



Clachaig Glen Wind Farm

Environmental Impact Assessment Report

Volume 2a

Main Report

Chapter 11: Geology, Hydrology and Hydrogeology

11. Geology, Hydrology and Hydrogeology

11.1 Introduction

- 11.1.1 This chapter of the Environmental Impact Assessment Report (EIAR) details the findings of an assessment of the potential effects of the Proposed Development, as described in Chapter 3 of the EIAR: Project Description, on Geology, Hydrology and Hydrogeology.
- 11.1.2 Consideration of potential effects is made in the context of existing Development Site conditions (baseline), the construction phase, the operational phase once the Proposed Development is complete, and decommissioning of the Proposed Development.
- 11.1.3 Potential effects on ground conditions and water resources (geology, hydrology and hydrogeology) are interrelated and connected to a degree with effects on the surrounding forest and its uses. This chapter should be read in conjunction with Chapter 3: Project Description, Chapter 6: Planning and Energy Policy Context, Chapter 9: Ecology, and Chapter 17: Forestry of the EIAR.
- 11.1.4 This chapter is supported by the following Appendices provided in Volume 3 of the EIAR:
- Appendix 11.1: Watercourse Crossing Strategy,
 - Appendix 11.2: Groundwater Dependent Terrestrial Ecosystems (GWDTE) Assessment,
 - Appendix 11.3: Peat Landslide Hazard and Risk Assessment (PLHRA),
 - Appendix 11.4: Carbon Balance Assessment,
 - Appendix 11.5: End User Private Water Supply (PWS) Questionnaire,
 - Appendix 11.6: Existing Controlled Activities Regulations (CAR) Licences, and
 - Appendix 11.7: Peat Balance Calculations.

11.2 Legislation, Policy and Guidance

Legislative Background

- 11.2.1 Protection of the water environment in Scotland is regulated by a number of national legislation, much of which derived from European Directives and pieces of national legislation.
- 11.2.2 The Water Framework Directive (WFD) was transposed into Scots Law by the Water Environment and Water Services (Scotland) Act 2003 (WEWS Act), which gave Scottish Ministers powers to introduce regulatory controls over activities in order to protect and improve Scotland's water environment.

- 11.2.3 The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended), more commonly known as the Controlled Activities Regulations or CAR, provide for the regulatory controls enabled by the WEWS Act. CAR serves to protect surface waters against the discharge of poisonous, noxious or polluting substances. Under CAR it is an offence to make a discharge to any wetlands, surface water or groundwater without prior authorisation.
- 11.2.4 Detailed information on planning policy is contained within the Planning Statement accompanying the S36 Application, with a summary of the relevant planning policies in Chapter 6 of the EIA: Planning and Energy Policy Context. Key legislation relevant to this assessment is described in Table 11-1.

Table 11-1 Water Related Legislation

Legislation	Description
European Directives	
Water Framework Directive (WFD) (2000/60/EC)	Provides that the ecological and chemical status of waters in the principal parameter against which waterbodies should be measured.
Groundwater Daughter Directive to WFD (2006/118/EC)	Establishes specific measures in order to prevent and control groundwater pollution.
The Urban Waste Water Treatment Directive (UWWTD) (91/271/EEC) (as amended by Directive 98/15/EC)	Protects the environment from potentially adverse effects of urban and industrial waste water discharges in the European Union (EU).
UK Legislation	
Water Environment and Water Services (Scotland) Act 2003 (WEWS) Act 2003	Implements the WFD in Scotland and provides for the water abstraction management system and regulatory arrangements to make water use more sustainable. The Scottish Environment Protection Agency (SEPA) is the body responsible for the implementation of the WFD in Scotland. The WEWS Act created a new River Basin Management Plan (RBMP) process to improve the water environment in a sustainable way and provided regulations to control adverse impacts of activities deemed likely to have an impact on the water environment.
Water Environment (River Basin Management Planning: Further Provision) (Scotland) Regulations 2013	The river basin management planning process involves defining specific environmental objectives for each water body and identifying and implementing a programme of measures to deliver those objectives. The objectives are set in accordance with the provisions set out in the Water Environment (River Basin Management Planning: Further Provision) (Scotland) Regulations 2013.

Legislation	Description
The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended)	Regulates development and activities such that surface waters are protected against the discharge of poisonous, noxious or polluting substances, and provides for licensing of discharges.
Flood Risk Management (Scotland) Act 2009	Makes provision for coordination between organisations involved in flood risk management and creates duties on such organisations in relation to the preparation and review of flood risk assessments.
The Water Intended for Human Consumption (Private Water Supplies) (Scotland) Regulations 2017	Defines 'wholesomeness' for drinking water from private supplies and sets water quality standards that must be complied with.
Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003	Makes it an offence to knowingly block the passage of migrating salmon or disturb salmon spawning grounds.

Planning Policy Context

11.2.5 This assessment has been made with due consideration of the policies and guidance set out in national, regional and local policy. A complete review of the planning context in relation to the Proposed Development is provided in Chapter 6 of the EIAR: Planning and Energy Policy Context. This section summarises the guidance and policies in relation to the geological, hydrological and hydrogeological environment.

Scottish Planning Policy

11.2.6 National Planning Framework 3 (NPF3; 2014) provides a framework for Scotland's long-term spatial development. This sits alongside Scottish Planning Policy (SPP; 2014) which sets out national planning policies to ensure there is a consistent approach across Scotland with, for example, the determination of planning applications.

11.2.7 Paragraphs 254 to 268 of SPP outline the Scottish Government's specific guidance with regards to flooding and drainage. To summarise, the guidance states that local planning authorities must ensure that they:

- Consider the probability of flooding from all sources (coastal, fluvial, pluvial, groundwater, sewers and blocked culverts) and the risks involved when preparing development plans and determining planning applications,
- Do not permit development that would be at significant risk of flooding or would increase the risk of flooding elsewhere,
- Adhere to the statutory framework set out in the Flood Risk Management (Scotland) Act 2009 for delivering a sustainable and risk-based approach to managing flooding,

- Safeguard flood storage and the conveyance capacity of functional floodplains, indicate circumstances where a freeboard allowance should apply, indicate when a drainage assessment will be required and indicate where water resistant materials and forms of construction will be appropriate,
- Require a thorough justification of whether flood risk protection measures are required for a development to proceed, including an examination of alternative options,
- Promote the use of Sustainable Urban Drainage Systems (SuDS), which target the sources and pathways of flood waters and the impact of flooding,
- Promote a coordinated approach to SuDS between new developments and set out expectations in relation to the long-term maintenance of SuDS. Planning permission should not be granted unless the proposed arrangements for surface water drainage are adequate and appropriate long-term maintenance arrangements will be in place,
- Consider land raising only when a number of considerations have been explored and justified, and
- Limit the culverting of watercourses unless there is no practical alternative.

11.2.8 SPP states that Flood Risk Assessments (FRAs) should accompany applications to local planning authorities for developments where flood risk is considered to be an issue. For low to medium flood risk areas, it is not usually necessary to consider flood risk unless local conditions indicate otherwise; although a FRA may be required at the upper end of this probability range or where the nature of the development or local circumstances indicate heightened risk. Where the local planning authority considers there may be a risk of flooding to a development site, it has a statutory duty to consult SEPA for advice and guidance on flood risk.

Draft National Planning Framework 4

11.2.9 Both NPF3 and SPP are set to be replaced by one overarching National Planning Framework 4 (NPF4). A draft of the proposed NPF4 was published in November 2021 and, although it is subject to change, it will be a consideration in planning decisions. However, until NPF4 is adopted (anticipated summer 2022), NPF3 and SPP remain part of the statutory development plan.

11.2.10 Policy 13: 'Flooding' of Draft NPF4 relates to flood risk and water management. In summary, the following is relevant to a scheme such as the Proposed Development:

- Developments should not be placed in:
 - future functional floodplains (except in very limited circumstances),
 - areas at risk of surface water flooding (unless the risk can be mitigated),
 - where there would be an increased discharge to the public sewer network,

- where there would be a negative impact on the overall catchment (unless there is adequate blue and green infrastructure, safe operation and function of the proposal in a storm event, and managed water flow is not impeded),
 - Surface water flooding increases should be avoided by minimising impermeable surfaces and providing adequate drainage wherever practicable by blue and green infrastructure (such as SuDS), and
 - The creation, expansion or enhancement of natural flood risk management and blue-green infrastructure should be supported.
- 11.2.11 Key exclusions when comparing to SPP include reference to the Flood Risk Management (Scotland) Act 2009, justification for the requirement of flood risk protection measures, and limitations on land raising and culverting. Reference to SuDs have also been expanded to references to wider blue-green infrastructure.

Argyll and Bute Local Development Plan (2015)

11.2.12 The following planning policies from the Argyll and Bute Local Development Plan (LDP) are relevant to this assessment and is further detailed in Chapter 6 of this EIAR: Planning and Energy Policy Context:

- Policy LDP STRAT 1 – Sustainable Development,
- Policy LDP 3 – Supporting the Protection, Conservation and Enhancement of our Environment,
- Policy LDP 6 – Supporting the Sustainable Growth of Renewables, and
- Policy LDP 10 – Maximising our Resources and Reducing our Consumption.

11.2.13 Relevant Supplementary Guidance documents to the LDP include:

- Supplementary Guidance LDP ENV 6 – Development Impact on Trees/Woodland,
- Supplementary Guidance LDP ENV 7 – Water Quality and the Environment,
- Supplementary Guidance LDP ENV 11 – Protection of Soil and Peat Resources,
- Supplementary Guidance LDP SERV 2 – Incorporation of Natural Features/Sustainable Drainage Systems,
- Supplementary Guidance LDP SERV 3 – Drainage Impact Assessment,
- Supplementary Guidance LDP SERV 7 – Flooding and Land Erosion – The Risk Framework for Development, and
- Supplementary Guidance LDP Sust Check – Sustainability Checklist.

Argyll and Bute Proposed Local Development Plan 2

11.2.14 Argyll and Bute Council are currently in the process of preparing their new Local Development Plan (LDP2). This is expected to be adopted in January 2023. Until LDP2 is adopted, the LDP (2015) remains the primary policy consideration. The LDP2 policies, as they are currently

stand in draft form, do not represent a significant change to those in the LDP and Supplementary Guidance.

11.2.15 Nevertheless, relevant proposed policies in LDP2 include:

- Policy 04 – Sustainable Development,
- Policy 28 – Supporting Sustainable Aquatic and Coastal Development,
- Policy 30 – The Sustainable Growth of Renewables,
- Policy 55 – Flooding,
- Policy 59 – Water Quality and The Environment, and
- Policy 79 – Protection of Soil and Peat Resources.

Best Practice Guidance

11.2.16 In addition to specific legislative and planning requirements, a range of guidance documents have been published in order to provide information on legal responsibilities and good environmental practices. Specific documents are available for wind farm developments and developments on peatland, as well as general good construction practices.

11.2.17 Guidance documents relevant to the Proposed Development and the geological, hydrological and hydrogeological environment include, but are not limited to, those shown in Table 11-2.

11.2.18 In August 2020 Scottish Natural Heritage (SNH) became NatureScot. Due to the recent nature of this change, the relevant guidance documents listed in Table 11-2 were published under the name SNH.

Table 11-2 Best Practice Guidance

Guidance Documents

Construction Industry Research and Information Association (CIRIA) Guidance

- CIRIA Report 502: Environmental Good Practice on Site (CIRIA, 2015),
- CIRIA Report C532: Control of Water Pollution from Construction Sites (CIRIA, 2001),
- CIRIA (R125): A Guide to the Control of Substances Hazardous to Health in Design and Construction (CIRIA, 1993),
- CIRIA Report C753: The SUDS Manual (CIRIA, 2015), and
- CIRIA Report C624 Development and Flood Risk (CIRIA, 2004).

SEPA Guidance

- Engineering in the Water Environment Good Practice Guide – River Crossings (SEPA, 2010a),
- Engineering in the Water Environment Good Practice Guide – Sediment Management (SEPA, 2010b),
- SEPA Regulatory Position Statement – Developments on Peat (SEPA, 2010c),
- SEPA Position Statement WAT-PS-06-02 – Culverting of Watercourses (SEPA, 2015), and

Guidance Documents

- SEPA Land Use Planning System Guidance Note 4 – Planning guidance on on-shore windfarm developments (SEPA, 2017).
- SEPA The Water Environment (Controlled Activities) (Scotland) Regulations 2011 – A Practical Guide (SEPA, 2021).

Guidance for Pollution Prevention (GPPs) and Pollution Prevention Guidelines (PPGs)*

- PPG 1 – Understanding your environmental responsibilities – good environmental practices (July 2013),
- GPP 2 – Above ground oil storage tanks (January 2018),
- PPG 3 – Use and design of oil separators in surface water drainage systems (April 2006),
- GPP 4 – Treatment and disposal of wastewater where there is no connection to the public foul sewer (November 2017),
- GPP 5 – Works and maintenance in or near water, version 1.2 (January 2017),
- PPG 6 – Working at construction and demolition sites (2012),
- PPG 7 – Safe storage – The safe operation of refuelling facilities (July 2011),
- GPP 8 – Safe storage and disposal of used oils (July 2017),
- GPP 13 – Vehicle washing and cleaning (April 2017),
- PPG 18 – Managing fire water and major spillages (June 2000),
- GPP 19 – Vehicles: Service and Repairs (June 2017),
- GPP 20 – Dewatering underground ducts and chambers (January 2018),
- GPP 21 – Pollution incidence response planning (July 2017),
- GPP 22 – Dealing with spills (October 2018),
- GPP 26 – Safe storage – drums and intermediate bulk containers (February 2019),
- PPG 27 – Installation, decommissioning and removal of underground storage tanks (April 2002), and
- PPG 28 – Controlled burn (July 2007).

Scottish Government, NatureScot and others

- Constructed Tracks in the Scottish Uplands (SNH, 2015),
- Guidance on Developments on Peatland, Peatland Survey, on-line version only (Scottish Government, SNH and SEPA, 2017),
- Advising on carbon-rich soils, deep peat and priority peatland habitat in development management (NatureScot, 2021)
- Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments (Scottish Government, 2017),
- Floating Roads on Peat (SNH and Forestry Commission Scotland, 2010),
- Good Practice during Wind Farm Construction (Scottish Renewables, SNH, SEPA, Forestry Commission Scotland, Historic Environment Scotland and Marine Scotland Science, 2019); Developments on Peatland: Guidance on the assessment of peat volumes, reuse of excavated peat and the minimisation of waste (Scottish Renewables and SEPA, 2012),

Guidance Documents

- Design Manual for Roads and Bridges (DMRB) LA 113 Road drainage and the water environment (formally HD 45/09) (Highways Agency, 2020a), and
- Design Manual for Roads and Bridges (DMRB), LA 109 Geology and Soils (formally Volume 11, Part 11, Section 3, and Part 11 (Geology & Soils) and Part 6 (Land Use)). (Highways Agency, 2020b).

British Standards

- BS5930:1999+A2:2010 Code of practice for Site investigations (2010), and
- BS 10175:2011+A2:2017 Investigation of potentially contaminated Sites. Code of practice (2017).

**The GPPs are a guidance series replacing the PPGs. The PPGs listed are considered as a source of information and good practice only.*

11.3 Methodology

Consultation

- 11.3.1 A Scoping Report was submitted to the Scottish Government Energy Consents Unit (ECU) in July 2020 and a Scoping Opinion issued by the ECU in October 2020 (Appendix 5.2, EIAR Volume 3). Consultation responses have been set out within Chapter 5 of the EIAR: Summary of Consultation. Details of the scoping responses relevant to Geology, Hydrology and Hydrogeology are included in Table 11-3.

Table 11-3 Summary of Consultation Responses in relation to Geology, Hydrology and Hydrogeology

Consultee	Summary of Response / Issue Raised	Comment / Action Taken
	Peat – The planning submission must demonstrate how the layout has been designed to minimise disturbance of peat and consequential release of carbon dioxide (CO ₂).	The Proposed Development infrastructure layout has been designed to avoid deeper areas of peat. Please refer to Figure 11.5 (EIAR Volume 2b).
SEPA	Peat – The planning submission must outline the preventative / mitigation measures to avoid significant drying or oxidation of peat.	Mitigation measures included in Section 11.6 of this chapter, please refer to paragraphs 11.6.15 and 11.6.16.
	Peat – A detailed map of peat depths (this must be to full depth and follow the survey requirement of the Scottish Government's Guidance on Developments on Peatland - Peatland Survey (2017)).	Peat probing has been undertaken over several years, please refer to paragraphs 11.4.11 to 11.4.23 and Figures 11.4 and 11.5 (EIAR Volume 2b).

Consultee	Summary of Response / Issue Raised	Comment / Action Taken
	<p>If it is thought that the Proposed Development could result in an increased risk of flooding to a nearby receptor, then a Flood Risk Assessment must be submitted.</p>	<p>A screening review of flood risk has been carried out in Section 11.4 of this chapter (Paragraphs 11.4.38 to 11.4.41) which concluded a Flood Risk Assessment is not required.</p>
	<p>GWDTE – A map demonstrating that all GWDTE are outwith a 100m radius of all excavations shallower than 1m and outwith 250m of all excavations deeper than 1m and proposed groundwater abstractions. If the minimum buffers above cannot be achieved, a detailed site specific qualitative and/or quantitative risk assessment will be required.</p>	<p>National Vegetation Classification (NVC) surveys have been undertaken (Chapter 9 of this EIAR: Ecology) to identify the presence of GWDTEs.</p> <p>The Proposed Development has been designed to minimise the potential impact on potentially moderate and highly dependent GWDTEs and limit the requirement for works within the water environment.</p> <p>Assessment included in Appendix 11.2: Groundwater Dependent Terrestrial Ecosystems (GWDTE) Assessment (EIAR Volume 3).</p>
Argyll & Bute Council	<p>Private Water Supplies – The applicants should identify all properties served by a private water supply, to determine the source & of those supplies that may be affected (e.g. surface supply, borehole, etc.) and, where appropriate, should outline the proposed measures to avoid causing contamination during the construction and operational phases.</p>	<p>Argyll & Bute Council were consulted and provided details they held on private water suppliers.</p> <p>Following this, AECOM (on behalf of the Applicant) sent a private water supply (PWS) questionnaire out to property owners within 1km of the Development Site to confirm exact locations and details of supplies (refer to Appendix 11.5: End User Private Water Supply (PWS) Questionnaire (EIAR Volume 3)).</p>
NatureScot	<p>Peat – the Applicant should ensure that any locations of new infrastructure, i.e. battery storage and areas of track that require widening, should be sufficiently surveyed for deep peat if they were outwith the survey area in 2013 or 2016.</p>	<p>All proposed infrastructure is within the peat probing survey area please refer to Figures 11.4 and 11.5 (EIAR Volume 2b).</p>

Consultee	Summary of Response / Issue Raised	Comment / Action Taken
RSPB	<p>Peat – The design process should ensure peat impacts are avoided and should promote opportunities for restoration and positive management. Borrow pits should be located in areas where peat / open habitats are already impacted from forestry and turbines relocated from open blanket bog into areas modified by forestry.</p> <p>Carbon calculations for the proposal should be based on the latest version of the Scottish Government’s carbon calculator and should clearly show the carbon payback period for the proposed scheme.</p>	<p>All proposed infrastructure is within the peat probing survey area please refer to Figures 11.4 and 11.5 (EIAR Volume 2b). Please refer to the Ecology Chapter within the EIAR for information on peat restoration plans.</p> <p>The Proposed Development infrastructure layout has been designed to avoid deeper areas of peat and indicative borrow pit locations have been proposed in areas already impacted from forestry.</p> <p>A carbon balance assessment has been undertaken (refer to Appendix 11.4: Carbon Balance Assessment (EIAR Volume 3)).</p>

Micro-siting

- 11.3.2 A micro-siting tolerance of 50m forms part of the Section 36 Application for the Proposed Development and this is applied to the turbines and other infrastructure, with the exception of the substation building, construction compound / battery storage, new access tracks, passing places and borrow pits (which have a 100m micro-siting tolerance).

Scope of the Assessment

- 11.3.3 A qualitative assessment has been undertaken using a combination of legislative standards and other statutory policy and guidance, a desk-based review, site surveys and professional judgement. The assessment involved:
- Analysis of current policy and guidance in relation to wind energy and the likely effects of the Proposed Development on the geological, hydrological and hydrogeological environment,
 - Desk study based on available information,
 - Scoping study to establish the existing baseline geological, hydrological and hydrogeological conditions at the Development Site,
 - Phase I and Phase II peat probing to assess the depth of peat across the Development Site, allowing the preliminary assessment of peat landslide risk and informing the infrastructure layout design of the Proposed Development, and

- Identification of the potential impacts of the Proposed Development on the geological, hydrological and hydrogeological environment and evaluation of the significance of effects.

11.3.4 The desk-based research undertaken as part of the EIA included a review of data from the following sources:

- Centre for Ecology and Hydrology (CEH), National River Flow Archive (NRFA) (www.ceh.ac.uk/data/nrfa) for flows and rainfall,
- SEPA (www.sepa.org.uk) for river basin management plans, groundwater classification, groundwater vulnerability, water quality and hydrogeology,
- British Geological Survey (BGS) for geology and hydrogeology,
- Scotland's Soils for soil coverage,
- Aerial Photography, and
- Ordnance Survey maps and Digital Terrain Model (DTM) for topography.

Summary of Surveys

11.3.5 The following surveys were undertaken at the Development Site as part of the 2016 EIA for the Consented Development:

- A site walkover was carried out in September / October 2013,
- Phase 1 Peat Probing was carried out in September / October 2013 and January 2014, and
- Phase 2 Peat Probing was carried out in February 2016.

11.3.6 The following surveys were undertaken at the Development Site to inform this EIA:

- Forestry and Land Scotland (FLS) Peat Probing was carried out in September / October 2020,
- A site walkover within the Development Site was carried out in June 2021, and
- An update to the Phase II Peat Probing was completed in June 2021 focusing specifically on areas of design evolution out with the original probing survey.

Approach to the Assessment

11.3.7 An assessment of the likely potential geological, hydrological and hydrogeological impacts is considered necessary due to the presence of peat and watercourses within the Development Site. This could result in potential effects due to the impact from the excavation of peat and an increased risk of pollution of the watercourses within and downstream of the Proposed Development.

- 11.3.8 The assessment has been undertaken based on consultations with various statutory and non-statutory bodies, the collection and interpretation of a wide range of data and published material including publicly available information as well as field surveys.
- 11.3.9 The general approach to the assessment of effects within an EIA is established in Chapter 2 of this EIAR: Approach to EIA. Paragraphs 11.3.10 to 11.3.13 provide detail on the specific assessment criteria used for the geology, hydrology and hydrogeology assessment reported within this chapter.

Sensitivity

- 11.3.10 The assessment of the significance of individual effects on the receiving environment will be based on criteria for the sensitivity or importance of the resource and the magnitude of the effect, defined in Table 11-4.

Table 11-4 Importance of Receptors

Importance / Sensitivity	Capacity	Receptor	Description
Very High	The receptor has little or no capacity to absorb change without fundamentally altering its present character, is of very high environmental value, or of international importance.	Geology / Soils	The area occupied by the development is protected by International EU legislation (World Heritage Sites, Geopark).
		Hydrology / Hydrogeology	Watercourse having a WFD classification as shown in a RBMP and Q95 \geq 1.0 metres cubed per second (m ³ /s): Source Protection Zone (SPZ) 1 within a Principal Aquifer. Feature of international importance, for example a Special Area of Conservation (SAC). Alternatively, groundwater is critical to designated sites of nature conservation. Water abstraction: >1000m ³ /day. Receptors to flood risk: essential infrastructure or highly vulnerable development.
High	The receptor has low capacity to absorb change without fundamentally altering its present character, is of high environmental value, or of national importance.	Geology / Soils	Feature of national importance, for example a Site of Special Scientific Interest (SSSI). Peat \geq 2m depth.
		Hydrology / Hydrogeology	Watercourse having a WFD classification as shown in a RBMP, and Q95 < 1.0m ³ /s; Principal Aquifer (not within SPZ 1). Sensitive habitats of national importance. Groundwater is a locally valuable resource because of its moderate quality and/or yield or is known to be locally exploited for water supply. GWDTE with high dependency on groundwater. Water abstraction: 1000-500m ³ /day.

Importance / Sensitivity	Capacity	Receptor	Description
			Receptors to flood risk: more vulnerable development.
		Geology / Soils	Site of local geological importance (Local Geological Site – previously Regionally Important Geological Site).
Medium	The receptor has moderate capacity to absorb change without significantly altering its present character, has some environmental value, or is of regional importance.	Hydrology / Hydrogeology	<p>Watercourse detailed in the Digital River Network but not having a WFD classification as shown in a RBMP; Secondary Aquifer.</p> <p>Groundwater of limited value because its quality does not allow potable or other quality sensitive uses.</p> <p>Exploitation of local groundwater is not extensive and/or local areas of nature conservation known to be sensitive to groundwater impacts.</p> <p>Sensitive habitats of regional importance.</p> <p>GWDTEs with moderate dependency on groundwater.</p> <p>Water abstraction: 50-499m³/day.</p> <p>Receptors to flood risk: less vulnerable development.</p>
		Geology / Soils	Sites with local geology / soils interest.
Low	The receptor is tolerant of change without detriment to its character, is low environmental value, or local importance.	Hydrology / Hydrogeology	<p>Surface water sewer, agricultural drainage ditch; non-aquifer.</p> <p>Unproductive Strata - rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.</p> <p>Changes to groundwater not expected to impact on local ecology.</p> <p>Limited economic or social uses.</p> <p>GWDTE with minimal dependency on groundwater i.e. fed by rain and natural surface drainage.</p> <p>Water abstraction: <50m³/day.</p> <p>Receptors to flood risk water compatible development.</p>

**Note: Q95 is the flow equalled or exceeded 95% of the time.*

Magnitude

11.3.11 The magnitude of impact considers the scale of the predicted change to baseline conditions resulting from a given potential impact and considers both duration of an effect, namely temporary or permanent, and whether the effect is direct or indirect. The magnitude of an impact is independent of the importance / sensitivity of a receptor. Definitions are described in Table 11-5.

Table 11-5 Magnitude of Impact

Magnitude	Criteria	Example
High	Adverse: Loss or major alteration of an attribute and/or quality and integrity of an attribute	Loss of a designated geological site, peat, fishery etc.; decrease in surface water ecological or chemical WFD status or groundwater qualitative or quantitative WFD status. Change in flood risk to receptor from low or medium to high risk.
	Beneficial: Creation of a new attribute or major improvement in quality of an attribute	Increase in productivity or size of fishery; increase in surface water ecological or chemical WFD status; increase in groundwater quantitative or qualitative WFD status. Change in flood risk to receptor from high to low. Increase in peatland through peatland restoration.
Medium	Adverse: Loss or alteration of part of an attribute or decrease in integrity of an attribute	Partial loss of a geological site, peat, fishery; measurable decrease in surface water ecological or chemical quality, or flow; reversible change in the yield or quality of an aquifer; such that existing users are affected, but not changing any WFD status. Change in flood risk to receptor from low to medium.
	Beneficial: Moderate improvement in quality of an attribute	Measurable increase in surface water quality or in the yield or quality of aquifer benefiting existing users but not changing any WFD status. Change in flood risk to receptor from medium to low.
Low	Adverse: Some measurable change to the integrity of an attribute	Measurable decrease of geological site, peat, or in surface water ecological or chemical quality, or flow; decrease in yield or quality of aquifer; not affecting existing users or changing any WFD status. Change in flood risk to receptor from no risk to low risk.
	Beneficial: Measurable increase, or reduced risk of adverse effect to an attribute	Measurable increase in surface water ecological or chemical quality; increase in yield or quality of aquifer not affecting existing users or changing any WFD status. Change in flood risk to receptor from low risk to no risk.
Negligible	No change or integrity of attribute	Imperceptible change to a designated geological site, peat deposits, discharges to watercourse or changes to an aquifer which lead to no change in the attribute's integrity.

Significance of Effect

- 11.3.12 The significance of the effect is determined using the matrix presented in Table 11-6. The significance of a given effect is based on a combination of the sensitivity or importance of the receptor and the magnitude of a given potential impact. These can be adverse or beneficial and their significance Major, Moderate, Minor or Negligible.
- 11.3.13 When professional judgement is considered, some receptors may experience a significance of effect that is different to that arising from the matrix in Table 11-6. In these instances, an explanation will be provided in the impact section.

Table 11-6 Significance of Effects

Magnitude	Sensitivity			
	Very High	High	Medium	Low
High	Major	Major	Moderate	Moderate
Medium	Major	Moderate	Moderate	Minor
Low	Moderate	Moderate	Minor	Negligible
Negligible	Minor	Minor	Negligible	Negligible

Note: Grey shaded boxes indicate a significant effect in terms of EIA

11.4 Baseline Environment

Topography

- 11.4.1 The Development Site is characterised by relatively elevated and undulating terrain which falls to the south west with the lowest points present around Clachaig Water at 180m Above Ordnance Datum (AOD).
- 11.4.2 Ground surface elevations are generally between 180 to 230m AOD, although do descend to a low point of 110m AOD in the west of the site and, along the eastern boundary, there is a prominent ridge of open ground with a high point rising to 364m AOD at Cruach Mhic an t-Saoir in the north east.

Geology and Soils

Bedrock (Solid Deposits)

- 11.4.3 A review of the BGS online Onshore GeoIndex viewer (BGS, 2021) indicates that the that the majority of the Development Site lies within an area of bedrock dominated by metamorphic rock, namely metalimestone, psammite, semipelite pelite and metavolcaniclastic sedimentary rock. Metigneous intrusions are present across the Development Site as are two igneous

intrusion. Figure 11.1 (a and b) (EIAR Volume 2b) shows the recorded location of these rock formations in relation to the Development Site.

11.4.4 The Development Site comprises the following succession of metamorphic strata from east to west:

- Beinn Bheula Schist Formation: consisting of gritty psammites and pelites. A thin metaigneous type rock of metamafite is recorded to subcrop in the east of the Development Site which is recorded to be part of the Beinn Bheula Schist Formation,
- Green Beds Formation: consisting of metavolcaniclastic sedimentary rock,
- Glen Sluan Schist Formation: consisting of psammite and semipelite,
- Loch Tay Limestone Formation: consisting of metalimestone, and
- Ben Lui Schist Formation: consisting of semipelite.

11.4.5 The following metaigneous intrusions are present within the Development Site:

- Neoproterozoic Basic Minor Intrusion Suite: consisting of amphibolite and hornblende schist.

11.4.6 The following igneous intrusions are present within the Development Site:

- North Britain Palaeogene Dyke Suite: consisting of olivine microgabbro.

Drift Geology (Superficial Deposits)

11.4.7 A review of the BGS online Onshore GeoIndex viewer (BGS, 2021) indicates that the majority of the Development Site has superficial cover of glacial till. The glacial till is likely to consist of poorly sorted sandy, silty clay with potential laminated sand layers and coarse granular material. In areas of raised elevation (e.g. the ridge running along the east side of the Development Site and at Cnoc na Seilg) and locally along the Clachaig Water towards the centre of the Development Site the BGS record the absence of superficial cover indicating that rock will likely be encountered at or close to the ground surface. The extent and location of the recorded superficial deposits across the Development Site are shown on Figure 11.2a (EIAR Volume 2b).

11.4.8 A supplementary review of the online National Soil Map of Scotland (Scotland's Environment, 2021) viewer shows that the majority of the Development Site comprises peaty gleys. Peat is also noted over a sizeable area in the south of the Development Site.

Walkover Survey

11.4.9 A site walkover was undertaken by an AECOM geotechnical specialist and geologist (on behalf of the Applicant) at the Development Site between Monday 30 September and Friday 4 October 2013 as part of the 2016 EIA. For the purposes of subsequent reporting, the Development Site was split into areas A-F (Figure 11.3 (EIAR Volume 2b)). The findings of this are summarised below:

- The ground comprises densely forested blocks of trees split by breaks, which are sometimes wet and boggy underfoot, particularly in Area B,
- An area of windblown trees is located in the southwest corner of Area A,
- No areas of peat instability were noted,
- Bedrock was noted as being frequently exposed in the open section of the hillside to the east of the Development Site (Area C) and the adjacent sloping forestry ground. Over the central and western areas of the site, shallow / exposed bedrock was frequently noted in access track cuttings, and locally within stream cuttings,
- An existing quarry / borrow pit presumed to be used for the existing access track construction is located adjacent to the site boundary where the access track enters the Development Site to the north,
- Access tracks throughout the Development Site are generally in good condition with no signs of obvious surface settlement or failures noted and are more extensive than indicated on the existing OS maps,
- A number of substantial turning places were noted off the existing access track, and
- No mining features were identified.

11.4.10 Further site visits were undertaken during recent peat probing surveys. The findings of these visits remain consistent with the abovementioned walkover survey findings.

Peat Probing - Consented Layout

11.4.11 A Phase I peat depth survey was undertaken by an AECOM geotechnical specialist and geologist (on behalf of the Applicant) at the Development Site between Monday 30 September and Friday 4 October 2013, as part of the site walkover survey noted above. A subsequent visit was then made on Monday 27 and 28 January 2014 to undertake further peat survey work for additional areas within the Development Site.

11.4.12 A Phase II peat depth survey was undertaken on 9 and 11 February 2016 for the consented layout. Probes were taken at 50m intervals along the proposed access tracks and at key infrastructure locations such as at the turbine locations, the crane pads, the temporary construction compound / battery storage, the substation and the borrow pits.

Forestry Land Scotland (FLS) Peat Probing

11.4.13 Peat probing was undertaken by FLS in September to October 2020. The probing was done as part of FLS' peat restoration plans and to inform their future Land Management Plan for the Carradale area, with the data being provided to the Applicant.

Peat Probing - New Application 2021

11.4.14 Due to the changes to the turbine locations, access tracks and associated infrastructure, additional peat probing was undertaken by AECOM at the Proposed Development Site between Tuesday 28 June and Thursday 01 July 2021 to update the Phase II survey. Probes

were taken at 50m intervals along the updated access tracks and at infrastructure locations which had been relocated.

Peat Probing Summary

11.4.15 In total, 1,821 probes were taken across the site during the four peat probing exercises, the results of which are shown on Figures 11.4 and 11.5 (EIA Volume 2b). 493 probes were taken during the initial Phase I and Phase II surveys in 2013 and 2016, 1166 probes were taken during the FLS peat probing in September / October 2020 and 162 probes were taken during AECOM's updated Phase II survey in June / July 2021.

11.4.16 The results of the probing generally indicate peat depths across the Development Site vary between 0.5m to 5.0m, with some small, localised areas of peat recorded at greater than 5.0m.

11.4.17 The deepest areas of peat, from 3.0m to greater than 5.0m, were generally encountered to the south of the Development Site in areas of gently sloping topography, often with no trees. Deep peat was also encountered within level areas along the north eastern boundary and locally along the ridge in the east of the Development Site (Area E and Area C, respectively). In general, areas of the deeper peat encountered were consistent with the peat extents shown on the National Soil Map of Scotland's, although locally peat depths encountered were greater than expected over the high ground in Area C and along the north eastern boundary in Area E.

Area A

11.4.18 Across Area A, peat depths are typically less than 0.5m with occasional isolated pockets up to 4.0m.

Area B

11.4.19 Across Area B, there is a variation of peat depths. Peat depths of greater than 5.0m were found at the south of the Proposed Development site. Locally in the north and east of Area B there were areas of up to 5.0m peat depth with the rest of the area generally noted to have a depth of up to 1.0m of peat.

Area C

11.4.20 Peat depths were found to vary widely across Area C. Maximum peat depths of greater than 5.0m were encountered in the south east and north east of the area. Otherwise, Area C generally exhibited peat depths of up to 3.0m.

Area D

11.4.21 In Area D peat depths were typically up to 1.50m, however, locally. peat depths of up to 4.0m were encountered with one probe location in the north west of the area indicating a peat depth of up to 5.0m.

Area E

- 11.4.22 Peat depths were typically less than 1.50m throughout the area, however, locally pockets up to 2.0m were present. Towards the north eastern boundary of the area, in the lower-lying ground, localised peat deposits of up to 3.0m, up to 5.0m and >5.0m were also recorded.

Area F

- 11.4.23 Area F is no longer within the Development Site boundary.

Hydrogeology

- 11.4.24 A review of the BGS online Hydrogeological Map of Scotland viewer (1:625,000 scale, 1988) identified the majority of the Development Site to be in a region 'underlain by impermeable rocks, generally without groundwater except at shallow depths. A relatively small part of the western area of the Development Site is underlain by the Loch Tay Limestone and is indicated to be a 'concealed aquifer' or an 'aquifer with limited potential'. Therefore, only a limited amount of groundwater, if any, is expected.
- 11.4.25 Shallow groundwater is considered to be at or near the ground surface in the waterlogged and peaty areas of the Development Site. This shallow groundwater may be 'perched' on the relatively low permeability glacial till deposits. No other groundwater features were noted during the site walkover.

Groundwater Dependent Terrestrial Ecosystems (GWDTEs)

- 11.4.26 A National Vegetation Classification (NVC) Survey reported in Chapter 9 of the EIA: Ecology identifies species which are classified by SEPA as potentially groundwater dependent in their Land Use Planning System SEPA Guidance Note 4 (SEPA, 2017). The following habitats, which are potentially dependent on groundwater (and therefore can be classed as GWDTEs), have been identified within the Development Site and are discussed in Appendix 11.2 (EIA Volume 3):

- M15 *Scirpus cespitosus* - *Erica tetralix* wet heath,
- W4 *Betula pubescens* - *Molinia caerulea* woodland,
- M23 *Juncus effusus/acutiflorus* - *Galium palustre* rush-pasture,
- M6 *Carex echinata* - *Sphagnum recurvum* mire, and
- M10 *Carex dioica* – *Pinguicula vulgaris* mire

- 11.4.27 Depending on the hydrological setting, habitat M15 is potentially moderately dependent on groundwater, and habitats W4, M10, M23 and M6 are potentially highly dependent on groundwater.

- 11.4.28 The GWDTE boundaries were defined either by the spatial extent of a single habitat type or by defining a wider area which encompassed a group of small isolated habitats with similar habitat characteristics and the same dependency classification.

- 11.4.29 A total of 26 of the five types of GWDTEs listed in Paragraph 11.4.26 were defined within the Development Site. The locations of the GWDTEs, together with the 100m and 250m buffers recommended by SEPA, are shown on Figure 11.7 (EIAR Volume 2b).
- 11.4.30 The GWDTEs and their buffers cover a large proportion of the Development Site. As such, it was not possible to design the Proposed Development such that turbines and other infrastructure avoided all of the GWDTEs or their buffer zones. An assessment of the potential impact upon the identified GWDTEs and likely groundwater dependence of these habitat areas has therefore been undertaken and the results are outlined in detail within Appendix 11.2 (EIAR Volume 3). The ecological impacts of the Proposed Development on the habitats noted above are addressed in Chapter 9 of the EIAR: Ecology.
- 11.4.31 Groundwater dependency of the GWDTEs was assessed considering information on topography, habitat type, underlying geology and hydrogeology. The underlying geology of the Development Site is largely impermeable and is classified as a low productivity aquifer in which flow is virtually all through fractures and other discontinuities.
- 11.4.32 Areas where GWDTEs are present typically correspond to areas where shallow groundwater is likely to be within glacial till deposits and / or peaty soils where perched groundwater is present.

Groundwater Vulnerability

- 11.4.33 A review of the Groundwater classification layer of the online Scotland's environment map (Scotland's Environment, 2021), indicates the Proposed Development lies within the Oban and Kintyre waterbody with an overall classification of good. The BGS Groundwater Vulnerability (Scotland) dataset Version 2 (BGS, 2015) indicated that the Proposed Development Area generally lies within a vulnerability class of 4, defined as 'vulnerable to those pollutants not readily absorbed or transformed' and due to the presence of rock at or near to ground surface within the Proposed Development, vulnerability class 5 – 'vulnerable to most pollutants with rapid impact in many scenarios.

Surface Hydrology

- 11.4.34 The hydrology of the Development Site is illustrated in Figure 11.6 (EIAR Volume 2b).
- 11.4.35 The majority of the Development Site is drained by the Clachaig Water and its tributaries which originates in Loch na Naich to the northeast of the Development Site and flows in a south westerly direction into the Mull of Kintyre West Coastal catchment.
- 11.4.36 The area of the Development Site located to the east of the rocky ridge, which run north to south along the eastern boundary, drain into the Barr Water. The Barr Water is located outwith the Development Site and originates from Loch Losgainn, located to the northeast of the Development Site. This watercourse flows in a south / south westerly direction, adjacent to the eastern boundary of the Development Site and eventually drains into the Mull of Kintyre West Coastal catchment.

11.4.37 There are various unnamed tributaries which drain to both Clachaig Water and Barr Water which are present across the Development Site, as well as numerous minor artificial land drains associated with the forestry plantation.

Flooding

11.4.38 Following feedback from SEPA in the Scoping Opinion (see Table 11-3 above), a screening review of flood risk was conducted for the EIA.

11.4.39 Although the likelihood of river flooding is classed as being High, the extent of the flooding is wholly contained within the banks of Clachaig Water. Surface water flooding is shown as a series of small areas of High likelihood, which is likely associated with the peat deposits present across the Development Site.

11.4.40 Based on this screening review, it is considered that flooding is isolated within the banks of Clachaig Water or to small, localised areas of surface water and therefore the Development Site can be considered to be a low risk area for flooding and no further assessment is required to be undertaken in terms of flood risk to the Proposed Development.

11.4.41 Due to the minimal areas of hardstanding proposed, it is considered that the Proposed Development would not significantly increase the risk of downstream flooding. A Flood Risk Assessment is not considered to be required in this instance and as such, it has been scoped out of this EIA in accordance with SEPA's (2017) Land Use Planning System – Guidance Note 4 which states "*Where flooding may be an issue a flood risk assessment should also be submitted*".

Climate

11.4.42 A review of SEPA's online indicative flood map shows the Development Site can be subject to river flooding and surface water flooding. The likelihood of river flooding in Clachaig Water is classed as being High, and the likelihood of surface water flooding is classed as High in a few small and localised instances. Barr Water has associated floodplains located out with the Development Site.

11.4.43 Rainfall data for the Carradale Water at Dippen flow gauge is available from the NRFA. It can be seen in Table 11-7 that the annual average rainfall is approximately 1,900mm in the vicinity of the Development Site. To put this data into context, based on publicly available data from the Met Office, the wettest part of the UK is the north west of Scotland which has an annual average rainfall in excess of 3,000mm and the driest part is the south east of England with less than 600mm. Therefore, it can be expected that the Development Site is likely to experience medium to high rainfall during construction, operation and decommissioning.

Table 11-7 Spatial Rainfall Information

Flow Gauge Station	NGR	Period of Record	Annual Average Rainfall (mm)
88001 – Carradale at Dippen	NR 797376	1961-1990	1,819

Water Quality

11.4.44 SEPA's current RBMP classifications for the catchments associated with the Development Site are detailed in Table 11-8. All identified water bodies have an overall status of 'Good' (SEPA, 2020).

Table 11-8 SEPA's RBMP Classifications

Water Body Name	Category	Overall Status	Ecological Status
Clachaig Water	River	Good	Good
Barr Water	River	Good ecological potential	Moderate
Oban and Kintyre	Groundwater	Good	-
Mull of Kintyre	Coastal	Good	Good

Private Water Supplies

11.4.45 Under the Water Intended for Human Consumption (Private Water Supplies) (Scotland) Regulations 2017, local authorities have a duty to compile a database and monitor the quality of Private Water Supplies (PWS). Argyll and Bute Council were contacted for information and they confirmed that there were no PWS within the Development Site. However, they identified six PWS within 1km of the Development Site.

11.4.46 Argyll and Bute Council advised that whilst it can reasonably be assumed that any property / premises falling out with the distribution area for Scottish Water is on a private supply, the reverse is not always the case and there may be property owners who choose to retain a private supply even when a mains connection is available. As such, they advised that the end users of PWS should be contacted to confirm the exact location and details of sources. Further consultation via a questionnaire was undertaken.

11.4.47 Questionnaires were sent out to 51 properties located within 1km of the Development Site boundary on 7 September 2020. Of the 51 properties contacted, six responded (refer to Appendix 11.5 (EIAR Volume 3)) and of the respondents, only two of them indicated that they had a PWS.

- 11.4.48 One of the questionnaire respondents confirmed that their property, 30 Cara View, and all others on that street were on mains supply as follows; “*Cara View is a council estate and therefore on public water supply. Although some houses are privately owned (including mine) none are on private water supply*”. This accounts for eight of the properties which the questionnaire was sent to.
- 11.4.49 Table 11-9 summarises the supplies that Argyll and Bute Council recorded within 1km of the Development Site and those that were identified via the responses to the questionnaire. PWS locations are shown on Figure 11.6 (EIA Volume 2b).
- 11.4.50 The PWS at South Beachmore was located on the site boundary to the extreme west. Despite its location, the distance from infrastructure is greater than 2km. The exact location of the source of this PWS is unknown. However, given the abstraction type is from a watercourse and the approximate location advised is over 2 km from any proposed wind farm infrastructure (turbine T10), it is not anticipated the source location will be within the SEPA buffer distances indicated below, and therefore is not considered at risk.
- 11.4.51 SEPA’s (2017) *Land Use Planning System – Guidance Note 4* states that no development of roads / tracks or trenches should not be within 100m of the source of a PWS and borrow pits and foundations should not be within 250m of the source. As the distances between the proposed infrastructure and known PWS are greater than SEPA’s development distances buffers, PWS have not been assessed further.

Table 11-9 Private Water Supplies

Supply Name	Location (NGR)	Distance from Proposed Development Infrastructure (km)	Type	Source of Information
Culfuar Farm	NR 70098 45411	2.45	Surface – Watercourse	Argyll and Bute Council
North Beachmore Farm	NR 68928 41953	0.30	Surface – Loch	Argyll and Bute Council
Cruachan Cottage	NR 69615 45152	2.57	Surface – Rainwater	Argyll and Bute Council
Largie Estate	NR 70235 45817	2.70	Groundwater – Borehole	Argyll and Bute Council
Colt House	NR 70235 45817	2.70	Groundwater – Well	Argyll and Bute Council
North Beachmore House	NR 68883 42008	0.37	Groundwater – Spring	Argyll and Bute Council

Supply Name	Location (NGR)	Distance from Proposed Development Infrastructure (km)	Type	Source of Information
Ron Mara	Drawn on map (approx. NR 68883 42008)	0.37	Groundwater - Well	Questionnaire
South Beachmore	Drawn on map (approx. NR 68845 41623)	On Site boundary 2km from infrastructure	Surface – Watercourse	Questionnaire

Discharge and Abstraction Licences

- 11.4.52 SEPA provided details of CAR Licences within 2km of the Development Site, which are detailed in Appendix 11.6 (EIA Volume 3) and are shown on Figure 11.6 (EIA Volume 2b).
- 11.4.53 There are a total of 57 CAR Licences within 2km of the Development Site, one of which is within the Development Site and is for an existing bridge (potentially that will require upgrading to strength it for wind turbine delivery vehicles) which is to be utilised for the Proposed Development (EWC 02) (Appendix 11.2 (EIA Volume 3)).
- 11.4.54 Of the other 56 CAR Licences within 2km of the Development Site, 46 are associated with the discharge of sewage, two are associated with hydropower, three are for bridging culverts, two are for sheep dips onto land, and three are for bridge works including realignment.
- 11.4.55 If upgrade or strengthening works are required for the existing bridge within the Development Site, it is expected that a new / updated CAR Registration would be required, as per *Table 5: Engineering levels of authorisation* of The Water Environment (controlled Activities) (Scotland) Regulations 2011 V8.5.
- 11.4.56 Due to the nature of the remaining CAR Licences, they will be unaffected by the Proposed Development and have not been assessed further.

Geomorphology

- 11.4.57 The geomorphology of the Development Site is dominated by the topography and resulting drainage pattern. The topography of the site consists of predominantly undulating hills with one steep sided valley, Clachaig Glen, and several smaller valleys which connect to Clachaig Water at approximately 180m AOD.
- 11.4.58 The eastern boundary is dominated by a prominent ridge of open ground with a high point rising to 364m AOD at Cruach Mhic an t-Saoir in the north east. Due to the topography of the terrain, the area presents localised rock outcrops and low depressions with peat.

11.4.59 The Development Site drainage is dictated by the watershed which runs in a south westerly direction facing the lowest area of the site where deep peat has been encountered. This area is located at Clachaig Water before it exits through the western boundary into the Sound of Jura.

Designated Sites

11.4.60 The entire Development Site is underlain by the Kintyre bedrock and localised sand and gravel aquifer within the Oban and Kintyre groundwater body, designated by SEPA as a Drinking Water Protection Zone.

11.4.61 No other designated sites are located within or adjacent to the Development Site.

Land Use

11.4.62 The majority of the Development Site is dedicated to plantation timber (coniferous wood) production operated by Forest and Land Scotland (FLS). The eastern and central northern areas of the Development Site comprise an area of heath and rough grassland. There is existing farmland to the north western area of the site.

Quarrying

11.4.63 A review of the OS mapping did not identify any quarrying activity within the Development Site; however, several small quarries are located in the vicinity to the north and north east of the Development Site and are shown as disused.

11.4.64 A review of the aerial photography identified a quarry to the north located within the site boundary, where the access track enters the Development Site. This was confirmed during the site walkover in June 2021.

11.4.65 The Coal Authority Interactive Map viewer (2021) indicates that the Development Site is not recorded to be within development high risk area, with no known past shallow coal mine workings or probably shallow coal mine workings shown. Furthermore, no mine entries are recorded underlying or in close vicinity to the Proposed Development and the rock type underlying is not recorded to be coal bearing.

Forestry

11.4.66 The Development Site is dominated by coniferous woodlands which is primarily used for plantation forestry.

Historical Landslide

11.4.67 A review of the BGS online Onshore GeoIndex viewer and historical maps has not identified any historical landslides within the Development Site.

Potentially Sensitive Receptors

11.4.68 The importance of potential receptors is based on the definitions provided in Table 11-4 above. Important or sensitive receptors that may be directly or indirectly affected by the Proposed Development and the value of each receptor are summarised in Table 11-10.

Table 11-10 Potentially Sensitive Receptors

Receptor	Distance from Development Site	Value	Reason for Sensitivity
Geology and Soils			
Peat	On Development Site	High	Potential for release of carbon due to disturbance (raised as a concern by SEPA).
Hydrology			
Clachaig Water	On Development Site	High	Water quality classification of 'Good'
Barr Water	On Development Site	High	Water quality classification of 'Good'
Mull of Kintyre	Approx. 1.8km south west of the Development Site	High	Water quality classification of 'Good'
Private Water Supplies	Within 1km of the Development Site	High	Water quality standards that must be complied with.
Hydrogeology			
Oban and Kintyre	On Development Site	High	Water quality classification of 'Good' and designated by SEPA as Drinking Water Protection Zone
GWDE	On Development Site	High	Potentially highly and moderately dependent GWDEs have been identified within the Proposed Development Site and these are shown on Figure 11.7 (EIA Volume 2b) and assessed in Appendix 9.2 (EIA Volume 3).

11.5 Potential Effects

- 11.5.1 All of the receptors identified across the Proposed Development have been classified as **high**, as referenced in Table 11-10 above.
- 11.5.2 This section considers the likely significant effects of the Proposed Development on soils, geology, hydrology, and hydrogeology receptors, prior to consideration of any additional mitigation measures and considers the construction, operation and decommissioning phases of the Proposed Development.
- 11.5.3 The approach to mitigation in this chapter differs from the approach set out in Chapter 2: Approach to EIA. The reason for the variation in approach is that mitigation for potential effects to ground conditions and hydrology / hydrogeology must be taken into consideration during the design process (i.e. the embedded mitigation is already part of the design of the Proposed Development). However, to demonstrate the likely significant effects of the Proposed Development without these mitigation measures in place, the assessment of potential effects is based on a 'no mitigation scenario'. The residual effects of the Proposed Development are then set out in Section 11.7.

Construction

- 11.5.4 The sensitivity of all of the receptors identified across the Proposed Development have been classified as **High**, as discussed in Table 11-10 above.
- 11.5.5 Construction of the access tracks and cable trenches, as well as felling of forestry, has the potential to cause increased surface water run-off. Heavy rainfall on exposed ground could cause pollution of adjacent watercourses, private water supplies and groundwater with suspended solids or construction materials. Excavation of access tracks is expected to have an adverse temporary effect of Medium magnitude and **Moderate** significance on adjacent watercourses, water bodies (lochs and coastal strips), groundwater and on private water supplies without mitigation.
- 11.5.6 Excavations for the Proposed Development infrastructure may result in the loss of peat deposits. Excavation for the Proposed Development infrastructure is expected to have an adverse permanent effect of Medium magnitude and **Moderate** significance on peat deposits within the Development Site without mitigation.
- 11.5.7 Installation of watercourse crossings has the potential to cause pollution to the watercourse from construction materials entering or disrupting the natural flow regime, which could cause erosion of the banks or affect the migration of aquatic species. Construction of watercourse crossings is expected to have adverse temporary effect of Medium magnitude and **Moderate** significance on the watercourses prior to mitigation.
- 11.5.8 Constructions of access tracks and cable trenches have the potential to cut off natural surface and groundwater pathways. Construction of access tracks and cable trenches is expected to

- have an adverse temporary effect of Medium magnitude and **Moderate** significance on groundwater bodies and on GDWTEs without mitigation.
- 11.5.9 Excavation for small temporary quarries and for foundations during construction may extend below the ground water level and there is a risk of locally lowering the level; this is expected to have an adverse temporary effect of Medium magnitude and **Moderate** significance on groundwater bodies without mitigation.
- 11.5.10 The construction works will require areas of hardstanding for the temporary construction compound / battery storage and crane pads, which along with new access tracks have the potential to cause increased run-off to adjacent watercourses which may result in flooding on site or downstream of the site. Construction of hardstanding / impermeable areas is expected to have an adverse permanent effect of Medium magnitude and **Moderate** significance on adjacent watercourses.
- 11.5.11 Construction of turbine foundations could lead to temporary minor dewatering of the ground or leakage of concrete residues into groundwater or watercourses if not managed effectively. The construction of the wind turbine foundations is expected to have an adverse temporary effect of Medium magnitude and **Moderate** significance on adjacent watercourses and have an adverse temporary effect of High magnitude and **Major** significance on groundwater bodies, private water supply and on GDWTEs without mitigation.
- 11.5.12 Use of construction equipment or the storage of chemicals and waste have the potential to cause pollution of watercourses and groundwater following any accidental spills if appropriate emergency procedures are not in place. Accidental spillages are expected to have an adverse temporary effect of Medium magnitude and **Moderate** significance on adjacent watercourse and have an adverse temporary effect of High magnitude and **Major** significance on groundwater bodies, private water supplies and on GDWTEs without mitigation.
- 11.5.13 Disturbance of peat will release carbon stored in peat deposits. Manufacture of equipment for the wind farm will also produce carbon emissions. The balance between the carbon 'losses' and relative 'savings' of constructing and operating the Proposed Development compared to the equivalent electricity generation using a fossil fuels mix needs to be considered through a carbon balance assessment; the results of this assessment are included in Appendix 11.4 (EIA Volume 3). Release of carbon from constructing in areas of peat is expected to have an adverse permanent effect of High magnitude and **Major** significance prior to mitigation.
- 11.5.14 There is the potential for peat deposits on slopes to be destabilised by the construction of the Proposed Development. A peat slide could affect infrastructure or peat debris from a slide could enter a watercourse.
- 11.5.15 A preliminary peat landslide hazard and risk assessment (PLHRA) has been undertaken, the results of which are included in Appendix 11.3 (EIA Volume 3). The results of the preliminary PLHRA have indicated that the Development Site infrastructure is located in areas assessed to be 'Negligible' to 'Likely' potential peat slide hazard. The potential impact and the consequences of a peat landslide to the Proposed Development infrastructure (turbines,

access tracks, etc.), otherwise defined as Exposure, were judged to be 'High' to 'Very Low'. The Development Site infrastructure is therefore assessed as having a worst-case baseline hazard ranking of **Low** significance. The majority of the Development Site was judged to have a worst-case baseline hazard ranking of **Negligible** and where **Low** worst-based baseline hazard ranking were identified, specific mitigation has been considered in the PLHRA, thus reducing the overall significance of the Development Site to **Negligible**.

Operation

- 11.5.16 The sensitivity of all of the receptors identified across the Proposed Development have been classified as **High**, as discussed in Table 11-10 above.
- 11.5.17 Peat excavated during the construction period will be permanently displaced from the areas required to accommodate the Proposed Development infrastructure. This is expected to have an adverse permanent effect of Medium magnitude and **Moderate** significance on peat deposits without mitigation.
- 11.5.18 Access tracks and cable trenches have the potential to become barriers to natural surface water pathways or groundwater 'pipes' in peat deposits. This could result in drying out areas of peat, which is considered to have an adverse permanent effect of Medium magnitude and **Moderate** significance on peat deposits without mitigation.
- 11.5.19 Construction of the access tracks, cable trenches as well as felling of forestry has the potential to cause increased surface water run-off. Heavy rainfall on exposed ground could cause pollution of adjacent watercourses, private water supplies and groundwater with suspended solids or construction materials. Excavation of access tracks is expected to have an adverse temporary effect of Medium magnitude and **Moderate** significance on adjacent watercourses, water bodies (lochs and coastal strips), groundwater and on private water supplies without mitigation.
- 11.5.20 Access tracks could become conduits for flow, which could lead to erosion of the road surface and pollution of adjacent watercourses or groundwater receptors, if adequate drainage is not in place. This is expected to have an adverse temporary effect of Medium magnitude and **Moderate** significance to adjacent watercourses, water bodies (lochs and coastal strips), groundwater bodies, private water supplies and on GWDTEs without mitigation.
- 11.5.21 Permanent watercourse crossings have the potential to affect the natural flows and bed morphology. Inappropriate design of these crossings has the potential to restrict the flow leading to an increased head upstream and increased flow within the watercourse, which could cause erosion of the banks and bed. This is expected to have an adverse permanent effect of Medium magnitude and **Moderate** significance on watercourses without mitigation.
- 11.5.22 There is a continued risk of accidental spillages from maintenance of wind turbines and associated infrastructure causing contamination of soils and or pollution of the water environment. This is expected to have an adverse temporary effect of Medium magnitude and **Moderate** significance on adjacent watercourses and have an adverse temporary effect of

High magnitude and **Major** significance on water bodies (lochs and coastal strips), private water supplies, groundwater bodies, and on GWDTEs without mitigation.

- 11.5.23 There is a risk that concrete residues could leach into the groundwater if the appropriate type of concrete is not used. This is expected to have an adverse temporary effect of Medium magnitude and **Moderate** significance on adjacent watercourses and have an adverse temporary effect of High magnitude and **Major** significance on groundwater bodies, private water supplies and on GWDTEs without mitigation.

Decommissioning

- 11.5.24 Potential effects during the decommissioning stage are expected to be very similar or less than those identified during the construction stage.

Micro-Siting

- 11.5.25 A micro-siting 'tolerance' of 50m for turbines and other infrastructure (with the exception of the substation building, construction compound / battery storage, new access tracks, passing places and borrow pits (which have a 100m micro-siting tolerance)) forms part of the application for the Proposed Development, and this has been taken into account in the context of this assessment.
- 11.5.26 However, due consideration will be taken during any micro-siting of separation distances suggested by planning guidance or mitigation measures presented in this EIAR. For example, if a given separation distance is required between a watercourse to maintain the level of residual effects presented in this EIAR, this would not be encroached during micro-siting without prior consent from Argyll and Bute Council.

11.6 Mitigation

- 11.6.1 The potential effects of the Proposed Development during construction, operation and decommissioning will require mitigation to protect the sensitive receptors in the vicinity.
- 11.6.2 Mitigation measures are proposed below to ensure that no significant environmental effects arise. As stated in Section 11.5, the majority of mitigation for potential effects to ground conditions and hydrology and hydrogeology is embedded into the wind farm design process. Mitigation taken into consideration during the design process is listed below.

Design Stage – Embedded Mitigation

- 11.6.3 The existing constraints within the Development Site were intrinsically linked to the evolution of the design of the wind farm.
- 11.6.4 Numerous measures have been considered during design of the Proposed Development in order to mitigate the impacts on hydrology, hydrogeology and geology, as detailed below:

- Use of existing access tracks where possible in order to minimise new access tracks and water crossings,
- Avoidance of GWDTE areas where possible. Assessment undertaken for locations that are within GWDTE zones (see Appendix 11.2 (EIAR Volume 3),
- Optimising the design of the Proposed Development infrastructure to reduce the land take, such as keeping inter-turbine cabling adjacent to roads.
- No infrastructure located within areas of peat with a depth > 2m, apart from limited areas of access track – at these locations, floating tracks to be utilised.
- 50m watercourse buffer observed, with the exception of watercourse crossings, and
- SEPA PWS buffers observed.

Construction

- 11.6.5 A Construction Method Statement (CMS) will be developed and adhered to in the course of construction of the Proposed Development following planning permission. The CMS will include the measures set out below but will be finalised and agreed post consent, in line with the planning conditions.
- 11.6.6 Pre-construction drainage will be installed including interception drains and settlement lagoons to ensure natural drainage pathways are preserved as closely as possible and not mixed with construction drainage. Swales will be created during access road construction as well as regular cross drains to collect construction drainage and route it through the settlement lagoons before discharging to natural ground. Swales and interception ditches will generally be shallow to avoid altering the natural ground water pathways or lower the natural water table. Temporary and permanent drainage for the Proposed Development will be part of a pre-construction SuDs design.
- 11.6.7 There is not considered to be a risk of the works increasing flooding upstream or downstream of the study area. As such, it is proposed to install closed pipe and single span bridges in accordance with SEPA's '*Engineering in the Water Environment Good Practice; Construction of River Crossing*' (SEPA, 2010).
- 11.6.8 Pollution from run-off from access tracks and river crossings will be reduced by brushing or scraping roads to reduce dust and mud deposits and installation of small dams in artificial roadside ditches to retain silt. Where possible, work will be conducted an appropriate distance from the bank and not in the river (NRW, NIEA and SEPA, 2018a)).
- 11.6.9 Installation of turbine foundations and cable trenches will generally be carried out during periods of dry weather. An appropriate construction method statement will be produced to ensure any groundwater ingress is managed suitably. If required, a sump will be created and ground water pumped back onto natural ground to maintain the groundwater level and ensure sediment is not transferred to watercourses. Direct discharge of pumped groundwater to watercourses will not be permitted.

- 11.6.10 Concrete pouring will be sited a minimum of 10m from any surface drains (new or existing [unmodified]) and 50m from any watercourse and sensitive receptors to minimise the risk of run off entering a watercourse (as set out in GPP 5 (NRW, NIEA and SEPA, 2018a) and PPG 6 (Environment Agency, NIEA and SEPA, 2012)).
- 11.6.11 The proposed new temporary quarries (borrow pits) have been located within the Development Site in areas where there are no identified constraints (e.g., water courses, deep peat). Any groundwater ingress will need to be managed during construction by creating a sump area and pumping into a settlement lagoon before discharging to natural ground. Discharging water directly to a watercourse will not be permitted.
- 11.6.12 Drainage will be installed at crane pads as well as at temporary hardstanding areas such as the construction compound / battery storage area. Drainage installed at crane pads in general will discharge via settlement lagoons unless they are located at a significant distance away from watercourses or sensitive receptors. Settlement lagoons will be appropriately sized.
- 11.6.13 Refuelling areas at the construction compound / battery storage will be bunded and discharge via both an oil separator and SuDS, such as a natural soakaway located within the construction compound / battery storage area. All construction equipment is to be equipped with emergency spill kits and the operatives trained as to how to use them.
- 11.6.14 Ground investigations following receipt of planning permission, to be carried out post-consent, will confirm soil and rock properties to assist the detailed design. Geotechnical properties for access tracks and other hardstanding construction and water crossings design will also be confirmed during the ground investigation. Following the ground investigation, turbines/ infrastructure will be micro-sited away from any variable and/or poor ground conditions.
- 11.6.15 Peat will be encountered during construction of the Proposed Development. Mitigation measures in relation to development and road development on peat include use. Design and construction of the Proposed Development will be carried out in accordance with good industry practice, as detailed in Table 11-2. Excavations will be prevented from drying out or desiccating as far as possible. This can be achieved by minimising disturbance or movement of the spoil peat once excavated. Consideration will also be given to spraying the peat to keep it moist in appropriate circumstances. Stockpiling of peat will be located in areas of minimal risk from erosion and water quality deterioration, with an appropriate buffer from watercourses. Designated areas for stockpiling / side casting will be generally flat and stable, and side casting will be restricted to thin layers of fibrous peat (as encountered during the walkover). Where required, peat will be stockpiled taking due regard to potential loading effects for peat slide risk. Stockpiles will be bladed off at the side to minimise the available drying surface area. Where surface run-off may be encountered, stockpiles will be bunded, whereby bunds will extend above the toe level of the stockpile and water quality monitored before discharge.
- 11.6.16 The peat will be restored as soon as possible after disturbance. During construction of access tracks and crane pads, mitigation can be undertaken as access road construction progresses.

However, for small temporary quarries reinstatement cannot be undertaken until extraction is complete.

- 11.6.17 Mitigation measures in relation to the soil environment include use of good practice during construction to prevent or minimise spillage risk and spillage effects. The '*Good Practice during Wind Farm Construction*' guidance from SNH et al. (2019) and '*Advising on carbon-rich soils, deep peat and priority peatland habitat in development management*' from NatureScot (2021) will be used to inform a CMS to be approved by SEPA and Argyll and Bute Council, and will be developed covering each construction activity before construction commences. This will include compliance with all of the guidance contained in relevant GPPs and PPGs.

Operation

- 11.6.18 Access tracks will be designed such that they do not become a conduit for water flow. A cross-fall or camber will shed water to swales on either one or both sides of the access tracks. Cross drains will be installed at low points and as otherwise required to remove surface water from the access tracks. Intermittent maintenance will be carried out during the operational phase.
- 11.6.19 Construction of new access tracks has been minimised by utilising existing access tracks where possible and where possible avoiding areas of deeper peat.
- 11.6.20 Settlement lagoons will be removed following construction to avoid encouraging birds and reducing the collision risk. During detailed design, an assessment will be made of the most appropriate drainage layout for the operational phase.
- 11.6.21 Appropriate concrete will be used in the turbine foundations to minimise the risk of residues polluting the groundwater.

Decommissioning

- 11.6.22 Mitigation proposed during decommissioning stage will be very similar to the construction stage. A decommissioning management plan will be prepared and relevant statutory consultees contacted prior to any decommissioning works. The plan will adhere to best practice guidance and legislation in place at that time.

11.7 Residual Effects

- 11.7.1 In accordance with the methodology described above, potential effects have been assessed prior to mitigation, with the residual effects and implementation of the mitigation measures detailed in Table 11-11. As can be seen in Table 11-11, no significant residual effects are anticipated to remain after the implementation of mitigation.
- 11.7.2 Through the adoption of best working practices, the development of an appropriately designed drainage system and reinstatement, potential effects on the water environment and ground

conditions will be mitigated. Effects on surface and groundwater resources and the underlying geology of the Development Site are predicted to be **Negligible** or **Minor adverse**.

- 11.7.3 The assessment also concludes that the completed and operational Proposed Development will have a **Minor beneficial** effect (not significant) on carbon savings (see Appendix 11.4 Carbon Balance Assessment and Appendix 11.7 Peat Balance Calculations).

11.8 Cumulative Effects

- 11.8.1 All operational wind farms and wind farm developments in various stages of the planning process within 35km of the Proposed Development have been identified. Within the Mull of Kintyre West Coastal catchment area, several wind farms adjacent to the Proposed Development have been considered as, together with the Proposed Development, they could potentially result in cumulative effects. They are listed below:

- Blary Hill Wind Farm,
- Beinn an Tuirc Wind Farms (Phases 1 – 3), and
- Auchadaduie Community Wind Farm.

- 11.8.2 Beinn an Tuirc Wind Farm is located approximately 3km south southeast of the Development Site and drains to the west into Barr Water. None of the infrastructure for the Proposed Development drains into Barr Water, therefore the two sites are not hydrologically linked. There are not expected to be any cumulative effects with the Proposed Development.

- 11.8.3 Blary Hill Wind Farm is located approximately 5km south of the Development Site and drains into Abhainn a' Chnocain. None of the Proposed Development drains into Abhainn a' Chnocain, therefore the two sites are not hydrologically linked. There are not expected to be any cumulative effects with the Proposed Development.

- 11.8.4 Auchadaduie Community Wind Farm is located approximately 5.5km south west of the Development Site. The Barr Water runs to the north and west of the development but does not appear to interact with Auchadaduie Wind Farm. Therefore, the Proposed Development and Auchadaduie are not hydrologically linked. There are not expected to be any cumulative effects with the Proposed Development.

- 11.8.5 All other wind farms are located further away from the Proposed Development and the geology, hydrology and hydrogeology of these wind farms are not judged to be affected in any way by the Proposed Development.

- 11.8.6 Since there are no anticipated cumulative effects associated with these other schemes, there is no change to the residual effects discussed above.

11.9 Summary of Assessment

- 11.9.1 This chapter describes the baseline conditions of the Proposed Development and its surroundings, and highlights the potential effects and their significance on geology, hydrology and hydrogeology.
- 11.9.2 The Development Site is underlain by low-grade metamorphic rocks of the Dalradian Supergroup (Argyll Group), including metamorphosed basaltic intrusions. Peat occupies discreet areas associated with depressions and topographically level areas. Peat areas feed into watercourses.
- 11.9.3 The Development Site is located within the Kintyre Ground Water Body. This is classified by SEPA as having good groundwater quality and quantity. The Development Site is underlain by impermeable rocks, generally without groundwater. Shallow perched groundwater is present in the relative topographical lows and has allowed the peat deposits to form.
- 11.9.4 Two main watercourses drain the Development Site: Clachaig Water and Barr Water, with various other minor watercourses present. All identified watercourses have an overall status of good with an ecological status of bad to good.
- 11.9.5 Private Water Supply questionnaires were sent out to fifty-one properties. To date there has been six replies which identify that there are two properties located to the west and southwest of the Development Site that have PWS. One PWS source for the property of Ron Mara is located outside the recommended SEPA buffer (250m). Details of the source location for the known PWS can be seen in Appendix 11.5 (EIA Volume 3).
- 11.9.6 Potential effects on the water environment and ground conditions are interrelated and include:
- Pollutions incidents,
 - Erosion and sedimentation,
 - Compaction of soils,
 - Increase in runoff and increased localised flood risk,
 - Modification of surface water drainage patterns and flows,
 - Modifications of groundwater flows and levels, and
 - Peat instability.
- 11.9.7 Through the adoption of good working practices, the development of an appropriately designed drainage system and reinstatement, potential effects on the water environment and ground conditions will be mitigated. Effects on surface and groundwater and the underlying geology of the Development Site are predicted to be **Negligible** or **Minor adverse**.
- 11.9.8 A summary of the assessment of effects is provided below in Table 11-11.

Table 11-11 Summary of Assessment

<i>Description of Receptor</i>		<i>Description of Potential Effect</i>			<i>Description of Residual Effect</i>			
Receptor	Value/ Sensitivity	Effect	Duration	Magnitude of Change	Potential Significance	Summary of Mitigation	Magnitude of Change Following Mitigation	Residual Significance
Construction and Decommissioning								
	High	Excavation for development infrastructure resulting in loss of habitat.	Permanent	Medium	Moderate Adverse	Layout developed to minimise infrastructure in areas of deep peat. Compensatory mitigation by peat restoration (see Chapters 9: Ecology, and 17: Forestry, of this EIAR)	Minimisation of disturbance of peat reducing magnitude of effect from High to Negligible.	Minor Adverse
Peat	High	Excavation for development infrastructure resulting in release of carbon into the atmosphere.	Permanent	High	Major Adverse	Layout developed to avoid infrastructure in areas of peat > 2m where possible. Where unavoidable, floating access tracks to be utilised. Appropriate peat guidance to be adhered to as follows: Guidance on Developments on Peatland (Scottish Government, SNH and SEPA, 2007) - Advising on carbon-rich soils, deep peat and priority peatland habitat and development management (NatureScot, 2021)	Minimisation of disturbance of peat reducing magnitude of effects from High to Low.	Minor Adverse

<i>Description of Receptor</i>		<i>Description of Potential Effect</i>			<i>Description of Residual Effect</i>	
					<p>Good Practice during Wind Farm Construction (Scottish Renewables, SNH, SEPA, Forestry Commission Scotland, Historic Environment Scotland and Marine Scotland Science, 2019); Developments on Peatland: Guidance on the assessment of peat volumes, reuse of excavated peat and the minimisation of waste (Scottish Renewables and SEPA, 2012), Compensatory mitigation by renewable energy generation (see Appendix 11.4 - Carbon Balance Assessment) and peat restoration (see Chapters 9: Ecology, and 17: Forestry, of this EIAR)</p>	
Watercourses (Clachaig Water and Barr Water)	High	Excavation for access tracks and cable trenches leading to increased run-off on exposed ground causing pollution.	Temporary	Medium	Moderate Adverse	<p>Layout developed to minimise effect on watercourses by adhering to 50m offset and minimising the number of watercourse crossings.</p> <p>Appropriate drainage strategy will be developed and adhered to.</p> <p>Residual magnitude reduced from Medium to Negligible. Minor Adverse</p>

<i>Description of Receptor</i>		<i>Description of Potential Effect</i>			<i>Description of Residual Effect</i>			
Watercourses (Clachaig Water and Barr Water)	High	Dewatering of ground during turbine foundation construction.	Temporary	Medium	Moderate Adverse	CMS to be developed and adhered to.	Residual magnitude reduced from Medium to Negligible.	Minor Adverse
						Layout developed to minimise effect on watercourses by adhering to 50m offset.		
		Potential pollution of groundwater due to leaching of concrete residue from foundations.	Temporary	Medium	Moderate Adverse	CMS to be developed and adhered to.	Residual magnitude reduced from Medium to Negligible.	Minor Adverse
						Layout developed to minimise effect on watercourses by adhering to 50m offset.		
Disturbance of bed material or increased erosion from watercourse crossings.	Temporary	Medium	Moderate Adverse	CMS to be developed and adhered to.	Residual magnitude reduced from Medium to Negligible.	Minor Adverse		
				Layout developed to minimise effect on watercourses minimising the number of water crossings.				
Increased run-off from access tracks, crane pads and compound / battery storage area.	Permanent	Medium	Moderate Adverse	Implementation of appropriate watercourse strategy.	Residual magnitude reduced from Medium to Negligible.	Minor Adverse		
				Layout developed to minimise effect on watercourses by adhering to 50m offset.				
				Appropriate drainage strategy will be developed and adhered to.				

<i>Description of Receptor</i>	<i>Description of Potential Effect</i>	<i>Description of Residual Effect</i>
		<p>CMS to be developed and adhered to.</p>
		<p>Layout to minimise effect on watercourses by adhering to 50m offset.</p> <p>Appropriate drainage strategy will be developed and adhered to.</p>
	<p>Pollution from accidental spillages.</p> <p>Temporary Medium</p>	<p>Moderate Adverse</p> <p>CMS to be developed and adhered to. Vehicles to have spill kits and trained operatives in accordance with the CMS.</p>
		<p>Re-fuelling of construction vehicles and storage of fuel will be within a bunded area of the construction compound / battery storage.</p>
<p>Private Water Supplies</p>	<p>High</p> <p>Excavation for access tracks and cable trenches leading to increased run-off on exposed ground causing pollution.</p> <p>Temporary Medium</p>	<p>Moderate Adverse</p> <p>Layout developed to minimise effects on watercourse.</p> <p>Access >100m from PWS and other infrastructure sited >250m from PWS as per SEPA guidance.</p>

Residual magnitude reduced from Medium to Negligible. Minor Adverse

Residual magnitude reduced from Medium to Negligible. Minor Adverse

<i>Description of Receptor</i>	<i>Description of Potential Effect</i>			<i>Description of Residual Effect</i>		
				CMS to be developed and adhered to.		
Increased run-off from access tracks, crane pads and compound / battery storage area.	Permanent	Medium	Moderate Adverse	Layout developed to minimise effect on PWS. Access tracks >100 m from PWSs and other infrastructure sited >250 m from PWSs as per SEPA guidance.	Residual magnitude reduced from Medium to Negligible.	Minor Adverse
				CMS to be developed and adhered to.		
Dewatering of ground during turbine foundation construction	Temporary	High	Major Adverse	CMS to be developed and adhered to.	Residual magnitude reduced from High to Negligible.	Minor Adverse
				Layout developed to minimise effect on watercourse. Appropriate drainage strategy will be developed and adhered to. Vehicles to have spill kits and trained operatives in accordance with the CMS. Re-fuelling of construction vehicles and storage of fuel will be within a bunded area of the construction compound / battery storage.	Residual magnitude reduced from High to Negligible.	Minor Adverse
Pollution from accidental spillages.	Temporary	High	Major Adverse			

<i>Description of Receptor</i>		<i>Description of Potential Effect</i>			<i>Description of Residual Effect</i>			
		Pollution of groundwater due to leaching of concrete residue from foundations.	Temporary	High	Major Adverse	Layout to minimise effects on PWS. Access tracks >100m from PWS and other infrastructure >250m from PWS as per SEPA guidance. CMS to be developed and adhered to.	Residual magnitude reduced from High to Negligible.	Minor Adverse
Mull of Kintyre West - Coastal	High	Excavation for access road and cable trenches leading increased run-off on exposed ground causing pollution.	Temporary	Medium	Moderate Adverse	Layout developed to minimise effect on watercourses be adhering to 50m offset and minimising the number of water crossings. Appropriate drainage strategy will be developed and adhered to. CMS to be developed and adhered to.	Residual magnitude reduced from Medium to Negligible.	Minor Adverse
Kintyre bedrock and localised sand and gravel aquifer- Groundwater	High	Excavation for access tracks and cable trenches leading to increased run-off on exposed ground causing pollution.	Temporary	Medium	Moderate Adverse	Appropriate drainage strategy will be developed and adhered to. CMS to be developed and adhered to.	Residual magnitude reduced from Medium to Negligible.	Minor Adverse

<i>Description of Receptor</i>		<i>Description of Potential Effect</i>			<i>Description of Residual Effect</i>			
		Localised dewatering of ground during turbines foundation construction.	Temporary	High	Major Adverse	No turbines located within 250m of abstractions.	Residual magnitude reduced from High to Negligible.	Minor Adverse
		Dewatering of ground during temporary quarry and for foundations construction.	Temporary	Medium	Moderate Adverse	CMS to be developed and adhered to.	Residual magnitude reduced from Medium to Negligible.	Minor Adverse
		Pollution from accidental spillages.	Temporary	High	Major Adverse	CMS to be developed and adhered to. Re-fuelling of construction vehicles and storage of fuel will be within a bunded area of the construction compound / battery storage.	Residual magnitude reduced from High to Negligible.	Minor Adverse
		Access tracks and cable trenches cutting off natural surface and groundwater pathways.	Temporary	Medium	Moderate Adverse	Appropriate drainage strategy will be developed and adhered to. CMS to be developed and adhered to.	Residual magnitude reduced from Medium to Negligible.	Minor Adverse
		Pollution of groundwater due to leaching of concrete residue from foundations.	Temporary	High	Major Adverse	CMS to be developed and adhered to. Appropriate concrete to be used.	Residual magnitude reduced from High to Negligible.	Minor Adverse
Groundwater Dependant Terrestrial	High	Dewatering of ground during turbine foundation construction.	Temporary	High	Major Adverse	Layout developed to minimise impact on habitat.	Residual magnitude reduced	Minor Adverse

<i>Description of Receptor</i>	<i>Description of Potential Effect</i>			<i>Description of Residual Effect</i>
Ecosystems (GWDTE s)				<p>Extents and depth of excavations minimised within 250m of GWDTE habitat.</p> <p>Temporary drainage measures, such as cut off drains, should be used to reroute shallow groundwater around foundations and diffuse flows to habitat.</p>
	Pollution from accidental spillages.	Temporary	High Major Adverse	<p>Appropriate drainage strategy will be developed and adhered to.</p> <p>Vehicles to have spill kits and trained operatives in accordance with the CMS.</p> <p>Re-fuelling of construction vehicles and storage of fuel will be within a bunded area of the construction compound / battery storage.</p> <p>Residual magnitude reduced from High to Negligible. Minor Adverse</p>
	Access tracks and cable trenches cutting off natural surface and groundwater pathways.	Temporary	Medium Moderate Adverse	<p>Access tracks to be designed appropriately, where possible floating roads will be used within 100m of habitat or through habitat.</p> <p>Where excavated tracks are to be used they should be designed appropriately to minimise loss of hydrological connectivity within habitat.</p> <p>Residual magnitude reduced from Medium to Negligible. Minor Adverse</p>

<i>Description of Receptor</i>		<i>Description of Potential Effect</i>			<i>Description of Residual Effect</i>			
		Pollution of groundwater due to leaching of concrete residue from foundations.	Temporary	High	Major Adverse	CMS to be developed and adhered to. Appropriate concrete to be used.	Residual magnitude reduced from High to Negligible.	Minor Adverse
Operation								
Peat	Medium	Permanent displacement of peat habitat to accommodate Development infrastructure	Permanent	Medium	Moderate Adverse	Layout developed to minimise infrastructure in areas of deep peat. No infrastructure has been placed in area of peat >2 m in depth apart from isolated instances where floating tracks will be utilised.	Residual magnitude reduced from Medium to Negligible.	Negligible Adverse
		Access tracks and cable trenches cutting off natural surface and groundwater pathways resulting in areas of peat drying out.	Permanent	Medium	Moderate Adverse	Appropriate drainage strategy will be developed and adhered to.	Residual magnitude reduced from Medium to Negligible.	Negligible Adverse
Watercourses (Clachiag Water and Barr Water)	High	Access tracks could become conduits for surface water leading to erosion of surface causing pollution.	Temporary	Medium	Moderate Adverse	Layout developed to minimise effect on watercourses by adhering to 50 m offset and minimising the number of water crossings. Appropriate drainage strategy will be developed and adhered to.	Residual magnitude reduced from Medium to Negligible.	Minor Adverse

<i>Description of Receptor</i>	<i>Description of Potential Effect</i>			<i>Description of Residual Effect</i>	
					<p>CMS to be developed and adhered to.</p> <hr/> <p>Layout developed to minimise effect on watercourses by adhering to 50m offset.</p> <p>Appropriate drainage strategy will be developed and adhered to.</p> <p>CMS to be developed and adhered to.</p> <hr/> <p>Layout developed to minimise effect on watercourses by adhering to 50m offset.</p> <p>Appropriate drainage strategy will be developed and adhered to.</p> <p>CMS to be developed and adhered to.</p> <p>Vehicles to have spill kits and trained operatives in accordance with the CMS.</p> <p>Re-fuelling of construction vehicles and storage of fuel will be within a bunded area of the construction compound / battery storage.</p>
<p>Increased run-off from access tracks, crane pads and compound area.</p>	<p>Permanent</p>	<p>Medium</p>	<p>Moderate Adverse</p>		<p>Residual magnitude reduced from Medium to Negligible.</p> <p>Minor Adverse</p>
<p>Pollution from accidental spillages.</p>	<p>Temporary</p>	<p>Medium</p>	<p>Moderate Adverse</p>		<p>Residual magnitude reduced from Medium to Negligible.</p> <p>Minor Adverse</p>

<i>Description of Receptor</i>		<i>Description of Potential Effect</i>			<i>Description of Residual Effect</i>			
		Potential pollution of groundwater due to leaching of concrete residue from foundations.	Temporary	Medium	Moderate Adverse	Layout developed to minimise effect on watercourses by adhering to 50m offset. CMS to be developed and adhered to.	Residual magnitude reduced from Medium to Negligible.	Minor Adverse
		Permanent watercourse crossings could affect natural flows and bed morphology of watercourse	Permanent	Medium	Moderate Adverse	Layout developed to minimise effect on watercourses minimising the number of water crossings. Use of existing access tracks to keep new watercourse crossings to a minimum. Implementation of appropriate watercourse strategy.	Residual magnitude reduced from Medium to Negligible.	Minor Adverse
Private Water Supplies	High	Pollution from accidental spillages.	Temporary	High	Major Adverse	Layout developed to minimise effect on watercourse. Appropriate drainage strategy will be developed and adhered to. Vehicles to have spill kits and trained operatives in accordance with the CMS. Re-fuelling of construction vehicles and storage of fuel will be within a bunded area of the construction compound / battery storage.	Residual magnitude reduced from High to Negligible.	Minor Adverse

<i>Description of Receptor</i>		<i>Description of Potential Effect</i>			<i>Description of Residual Effect</i>			
		Increased run-off from access tracks, crane pads and compound area.	Permanent	Medium	Moderate Adverse	Layout developed to minimise effect on PWS. Access tracks >100m from PWSs and other infrastructure sited >250m from PWSs as per SEPA guidance. CMS to be developed and adhered to.	Residual magnitude reduced from Medium to Negligible.	Minor Adverse
		Pollution of groundwater due to leaching of concrete residue from foundations.	Temporary	High	Major Adverse	Layout developed to minimise effect on PWS. Access tracks >100m from PWSs and other infrastructure sited >250m from PWSs as per SEPA guidance. CMS to be developed and adhered to.	Residual magnitude reduced from High to Negligible.	Minor Adverse
		Access tracks could become conduits for surface water leading to erosion of surface causing pollution.	Temporary	Medium	Moderate Adverse	Layout developed to minimise effect on watercourses by adhering to 50m offset. Appropriate drainage strategy will be developed and adhered to. CMS to be developed and adhered to.	Residual magnitude reduced from Medium to Negligible.	Minor Adverse
Mull of Kintyre West - Coastal	High	Pollution from accidental spillages.	Temporary	High	Major Adverse	Layout developed to minimise effect on watercourse. Appropriate drainage strategy will be developed and adhered to.	Residual magnitude reduced from High to Negligible.	Minor Adverse

<i>Description of Receptor</i>	<i>Description of Potential Effect</i>				<i>Description of Residual Effect</i>		
					Vehicles to have spill kits and trained operatives in accordance with the CMS.		
	Access tracks could become conduits for surface water leading to erosion of surface causing pollution.	Temporary	Medium	Moderate Adverse	Layout developed to minimise effect on watercourses by adhering to 50m offset and minimising the number of water crossings. Appropriate drainage strategy will be developed and adhered to. CMS to be developed and adhered to.	Residual magnitude reduced from Medium to Negligible.	Minor Adverse
	Access tracks could become conduits for surface water leading to erosion of surface causing pollution.	Temporary	Medium	Moderate Adverse	Appropriate drainage strategy will be developed and adhered to. CMS to be developed and adhered to.	Residual magnitude reduced from Medium to Negligible.	Minor Adverse
Kintyre bedrock and localised sand and gravel aquifer- Groundwater	Pollution of groundwater due to leaching of concrete residue from foundations.	Temporary	High	Major Adverse	CMS to be developed and adhered to. Appropriate concrete to be used.	Residual magnitude reduced from High to Negligible.	Minor Adverse
	Pollution from accidental spillages.	Temporary	High	Major Adverse	Appropriate drainage strategy will be developed and adhered to. Vehicles to have spill kits and trained operatives in accordance with the CMS.	Residual magnitude reduced from High to Negligible.	Minor Adverse

<i>Description of Receptor</i>		<i>Description of Potential Effect</i>			<i>Description of Residual Effect</i>			
Groundwater Dependant Terrestrial Ecosystems (GWDTEs)	High	Access tracks could become conduits for surface water leading to erosion of surface causing pollution.	Temporary	Medium	Moderate Adverse	Re-fuelling of construction vehicles and storage of fuel will be within a bunded area of the construction compound / battery storage. Appropriate drainage strategy will be developed and adhered to. CMS to be developed and adhered to.	Residual magnitude reduced from Medium to Negligible.	Minor Adverse
		Pollution of groundwater due to leaching of concrete residue from foundations.	Temporary	High	Major Adverse	CMS to be developed and adhered to. Appropriate concrete to be used.	Residual magnitude reduced from High to Negligible.	Minor Adverse
		Pollution from accidental spillages.	Temporary	High	Major Adverse	Appropriate drainage strategy will be developed and adhered to. Vehicles to have spill kits and trained operatives in accordance with the CMS. Re-fuelling of construction vehicles and storage of fuel will be within a bunded area of the construction compound / battery storage.	Residual magnitude reduced from High to Negligible.	Minor Adverse

11.10 References

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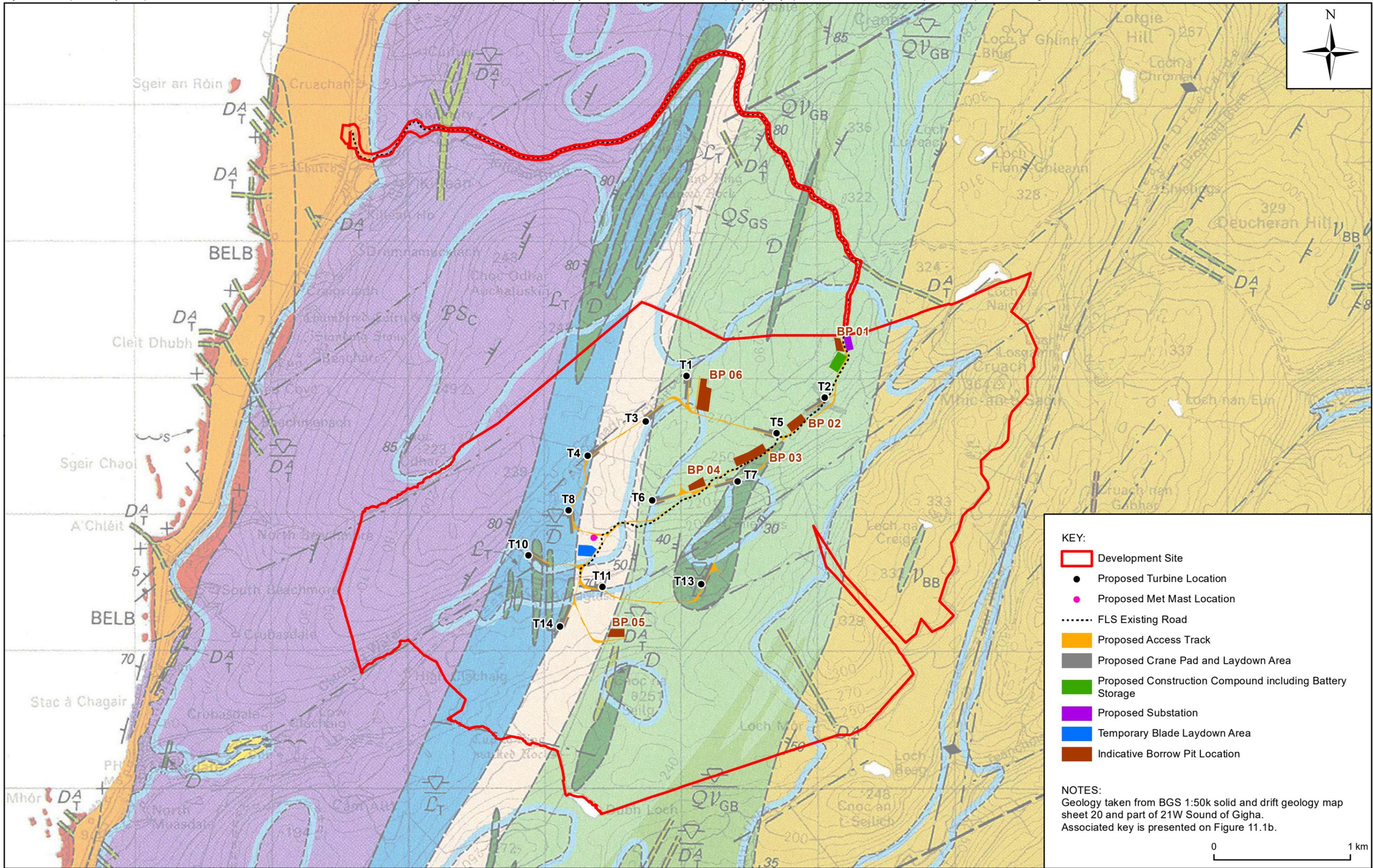
Clachaig Glen Wind Farm

Environmental Impact Assessment Report

Volume 2b

EIAR Figures

**Figures: 11.1a; 11.1b; 11.2a;
11.2b**



KEY:

- Development Site
- Proposed Turbine Location
- Proposed Met Mast Location
- FLS Existing Road
- Proposed Access Track
- Proposed Crane Pad and Laydown Area
- Proposed Construction Compound including Battery Storage
- Proposed Substation
- Temporary Blade Laydown Area
- Indicative Borrow Pit Location

NOTES:
 Geology taken from BGS 1:50k solid and drift geology map sheet 20 and part of 21W Sound of Gigha. Associated key is presented on Figure 11.1b.

0 1 km

Client: **RWE**

Project: **CLACHAIG GLEN WIND FARM ENVIRONMENTAL IMPACT ASSESSMENT**

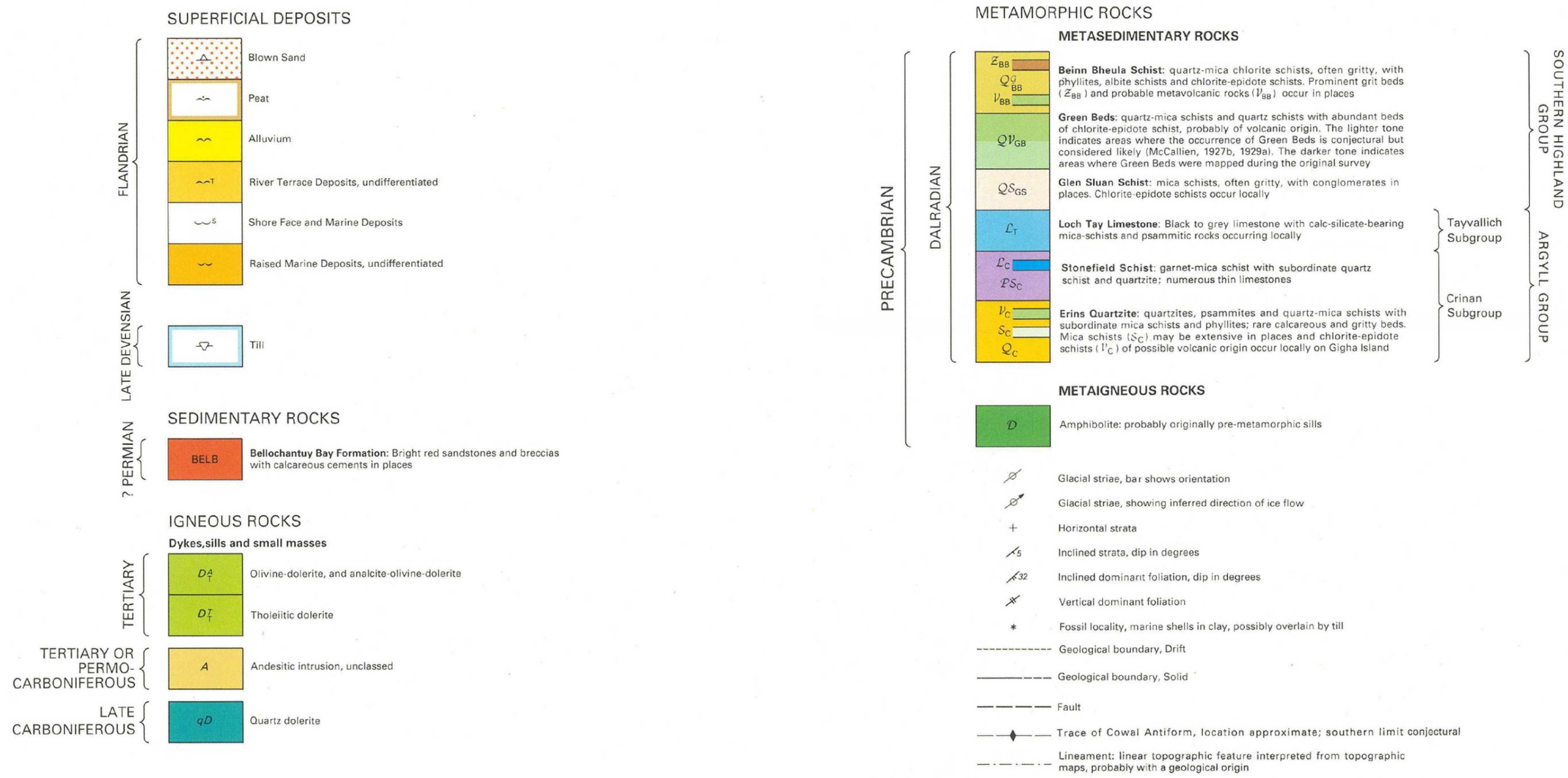
Title: **FIGURE 11.1a GEOLOGY**

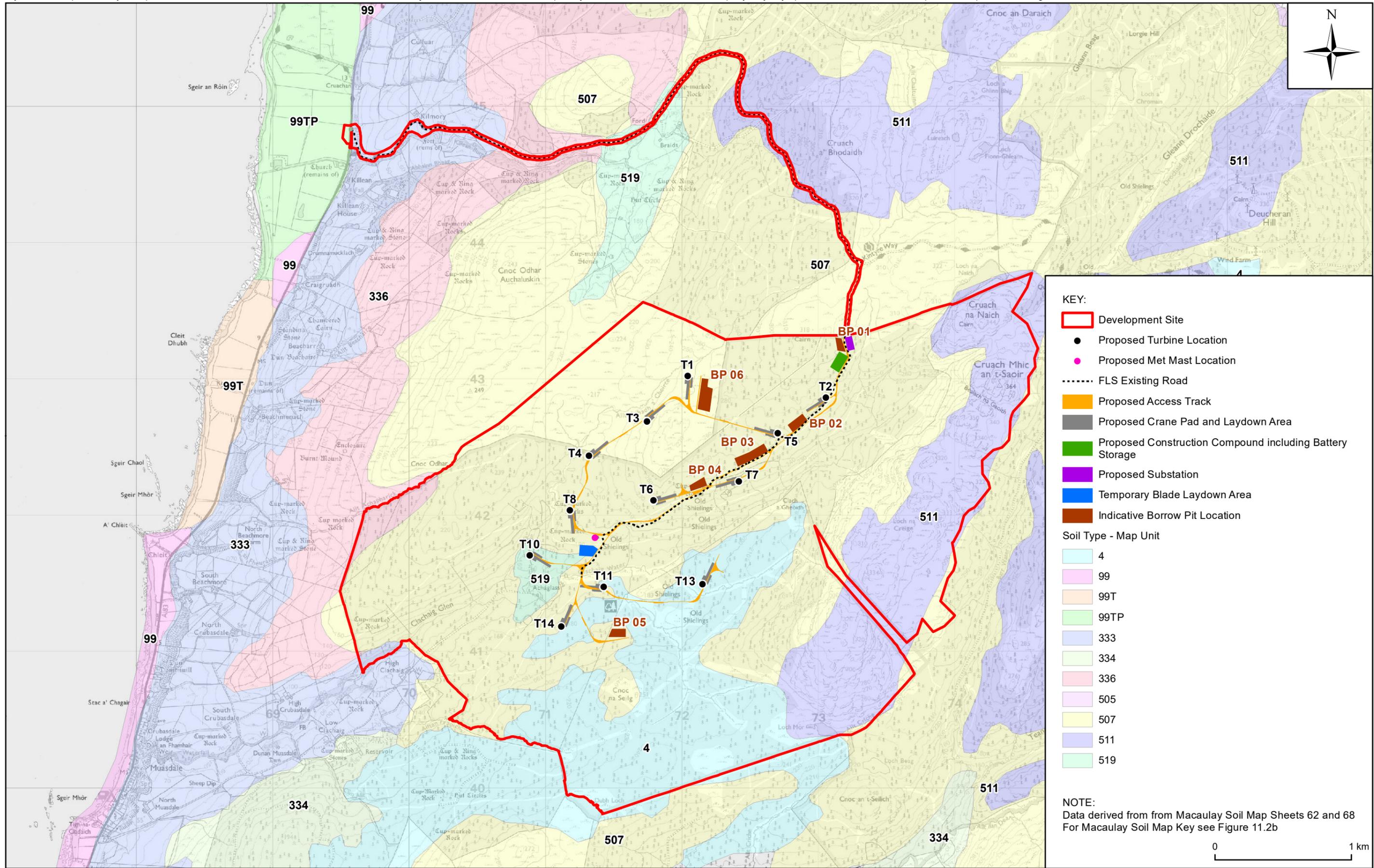
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Client: **RWE**

Project: **CLACHAIG GLEN WIND FARM ENVIRONMENTAL IMPACT ASSESSMENT**

Title: **FIGURE 11.2a MACAULAY MAP EXTRACT**

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ASSOCIATION	PARENT MATERIAL	MAP UNIT	COMPONENT SOILS	LANDFORMS	VEGETATION
Organic Soils	Organic Deposits	4	Blanket Peat	Uplands and northern lowlands with gentle and strong slopes	Blanket and flying bent bog. Upland and mountain blanket bog
Corby/Boyndie/Dinnet	Fluvioglacial and raised beach sands and gravels derived from acid rocks	99	Humus-iron podzols: some humic gleys and alluvial soils	Valley floors and lowland with gentle slopes	Permanent and rush pastures
Boyndie	Fluvioglacial and raised beach sands derived from acid rocks	99T	Humus-iron podzols: some humic gleys and alluvial soils	Valley floors and lowland with gentle slopes	Arable and permanent pastures. Acid bent-fescue grassland. Rush pastures and sedge mires
Boyndie	Fluvioglacial and raised beach sands derived from acid rocks	99TP	Noncalcareous gleys: some humus-iron podzols	Valley floors and lowland with gentle slopes	Permanent and rush pastures
Kintyre	Drifts derived from Dalradian schists and red sandstones, often water-modified	333	Noncalcareous gleys, humic gleys: some brown forest soils and peaty gleys	Undulating lowlands with gentle slopes: non-rocky	Arable and permanent pastures. Acid bent-fescue grassland. Rush pastures and sedge mires
Kintyre	Drifts derived from Dalradian schists and red sandstones, often water-modified	334	Peaty gleys: some peat	Undulating foothills with gentle slopes: non-rocky	Flying bent grassland and bog. Heath-grass - white bent grassland. Rush pastures
Kintyre	Drifts derived from Dalradian schists and red sandstones, often water-modified	336	Peaty gleys: some peat	Undulating foothills with gentle slopes: slightly rocky	Flying bent grassland and bog. Heath-grass - white bent grassland. Rush pastures
Strichen	Drifts derived from arenaceous schists and strongly metamorphed argillaceous schists of the Dalradian Series	505	Brown forest soils, humus-iron podzols, humic gleys	Hill and valley sides with strong to very steep slopes: slightly and moderately rocky	Bent-fescue grassland. Broadleaved woodland. Rush pastures and sedge mires
Strichen	Drifts derived from arenaceous schists and strongly metamorphed argillaceous schists of the Dalradian Series	507	Peaty gleys, peat: some peaty podzols and peaty rankers	Hill sides with gentle and strong slopes: moderately rocky	Bog heather moor and blanket bog. Atlantic and Boreal heather moor. Heath-rush - fescue grassland
Strichen	Drifts derived from arenaceous schists and strongly metamorphed argillaceous schists of the Dalradian Series	511	Peaty gleys, peaty rankers, peat: some peaty podzols	Rugged hills with gentle to strong slopes: very rocky	Atlantic, Boreal and bog heather moor. Blanket bog. Heath-rush - fescue grassland
Tarves	Drifts derived from intermediate rocks or mixed acid and basic rocks, both metamorphic and igneous	519	Humic gleys, brown forest soils: some peaty podzols and peaty gleys	Ridged low hills with strong slopes: moderately rocky	Rush pastures and sedge mires. Bent-fescue and white bent grassland. Bog heather moor

Client: 
 Project: CLACHAIG GLEN WIND FARM ENVIRONMENTAL IMPACT ASSESSMENT

Title: FIGURE 11.2b
 MACAULAY MAP EXTRACT KEY
 (ASSOCIATED WITH FIGURE 11.2a)


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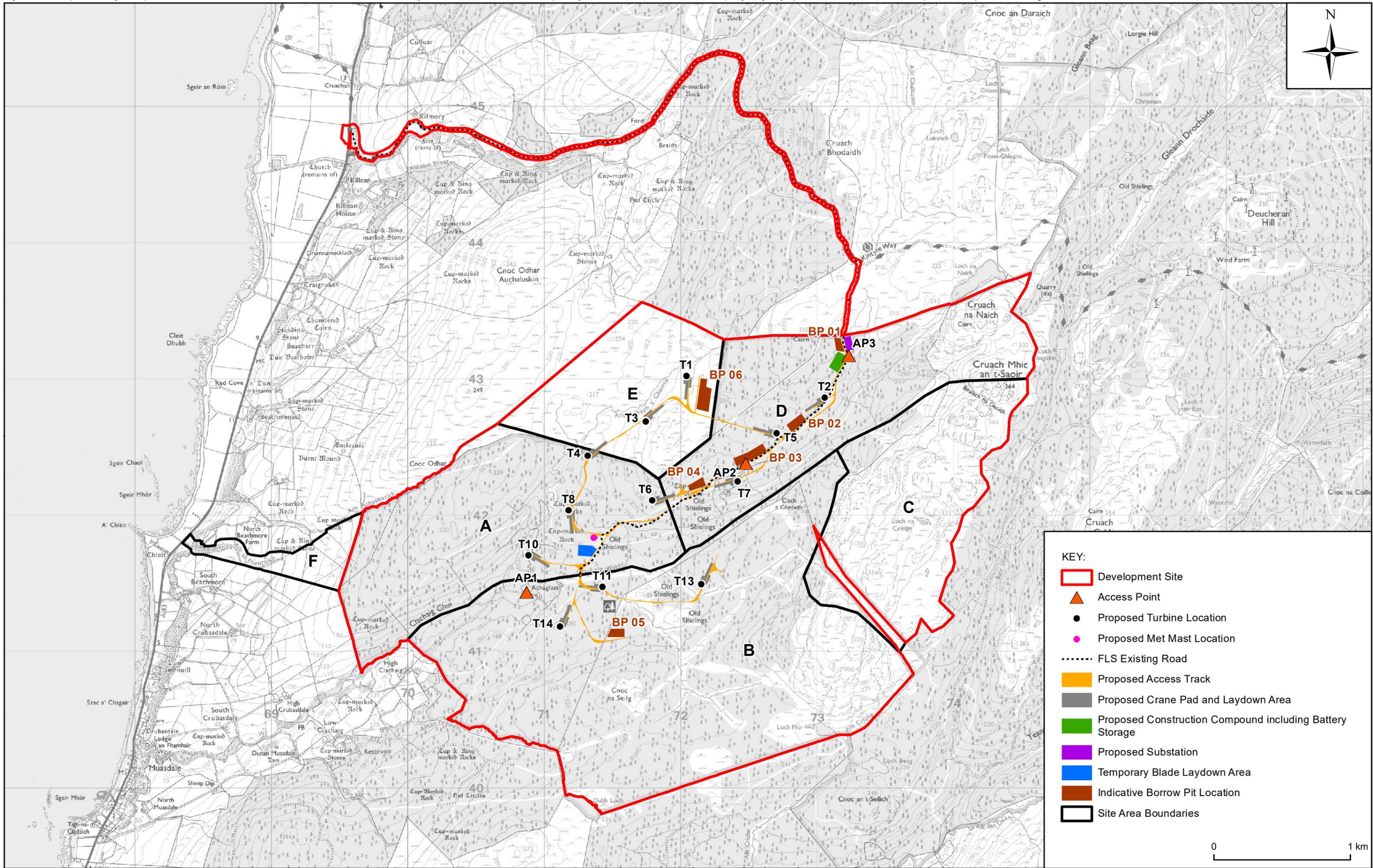
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EIAR Figures

Figures: 11.3; 11.4; 11.5



Client: **RWE**

Project: **CLACHAIG GLEN WIND FARM ENVIRONMENTAL IMPACT ASSESSMENT**

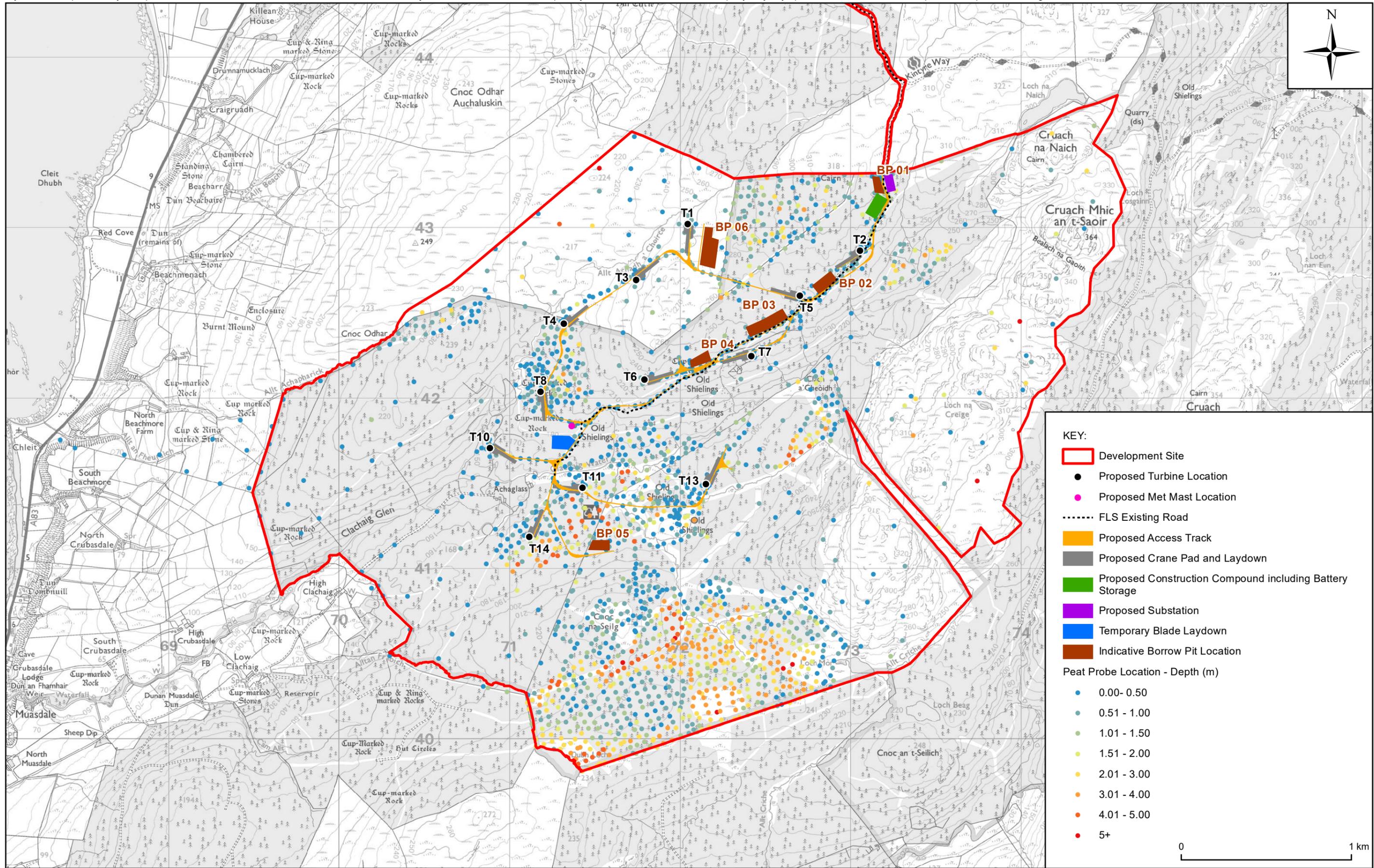
Title: **FIGURE 11.3 GEOLOGY, HYDROGEOLOGY AND HYDROLOGY SITE WALKOVER AREA**

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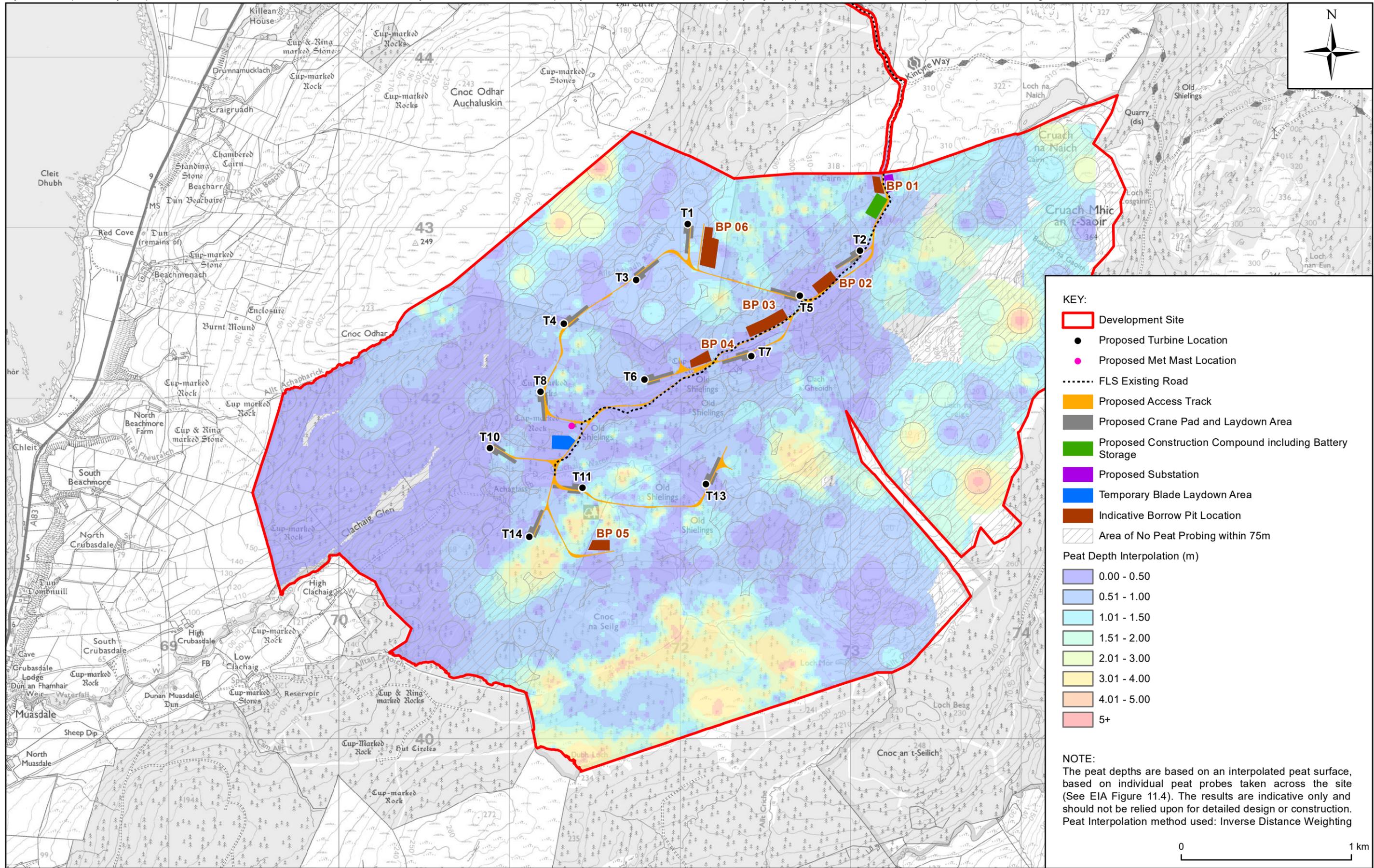
Client: **RWE**

Project: **CLACHAIG GLEN WIND FARM ENVIRONMENTAL IMPACT ASSESSMENT**

Title: **FIGURE 11.4 PEAT PROBE SURVEY RESULTS**

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Client: **RWE**

Project: **CLACHAIG GLEN WIND FARM ENVIRONMENTAL IMPACT ASSESSMENT**

Title: **FIGURE 11.5 PEAT DEPTH INTERPOLATION**

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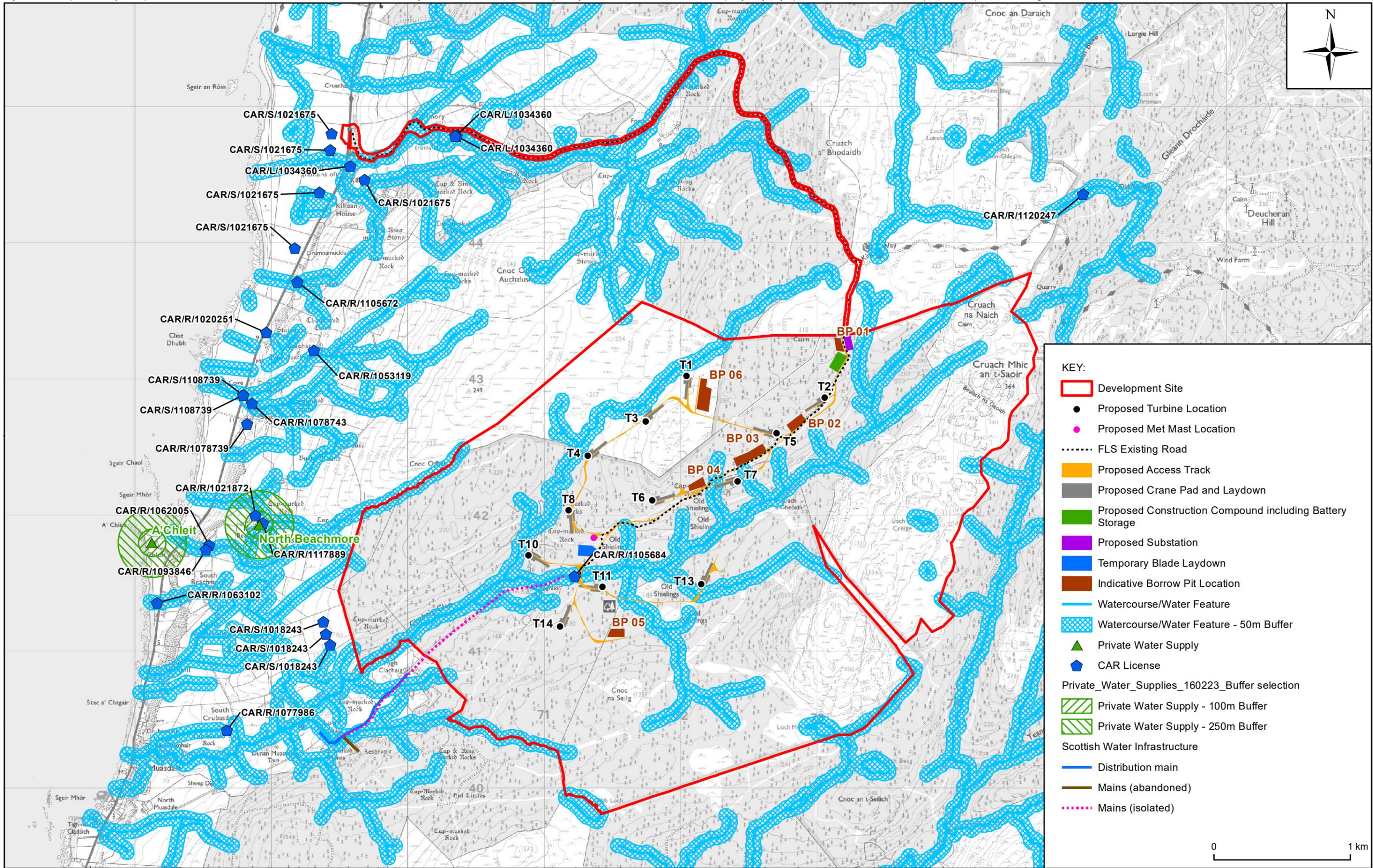
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EIAR Figures

Figures: 11.6; 11.7

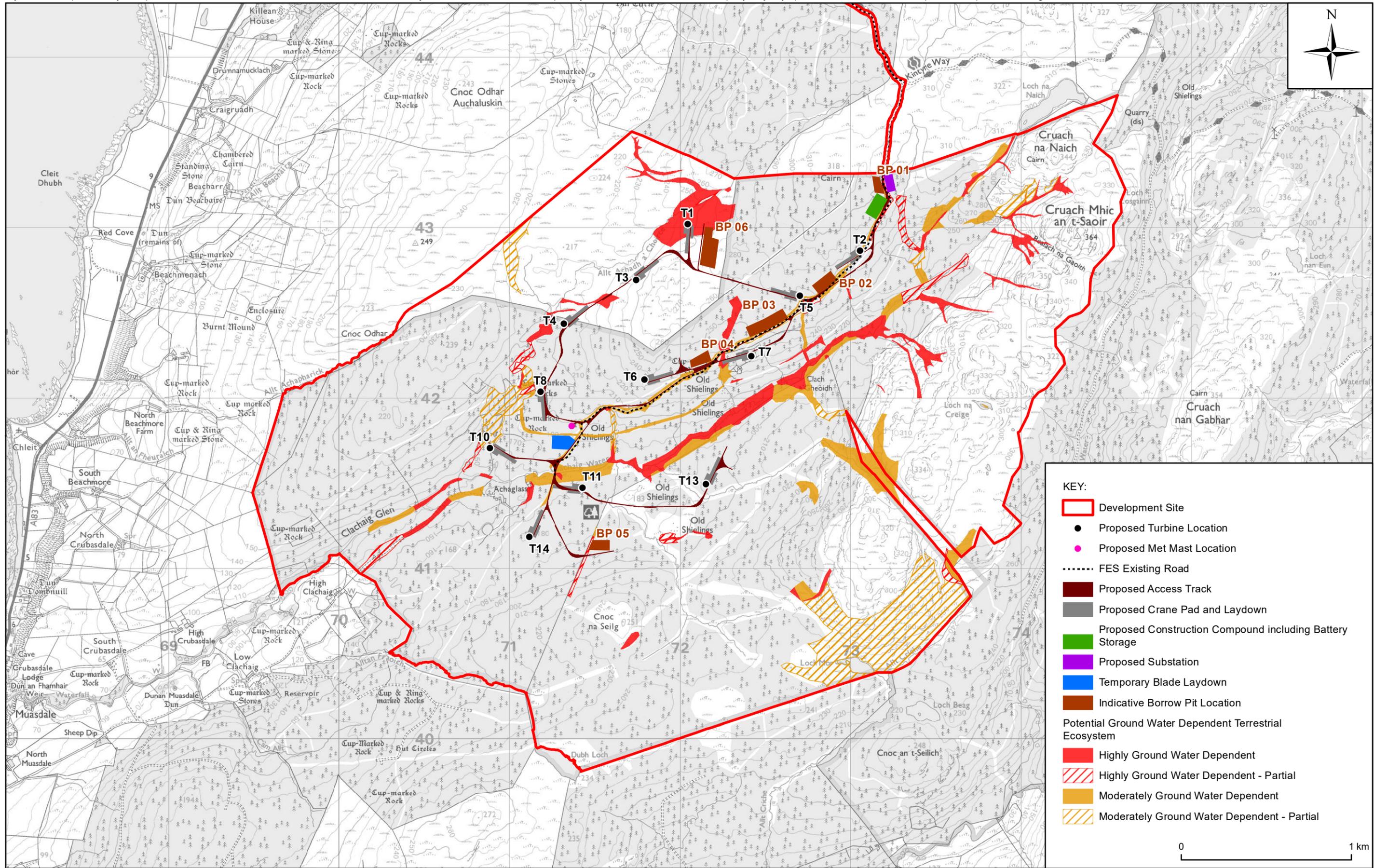


Client:	RWE
Project:	CLACHAIG GLEN WIND FARM ENVIRONMENTAL IMPACT ASSESSMENT

Title:	FIGURE 11.6 HYDROLOGY
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KEY:

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- Proposed Met Mast Location
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- Proposed Substation
- Temporary Blade Laydown
- Indicative Borrow Pit Location

Potential Ground Water Dependent Terrestrial Ecosystem

- Highly Ground Water Dependent
- Highly Ground Water Dependent - Partial
- Moderately Ground Water Dependent
- Moderately Ground Water Dependent - Partial

0 1 km

Client: **RWE**

Project: **CLACHAIG GLEN WIND FARM ENVIRONMENTAL IMPACT ASSESSMENT**

Title: **FIGURE 11.7 POTENTIAL GROUND WATER DEPENDENT TERRESTRIAL ECOSYSTEMS (GWDE)**

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