]	Soft Ground Presence
	From [m]	To [m]		
PS2	1090	1210	120	✓
PS3	2315	2835	520	✓
PS4	0	305	305	✓
PS5	3640	3825	185	✓
PS6 - ELE	1135	1470	335	✓
PS7 - ELE	1925	2135	210	✓
PS8	5455	6095	640	✓
PS9	6930	7090	160	✓
PS10	8550	8850	300	✓
PS11	9050	9260	210	✓
PS12	9630	9880	250	✓
PS13	9920	10180	260	✓
PS14	11030	11360	330	✓
PS15	12095	12310	215	✓
	0	278	278	✓
PS16	15750	16150	400	✓
PS17	16150	18100	1950	✓
PS18	18100	19000	900	✓
PS19	20450	21550	1100	✓
	0	259	259	✓

The peat and organic soils encountered along the route, particularly in the low-lying, waterlogged sections of greenfield areas, are more sensitive than other deposits comprising alluvium, glacial till, gravels and cobbles. They are assigned an importance rating of *Medium Importance*. This rating reflects their local significance for carbon storage, the role of supporting peatland habitats and biodiversity and vulnerability to physical disturbance and hydrological change (refer to Chapter 7: Biodiversity and Chapter 9: Hydrology in Volume 2 of this EIAR). Where earthworks intersect peatland areas, proposed excavations would result in direct loss of peat and organic materials and their associated carbon storage function. Where peat is not excavated, there is a risk that construction related activities (e.g., dewatering, drainage etc.) may lower the local groundwater table, leading to deterioration of peat and the gradual release of stored carbon. Additionally, the movement of construction machinery may create physical disturbance and deformation on peatlands. However, the design of the proposed route avoids these impacts wherever possible by employing the floating construction technique and the lightweight construction machinery as also discussed in Section 8.6.2.2. Thus, disturbance and deformation of peatlands are anticipated to be minimal. Consequently, the magnitude of the impact on peat and organic soils is assessed as *Small Adverse* and the resulting effect is considered as a *Slight Effect*, if unmitigated.

8.5.2.3 Structures

The proposed development includes repairs and modifications to several existing structures along the route, primarily comprising former railway underbridges and overbridges, culverts, and retaining walls (refer to Chapter 4: Description of the Proposed Development in Volume 2 of this EIAR).

The repair works can temporarily disturb soils in the immediate vicinity of each structure, particularly where excavations or drilling are required for foundation repairs, structural connections or drainage improvements. At river crossings such as the River Eske and River Lowerymore, there is a risk of sediment release into the watercourse during in-water works.

The construction of new structures along the proposed development will involve significant ground intervention works that can affect soil integrity and stability. Structure foundations will require temporary excavation works such as shoring and trench boxes. Dewatering equipment will also be used to ensure the formation levels remain dry.

This will necessitate significant temporary stockpiling of the excavated material and corresponding management of these materials. Soils exposed in excavations are likely to be subject to erosion by wind and rain, potentially depositing silt in nearby watercourses. Additionally, soil compaction will occur due to movement of construction machinery. These are likely to result in a temporary increase in surface runoff and erosion which would have a short-term *Slight to Moderate Effect* on the soils in the vicinity of the newly proposed structures, if unmitigated.

The use of plant and machinery for structural repairs and construction of newly proposed structures will necessitate the storage and handling of fuels, oils, and construction materials within temporary work areas. Uncontrolled spills or leaks will lead to localised soil contamination, representing a short-term *Slight to Moderate Effect* on soil quality. Vibration from piling or drilling operations can also temporarily affect adjacent soils. However, this is expected to be limited to the immediate workspace and is likely to result in a locally *Imperceptible Effect* on soils.

All proposed river bridges avoid in-river works for foundation construction. The abutments and piers will be founded on either pad/shallow or piled foundations on the riverbanks. This will mitigate the risk of sediment release and direct ecological disturbance within the watercourses up to a certain extent. In this regard, the effects on soils from structural works is expected to be *Not Significant to Slight Effect*.

8.5.3 Potential Operational Impacts

During the operational phase of the proposed development, it is highly unlikely that earthworks will be required as part of the routine maintenance, and therefore there will be no impacts.

As discussed in Section 8.6.3, the 5-yearly inspections at the mountain slopes are mitigation measures against the external natural hazard of rockfall, not an impact caused by the proposed greenway. These inspections have no environmental impact.

8.6 Mitigation Measures

8.6.1 Design Phase

8.6.1.1 Earthworks Footprint and Material Demands

The design of the proposed development has mitigated potential impacts through minimisation of earthworks, with floating pavement across soft ground, and reuse of cut materials for embankments within the site, thus avoiding the necessity to import or export soil materials.

8.6.2 Construction Phase

The following sections outline appropriate mitigation measures during the construction phase to avoid or reduce the potential impact of the proposed development.

8.6.2.1 Soil Disturbance, Erosion and Seepage

To prevent soil erosion, excavations will be completed and promptly backfilled or topsoiled. Construction works will need to be limited during heavy rainfall (heavy rainfall is defined as status yellow-level rainfall, defined by Met Éireann as 20mm – 30mm in 6 hrs or less, 30mm – 40mm in 12 hrs or less, or 30mm – 50mm in 24 hrs. To reduce contamination risks. Refuelling of machinery will be restricted to designated areas with spill containment measures.

Earthworks for the proposed development will be managed by erosion and sediment control measures as described in Appendix 4.1 Construction Environmental Management Plan (CEMP) in Volume 4 of this EIAR. This plan will incorporate multiple protective measures including the installation of sediment traps, swales and ditches before any major site earthworks take place.

8.6.2.2 Peatland Protection

The proposed development contains deposits of peat/organic soils that require specialised protection measures. Disturbance of these soils will be generally avoided through use of a floating construction technique consisting of geotextile and geogrid layers across the peat surface under a crushed stone capping layer. All plant movement in these areas will be restricted to designated routes protected by temporary matting, with specialist machinery having lower ground pressure.

Where peat excavation is unavoidable, the material will be reused on-site for habitat restoration areas and landscaping.

8.6.2.3 Soil Contamination

Due to original lightweight nature of the original narrow-gauge railway which ceased operation 70 years ago, it is not expected that contaminated soil will be encountered in the proposed greenway works. There are no known areas of risk for soil contamination along the route.

However, as a precaution, a comprehensive soil testing program shall be implemented prior to construction in areas of suspected contamination, particularly along the abandoned railway corridor. No specific areas of suspected contamination are currently known. Any identified contaminated materials will be segregated and disposed of at licensed facilities. All construction compounds will be equipped with spill containment kits and designated refuelling areas located far enough from watercourses to prevent hydrocarbon contamination.

8.6.2.4 Slope Stability during Construction

The proposed development passes through zones, particularly near the Barnesmore Gap, that may be susceptible to ground instability, including landslides, rockfalls, and bog-slides.

During the construction stage for the proposed greenway, a geological inspection will be undertaken by a qualified engineering geologist. This inspection will cover the mountainside above the old railway through Barnesmore Gap to identify any potentially unstable boulders and/or rock faces that could create a rockfall risk towards the greenway. If necessary, stabilisation works will be undertaken to reduce such risk to an acceptably low level. Targeted stabilisation works shall be carried out including removal or scaling of loose, unstable boulders and provision of low height drystone walling or gabion baskets locally using rock and stone materials obtained on site. The maximum heights of such structures are of the order of 1.0 to 1.5 metres in the majority of cases. The environmental implications of these works are expected to cause minor localised disturbance which would result in *Not Significant to Slight Effect* on the corresponding mountain slopes.

The CEMP will incorporate detailed method statements for inspection for any potential slope stability risks within or adjacent to the works areas supervised by a qualified engineering geologist who may identify suitable protective measures to be adopted.

8.6.3 Operation Phase

During the operational phase, repeat geological inspections of the mountainside above the old railway through Barnesmore Gap will be carried out every 5 years to monitor the stability and safety of the mountain slope, and any necessary further stabilisation measures will be implemented to ensure the ongoing safety of the greenway (see Section 8.6.2.4). These inspections will be mitigation measures against external natural hazard of rockfall, not against any impact caused by the proposed greenway.

8.7 Monitoring

Periodic inspections and monitoring will be undertaken of the geological stability of the mountain slope at Barnesmore Gap so that any necessary stabilisation measures can be applied. All inspections and monitoring activities shall be carried out by or on behalf of Donegal County Council with a qualified engineering geologist. The inspections will involve visual inspections and walkovers which have no environmental impact. Mountain slopes above the greenway from Ch. 12300 to 14400 shall be monitored with a focus on identifying loosened boulders and/or unstable rock faces as well as signs of recent rockfall. The scope includes visual assessment of rock slopes, comparison with baseline boulder mapping and inspection of any installed mitigation measures as detailed in Section 8.6.2.4. If unstable features are identified after each inspection, a separate assessment shall be undertaken to determine the further works required.

Monitoring of existing structures and earthworks during construction activities will be required to ensure their long-term stability and durability by the Contractor under the supervision of Employer’s Representative. Periodic inspections of all slope stabilisation works and earthworks by a qualified project geotechnical engineer and/or engineering geologist shall be conducted during and immediately following construction activities.

8.8 Residual Effects

No residual effects are expected from the proposed development.

8.9 References

This document has been prepared with reference to following key documents, guidelines and data sources given below.

Legislation and Policy Documents:

- Donegal County Council (2024). Donegal County Council Climate Action Plan 2024–2029.
- Donegal County Council (2024). Donegal County Development Plan 2024–2030.

- Donegal County Council. (2018). Donegal County Development Plan 2018–2024.
- European Commission (2017). Environmental Impact Assessment of Projects: Guidance on the Preparation of the Environmental Impact Assessment Report.
- European Union Directive (EIA Directive) (2011/92/EU, as amended by Directive 2014/52/EU). European Union (2011). Council Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment, as amended by Directive 2014/52/EU of the European Parliament and of the Council. Official Journal of the European Union, L236, 1–23.
- Government of Ireland (2018). European Union (Environmental Impact Assessment) Regulations 2018 (Statutory Instrument No. 296/2018).
- Oireachtas (2000). Planning and Development Act 2000.
- Oireachtas (2021). Climate Action and Low Carbon Development (Amendment) Act 2021.
- Strategic Environmental Assessment (SEA) Directive (2001/42/EC). European Union (2001). Council Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment. Official Journal of the European Union, L189, 43–50.

Technical Guidance:

- Environmental Protection Agency (EPA) (2015), *Advice Notes for Preparing Environmental Impact Statements;*
- Environmental Protection Agency (EPA) (2022), *Guidelines on the Information to be contained in Environmental Impact Assessment Reports;*
- Institute of Geologists of Ireland (IGI) (2013), *Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements;*
- Transport Infrastructure Ireland (December 2008), *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes PE-ENV-01116;*
- Transport Infrastructure Ireland (February 2023), *Environmental Planning of National Road and Greenway Projects*, *RE-ENV-07008;*
- Transport Infrastructure Ireland (November 2024), *Environmental Impact Assessment of Rural Cycleways (Offline & Greenway) – A Practical Guide PE-ENV-01109;*
- Transport Infrastructure Ireland (May 2024) *Managing Geotechnical Risk, DN-ERW-03083, and;*
- Transport Infrastructure Ireland (February 2025), *Rural Cycleway Design (Offline and Greenways), DN-GEO-03047.*

Scientific and Site-Specific Sources:

- Geological Survey Ireland (GSI) (2024). Quaternary Sediments 50k, Quaternary Geomorphology 50k, Bedrock Geology 1 Million, Bedrock Geology 500k, Bedrock Geology 100k; Geological Heritage Audited and Unaudited Sites; Groundwater Karst and Surface Water Features; Landslides Landslide Events Databases.
- Ordnance Survey Ireland (OSI) (2024). Historical Mapping Archives (map.geohive.ie).
- McKeon, C. (2016). National landslide susceptibility mapping project summary. Final Report. Geological Survey Ireland.
- Northwest Geotech Ltd (November 2025). Ground Investigation Report Barnesmore Gap Greenway, Report No: 24-0069, Revision: A02.
- Roughan & O'Donovan – AECOM (2024). Geotechnical Risks – Statement of Intent, 60666974-ACM-VGT-SW_ZZ_ZZ_ZZ-RP-Z-0001.