Cloich Forest Wind Farm

Volume 3 – SEI Report Technical Appendices (Part 2 of 2)

November 2022

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CLOICH FOREST WIND FARM

SEI Report – Volume 3 – SEI Report Technical Appendices (Part 2 of 2)

A10.1 Supplementary Information for Private Water Supply Risk Assessment
A12.1 Construction Development Programme
A14.1 Cloich Forest Wind Farm Eskdalemuir Seismic Array Calculations
A16.1 Carbon Balance Calculations

edf renewables

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CLOICH FOREST WIND FARM

VOLUME 3: SEI REPORT TECHNICAL APPENDICES

TECHNICAL APPENDIX A10.1: SUPPLEMENTARY INFORMATION FOR PRIVATE WATER SUPPLY RISK ASSESSMENT

NOVEMBER 2022

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TABLE OF CONTENTS

1 INTRODUCTION

This Technical Appendix, the Supplementary Information for Private Water Supply Risk Assessment ('the updated PWSRA'), provides an updated risk assessment of the Private Water Supplies (PWS) identified within hydrologically connected catchments of the Cloich Forest Wind Farm ('the Development').

This Technical Appendix supplements **Chapter 10: Hydrology and Hydrogeology** of the Cloich Forest Wind Farm Supplementary Environmental Information Report ('the SEI Report'), which outlines the updated assessment of potential effects of the SEI Layout on the hydrological environment, including PWS. It should also be read in conjunction with the PWSRA Technical Appendix A10.1, referred to as the 'original PWSRA' and provides full detail on the methodology and assessment submitted as part of the EIA Report.

Following submission of the EIA Report in 2021, SEPA submitted a holding objection to the Development in relation to PWS and requested further information in relation to the PWS at Nether Stewarton in order to review this position. The updates to this PWSRA, submitted as part of the SEI Report, are in relation to the subsequent site investigation (SI) and updated impact assessment for PWS Stewarton.

It is noted that conditions were placed by SEPA on other PWS (Earlyburn Observatory and Cloich Farm), however, no updated assessment is required for these supplies based on the layout changes outlined in the SEI Report.

This Technical Appendix is supported by the following Annexes:

- **Annex A** – Site Investigation Borehole Location Figure;
- **Annex B** – Site Investigation Technical Note;
- **Annex C** – Site Investigation Report;
- **Annex D** – Groundwater Monitoring Results; and
- **Annex E -** Consultation**.**

It should be noted that supporting communications and consultation refer to the PWS 'Nether Stewarton' as 'Stewarton'. As there are two supplies in the Stewarton area, 'Nether Stewarton' and 'Upper Stewarton' (outlined in the original PWSRA), any reference to Stewarton in this document refers only to the supply at Nether Stewarton.

2 BACKGROUND

2.1 Changes to the Baseline Environment

Supplementary information baseline conditions, outlined in Section 10.4 of the EIA report, have been supplemented in Section 10.3 of the SEI report and within Section 4 of this report.

2.2 Changes to the Development

Chapter 3: Project Description of the SEI Report sets out the SEI Layout. The changes in the Development layout are as follows:

- Relocating T8 and its associated infrastructure;
- An additional Temporary Construction Compound (TCC) in the north of the Site;
- An additional control building at the substation compound; and
- An additional area of felling due to the relocation of T8 and additional TCC.

The location of the Development and the PWS Study Area is provided in Figure 10.1 of the EIA Report. Outlines of the hydrological catchment are provided in Figure 10.2 of the EIA Report. The SEI Layout is shown in Figure 3.1 of the SEI Report.

2.3 Post Submission Consultation

Following submission of the EIA Report, a holding objection was submitted by SEPA regarding PWS. Table 2.1 summarises the ongoing consultation between Arcus, SEPA and other consultees in relation to PWS. It should be noted some of this relates to consultation regarding the site investigation works (and not the Development).

Table 2.1 Post-Submission Consultation relating to PWS

Consultee	Summary of Consultation Response	Response to Consultee
SEPA (19/08/2021)	Paragraph 1.1 *"Having reviewed the information supplied with this planning application, SEPA consider the information supplied to allow for determination of potential impacts for the Private Water Supplies (PWS) of Stewarton.*	Response dated (19/10/2021) is provided in Annex E but summarised below. Arcus acknowledges the holding objection lodged.
	1.2 SEPA note that there is uncertainty on the location of the upper groundwater spring source and the potential hydrogeological connection between T3 excavations and the Stewarton PWS source.	Arcus acknowledges in their initial response dated 19/10/2022 the potential for confusion due to the large amount of information shown on the PWS figure initially submitted, confirming the catchment relates to surface water.
	1.3 SEPA therefore request a site investigation to further inform on the PWSRA (pre-determination).	Arcus acknowledge that there is potential for hydrogeological connectivity. Arcus also state that the findings of the PWSRA are still valid in the absence of intrusive site investigation works at T3. Arcus confirm that a site investigation at T3 is possible and it would also be possible to microsite T3 by up to 50 m if the conditions are more favourable.
	1.4 SEPA also request that groundwater monitoring is carried out for Earlyburn (Observatory) PWS and Cloich Farm PWS.	No comment provided.
	1.5 SEPA also recommend further groundwater monitoring including groundwater sources and the duration of post-construction monitoring.	No comment provided.
	1.6 SEPA find mitigation for Earlyvale PWS, Shiplaw and Shiphorn PWS and Upper Stewarton PWS acceptable.	No comment provided.
SEPA (03/11/2021)	SEPA acknowledge the letter from Arcus on 19/10/2021 and state that it does not change SEPA's initial response.	Arcus response to SEPA dated (11/11/2021) (Annex E)

Consultee	Summary of Consultation Response	Response to Consultee
	SEPA state that a site investigation and groundwater assessment is still required at T3. SEPA request that the applicant ascertains a worst case scenario for the reduction in groundwater yield by conducting an intrusive site investigation at T3. The investigation should inform on the groundwater table and groundwater flow and answer the uncertainties exposed in the conceptual site model.	Arcus state that the applicant will proceed to undertake the site investigation and groundwater assessment. Arcus states that a SI at the exact location of T3 is not possible due to forestry felling concerns. Therefore, Arcus proposes using proxy borehole locations where groundwater levels in the vicinity of T3 will be assessed. In this response, Arcus submitted technical note (Appendix B 'Site Investigation and Technical Note') to establish a scope of works.
SEPA (16/11/2021)	SEPA acknowledge the previous email from Arcus on 11/11/2021. SEPA acknowledge the difficulty in assessing T3 and accept the triangular borehole array as an acceptable form of assessment. SEPA accept the proposed borehole depth and also accept the initial monitoring period of three months but this may require additional monitoring after evaluation of results.	Arcus Response dated (27/06/2022) (Annex E Consultation): Arcus confirm that site investigation works have now been completed at the proposed T3 location. Arcus state this addresses SEPA's initial request for further information. In this correspondence Arcus provided a figure showing groundwater monitoring locations, groundwater monitoring data and the SI report.
SEPA (12/08/2022)	SEPA comment on the finding of the site investigation and highlight the key points: • No further monitoring is required but applicant may wish to continue through the winter; • Additional permeability testing could be carried out in the winter or through a different testing method; • Comment required on the final siting of T3 in relation to different geological settings at BH01 and BH02; and	Arcus did not provide an immediate response at the time, as this would be included within the SEI submission. In relation to the items below: Noted. No additional permeability testing has been proposed as sufficient and proportionate permeability data has already been collected. This is covered within Section 5.5 of this risk assessment. No information has been provided by the residents to

Consultee	Summary of Consultation Response	Response to Consultee
	• Comment required on the productivity of the supply during summer period. Summer groundwater levels show depth is below turbine foundation depth and therefore predicted to have a Negligible impact on groundwater contribution to the Nether Stewarton water supply yield.	date about the supply productivity at PWS Nether Stewarton over the summer period. This PWSRA covers groundwater levels from the period May to October 2022.
Energy Consents Unit (ECU) (21/12/2021)	ECU were contacted by the residents at Stewarton in relation to the private water supplies and proposed ground investigation. The following questions were asked: 1. What, in your view, are the potential risks of this site investigation work on the Stewarton PWS? 2. Prior to undertaking this site investigation work and assessment is the Applicant required to obtain any licences or authorisations prior to work commencing on site? If so from whom? 3. Is it necessary for this site investigation work by the Applicant be overseen or monitored by either SEPA or SBC or any other authorised body? 4. As far as ECU are aware no water monitoring or sampling of the Stewarton private water supply has been done to date nor has it been proposed as part of these intended works - Is it necessary to have an assessment of the current baseline of the water quality at these properties? How could a comparison be done in the event of a complaint arising by property owners claiming impacts due to the ground investigation works? Is this something SBC's EHO would be able to answer?	SEPA response to ECU (no Arcus input).
Scottish Borders Council (SBC) (04/02/2022)	SBC response to ECU queries in relation to their views on the proposed site investigation works at T3, including a review of information to date. SBC state there is potential for impact to water quality and quantity however revert back to SEPA and their guidance. Confirms no licence, authorisation or monitoring required from SBC. SBC also recommend baseline monitoring at the supply.	Letter response dated (05/04/2022) confirms applicant view is that SI works pose a very low residual risk, with a number of mitigation measures in place, such as risk assessment and method statements, supervision of works by an Ecological Clerk of Works (ECoW) and hydrologist.
Midlothian Council (22/10/2021)	"Midlothian Council notes that a Private Water Supply study area has been established on the basis of a 3km cordon from the core study area (Technical Appendix A10.2 Private Water Supplies). Midlothian Council considers this to be a reasonable approach. Figure 10.1 presents a map of the PWS study area which	Figure 10.1 of the EIA Report included an error within the legend where a '2 km' study area was noted; the PWS survey area did extend to 3 km, in line with the EIA

Consultee	Summary of Consultation Response	Response to Consultee
	reduces this to 2km. It is unclear whether this is an error on the Figure 10.1 map key or if the actual study area has been reduced to a 2km radius. It will be necessary to have this discrepancy explained, and if necessary any additional identified private water supplies considered."	Chapter and Technical Appendix 10.2.
Peebles & District Community Council (22/09/2021)	"We are further concerned by the lack of consideration given to the smaller settlements, farms, businesses, and groups of houses. These settlements, etc. around Cloich, including Stewarton, Cringletie, Whitmuir and others, are mainly dependent on private water supplies which may be adversely affected by the development. These are dismissed in the non-technical overview as "isolated individual dwellings." This is both unsatisfactory and incorrect and they deserve the same consideration as larger settlements."	Small settlements were given due consideration within the Application documents, in relation to PWS. The Applicant is fully aware of the small settlements, such as Stewarton, and has considered them fully within the EIA Report and SEI Report assessments/documents.
Manor, Stobo & Lyne Council (30/10/2021)	"Most of the properties within 2-3 km of the development rely upon private water supplies which are fed from springs in the Cloich Hills that may be affected by the civil works required to build the turbines. There are up to 40 properties including several farms that might be at risk if private water supplies are damaged. This was a major concern for the original development proposal and is significantly worsened for the much larger turbines proposed. The advisers acting on behalf of EDF-RE have done little to address this issue and appear to believe that they can rely upon poorly drafted conditions in the original planning consent. They have not been willing to give concrete and legally-binding guarantees"	All properties with potential PWS within the 3 km of the Proposed Development have been given consideration within the PWSRA found in Technical Appendix A10.2 of the EIA Report and Technical Appendix A10.1 of the SEI Report.
Eddleston & District Community Council (30/09/2021)	EDCC previously raised concerns about the potential impact on private water supplies to houses and farms in the immediate vicinity of the proposed scheme. This concern was upheld in the prior consented scheme, resulting in Condition 20, which states: "There shall be no commencement of development unless a method statement has been submitted to and approved in writing by the planning authority, detailing all mitigation measures to be delivered to secure the quality, quantity and continuity of water supplies to properties which are served by private water supplies at the date of this consent and which may be affected by the development….The approved method statement shall accord with SEPA guidance note 31 and shall thereafter be implemented in full. Reason: to maintain a secure and adequate quality water supply to all properties with private water supplies which may be affected by the development." Environmental Impact Assessment Chapter 10, paragraph 100 reveals a total of some 145	Technical Appendix A10.2 accompanying the EIA report and A10.1 of the SEI Report fully assesses the risk to all PWS within the 3 km study area. These appendices identify potential hydrological connection to the Development, all potential risks to PWS and outline mitigation where appropriate. Small settlements were given due consideration within the Application documents, particularly in relation to PWS. The Applicant is fully aware of the small settlements, such as Stewarton, and has considered them fully within the EIA Report and SEI Report assessments/documents.

Consultee	Summary of Consultation Response	Response to Consultee
	properties within the study area supplied by private water supplies. Paragraph 103 shows that the following, all within EDCC's boundary, "have the potential to be at risk": • Earlyvale House • Upper Stewarton • Cloich Fram; • Foresthill (Woodbank) • Darnhall Mains and Whitelaw Burn • Stewarton • Black Barony Home Farm • Earlyburn (Observatory) • Shiplaw and Shiphorn • Harehope A & B We dispute the reference to these as "scattered individual dwellings" they are settlements, collections of houses, farms, businesses where real people and livestock live; and use water. We would urge Scottish Ministers to consider the extent to which householders have already – at their own expense – shown up large flaws in the developer's assessment of water sources and their relationship with dwellings and farm businesses. This work was conducted as part of the public inquiry into the 2016 consented scheme and showed the hydrological connection between the development and the residences listed above. The wider Eddleston community is dismayed by the developer's proposal for a 'watching brief' and the acknowledgement that this scheme might result in bottled or bowsered water having to be provided to farms and homes should the water supply be impacted. There should be zero tolerance to any such risk. EDCC considers this unacceptable and reason alone to reject this application. The new proposal, with turbines significantly taller than those currently consented will require increased disturbance to ground conditions and therefore increased risk to PWS. Scottish Ministers and the ECU must not allow their own conditions to be undermined by a successor application and should reject this application for its failure to adequately address Condition 20."	
Lamancha, Newlands and Kirkurd Community Council (20/10/2021)	In addition to our concerns about the adverse landscape and visual impact of these turbines (which are 30 per cent higher that those proposed under the previous proposal), we are also aware that there are serious concerns about the impact of the scheme on private water supplies.	A full assessment of PWS is found in Technical Appendix A10.2 of the EIA Report and an updated review of PWS can be found in Technical Appendix A10.2 of the SEI Report.
Public Comments	The main comments and concerns from public comments are as follows:	A comprehensive assessment of PWS within the vicinity of the proposed Development

Consultee	Summary of Consultation Response	Response to Consultee
	▪ All PWS within the vicinity of the Development should be identified and any potential risks should be assessed. ▪ There are concerns that PWS will be impacted and mitigation measures put in place for PWS are not satisfactory. ▪ It has been commented that the River Tweed SAC/SSSI is connected to the Site by various burns and tributaries which flow through the Development area. ▪ There are concerns regarding flooding to the surrounding areas caused by the Development. ▪ Public consultees are concerned by the earthworks associated with the Development and how they may impact the watercourses and PWS. There are concerns that the Development may result in watercourse diversions which will change the hydrology of the area.	has been carried out in Technical Appendix A10.2 of the EIA Report and A10.1 of the SEI Report. Within Technical Appendix A10.2 of the EIA Report, a potential hydrological or hydrogeological connection was found between five PWS and the proposed Development. The risk to each PWS was deemed negligible to low with mitigation implemented. Supplementary information was provided for Nether Stewarton in Technical Appendix A10.1 of the SEI Report. This assessment included carrying out a site investigation to assess groundwater conditions and confirm potential hydrological connection. This assessment is ongoing. An assessment of potential impacts to hydrological receptors including potential impacts from activities both during construction and during the operational phase are found within Section 10.6 of the EIA Report and Section 10.7 of the SEI Report. Impacts to statutory designated receptors such as the River Tweed SAC/SSSI and all construction activities have been fully assessed within the EIA Report. Within this report, embedded mitigation has been detailed within Technical Appendix A10.1 WCEMP of the EIA Report which accompanied the EIA Report, detailing all further mitigation. Engineering activities within the water environment such as culverts or watercourse diversions are fully compliant with Controlled activities (Scotland)(Water Environment) Regulations 2011 as discussed within Technical Appendix A10.2 of the EIA Report.

3 METHODOLOGY

The Arcus methodology for Private Water Supplies Risk Assessment (Version 2) is based on Annex E of Appendix A10.2 of the EIA report, with changes to the methodology outlined in Section 3.3.

3.1 Legislation and Guidance

The following guidance, legislation and information sources have been updated since the EIA Report submission in June 2021:

- The Water Environment (Controlled Activities) (Scotland) Amendment Regulations 2021 (the CAR Regulations)[1]; and
- SEPA (2022). CAR - A Practical Guide, Version 9.1[2].

3.2 Survey Area

No changes to the study area have been identified within the original PWSRA in Appendix A10.2 of the EIA Report.

3.3 Method

The methodology is outlined within the original PWSRA in Appendix A10.2 of the EIA Report.

Due to the objection raised by SEPA in post-submission consultation (Stage Two), further surveys (Stage Four) and an updated risk assessment (Stage Five) was required. The additional activities to be carried out at these stages, resulting in a change in methodology are outlined in sections 3.3.1 to 3.3.3.

3.3.1 Stage Two: Consultation

This section outlines the additional activities carried out within the Consultation stage. Following post submission consultation with SEPA, it was established that SI was required. The location and specification for three boreholes was agreed with SEPA surrounding the proposed location of T3 (further information is provided in Annex B). The purpose of this was to:

- Confirm the underlying geological conditions;
- Confirm the presence of groundwater;
- Obtain groundwater flow direction; and
- Obtain aquifer conditions (including hydraulic conductivity).

In addition to this, groundwater monitoring was carried out between May and October 2022 at each borehole location.

A Hydrological Site Investigation Note (see Annex B) was also provided for review to SEPA, Scottish Borders Council and residents to outline the works taking place, provide an overview of mitigation in place and provide a qualitative review of risks associated with borehole installation. The scope of these works were agreed with SEPA, outlined within Table 2.1.

1 SEPA (2022) The Water Environment (Controlled Activities) (Scotland) Amendment regulations 2021 [Online] Available at: https://www.legislation.gov.uk/ssi/2021/412/body/made (Accessed 12/08/2022)

2 SEPA (2022) The CAR Practical Guide, Version 9. Available at: https://www.sepa.org.uk/media/34761/car_a_practical_guide.pdf (Accessed on: 12/08/2022)

3.3.2 Stage Four: Site Based Survey

Full details of the SI works and monitoring are outlined in Section 4 (Site Investigation).

3.3.3 Stage Five: Risk Assessment

There has been no change in the risk assessment methodology which has been previously applied in attributing the sensitivity of PWS source, magnitude of effect from the Development or the risk rating applied. The risk assessment is updated based on the new information provided from the SI.

The following limitations have been noted for this updated risk assessment:

- No further information has been made available on the source at PWS Nether Stewarton in relation to current yield or condition; and
- Groundwater monitoring has been conducted over six rounds between May and October 2022, which will not fully reflect all temporal and hydrological conditions (i.e. winter monitoring periods).

4 SITE INVESTIGATION

4.1 Introduction

The aim of the SI was to:

- Confirm the underlying geological conditions;
- Confirm the presence of groundwater;
- Obtain groundwater flow direction; and
- Obtain aquifer properties (hydraulic conductivity).

These aims were proposed through the installation of a triangular array of boreholes around the location of T3, in addition to an initial three months of groundwater monitoring to confirm baseline conditions.

4.2 Site Investigation

To complete the aims and assess the potential worst-case scenario for reduction in yield at PWS Stewarton, the following tasks were completed:

- A site walkover was carried out to verify the proposed drilling locations given the existing forestry cover;
- Three boreholes were drilled up to 10 m depth, or where groundwater is encountered, with monitoring wells installed at all locations;
- The underlying geology at each borehole location was logged in line with BS 5930:2015+A1:2020, with depth to bedrock determined (where encountered) and any potential changes in geology identified;
- The geological logging confirmed the presence of fractures;
- In-situ hydrogeological testing was undertaken to determine the hydraulic conductivity (k) of the principal aquifer; and
- Groundwater monitoring undertaken over six rounds between May and October 2022.

The findings of the site investigation are detailed in Section 4.3.

4.2.1 Drilling Methodology

To obtain an understanding of the underlying principal aquifer, three boreholes (BH01, BH02 and BH03) were installed, shown on Figure 10.1.1 of Annex A of this Appendix. These locations were identified due to forestry restrictions as the proposed keyhole felling would leave the remaining trees within the forestry coupe susceptible to wind blow.

SI works were carried out by Natural Power in May 2022. Drilling was completed by using rotary air flush methods due to the anticipated bedrock strata and to minimise water run-off into the aquifer. The drilling was undertaken by a motorised tracked drilling rig which is small enough in size to allow drilling to take place in remote terrain.

All locations are situated north of the mapped geological fault which separates T3 and the Nether Stewarton PWS.

4.3 Site Investigation Findings

The results from SI works are outlined in Table 4.1 and Annex C provides full detail including geological logs for each location.

Table 4.1 Borehole Installation Details

Borehole ID	Drilled Depth (m)	Depth to Bedrock (mbgl)	Screened Section (mbgl)	Groundwater Levels (mbgl)	Geological Strata / Comment
BH01	7.2	N/A	1 - 5	1.16 – 1.27	Glacial Till No bedrock encountered
BH02	10.0	N/A	1 - 5	2.4 – 2.71	Glacial Till No bedrock encountered
BH03	6.2	1.2	1.5 - 6	Dry – 3.25	Water flush used during drilling (closed system)

4.4 Groundwater Monitoring

Groundwater monitoring was undertaken over five months between May and October 2022 using a hand held dipmeter at all three borehole locations. BH03 was noted to be dry during the period June to August 2022.

4.5 Summary of ground conditions

The key findings are summarised below:

- At BH01 and BH02, ground conditions included fill/made ground material and underlying superficial deposits (glacial till) with no bedrock encountered;
- At BH03, shallow superficial deposits (topsoil and peat) were encountered with bedrock encountered at 1.2 m depth. Bedrock was confirmed as sandstone (Portpatrick formation) which was highly weathered and fractured;
- The difference in geological conditions varies from the crest of the hill at BH03 (limited superficial cover) to a greater depth of superficial geological cover at BH01 and BH02;
- Groundwater flow direction could not be determined as bedrock was not encountered at all three boreholes;
- Shallow groundwater within superficial deposits was encountered at BH01 and BH02 located downslope of BH03 (although the locations of the borehole were immediately downslope of the existing forestry track location which may locally alter near surface flow). The highest groundwater level recorded at BH03 was 5.4 mbgl during the monitoring period; and
- In-situ rising head (permeability) tests were carried out at all three locations, reporting permeabilities of between 5.5 x 10^{-08} m/s and 7.4 x 10^{-09} m/s. On a review of BGS typical hydraulic conductivity ranges[3], this is a very low permeability aquifer.

[3] British Geological Survey. BGS Permeability. Open Report OR/20/54. Version 8. Accessed online on 29/09/2022 at https://www.bgs.ac.uk/datasets/permeability/

4.5.1 Limitations

During SI the following limitations were noted:

- As the number, location and depths of boreholes were consulted on prior to SI, two boreholes (BH01 and BH02) did not encounter bedrock (superficial deposits only). As a result of not having three boreholes within the same bedrock unit, a groundwater flow direction could not be determined.
- Drilling at BH03 was terminated at 6.2 m due to restrictions for transporting water on Site.
- Groundwater monitoring was limited to May to October 2022, reflecting summer hydrogeological conditions where the groundwater table is typically at a lower elevation.

5 RISK ASSESSMENT – PWS NETHER STEWARTON

5.1 Introduction

This section provides an updated risk assessment for the groundwater source PWS Stewarton based on the SI information outlined in Section 4. Whilst the baseline information for this PWS has not changed (detailed in Section 5.1 of the original PWSRA of the EIA Report) the baseline hydrogeological conditions have been updated to reflect the additional information obtained. It should also be noted that the updated risk assessment only applies to the groundwater supply aspect, as the original PWSRA identified there was no hydrological connection between the Development and the surface water supply at Stewarton. This is still the case for the SEI Layout.

5.2 Baseline Conditions

5.2.1 Rainfall

Baseline information on the hydrological conditions is outlined within the EIA Report.

Throughout May 2022, the level of precipitation was variable across the UK, with precipitation recorded in the east of Scotland meeting the May average (1991 – 2020)[4]. During the period following the SI and subsequent groundwater monitoring (May to September 2022) rainfall levels have been noted to be significantly lower than usual in the East of Scotland, with drought conditions reported during summer 2022. Rainfall conditions in October for Shiplaw[5] were higher than average, with a monthly mean of 111 mm within this monthly period.

5.2.2 Hydrology

The source catchment for the surface water and near-surface water source (outlined on Plate 10a within the original PWSRA) and is representative of the catchment of the small tributary of the Stewarton Burn which is located within a forestry ride. The burn forms as a defined watercourse at approximately NT 20997 46036 and drains east towards the Stewarton Burn.

5.2.3 Geology

Based on the BGS report for Cloich Hill[6] the source is underlain by the Portpatrick Formation (wacke and siltstone turbidite succession) with no superficial deposits mapped in this area. BGS 1:625,000 scale mapping indicates a faultline trending north-east to south-west

[4] MetOffice (2021) Regional Values for May 2022 [Online] Available at: https://www.metoffice.gov.uk/research/climate/maps-and-data/regional-values (Accessed 25/05/2022)

[5] SEPA (2022) Shiplaw Rainfall Data for October 2022 [Online] Available at https://www2.sepa.org.uk/rainfall

6 British Geological Survey. Georeport: Cloich Hill. Dated March 2015 (Ref GR_210800/1)

located approximately 800 m north, named on BGS 1:10,000 paper maps as the Leadhills fault. This separates the Portpatrick formation from the Kirkcolm Formation to the north-west. This is shown on Plate 10b (within the original PWSRA).

The SI at BH03 confirmed the presence of a thin superficial layer (1.2m depth) of topsoil and peat, underlain by a sandstone of the Portpatrick Formation, which was noted to be weathered and fractured. This differs from the geological conditions located further down the hill to the north-west, where there are thicker superficial deposits closer to the base of the valley.

5.2.4 Hydrogeology

BGS 1:625,000 Hydrogeology information shows the groundwater aquifer in this location is of the Portpatrick Formation and Glenwhargen Formation (indurated greywackes) low productivity bedrock aquifer which is stated to feature limited groundwater in near surface weathered zone and secondary fractures. Groundwater storage and flow is almost entirely via fractures, and groundwater flow paths are likely to be relatively shallow, short and localised. The groundwater vulnerability class ranges from Class 4b to Class 5, which are the most vulnerable to pollutants with rapid travel times in areas of fractures and faults.

The SI and subsequent monitoring confirmed that there is no substantial superficial aquifer (based on SEPA WAT-PS-10 guidance[7]) at this location due to the limited depth. Groundwater was encountered within the bedrock aquifer between 3.25 - 5.4 m bgl within a highly weathered and fractured horizon (Portpatrick Formation), supporting the desk based geological mapping. However, winter groundwater levels that are not covered within this monitoring data may be higher and it is noted that the rainfall over the summer months was lower than usual.

A potential groundwater spring is located at approximately NT 20853 46113. Whilst a spring was not visible at this location during the site walkover, it is thought there is potential for a groundwater spring at this location due to the presence of potential groundwater dependent terrestrial ecosystem habitats (NVC community M6: mire and M23: rush pasture)**Error! Bookmark not defined.**.

5.3 Proposed Infrastructure

The nearest proposed infrastructure to the supply at T3 comprises a new access track approximately 770 m north-west and upgradient of the supply, with excavation depths anticipated to be 1 m depth. Turbine T3 and its associated crane pad is located approximately 770 m north-west and upgradient of the PWS (approximately 400 m AOD), with Turbine T4 (and associated crane pad) located approximately 890 m north-west (approximately 380m AOD). The proposed infrastructure is located over the crest of the hill approximately 50 to 80 m in elevation higher than the supply point location. Excavations associated with the turbine foundations are 24 m in diameter and a maximum depth of 3 m (see **Chapter 4: EIA Methodology** of the EIA Report for further information) which is confirmed as bedrock.

5.4 Hydrogeological connectivity

In relation to hydrogeological impacts, Turbine T3 is assumed to be located within the same hydrogeological formation as the spring supply, based on BGS mapping and absence of ground information at the source itself. As there are limited superficial deposits in this area, the primary aquifer of concern relates to the bedrock aquifer associated with the Portpatrick formation. This aquifer, whilst low in productivity, is present within the near

[7] SEPA. Position Statement (WAT-PS-10) Assessing Groundwater Assessment Criteria for Pollutant Inputs. Version 3.0. 2014. Accessed online on 29/09/2022 at https://www.sepa.org.uk/media/152662/wat_ps_10.pdf

surface weathered zone and secondary fractures (confirmed by site investigation works) and therefore features a relatively high vulnerability to contaminants and changes in flow upslope.

Potential Impacts – Water Quality

In relation to impacts to water quality relating to construction phase, whilst there is no hydrological (surface water) connectivity, there is potential for the supply to be hydrogeologically connected. Potential impacts relate to the risk of spillage or leakage of chemicals, fuels etc, as well as erosion/sedimentation effects, which may impact private water supplies.

A number of good practice construction measures will be in place during turbine base construction to prevent the ingress of concrete and other liquids, such as blinding concrete at the base of the excavation prior to concrete pouring and other good practice measures. These are outlined in full within **Chapter 10: Hydrology and Hydrogeology** of the EIA Report.

These impacts have not changed from those outlined within the original EIA report.

Potential Impacts – Water Quantity

The original PWSRA stated that *"the Development (T3) may lead to a noticeable but not significant change in yield particularly in times of drought, as a worst case scenario".*

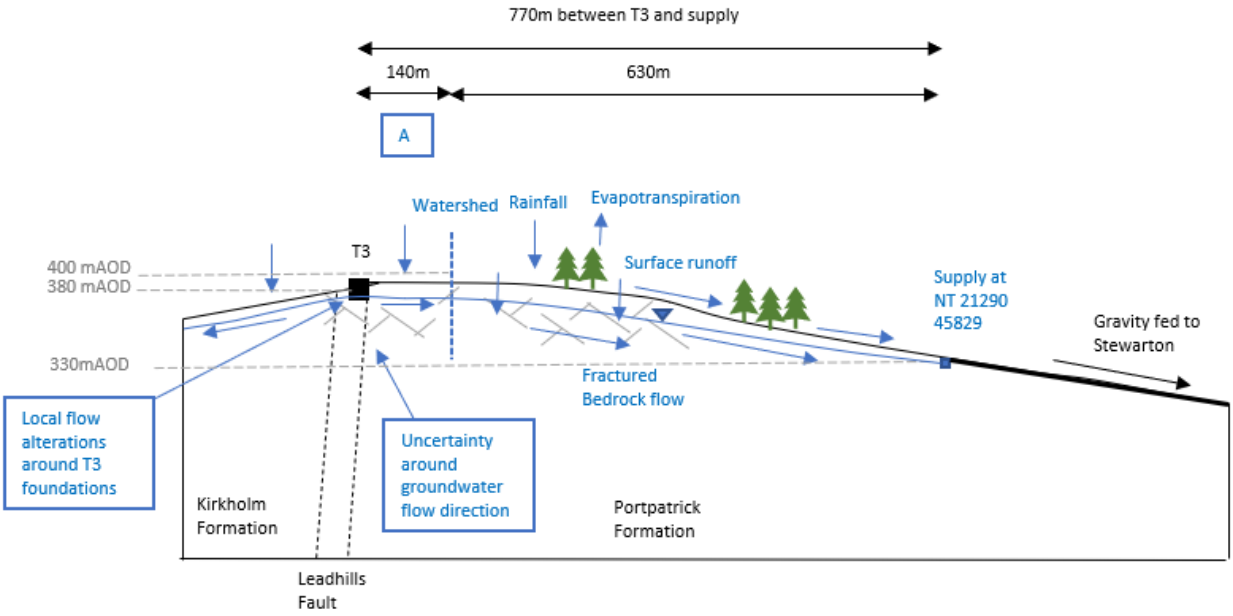
Site investigation information, including monitoring, confirm excavation for foundations (maximum 3 m depth) may encroach the groundwater table during the winter season (or periods of prolonged or higher rainfall), with groundwater monitoring data showing fluctuations in groundwater data during periods of heavy rainfall. Monitoring data shows in times of lower rainfall (summer periods) that groundwater levels are not shallow and therefore not likely to be supporting shallow superficial deposits within this period.

In relation to water quantity within the construction phase, the potential for shallow groundwater (taking a conservative approach) confirms the previous assumptions for the impact assessment outlined in the EIA Report. This could temporarily divert flows away from the excavation and lower the local water table and sub-surface water levels.

In relation to water quantity within the operational phase, localised temporary changes to groundwater and near surface water interflow patterns may arise. Turbine foundations and crane hardstandings have the potential to change sub-surface water flow by creating physical barriers within naturally occurring drainage macropores in superficial deposits, however it is it is anticipated that that near-surface water will migrate around the turbine foundation, directly downslope of the turbine location under gravity, as new pathways are taken.

This means the turbine foundations at T3 may marginally alter local groundwater flows. Any changes to groundwater flow would not result in a perceptible alteration to baseline conditions. As such, the conclusions of the original PWSRA overstate the potential impact on yield, with groundwater not anticipated to be near-surface.

Plate 1: Site Conceptual Model



Changes to impacts from micro-siting

In relation to the impacts from micro-siting of Turbine T3, any change in location would need to consider the change in topography, proximity to the private water supply, as well as change in underlying geological conditions.

No micrositing should be permitted to the south, which would also be topographically higher and in closer proximity to the brow of the hill and the surface water catchment of PWS Nether Stewarton supply.

Any micrositing to the north, at a topographically lower elevation and further away would result in the distance increased from the supply and likely deeper superficial deposits. This may result in deeper excavations to reach bedrock, however, may alter groundwater levels within the superficial deposits.

5.5 Sensitivity of Receptors

Table 5.1: Private Water Supply Sensitivity Rating

Ref	Supply Name	Sensitivity	Justification
114	Nether Stewarton	High	Groundwater spring source and surface water source serving four properties. Groundwater Vulnerability Classes 4 - 5.

The sensitivity of the PWS Stewarton supply is classified as High, based on groundwater vulnerability class and being supplied by both surface and groundwater sources.

5.6 Magnitude of Effects

Table 5.2: Private Water Supply Magnitude of Effect Rating (included embedded design mitigation)

Ref	Source Name	Magnitude of Effect	Rationale
114	Nether Stewarton Groundwater	Low	In relation to water quality (low magnitude), any changes will not result in a perceptible alteration to baseline conditions.
		Low	In relation to water quantity, (low magnitude) as turbine foundations are only likely to enter groundwater during winter and are unlikely to provide a perceptible alteration to baseline conditions. Groundwater pathways are likely to re-establish after the construction period.

5.7 Risk Rating

There has been no change to the good practice measures outlined in Technical Appendix A10.1 WCEMP as part of the EIA Report. The mitigation measures for Nether Stewarton are summarised below in Table 5.3.These are based on the original mitigation measures within the EIA report, with an additional micrositing mitigation measure.

Table 5.3: Private Water Supply Risk Rating and Residual Risk Following Mitigation for PWS Nether Stewarton

Ref	Source Name (Source Type)	Site Specific Mitigation (Detailed in Section 6)	Residual Risk
114	Nether Stewarton (Groundwater)	Watching brief to monitor groundwater impacts at pre-construction stage, considering any micro-sited location. This role would be undertaken by an experienced Ecological Clerk of Works (ECoW) to monitor compliance with good practice measures and provide specialist advice. Good practice measures outlined in the WCEMP (Technical Appendix A10.1 of the EIA report). Water Quality Monitoring in Stewarton Burn (tributary) and at supply (where access is granted). Micrositing restrictions - the location of T3, including any cranepad or harstanding areas, should not be microsited in any closer proximity to the PWS at Nether Stewarton, nor topographically higher than its existing location.	Low

6 MITIGATION

6.1.1 Introduction

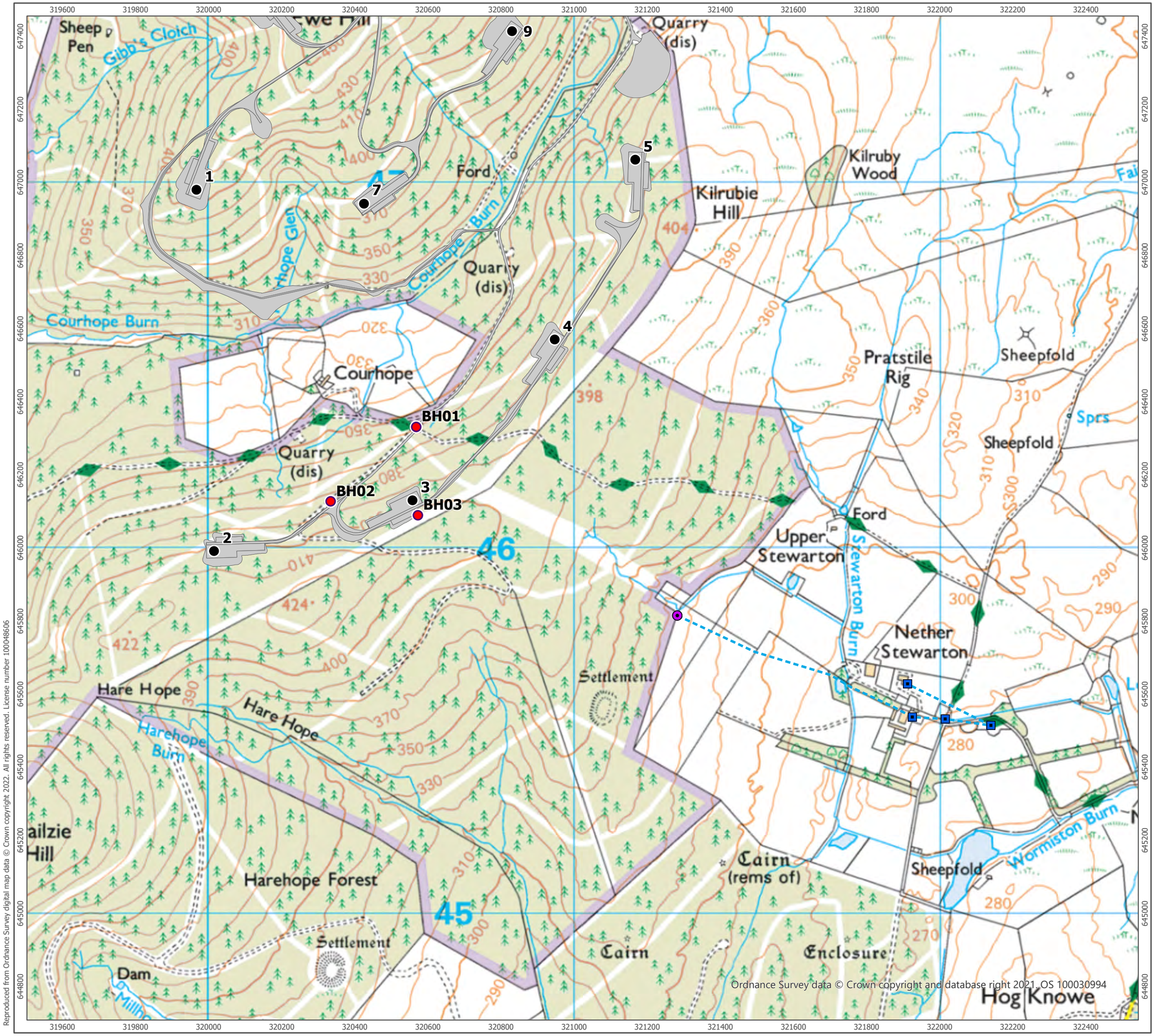
The original EIA report (Section 10.9) has previously outlined the requirement for site investigation at T3 to be carried out during the pre-construction phase, which will support this micrositing restriction.

The mitigation required for all PWS for the proposed development, are outlined in Table 6.1 below.

Table 6.1: Private Water Supply Mitigation

Ref	Source Name	Mitigation	Residual Risk
114	Nether Stewarton Groundwater	Watching brief to monitor groundwater impacts at pre-construction stage, considering any micro-sited location. Good practice measures outlined in the WCEMP (Technical Appendix A10.1 of the EIA report). Water Quality Monitoring in Stewarton Burn (tributary) and at supply (where access is granted). No construction works associated with the Development to be undertaken within the PWS Nether Stewarton surface water catchment. Micrositing restrictions.	Negligible
124	Earlyburn (Observatory)	Water Quality Monitoring in Early Burn and at supply (borehole) (where access is permitted by landowners). Good practice measures outlined in the CEMP.	Negligible
65	Cloich Farm	Watching brief to identify pipework and to protect infrastructure. Water Quality Monitoring at supply (borehole) (where access is permitted by landowners). Provision of alternative potable source on standby during the access track upgrade. Reinstatement of distribution infrastructure if required. Good practice measures outlined in the CEMP.	Negligible
124 130 & 115 64	Earlyvale House Shiplaw & Shiphorn Upper Stewarton	Water quality monitoring (where access is permitted by landowners). Good practice measures outlined in the CEMP.	Negligible

ANNEX A: FIGURE



Y:\GIS\Hydrology\Projects\4519 Cloich Post-Submission\4519 Cloich Post-Submission.aprx\4519-REP-001 Site Investigation

- Site Infrastructure
- Proposed Turbine Location
- Tank Location
- Boreholes
- Private Water Supply Property
- Private Water Supply Connection

BoreholeID	X	Y
BH01	320568	646331
BH02	320334	646127
BH03	320573	646089

1:10,000 Scale @ A3

0 0.25 0.5 km

NORTH

Produced By: JC	Ref: 4519-REP-001
Checked By: SC	Date: 17/10/2022

Site Investigation Borehole Locations
Figure 10.1.1

Cloich Forest Wind Farm Private Water Supply Risk Assessment

ANNEX B: SITE INVESTIGATION TECHNICAL NOTE

Cloich Forest Wind Farm

Hydrology Site Investigation Note

Summary

The purpose of this Hydrology Site Investigation Note (HSIN) is to provide further information for statutory consultees and the residents at Stewarton on the site investigation (SI) works for Cloich Forest Wind Farm ('the Development').

Purpose of Site Investigation

Following consultation with the Scottish Environment Protection Agency (SEPA) to the Development application (SEPA reference 3113, dated 9 November 2021), an intrusive SI and groundwater risk assessment will be carried out at the proposed turbine location at Turbine 3 (T3) to assess the potential hydrogeological connectivity to the Nether Stewarton Private Water Supply (PWS) and any potential changes to groundwater flow and yield.

The location of the three SI boreholes is shown on the figure attached (please note that a fourth borehole location is not required assuming the third borehole within the forest ride is accessible).

Consultation

The following consultation has taken place:

- 19 August 2021 – SEPA request the provision of a detailed qualitative and/or quantitative risk assessment for the PWS upper groundwater spring source Nether Stewarton, which demonstrates that the proposals will not have a significant impact on the groundwater flow and groundwater quality feeding identified sensitive receptors through the proposed design, construction and operation of the infrastructure.
- 11 November 2021 – The Applicant's agent Arcus response with covering letter – SEPA T3 Site Investigation Requirement which included Site Investigation Specification – Technical Note Aims.
- 16 November 2021 - SEPA's comments on the proposed scope.
- 16 December 2021 – EDF-R contacted PWS residents on site investigation.
- 17 December 2021 – response received from residents.
- 21 December 2021 – further queries received from ECU.

Regulatory Requirements

The SI works will not require a license from SEPA under the Water Environment (Controlled Activities) (Scotland) Regulations 2011 (CAR regulations) and in line with Guidance Note (WAT-SG-83)[1] as the borehole is not below 200 meter (m) in depth and is constructed for the purpose of monitoring.

All works will be carried out in line with SEPA and guidance (see Mitigation section), following best practice guidance at all times.

No supervision from SEPA or Scottish Borders Council is required for the SI.

No monitoring of the PWS has been carried out to date nor has it been proposed as part of the works, as the risk associated with the works is Low due to the distance from the supply and the nature of the drilling works, with no surface water connectivity. Sampling would not be an effective

[1] https://www.sepa.org.uk/media/219750/car-licences-for-deep-boreholes-information-requirements.pdf

way of monitoring works as there would be insufficient baseline to provide a robust set of threshold parameters to assess the fluctuations in flow or quality.

Potential Risks and Mitigation

Based on desk study information and understanding of the PWS, there is a negligible risk from shallow borehole drilling, assuming best practice measures followed.

In relation to surface water risks to the PWS catchment area, as the works area is not hydrologically connected (located on the western side of the hill) there is no surface water connection.

In relation to groundwater risks:

- Potential source – hazardous materials used within drilling and vehicle movements including fuel (diesel, petrol), oils and grease;
- Potential pathway – infiltration through the unsaturated zone;
- Potential receptor – the groundwater fed PWS at Nether Stewarton.

The drilling works are both temporary in nature (one day per borehole) with very localised effects within the borehole area. To ensure pollutant pathways are not realised, the mitigation measures are outlined below.

Potential Risks	**Mitigation Measures**
Potential pollution of surface water and groundwater from hazardous materials	• Refuelling procedures to be followed, including refuelling off-site where possible. • If refuelling of the drilling rigs is required to take place at the exploratory hole locations, fuel shall be transported in the rear Hägglunds unit in a bunded container, separate to the driver and any passengers. • Use of drip trays and plant nappies. • Spill kits on standby in event of any fuel incidents. These will be kept in each vehicle and rig. • Daily checks by the Site Engineer to ensure all processes are adhered to. • Hazardous Material (COSSH) Risk Assessments carried out.
Disturbance of ground along forest ride	• Use of tracked vehicle and protective bog mats, with movements to be kept to essential and planned trips only. • Use of low ground pressure plant with rubber tracks. • Experienced personnel to operate off-road tracked vehicles.
Sediment run-off	• De-silting of water runoff including recirculation of drilling flush in recycling tank to allow silt settlement. • Use of silt fencing to trap any run-off from borehole.

The following SEPA guidance documents[2] will also be adhered to in line with good practice, (all available online via NetRegs):

- Guidance for Pollution Prevention (GPP) 1 'A general guide to preventing pollution';
- Pollution Prevention Guidance (PPG) 7 'The Safe Operation of refuelling facilities'; and
- GPP22 'Dealing with Spills'.

[2] NetRegs Guidance. 2021. Available at https://www.netregs.org.uk/environmental-topics/guidance-for-pollution-prevention-gpp-documents/guidance-for-pollution-prevention-gpps-full-list

Based on the above mitigation measures, the residual risk to existing PWS associated with the drilling works is Low. The localised nature of the drilling works for shallow boreholes is extremely unlikely to affect the supply at Nether Stewarton given the distance to the supply, the duration of works (three days), the lack of surface water connectivity and the mitigation measures in place.

ANNEX C: SITE INVESTIGATION REPORT

Cloich Forest Wind Farm

Turbine T3 Factual Ground Investigation Report

22 June 2022

Ref: 1283415

EDF Renewables

Document history

Author	Allan Rutherford, Principal Geotechnical Engineer	07/06/2022
Checked	Emilija McCallie	07/06/2022
Approved	Allan Rutherford	08/06/2022

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Issue	Date	Revision Details
A	08/06/2022	First issue
B	22/06/2022	Updated with survey levels

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Contents

1. Introduction

1.1. Project Work Scope

Natural Power was appointed by EDF Renewables in May 2022 to undertake a geotechnical site investigation at the Cloich Forest Wind Farm project in the Scottish Borders region.

The investigation was focussed on one turbine location T3, located south of Courhope.

The site investigation was undertaken by Natural Power during 23 May to 27 May 2022.

The site investigation scope was specified by the Investigation Supervisor, Arcus, on behalf of EDF. The work scope was detailed in the following Arcus documents:

- 4519 Cloich SI Note for Tender
- 4519-REP-001 Site Investigation

The main objective of the work was to provide information on the ground and groundwater conditions at the turbine T3 area, to allow Arcus to assess whether there is potential for hydrogeological connectivity between the proposed turbine location and a local Private Water Supply catchment.

The work was carried out by Natural Power generally in accordance with the current Eurocode and British Standards.

The site investigation comprised the following main elements:

- Rotary borehole drilling.
- Soil and rock sampling and logging.
- Installation of groundwater monitoring standpipes.
- In-situ hydraulic testing.

This Factual Ground Investigation Report describes the site investigation procedures and presents the field data obtained during the works.

1.2. Purpose of Investigation

The site investigation was undertaken to:

- Investigate the ground conditions at the borehole locations.
- Investigate the groundwater regime.
- Carry out in-situ hydraulic testing.

1.3. Data Sources

Table 1.1 below table lists the related reports or documents undertaken or commissioned by Natural Power for the project, which should be read in conjunction with this GIR.

Table 1.1: Related Documents

Document	Report Reference	Date
Cloich Forest Wind Farm; site investigation method statements	1268620, 1282952	15/12/2021 and 19/05/2022
Cloich Forest Wind Farm; site investigation risk assessments	1268621	15/12/2021
Cloich Forest Wind Farm; Emergency Response Plan	1282953	19/05/2022
Cloich Forest Wind Farm; Technics Utility Report	SP21901	22/11/2021

Source: Natural Power

2. Development Proposals

The Cloich Forest Wind Farm project is being developed by EDF. The development will comprise 12 wind turbines, and their associated infrastructure, and a Battery Energy Storage System.

This site investigation was focussed on turbine T3 only, located south of Courhope. The location of the works is shown in Arcus Figure 1 (4519-REP-001 Site Investigation), a copy of which is included in Appendix A.

3. Site Description

The site is within an area of commercial forestry (Cloich Forest), located approximately 6 km north-west of Peebles.

Access into the site was via existing stone tracks from Cloich Farm.

Boreholes BH01 and BH02 were located on the verge of one of the forestry tracks, while BH03 was located in a forestry ride.

4. Published Geology

4.1. Superficial Deposits

The 1:50k scale British Geological Survey (BGS) data for the area indicates the superficial deposits at the site are likely to generally comprise partial coverage of Devensian Till.

Till typically consists of a heterogenous mixture of clay, sand, gravel, and boulders varying widely in size and shape (diamicton).

There are no known historical borehole records for the site, but the partial coverage shown suggests the glacial deposits are likely to be relatively thin over most of the site and are indicated as absent locally.

Source: BGS/ QGIS

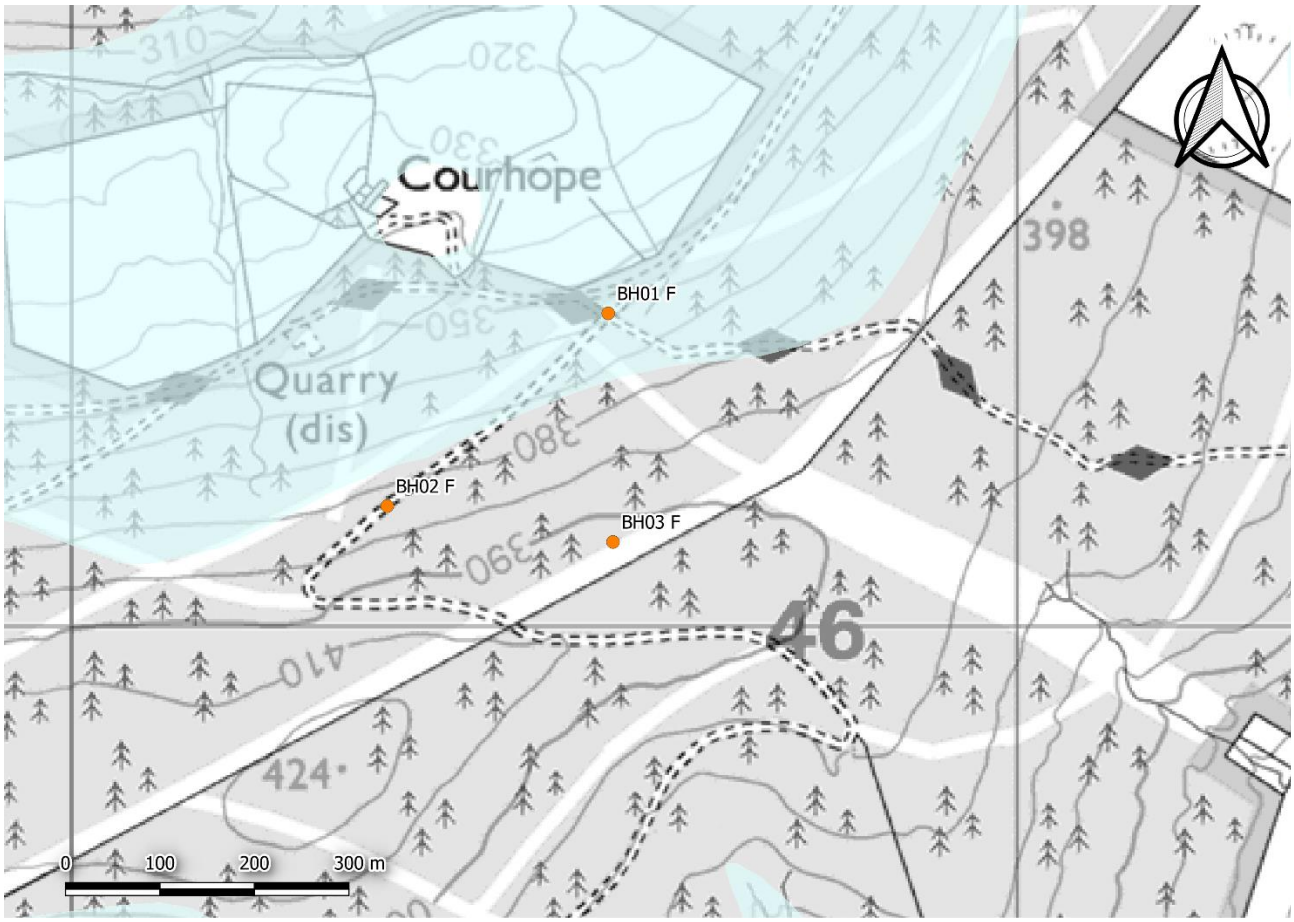


Figure 4.1: Overview of superficial deposits. Devensian Till shown in blue.

4.2. Bedrock

The 1:50k scale BGS data for the area indicates the bedrock underlying site to comprise Kirkcolm Formation – Wacke and Portpatrick Formation – Wacke.

Both formations are Ordovician age sedimentary rock described as sandstone/ siltstone turbidite sequences.

Two south west – north east trending thrust faults are mapped passing through the area.

Source: BGS/ QGIS

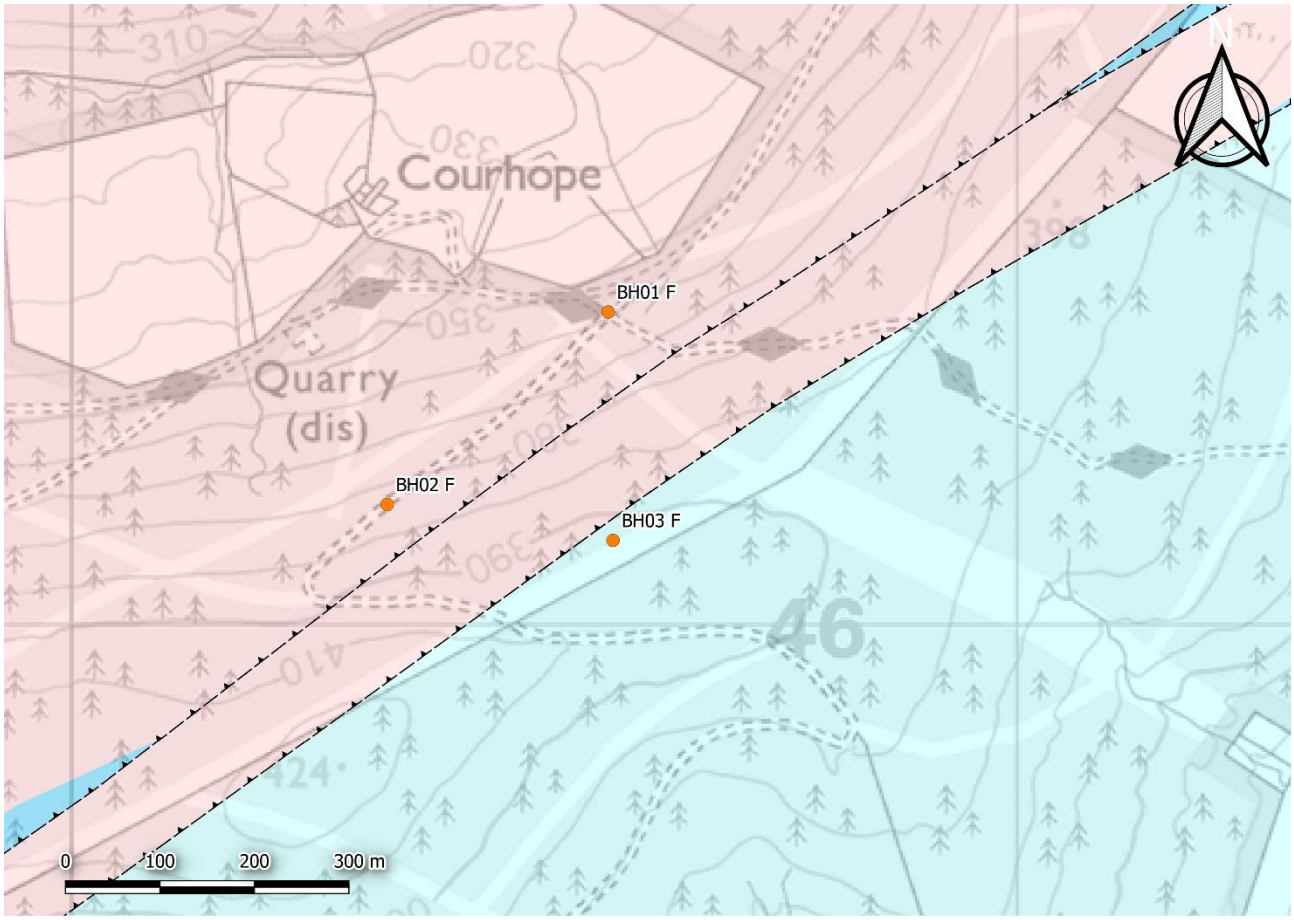


Figure 4.2: Overview of bedrock geology. Kirkcolm Formation shown in pink, and Portpatrick Formation shown in blue.

4.3. Hydrogeology

The 1:625k BGS data for the area indicates the bedrock of Kirkcolm Formation and Portpatrick Formation is a low productivity aquifer, comprising highly indurated greywackes with limited groundwater in near surface weathered zone and secondary fractures

5. Site Specific Restrictions

Notable restrictions affecting the site investigation works were:

- Difficult access to BH03 via forestry rides.

6. Site Safety

Site safety was managed in accordance with Natural Power's RAMS documents, emergency response plan, and relevant UK legislation relating to the Health and Safety at Work Act 1974.

All exploratory holes were CAT scanned to check for buried services prior to excavation. Additionally, hand dug pits were excavated to 1.20 m depth at each borehole location, in accordance with HSG47 safe digging best practice.

7. Summary of Site Investigation

7.1. Standards of Investigation

The ground investigation included intrusive sampling and testing methods, and was undertaken generally in accordance with the following standards:

Topographic survey

- Royal Institution of Chartered Surveyors (RICS).

Borehole drilling, soil and rock sampling

- BS EN 1997-2:2007. Eurocode 7. Geotechnical design. Ground investigation and testing.
- BS 5930:2015+A1:2020. Code of practice for ground investigations.
- BS EN ISO 22475-1:2006. Geotechnical investigation and testing. Sampling methods and groundwater measurements.
- BS EN ISO 14688-1:2018 and 14688-2:2018. Geotechnical investigation and testing. Identification and classification of soil.
- BS EN ISO 14689:2018. Geotechnical investigation and testing. Identification, description and classification of rock.

In situ testing

- BS 5930:2015+A1:2020. Code of practice for ground investigations.
- BS EN ISO 22476. Geotechnical investigation and testing. Field testing.

7.2. Setting Out

All exploratory borehole locations were marked out using a hand held GPS. Following completion of the works, all borehole positions were recorded using a Trimble R10 GNSS receiver of survey grade accuracy greater than 20mm. The surveyed coordinates and ground levels of the exploratory holes are recorded on the corresponding borehole logs.

7.3. Borehole Drilling

Natural Power undertook a borehole drilling investigation at the specified locations around turbine T3.

Boreholes are a deep investigation tool that allows for the detailed inspection, logging, sampling and in-situ testing of soil and/ or rock to the required depth, confirmation of engineering rock head, and the assessment of groundwater conditions.

A total of three boreholes were drilled on site:

- Two boreholes BH01 and BH02 were drilled by openhole methods
- One borehole BH03 was drilled by dynamic sampling of the soils, followed by coring of the bedrock.

Prior to drilling commencing, a hand dug pit was excavated to 1.20 m at each borehole location, in accordance with safe digging practices. Disturbed samples were retrieved from each hand pit.

The drilling was then undertaken by Natural Power using one of our specialist low ground pressure Fraste Multi-Drill rotary drill rigs mounted on Hagglunds BV206 all-terrain vehicles. Additional Hagglunds BV206 vehicles were used in support allowing transport of water supplies, air compressor and ancillary drilling equipment.

BH01 and BH02 were advanced using open-hole drilling through superficial deposits. Six inch casing was installed to stabilise the borehole walls during drilling.

BH03 was advanced by dynamic sampling of the superficial deposits, followed by rotary coring of the bedrock. Six inch casing was installed to stabilise the borehole walls during drilling. On reaching bedrock rotary coring was employed comprising a T2-101 thin wall double tube core barrel with diamond impregnated bits to suit the local geology and obtain the required core diameter. Water flush was used to assist the coring bit advance.

The boreholes were drilled to depths of 7.2 m, 10.0 m and 6.2 m bgl respectively.

The boreholes were terminated at depths as instructed by the Arcus engineer.

The location of the boreholes is shown in Arcus Figure 1 (4519-REP-001 Site Investigation), a copy of which is included in Appendix A.

The borehole logs are presented in Appendix B.

BH03 core photographs are presented in Appendix C.

7.3.1. Installations

Groundwater monitoring standpipe installations comprising 50 mm diameter plain and slotted standpipe were installed in all three boreholes as per the Arcus engineer's instructions. Install details are shown in table 7.1 below.

Table 7.1: Borehole Install Details

Material:	50 mm dia plain pipe/ concrete cap	50 mm dia plain pipe/ bentonite seal	50 mm dia slotted pipe gravel filter	Bentonite seal
Borehole ID:		**Depth (m bgl)**		
BH01	0.0-0.5	0.5-1.0	1.0-5.0	5.0-7.2
BH02	0.0-0.5	0.5-1.0	1.0-5.0	5.0-10.0
BH03	0.0-0.5	0.5-1.5	1.5-6.0	6.0-6.2

Source: Natural Power

The installations were completed with an upstanding cap which was locked with a padlock.

7.3.2. SPT Testing in Boreholes

Not required.

7.4. Sampling and Logging

Sampling for geotechnical purposes was undertaken generally in accordance with BS EN ISO 22475-1:2006 requirements.

Samples of the drill cutting returns of each core run were collected from the openhole boreholes BH01 and BH02.

Continuous soil and rock sampling was carried out over the full depth of BH03.

All samples were sealed and labelled on site prior to transportation to the store.

Following completion of the borehole drilling work, the borehole soil and core samples were subject to detailed geotechnical logging. The logging was undertaken by an experienced Natural Power geotechnical engineer and included the rock fracture state parameters Total Core Recovery (TCR), Solid Core Recovery (SCR), Rock Quality Designation (RQD) and Fracture Spacing (maximum, average and minimum).

BH03 core photographs are presented in Appendix C.

The core samples are currently held by Natural Power, and inspections can be arranged if required.

7.5. Groundwater Level Monitoring

Groundwater level monitoring was undertaken in each of the completed standpipe installations, using a standard dipmeter, at the end of the drilling works. The results are given below:

Table 7.2: Groundwater level monitoring

Borehole ID	Water Depth m bgl 27/05/2022	Water Level m AOD 27/05/2022
BH01	1.40	*358.75*
BH02	2.40	*383.57*
BH03	5.40	*400.11*

Source: Natural Power

The groundwater monitoring standpipes have been left in place on site to allow additional rounds of monitoring to be carried out.

In addition to the above monitoring data, daily water level observations during drilling were recorded on the borehole logs.

7.6. Permeability Testing

Rising Head tests were carried within the borehole installations, to determine the in-situ permeability of the ground at each borehole location.

The tests were carried out by using an electric pump to rapidly pump the standing water out of the borehole installation, and monitoring the water level response at regular intervals over a period of time while the well recovers towards its natural/ pre test level.

The permeability value (k) was then calculated using the general approach methodology specified in BS 5930 for borehole permeability tests:

$$k = \frac{A}{F(t_2 - t_1)} \log_e \frac{H_1}{H_2} \text{ (general approach)}$$

A = cross sectional area standpipe in m

F = intake factor from BS5930

t2-t1 = elapsed time in secs

H1, H2 = variable head measured at t1, t2 in m

The rising head test data and calculated permeability values are presented in Appendix D.

8. Laboratory Testing

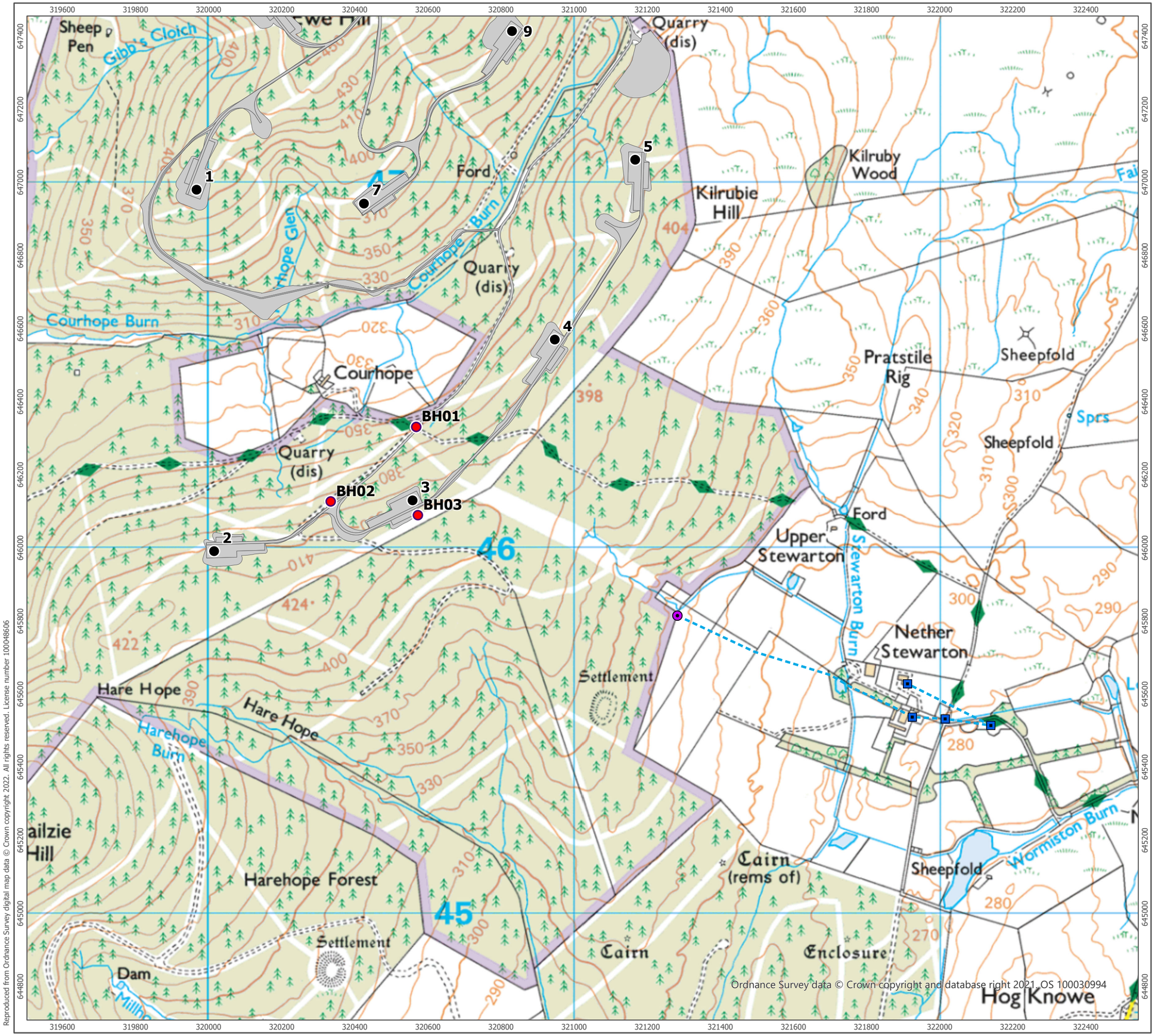
Not required.

9. References

- BS 5930: 2015. Code of practice for ground investigations.
- BS EN 1997-1: 2004+A1:2013. Eurocode 7. Geotechnical design. General rules.
- BS EN 1997-2: 2007. Eurocode 7. Geotechnical design. Ground investigation and testing.
- BS EN ISO 14688-1: 2018. Geotechnical investigation and testing. Identification and classification of soil. Identification and description.
- BS EN ISO 14688-2: 2018. Geotechnical investigation and testing. Identification and classification of soil. Principles for a classification.
- BS EN ISO 14689: 2018. Geotechnical investigation and testing. Identification, description and classification of rock. Part 1: Identification and description.
- BS EN ISO 22475-1: 2006. Geotechnical investigation and testing. Sampling methods and groundwater measurements. Technical principles for execution.
- BGS Geology of Britain viewer.

Appendices

A. Maps



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BoreholeID	X	Y
BH01	320568	646331
BH02	320334	646127
BH03	320573	646089

1:10,000 Scale @ A3

0 0.25 0.5 km

NORTH

Produced By: JC	Ref: 4519-REP-001
Checked By: SC	Date: 07/01/2022

Site Investigation Borehole Locations

Figure 1

Cloich Forest Wind Farm

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B. **Borehole Logs**

Geotechnical Log

Project Name: Cloich Forest Wind Farm	Client: EDF Renewables	Date: 24/05/2022
Location: Scottish Borders	Contractor: Natural Power	Co-ords: E320567.87 N646329.75
Project No. : 14781UKC VO2	Crew Name: RS SB	Drilling Equipment: Fraste SL

Borehole Number	Hole Type	Level	Logged By	Vertical Scale	Page Number
BH01	RC	360.15m AoD	EM	1:25	Sheet 1 of 2

Depth (m)	Type/ FSp (mm) Min,Ave, Max	Coring TCR	Coring SCR	Coring RQD	Recovery (SPT)	Depth (m) / Discontinuity Detail	Level (m)	Stratum Description
0.00	B1							Soil (Drillers description) *0.00 to 1.20m - Brown sandy gravelly CLAY. Gravel is subangular to subrounded, fine to medium, of mixed lithologies. (Probable Glacial Till)*
						0.40	359.75	Open-holed to 10m depth with DTH. Samples of hammer cuttings described in comments below:
1								
1.20	B2							*1.20 to 2.20m - Grey slightly sandy gravelly CLAY. Gravel is subangular to subrounded, fine to medium, of mixed lithologies. (Probable Glacial Till)*
2								
2.20	B3							*2.20 to 3.20m - Brownish grey clayey sandy GRAVEL. Gravel is subangular to subrounded, fine to medium of predominantly sandstone and mixed lithologies. (Sample wet, finer materials possibly washed out) (Probable Glacial Till)*
3								
3.20	B4							*3.20 to 5.20m - Brown slightly sandy gravelly CLAY. Gravel is subangular to subrounded, predominantly subangular, fine to medium, of predominantly sandstone and mixed lithologies. (Probable Glacial Till)*
4								
4.20	B5							
	Type/FSp	TCR	SCR	RQD	R/(SPT)			
5								

Hole Diameter		Casing Diameter		Shift Details			Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Date Time	BH Depth	Depth Water	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)
7.20	152	7.20	152	24/05/2022 12:00:00	7.20	4.3	0.00	7.20	90	0						

Remarks:

Hand excavated service pit dug to 1.20m.
Borehole cased to 7.20m.
Rotary open holed from 1.20 to 7.20m.
Minor groundwater strike recorded at 2.20m, substantial groundwater strike recorded at 3.20m.

Geotechnical Log

Project Name: Cloich Forest Wind Farm	Client: EDF Renewables	Date: 24/05/2022
Location: Scottish Borders	Contractor: Natural Power	Co-ords: E320567.87 N646329.75
Project No. : 14781UKC VO2	Crew Name: RS SB	Drilling Equipment: Fraste SL

Borehole Number	Hole Type	Level	Logged By	Vertical Scale	Page Number
BH01	RC	360.15m AoD	EM	1:25	Sheet 2 of 2

Well	Water	Depth (m)	Type/ FSp (mm) Min,Ave, Max	Coring TCR	Coring SCR	Coring RQD	Recovery (SPT)	Depth (m) / Discontinuity Detail	Level (m)	Legend	Stratum Description
		5.20	B6								Open-holed to 10m depth with DTH. Samples of hammer cuttings described in comments below:
											5.20 to 6.20m - Brown slightly sandy gravelly CLAY. Gravel is subangular to subrounded, predominantly subangular, fine to medium, of predominantly sandstone and mixed lithologies. Sample very wet. (Probable Glacial Till)
		6									
		6.20	B7								*6.20 to 7.20m - Brown slightly sandy gravelly CLAY with cobbles noted. Gravel is subangular to subrounded, predominantly subangular, fine to medium, of predominantly sandstone and mixed lithologies. Sample very wet. (Probable Glacial Till)*
		7									
								7.20	352.95		End of Borehole at 7.200m
		8									
		9									
			Type/FSp	TCR	SCR	RQD	R/(SPT)				

Hole Diameter		Casing Diameter		Shift Details			Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Date Time	BH Depth	Depth Water	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)
7.20	152	7.20	152	24/05/2022 12:00:00	7.20	4.3	0.00	7.20	90	0						

Remarks:

Hand excavated service pit dug to 1.20m.
Borehole cased to 7.20m.
Rotary open holed from 1.20 to 7.20m.
Minor groundwater strike recorded at 2.20m, substantial groundwater strike recorded at 3.20m.

Geotechnical Log

Project Name: Cloich Forest Wind Farm	Client: EDF Renewables	Date: 24/05/2022
Location: Scottish Borders	Contractor: Natural Power	Co-ords: E320330.42 N646120.68
Project No. : 14781UKC VO2	Crew Name: RS SB	Drilling Equipment: Fraste SL

Borehole Number	Hole Type	Level	Logged By	Vertical Scale	Page Number
BH02	RC	385.97m AoD	EM	1:25	Sheet 1 of 2

Well	Water	Depth (m)	Type/ FSp (mm) Min,Ave, Max	Coring TCR	Coring SCR	Coring RQD	Recovery (SPT)	Depth (m) / Discontinuity Detail	Level (m)	Legend	Stratum Description
		0.00	B1								Soil over sandy gravelly CLAY (Drillers description). Open-holed to 10m depth with DTH. Samples of hammer cuttings described in comments below: *0.00 to 1.20m - Black amorphous PEAT mixed with grey sandy gravelly CLAY.*
		1.20	B2					1.20	384.77		Open-holed to 10m depth with DTH. Samples of hammer cuttings described in comments below: *1.20 to 2.70m - Grey clayey sandy GRAVEL. Gravel is subangular to subrounded, fine to medium, of mixed lithologies. (Probable Glacial Till)*
		2.70	B3								*2.70 to 4.20m - Dark grey slightly sandy gravelly CLAY. Gravel is subangular to subrounded, fine to medium, of mixed lithologies. (Probable Glacial Till)*
	▼	4.20	B4								*4.20 to 10.00m - Dark bluish grey slightly sandy gravelly CLAY with cobbles noted. Gravel is subangular to subrounded, fine to medium, of mixed lithologies. (Probable Glacial Till)*
			Type/FSp	TCR	SCR	RQD	R/(SPT)				

Hole Diameter		Casing Diameter		Shift Details			Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Date Time	BH Depth	Depth Water	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)
10.00	152	10.00	152	24/05/2022 17:00:00	10.00	-	0.00	10.00	90	0						

Remarks:

Hand excavated service pit dug to 1.20m.
Borehole cased to 10.00m.
Rotary open holed from 1.20 to 10.00m.
Small groundwater pocket recorded at 4.20m.

Geotechnical Log

Project Name: Cloich Forest Wind Farm	Client: EDF Renewables	Date: 24/05/2022
Location: Scottish Borders	Contractor: Natural Power	Co-ords: E320330.42 N646120.68
Project No. : 14781UKC VO2	Crew Name: RS SB	Drilling Equipment: Fraste SL

Borehole Number	Hole Type	Level	Logged By	Vertical Scale	Page Number
BH02	RC	385.97m AoD	EM	1:25	Sheet 2 of 2

Well	Water	Depth (m)	Type/ FSp (mm) Min,Ave, Max	Coring TCR	Coring SCR	Coring RQD	Recovery (SPT)	Depth (m) / Discontinuity Detail	Level (m)	Legend	Stratum Description
		5.70	B5								Open-holed to 10m depth with DTH. Samples of hammer cuttings described in comments below:
		7.20	B6								
		8.70	B7								
			Type/FSp	TCR	SCR	RQD	R/(SPT)	10.00	375.97		End of Borehole at 10.000m

Hole Diameter		Casing Diameter		Shift Details			Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Date Time	BH Depth	Depth Water	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)
10.00	152	10.00	152	24/05/2022 17:00:00	10.00	-	0.00	10.00	90	0						

Remarks:

Hand excavated service pit dug to 1.20m.
Borehole cased to 10.00m.
Rotary open holed from 1.20 to 10.00m.
Small groundwater pocket recorded at 4.20m.

Geotechnical Log

Project Name: Cloich Forest Wind Farm	Client: EDF Renewables	Date: 25/05/2022 - 26/05/2022
Location: Scottish Borders	Contractor: Natural Power	Co-ords: E320578.93 N646074.17
Project No. : 14781UKC VO2	Crew Name: RS SB	Drilling Equipment: Fraste SL

Borehole Number	Hole Type	Level	Logged By	Vertical Scale	Page Number
BH03	RC	405.51m AoD	EM	1:25	Sheet 1 of 2

Depth (m)	Type/ FSp (mm) Min,Ave, Max	Coring TCR	Coring SCR	Coring RQD	Recovery (SPT)	Depth (m) / Discontinuity Detail	Level (m)	Stratum Description
						0.50	405.01	Firm black amorphous PEAT (H7-8/B2)
0.00 - 1.20		81						Firm brown slightly mottled with grey and orange slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded, fine to coarse of mixed lithologies. [GLACIAL TILL]
1						0.95	404.56	Grey clayey sandy GRAVEL of weak sandstone (greywacke). Gravel is angular to subangular, fine to coarse. Interpreted as completely weathered bedrock. [PORTPATRICK FORMATION]
						1.20 Non-intact.	404.31	Medium strong grey fine to medium grained SANDSTONE (greywacke). Highly weathered and highly fractured - recovered as angular medium to coarse gravel with brown and orange staining. [PORTPATRICK FORMATION]
1.20 - 2.20		100	0	0				
2						2.40	403.11	Medium strong to strong grey thinly laminated fine to medium grained SANDSTONE (greywacke). Moderately weathered with dark brown and orange staining on fracture surfaces. Frequent hairline fractures along laminations. [PORTPATRICK FORMATION]
2.20 - 3.50	0 35 150	96	3	0		Set 1: fractures dip 70-80°, extremely closely to very closely spaced, planar smooth. Set2: fractures dip 10-20°, very closely to closely spaced, stepped rough, dark brown, orange staining.		
3								
3.50 - 4.60		95	5	0		Non-intact.		
4						4.60	400.91	Medium strong to strong yellowish grey medium to coarse grained SANDSTONE (greywacke). Moderately weathered with dark brown and orange staining on fracture surfaces. Frequent randomly oriented hairline fractures with occasional quartz infill. [PORTPATRICK FORMATION]
4.60 - 5.20		99	5	0		Fractures dip 60-70°, very closely to closely spaced, planar smooth, dark brown, orange and yellow staining.		
5	Type/FSp	TCR	SCR	RQD	R/(SPT)			

Hole Diameter		Casing Diameter		Shift Details			Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Date Time	BH Depth	Depth Water	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)
4.60	152	4.60	152	25/05/2022 17:00:00	1.20	-	0.00	6.20	90	0	1.20	6.20	Water		100	100
6.20	101			26/05/2022 09:00:00	1.20	-										
				26/05/2022 16:00:00	6.20	-										

Remarks:

Hand excavated service pit dug to 1.20m.
Borehole cased to 4.60m.
Rotary cored from 1.20 to 6.20m.
No groundwater strikes recorded.

Geotechnical Log

Project Name: Cloich Forest Wind Farm	Client: EDF Renewables	Date: 25/05/2022 - 26/05/2022
Location: Scottish Borders	Contractor: Natural Power	Co-ords: E320578.93 N646074.17
Project No. : 14781UKC VO2	Crew Name: RS SB	Drilling Equipment: Fraste SL

Borehole Number	Hole Type	Level	Logged By	Vertical Scale	Page Number
BH03	RC	405.51m AoD	EM	1:25	Sheet 2 of 2

Well	Water	Depth (m)	Type/ FSp (mm) Min,Ave, Max	Coring TCR	Coring SCR	Coring RQD	Recovery (SPT)	Depth (m) / Discontinuity Detail	Level (m)	Legend	Stratum Description
		5.20 - 6.20	0 30 80	90	15	0					Medium strong to strong yellowish grey medium to coarse grained SANDSTONE (greywacke). Moderately weathered with dark brown and orange staining on fracture surfaces. Frequent randomly oriented hairline fractures with occasional quartz infill. [PORTPATRICK FORMATION]
								6.20	399.31		End of Borehole at 6.200m

Hole Diameter		Casing Diameter		Shift Details			Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Date Time	BH Depth	Depth Water	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)
4.60	152	4.60	152	25/05/2022 17:00:00	1.20	-	0.00	6.20	90	0	1.20	6.20	Water		100	100
6.20	101			26/05/2022 09:00:00	1.20	-										
				26/05/2022 16:00:00	6.20	-										

Remarks:

Hand excavated service pit dug to 1.20m.
Borehole cased to 4.60m.
Rotary cored from 1.20 to 6.20m.
No groundwater strikes recorded.

C. **BH03 Core Photographs**


natural power
PROJECT:
CLOICH WIND FARM
PROJECT ID: 14781 UKC
BOREHOLE NO: BH03
DEPTH (m): GL-2.20
TIFFEN Gray Scale
TIFFEN Color Control Patches
GL
1.20
1.20
2.20


natural power
PROJECT:
CLOICH WIND FARM
PROJECT ID: 14781 UKC
BOREHOLE NO: BH03
DEPTH (m): 2.20 - 3.50
TIFFEN Gray Scale
TIFFEN Color Control Patches
2.20
3.50


PROJECT:
natural power
CLOICH WIND FARM
PROJECT ID: 14781 UKC
BOREHOLE NO: BH03
DEPTH (m): 3.50 - 5.20
TIFFEN Gray Scale
TIFFEN Color Control Patches
4.60
5.20
5.20

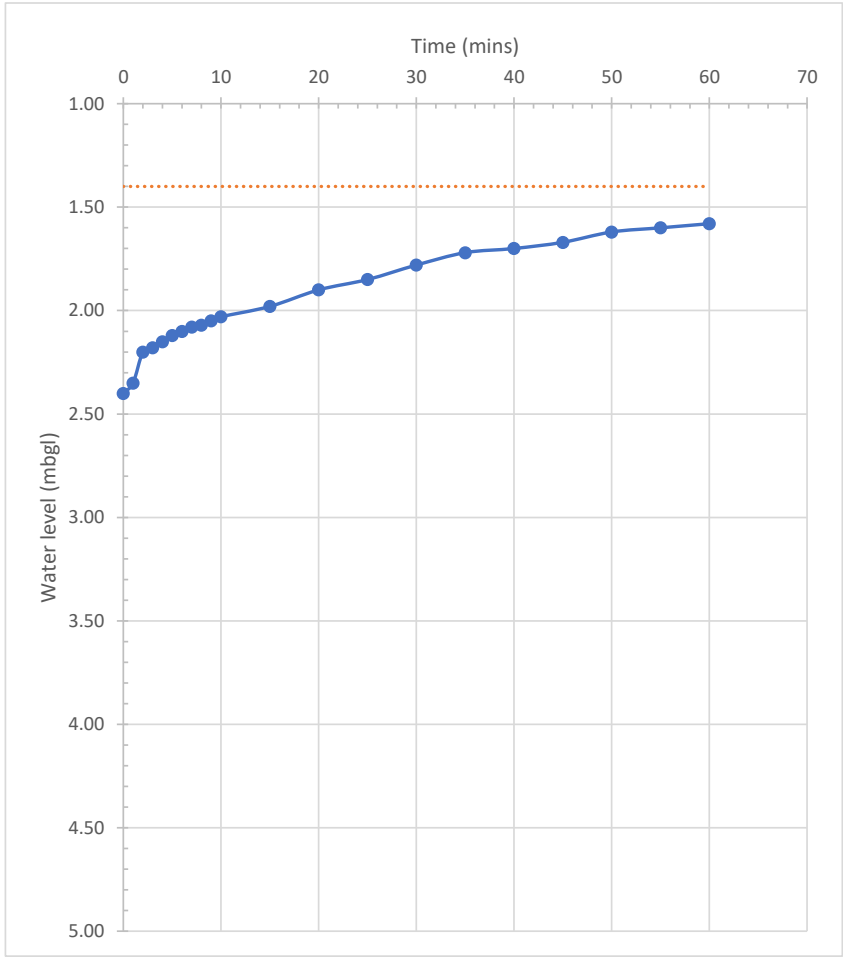

natural power
PROJECT:
CLOICH WIND FARM
PROJECT ID: 14781 UKC
BOREHOLE NO: BH03
DEPTH (m): 5.20 - 6.20
TIFFEN Gray Scale
TIFFEN Color Control Patches
5.20
6.20

D. **Rising Head Test Results**

Test type	Rising Head
Project	Cloich Wind Farm
Borehole	BH01
Test date	27/05/2022
Weather	Dry
Standing water level	1.40 m bgl
Response Zone	1.0-5.0 m
Approximate volume removed	20 litres
Notes	Groundwater recharging quicker than pumping out

Test data:

Elapsed Time (mins)	Water level (mbgl)	Water level (mOD)
0	2.40	357.75
1	2.35	357.80
2	2.20	357.95
3	2.18	357.97
4	2.15	358.00
5	2.12	358.03
6	2.10	358.05
7	2.08	358.07
8	2.07	358.08
9	2.05	358.10
10	2.03	358.12
15	1.98	358.17
20	1.90	358.25
25	1.85	358.30
30	1.78	358.37
35	1.72	358.43
40	1.70	358.45
45	1.67	358.48
50	1.62	358.53
55	1.60	358.55
60	1.58	358.57

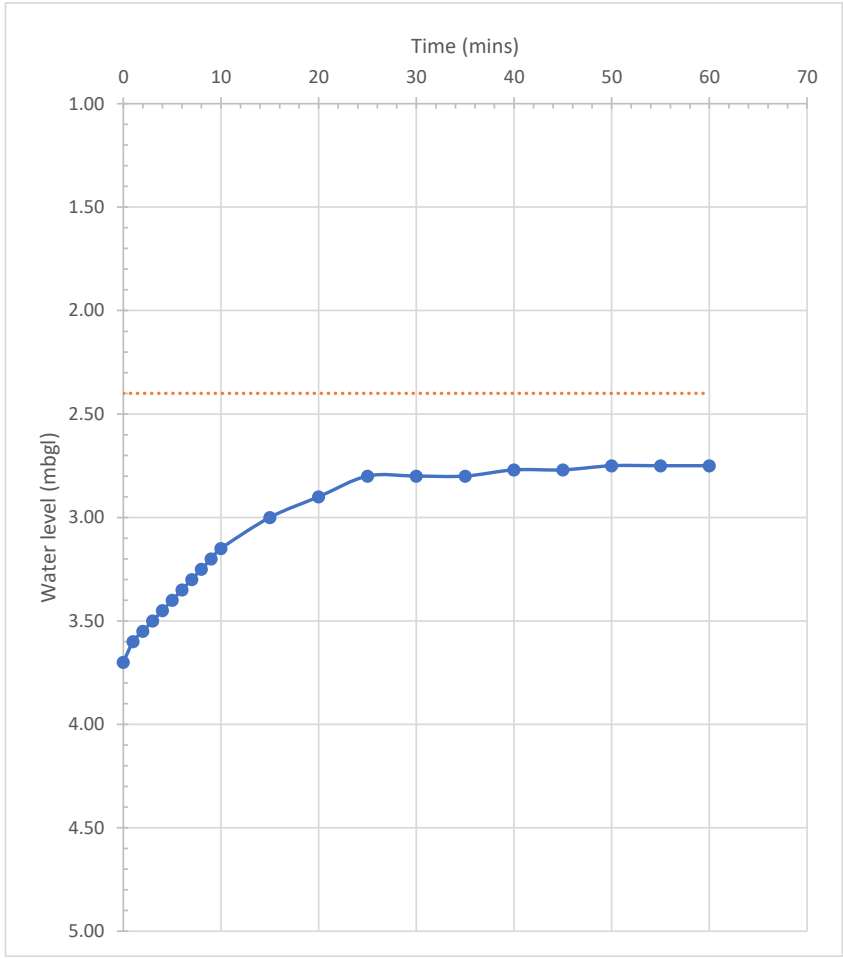


Calculated Permeability (k)	
k=	8.80066E-08 m/s

Test type	Rising Head
Project	Cloich Wind Farm
Borehole	BH02
Test date	27/05/2022
Weather	Dry
Standing water level	2.40m bgl
Response Zone	1.0-5.0 m
Approximate volume removed	18 litres
Notes	-

Test data:

Elapsed Time (mins)	Water level (mbgl)	Water level (mOD)
0	3.70	382.27
1	3.60	382.37
2	3.55	382.42
3	3.50	382.47
4	3.45	382.52
5	3.40	382.57
6	3.35	382.62
7	3.30	382.67
8	3.25	382.72
9	3.20	382.77
10	3.15	382.82
15	3.00	382.97
20	2.90	383.07
25	2.80	383.17
30	2.80	383.17
35	2.80	383.17
40	2.77	383.20
45	2.77	383.20
50	2.75	383.22
55	2.75	383.22
60	2.75	383.22

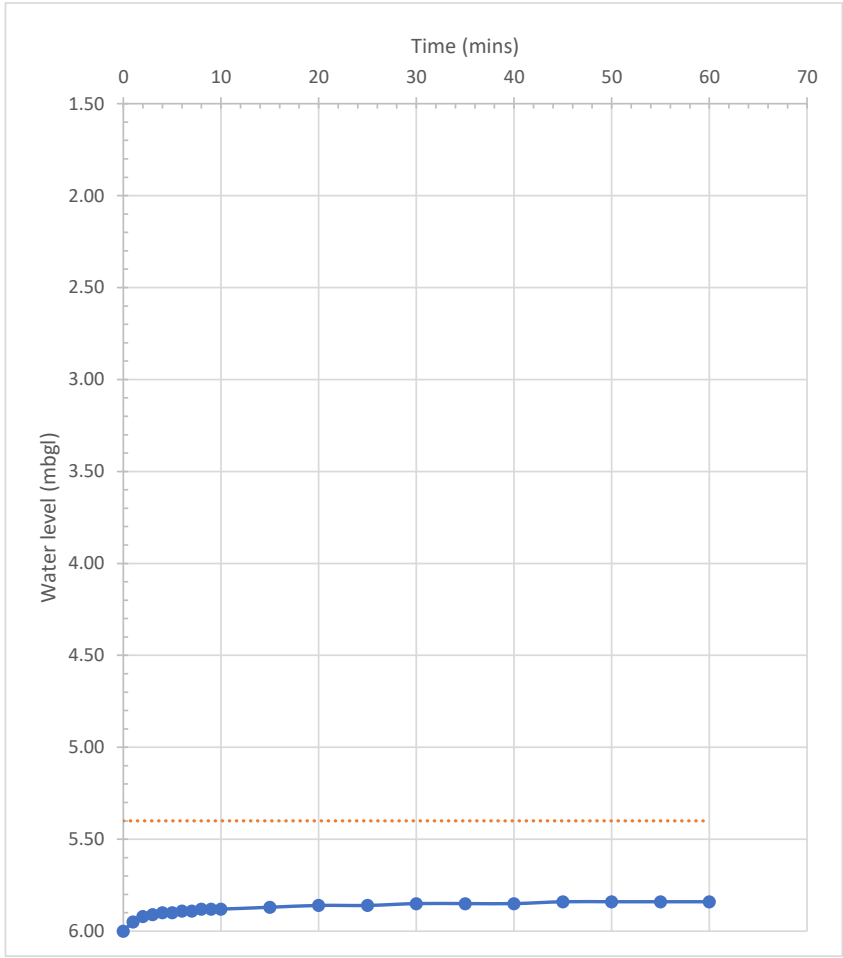


Calculated Permeability (k)	
k=	5.58924E-08 m/s

Test type	Rising Head
Project	Cloich Wind Farm
Borehole	BH03
Test date	27/05/2022
Weather	Dry
Standing water level	5.40m bgl
Response Zone	1.5-6.0 m
Approximate volume removed	1.5 litres
Notes	-

Test data:

Elapsed Time (mins)	Water level (mbgl)	Water level (mOD)
0	6.00	399.51
1	5.95	399.56
2	5.92	399.59
3	5.91	399.60
4	5.90	399.61
5	5.90	399.61
6	5.89	399.62
7	5.89	399.62
8	5.88	399.63
9	5.88	399.63
10	5.88	399.63
15	5.87	399.64
20	5.86	399.65
25	5.86	399.65
30	5.85	399.66
35	5.85	399.66
40	5.85	399.66
45	5.84	399.67
50	5.84	399.67
55	5.84	399.67
60	5.84	399.67



Calculated Permeability (k)	
k=	7.44087E-09 m/s

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ANNEX D: GROUNDWATER MONITORING RESULTS

Table 1.0: Groundwater monitoring data (May – October 2022)

Site Name: Cloich Forest Wind Farm					**Completed By: Patrick Harrison MSc of Arcus Consulting**	**Date: 18/11/2022**
Borehole Name	Grid Reference	Borehole Depth Below Ground Level (m)	Depth of Borehole Screen (m)	Date of Survey	Height of Dipwell Above Ground Level (m)	Water Level Below Ground Level (m)
BH01	NT205463	7.2	1 - 5	27/05/2022	n.s	1.40
				08/06/2022	0.23	1.26
				21/06/2022		1.25
				18/07/2022		1.27
				17/08/2022		1.13
				20/09/2022		1.16
				25/10/2022	n.s	1.06
BH02	NT203461	10	1 - 5	27/05/2022	n.s	2.40
				08/06/2022	0.23	2.64
				21/06/2022		2.66
				18/07/2022		2.71
				17/08/2022		2.63
				20/09/2022		2.62
				25/10/2022	n.s	2.32
BH03	NT205460	6.2	1.5 - 6	27/05/2022	n.s	5.40
				08/06/2022	0.24	Dry
				21/06/2022		Dry
				18/07/2022		Dry
				17/08/2022		Dry
				20/09/2022		5.22
				25/10/2022	n.s	3.25

n.s = Not surveyed

ANNEX E: CONSULTATION

Ms Silvia Cagnoni
Senior Planning Officer
Scottish Environment Protection Agency

19 October 2021

Your Ref: 2090
Planning Ref: ECU00003288

Dear Ms Cagnoni

Proposed Cloich Forest Wind Farm: Applicant Response to SEPA Holding Objection

Overview

Thank you for your recent consultation response regarding the proposed Cloich Forest Wind Farm ('the Development'). On behalf of EDF Renewables / Cloich Windfarm Partnership LLP ('the Applicant'), Arcus Consultancy Services Ltd (Arcus) would like to clarify matters in relation to the points raised by the Scottish Environment Protection Agency (SEPA) to demonstrate how Private Water Supplies (PWS) have been appropriately considered in accordance with guidance.

In SEPA's consultation response, dated 19 August 2021, a holding objection was lodged due to a lack of sufficient information on PWS. SEPA state that the holding objection on PWS is in relation to a lack of information on the potential impacts for the PWS of Stewarton.

Arcus approached SEPA, via email on the 22 September 2021, to arrange a call to discuss this holding objection; however, in SEPA's email response (30 September 2021) it was requested that matters were put into writing to determine the need for a discussion via phone call.

Applicant Response

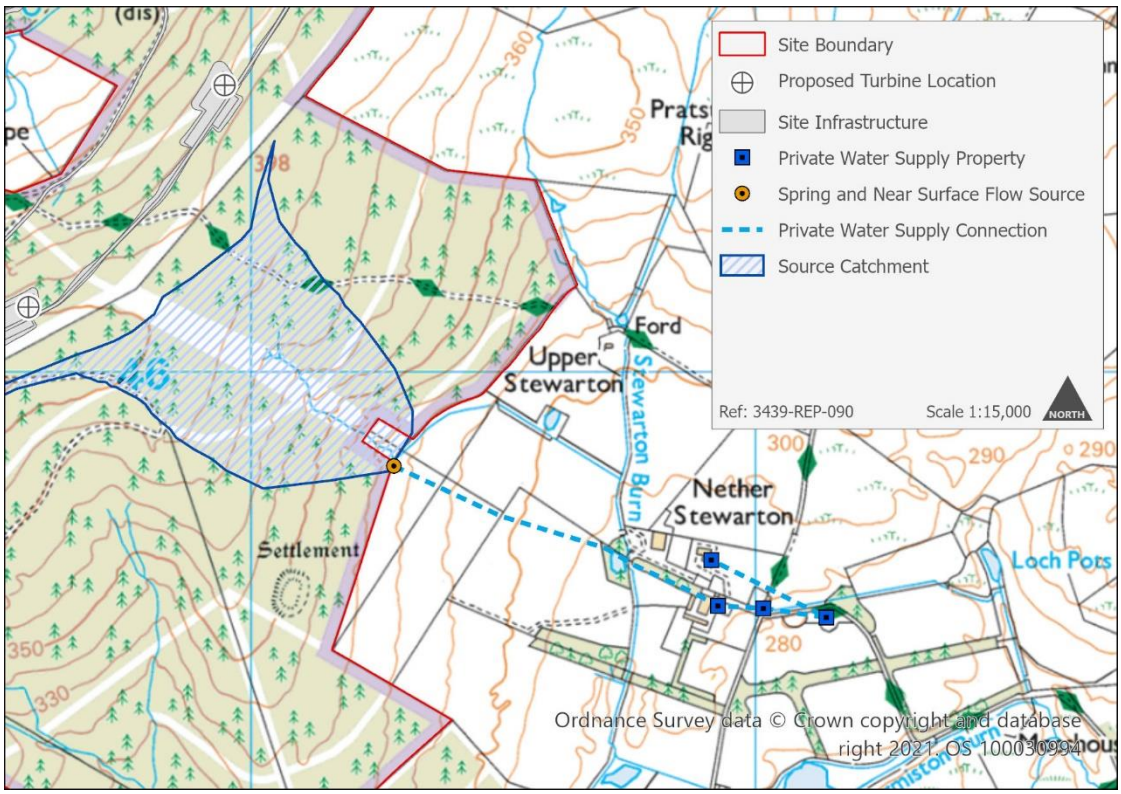
The points raised by SEPA that the Applicant seeks to respond to are provided below as *italicised text*; the Applicant response then follows in regular text.

1.2 We note the mitigation measures proposed, including an intrusive investigation before the construction phase to inform a further hydrogeological assessment and update the conceptual site model, watching brief during construction and water quality monitoring. However, there is uncertainty on the location of the upper groundwater spring source (green dot on Plate 4a of Volume 3: Technical Appendices. Technical Appendix A10.2: Private Water Supply Risk Assessment) which could potentially be within the applicable buffer zones around Turbine 3 which the foundations of are likely to require dewatering and there is the potential for a hydrogeological connection between the proposed excavations and the potential upper groundwater spring source for Stewarton (Plate 4a) as shown by the conceptual site model.

Plate 4a, '*Stewarton source catchment with surface water catchments',* in Section 5.1.10 of the Private Water Supplied Risk Assessment (PWSRA) was intended to demonstrate that Nether Stewarton is served by two sources (groundwater and surface water).

Surface water: the surface water catchment is defined by topography i.e. blue hatched area shown on Plate 4a of the PWSRA. We recognise that trying to convey this much information on one plate may have led to some confusion, and may have inadvertently given SEPA the impression that the blue hatched area is in relation to groundwater catchments. This is not the case and this area notes the surface water catchment. Therefore, we have reproduced Plate 4a (below) to remove the 100 m and 250 m buffers, as well as the green dot which notes the spring (groundwater) source point, as neither are applicable to surface water abstractions in accordance with LUPS-GU31. The Revised Plate 4a, shown below, is now specifically in relation to surface water.

Revised Plate 1a: Stewarton surface water supply catchment

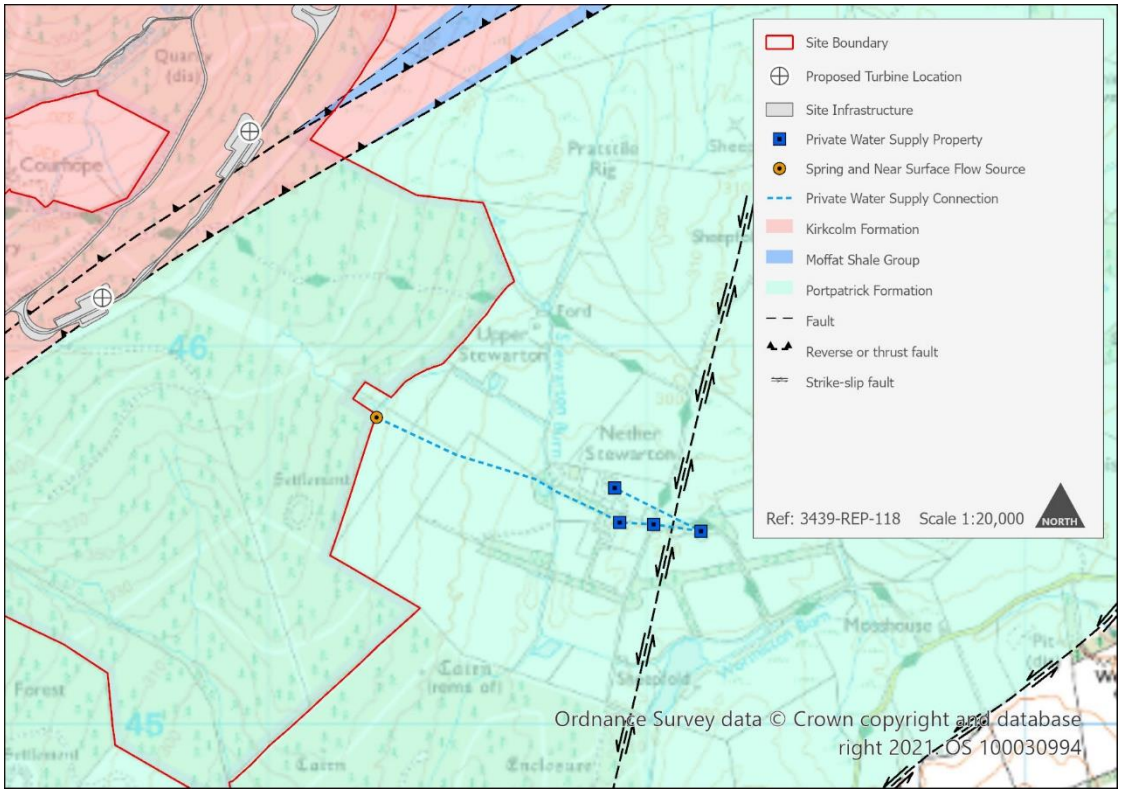


Groundwater: Plate 10a within the PWSRA was intended to support the PWSRA text in relation to groundwater. Due to the inconclusive nature of previous assessments and uncertainty regarding the extent of the groundwater unit from residents and previous reports, the Conceptual Site Model (CSM), presented in Section 5.1.10 and Plate 10d of the PWSRA (Revised Plate 10d shown below), assumed a worst case scenario that the groundwater table underlies T3; is within 3 m of the surface; and is potentially connected to the Nether Stewarton supply by the Leadhills Fault.

The PWSRA concluded that in the long-term, once the foundation for T3 has been completed and the exposed cut has been restored, it is anticipated that that near-surface water and groundwater will migrate around the turbine foundation, under gravity and by fracture flow.

Furthermore, a number of mitigation measures will be in place during turbine base construction to prevent the ingress of concrete and other liquids, such as blinding concrete at the base of the excavation prior to concrete pouring and other good practice measures.

Revised Plate 10b: Stewarton source catchment with groundwater aquifer units



1.3 We therefore request that the proposed site investigations around Turbine 3 are carried out prior to any grant of planning consent to ascertain the requirement and magnitude for dewatering and the hydrogeological conditions. The information attained should be used to further refine the Stewarton PWS risk assessment. The advice under Option 4 of our Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems LUPS-GU31 provides further guidance on the requirements for the assessment.

Due to the presence of the fault line which separates the Portpatrick formation (in which Nether Stewarton lies) from the Kirkcolm Formation (in which T3 lies), the CMS and the assessment of risk to the supply assumes that the groundwater unit supplying Nether Stewarton is connected to the area proposed for T3. Previous assessments[1] and correspondence from AMEC to SEPA relating to the extant consent suggested no connectivity, specifically "*The planned construction of an access track and wind turbine at the top of the hill appears to fall just outside the catchment of the water supply and thus should have no effect*". As such, the qualitative assessment of the supply in the PWSRA takes a worst case scenario *i.e.,* that groundwater is present at 380 m AOD and the Leadhills Fault allows groundwater flow to be transferred between the proposed working area for T3 and the watershed divide. The conclusions of the PWSRA are therefore appropriately conservative and remain valid in the absence of intrusive site investigations which would confirm the presence or absence of groundwater at excavation depths for T3.

In relation to suggested site investigations, due to the Sitka Spruce plantation in the area around T3, access is considered onerous from the west to get a borehole rig up to the location without felling forestry and steep topography prevents vehicular access from the south. Additionally, felling small scale areas of forestry to facilitate site investigations at T3 could potentially result in unstable forestry edges susceptible to wind blow which is contrary to forestry good practice. However, in terms of forestry felling, site investigations at T3 would be possible prior to construction as the

[1] Report on Site Visit to Cloich Forest on 02 April 2012 (Dr T R Nisbet)

surrounding forestry would be felled in accordance with felling plans within the Environmental Impact Assessment Report, submitted in support of the Application.

The presence or absence of groundwater underlying T3 would be confirmed through ground investigation (GI) works prior to construction, which should be secured through an appropriately worded pre-commencement planning condition specific to T3, and would inform whether dewatering and water quality monitoring (and other measures) is required.

It should be noted that should groundwater be encountered at the location of T3 then the turbine and associated infrastructure could be microsited 50 metres to the north should GI show a more favourable location.

I hope that the above information, combined with the information provided in the previous correspondence, provides sufficient information to address the points raised and for you to reconsider your objection.

Should you require any further information, please contact me on the details below to discuss or I would be happy to arrange a meeting or call if that would be helpful.

Yours sincerely,

Liam Nevins (BSc. Hons MCIWEM C.WEM)

Associate Director (Hydrology)

From:	Planning South East
To:	Fraser Clarke
Cc:	Debbie Flaherty; Liam Nevins; Fiona MacGregor; Richard Fisher
Subject:	RE: Cloich Forest Wind Farm: ECU00003288 SEPA ref 3113
Date:	03 November 2021 14:24:23
Attachments:	image003.png image006.png image007.png image008.jpg

PUBLIC

Dear Fraser

THE ELECTRICITY WORKS (ENVIRONMENTAL IMPACT ASSESSMENT) (SCOTLAND) REGULATIONS 2017
ELECTRICITY ACT 1989 SECTION 36 AND SCHEDULE 8: APPLICATION FOR THE PROPOSED CLOICH FOREST WINDFARM IN THE PLANNING AUTHORITY AREA OF SCOTTISH BORDERS COUNCIL.
ECU ref: ECU00003288
SEPA ref: 3113

Thank you for your letter of the 19 October 2021, in response to our letter to the Energy Consent Unit (ECU) of the 19 August 2021 (our ref: 2090), where we submitted a holding objection in relation to Private Water Supplies (PWS).

We have reviewed the information and clarification included in your letter and have found that it does not allows us to change our previous response. We therefore confirm our previous request for the following information to be submitted to SEPA, or to the ECU as part of a formal Additional Information submission, in order for us to review our current holding objection.

- appropriate intrusive site investigations and groundwater assessment at the turbine T3 location. Please find details in paragraph 1.4 below.

Please find further details below and also note the other comments from our previous response.

1. Private Water Supplies

1.1. We have reviewed the following documents:

- Ref 1 – Arcus, 19 October 2021, Proposed Cloich Forest Wind Farm: Applicant Response to SEPA Holding Objection, Letter to SEPA
- Ref 2 - Arcus, June 2021, Cloich Forest Wind Farm. Volume 3: Technical Appendices. Technical Appendix A10.2: Private Water Supply Risk Assessment.

1.2. We have previously interpreted the surface water catchment area presented correctly. We are not disputing that the T3 turbine and the access track are outside the surface water catchment area, and that the surface water component of the Stewarton Private Water Supply (PWS) source flow would not

be affected by the proposed development.

1.3. The groundwater source of the Stewarton PWS cannot be precisely located (green dot on Plate 10b, ref. [2]) and its component to the PWS flow has not been quantified. According to the applicant ref. [2] the groundwater component of the flow could be affected by the development as there is '*potential for the supply to be hydrogeologically connected'* to the T3 turbine foundation with '*potential impact to changes to groundwater flow and yield of supply*' (Vol 3 Technical Appendix A10.2 Private Water Supply Risk Assessment 5.1.10). This impact has been qualified as '*noticeable but not significant change in yield particularly in times of drought as a worst-case scenario'*.

1.4. At present there is no quantification on the Stewarton PWS yield and what proportion is assigned to groundwater and to surface water. The applicant assessment of a '*noticeable but not significant change in yield to the supply'* (ref. [2]) is not based on factual data. In this case it is our opinion that the applicant should ascertain the magnitude of a worst-case scenario investigating the potential for a reduction in groundwater yield (if any) by conducting an appropriate intrusive site investigation at the turbine T3 site. The site investigation should inform on the Groundwater table and groundwater flow direction at this site and answer those uncertainties exposed by the applicant conceptual site model (Plate 10d, ref. [2]).

If you have queries relating to this letter, please contact me or Alex Candlish.

Yours sincerely

Silvia Cagnoni
Senior Planning Officer
Scottish Environment Protection Agency

From: Fraser Clarke
Sent: 19 October 2021 10:42
To: Planning South East
Cc: Debbie Flaherty ; Liam Nevins; Fiona MacGregor ; Richard Fisher
Subject: RE: Cloich Forest Wind Farm: FAO – Ms Silvia Cagnoni, Senior Planning Officer

Good Morning Alex,

Thank you for your response below which requests matters are put into writing to establish the need for a call. Arcus, on behalf of the Applicant, have prepared the attached letter addressed to Ms Cagnoni.

Arcus would be amenable to a phone call discussion around the contents of this clarification letter, should SEPA wish to discuss the matter further.

Kind regards,
Fraser

From: Planning South East [
Sent: 30 September 2021 12:59
To: Fraser Clarke
Cc: Debbie Flaherty ; Liam Nevins ; Fiona MacGregor ; Richard Fisher
Subject: RE: Cloich Forest Wind Farm: FAO – Ms Silvia Cagnoni, Senior Planning Officer

OFFICIAL – BUSINESS

Fraser,

Thank you for getting in touch. Workload pressures are high at the minute. Could you possibly outline what aspects of the response you wish to discuss? This will help understand the need for the meeting and such a meeting can be prioritised if necessary. It should be added at this point we are unable to have a teleconference if there are no significant discussion points out with of our most recent response as our response is clear in terms of what is needed to address our concerns.

As a middle ground we are happy to review any documentation which outlines proposals of how you intend to address our objection in the first instance.

Kind Regards,

Alex

Alex Candlish
Acting Unit Manager – Planning South East

OFFICIAL – BUSINESS

From: Fraser Clarke
Sent: 22 September 2021 13:01
To: Planning South East
Cc: Debbie Flaherty ; Liam Nevins ; Fiona MacGregor; Richard Fisher <
Subject: Cloich Forest Wind Farm: FAO – Ms Silvia Cagnoni, Senior Planning Officer

Good Morning Sir/Madam,

FAO – Ms Silvia Cagnoni, Senior Planning Officer

I am emailing today to contact Ms Cagnoni regarding SEPA's consultation response (Dated: 19/08/2021, Ref: 2090) to the proposed Cloich Forest Wind Farm Section 36 Planning Application (Ref: ECU00003288). In SEPA's response Ms Cagnoni stated that any further communication should be sent to SEPA's planning email address.

The proposed Cloich Forest Wind Farm project team would like to request a conference call with Ms Cagnoni to discuss the SEPA response and to provide further clarity regarding our approach. This will allow us to reach a resolution of the concerns raised in the most effective and efficient manner.

I would be very grateful if this email is passed onto Ms Cagnoni so that a suitable time for a call can be arranged. The project team has availability from W/c 04/10/2021.

Please do not hesitate to get in touch if there are any questions/queries regarding this approach.

Kind regards,
Fraser

Fraser Clarke
Environmental Consultant
Arcus Consultancy Services Ltd

Web: www.arcusconsulting.co.uk

Ms Silvia Cagnoni
Senior Planning Officer
Scottish Environment Protection Agency

11 November 2021

Your Ref: 3113
Planning Ref: ECU00003288

Dear Ms Cagnoni

Proposed Cloich Forest Wind Farm: SEPA T3 Site Investigation Requirement

Overview

Thank you for your recent consultation response regarding the proposed Cloich Forest Wind Farm ('the Development'). On behalf of EDF Renewables / Cloich Windfarm Partnership LLP ('the Applicant'), Arcus Consultancy Services Ltd (Arcus) would like to present our approach to groundwater monitoring for T3.

In SEPA's consultation response, dated 03 November 2021, the previous holding objection was maintained and the requirement for site investigation (SI) and groundwater assessment for T3 was re-requested in order for SEPA to review their position on the Development proposals.

Applicant Response

The Applicant recognises SEPA's position and will now proceed to undertake the required SI and groundwater assessment for T3. Upon completion, this information will be presented by way of Supplementary Environmental Information (SEI).

As noted in the previous Applicant response to SEPA, dated 19 October 2021, the location of T3 is within dense commercial forestry and therefore access for SI is problematic. In order to ensure safe, appropriate access for SI at the exact location of T3 there would need to be substantial felling of trees. The trees in this location are mature and if keyhole felling was undertaken to gain access to T3 the remaining trees within the forestry coupe would be very susceptible to wind blow. Consequently, SI at the exact location of T3 would result in the full forestry coupe having to be removed. At this stage in the development process, with consent not yet secured, this is not likely to be acceptable from a forestry management point of view.

As such, the Applicant is proposing using proxy borehole locations adjacent to an existing access track and a forest ride, where the groundwater levels in the vicinity of T3 can be assessed. The technical note provided within Appendix A outlines: the aims and objectives of the SI; proposed borehole locations; and monitoring and potential outcomes of the SI. Figure 1, included within Appendix A of this letter, shows the location and approximate British National Grid (BNG) references of proposed borehole / SI locations.

The Applicant seeks SEPA's agreement on the approach and the proposed borehole locations outlined within Appendix A. Following agreement, the Applicant will commission SI.

Conclusion

The Applicant would be very grateful for SEPA's agreement on the above in a timely fashion so that SI can proceed at the earliest opportunity.

Yours sincerely,

Liam Nevins (BSc. Hons MCIWEM C.WEM)

Associate Director (Hydrology)

From:	Lewis, Paul
To:	Fraser Clarke
Cc:	Debbie Flaherty; Liam Nevins; Fiona MacGregor; Richard Fisher; Rebecca Simister
Subject:	PERMS 3371 (SEPA Ref) Cloich Forest Wind Farm: ECU00003288
Date:	16 November 2021 17:06:59
Attachments:	image001.png image002.png image004.jpg image005.png image006.png image007.jpg 4519_SI_Response_to_SEPA_v2-1_FC_20211111.pdf

OFFICIAL

Dear Mr Clarke

Thank you for your email of 11 November 2021.

My colleague, Silvia Cagnoni, is on leave, and I have consulted our colleagues on your proposal for intrusive site investigations for T3.

1. We welcome the proposal by the applicant to carry out intrusive site investigations.
2. The placement of three monitoring boreholes in a triangular array is the minimum acceptable in assessing the groundwater flow direction. All efforts should be made to have the location of BH03a installed and if BH3b is chosen then perhaps an additional fourth borehole may be installed on the eastern corner of the plantation cell.

3. We acknowledge the difficulty in accessing the area of the turbine T3 due to the presence of mature forest and note that aerial imagery shows windblown patches present in the forested area that could be exploited to gain better site access. A walk over as proposed by the applicant should aim to refine the placement of the proposed boreholes.

4. The proposed boreholes depth is acceptable as it would be below the planned turbine foundation depth. An initial monitoring of three months is acceptable, but further monitoring may be required following an evaluation of the initial results.

Please contact me in the first instance if you have any further questions.

Yours sincerely,

Paul Lewis MRTPI
Senior Planning Officer
Scottish Environment Protection Agency | Silvan House | SEPA 3rd Floor | 231 Corstorphine Rd | Edinburgh | EH12 7AT

At present I can only respond to agreed business critical work.

Further advice and guidance which may be of relevance is available on our website at https://www.sepa.org.uk/environment/land/planning/.

From: Fraser Clarke
Sent: 11 November 2021 14:06
To: Planning South East
Cc: Debbie Flaherty ; Liam Nevins; Fiona MacGregor ; Richard Fisher ;

Rebecca Simister
Subject: RE: Cloich Forest Wind Farm: ECU00003288 SEPA ref 3113

Good Morning Sir/Madam,

FAO – Ms Silvia Cagnoni, Senior Planning Officer

In response to recent written dialogue (via letter & emails below), please find attached the Applicant's response to SEPA's below email. As noted in the attached, the Applicant would be very grateful for a response in a timely fashion to allow proposed Site Investigations to proceed.

Should SEPA have any questions regarding the attached, please do get in touch.

Kind regards,
Fraser

Fraser Clarke
Environmental Consultant
Arcus Consultancy Services Ltd

Web: www.arcusconsulting.co.uk

Arcus Logo

Arcus values its people and are actively working to improve Work/Life Balance. As such, whilst it suits me to send this e-mail now, I do not anticipate a response or action if it is outside of your normal working hours.

From: Planning South East
Sent: 03 November 2021 14:24
To: Fraser Clarke
Cc: Debbie Flaherty ; Liam Nevins ; Fiona MacGregor
8 SEPA ref 3113

Dear Fraser

THE ELECTRICITY WORKS (ENVIRONMENTAL IMPACT ASSESSMENT) (SCOTLAND) REGULATIONS 2017
ELECTRICITY ACT 1989 SECTION 36 AND SCHEDULE 8: APPLICATION FOR THE PROPOSED CLOICH FOREST WINDFARM IN THE PLANNING AUTHORITY AREA OF SCOTTISH BORDERS COUNCIL.
ECU ref: ECU00003288
SEPA ref: 3113

Thank you for your letter of the 19 October 2021, in response to our letter to the Energy Consent Unit (ECU) of the 19 August 2021 (our ref: 2090), where we submitted a holding objection in relation to Private Water Supplies (PWS).

We have reviewed the information and clarification included in your letter and have found that it does not allows us to change our previous response. We therefore confirm our previous request for the following information to be submitted to SEPA, or to the ECU as part of a formal Additional Information submission, in order for us to review our current holding objection.

- appropriate intrusive site investigations and groundwater assessment at the turbine T3 location. Please find details in paragraph 1.4 below.

Please find further details below and also note the other comments from our previous response.

1. Private Water Supplies

1.1. We have reviewed the following documents:

- Ref 1 – Arcus, 19 October 2021, Proposed Cloich Forest Wind Farm: Applicant Response to SEPA Holding Objection, Letter to SEPA
- Ref 2 - Arcus, June 2021, Cloich Forest Wind Farm. Volume 3: Technical Appendices. Technical Appendix A10.2: Private Water Supply Risk Assessment.

1.2. We have previously interpreted the surface water catchment area presented correctly. We are not disputing that the T3 turbine and the access track are outside the surface water catchment area, and that the surface water component of the Stewarton Private Water Supply (PWS) source flow would not be affected by the proposed development.

1.3. The groundwater source of the Stewarton PWS cannot be precisely located (green dot on Plate 10b, ref. [2]) and its component to the PWS flow has not been quantified. According to the applicant ref. [2] the groundwater component of the flow could be affected by the development as there is '*potential for the supply to be hydrogeologically connected'* to the T3 turbine foundation with '*potential impact to changes to groundwater flow and yield of supply*' (Vol 3 Technical Appendix A10.2 Private Water Supply Risk Assessment 5.1.10). This impact has been qualified as '*noticeable but not significant change in yield particularly in times of drought as a worst-case scenario'*.

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proportion is assigned to groundwater and to surface water. The applicant assessment of a '*noticeable but not significant change in yield to the supply*' (ref. [2]) is not based on factual data. In this case it is our opinion that the applicant should ascertain the magnitude of a worst-case scenario investigating the potential for a reduction in groundwater yield (if any) by conducting an appropriate intrusive site investigation at the turbine T3 site. The site investigation should inform on the Groundwater table and groundwater flow direction at this site and answer those uncertainties exposed by the applicant conceptual site model (Plate 10d, ref. [2]).

If you have queries relating to this letter, please contact me or Alex Candlish

Yours sincerely

Silvia Cagnoni
Senior Planning Officer
Scottish Environment Protection Agency

From: Fraser Clarke
Sent: 19 October 2021 10:42
To: Planning South East
Cc: Debbie Flaherty ; Liam Nevins ; Fiona MacGregor ; Richard Fisher
Subject: RE: Cloich Forest Wind Farm: FAO – Ms Silvia Cagnoni, Senior Planning Officer

Good Morning Alex,

Thank you for your response below which requests matters are put into writing to establish the need for a call. Arcus, on behalf of the Applicant, have prepared the attached letter addressed to Ms Cagnoni.

Arcus would be amenable to a phone call discussion around the contents of this clarification letter, should SEPA wish to discuss the matter further.

Kind regards,
Fraser

From: Planning South East
Sent: 30 September 2021 12:59
To: Fraser Clarke
Cc: Debbie Flaherty ; Liam Nevins ; Fiona MacGregor ; Richard Fisher
Subject: RE: Cloich Forest Wind Farm: FAO – Ms Silvia Cagnoni, Senior Planning Officer

OFFICIAL – BUSINESS

Fraser,

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As a middle ground we are happy to review any documentation which outlines proposals of how you intend to address our objection in the first instance.

Kind Regards,

Alex

Alex Candlish
Acting Unit Manager – Planning South East

OFFICIAL – BUSINESS

From: Fraser Clarke
Sent: 22 September 2021 13:01

To: Planning South East
Cc: Debbie Flaherty ; Liam Nevins ; Fiona MacGregor ; Richard Fisher
Subject: Cloich Forest Wind Farm: FAO – Ms Silvia Cagnoni, Senior Planning Officer

Good Morning Sir/Madam,

FAO – Ms Silvia Cagnoni, Senior Planning Officer

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I would be very grateful if this email is passed onto Ms Cagnoni so that a suitable time for a call can be arranged. The project team has availability from W/c 04/10/2021.

Please do not hesitate to get in touch if there are any questions/queries regarding this approach.

Kind regards,
Fraser

Fraser Clarke
Environmental Consultant
Arcus Consultancy Services Ltd

Web: www.arcusconsulting.co.uk

Arcus Logo

From:	Rebecca Simister
To:	
Cc:	Richard Fisher; Becca Leake; Fiona MacGregor; Liam Nevins
Subject:	PERMS 3371 (SEPA Ref) Cloich Forest Windfarm - Further Information
Date:	26 July 2022 14:56:00
Attachments:	4519_SI_Response_to_SEPA_v1-2_RS_20220726.pdf 4519_Cloich_Windfarm_GWM_20220726.pdf image001.png image003.png image004.png image005.jpg 4519-REP-001 Site Investigation.pdf image006.png

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Good afternoon

In response to SEPA's previous email dated 16th November 2021. As site investigation works have now been completed at Cloich Forest Windfarm at the proposed T3 location, please find the following attached for your review and comment:

- Response to SEPA's request for further information;
- Figure – Groundwater monitoring locations;
- Groundwater Monitoring data.

Please let me know if you have any further queries or require any further information.

Kind regards

Rebecca

Rebecca Simister
Principal Hydrologist
Arcus Consultancy Services Ltd

Web: www.arcusconsulting.co.uk

Ms Silvia Cagnoni / Mr Paul Lewis
Senior Planning Officer
Scottish Environment Protection Agency

26 July 2022

Our Ref: 4519/PWS
Your Ref: 3113
Planning Ref: ECU00003288

Dear Ms Cagnoni and Mr Lewis,

Proposed Cloich Forest Wind Farm: SEPA T3 Site Investigation Update

Overview

Thank you for your recent consultation response regarding the proposed Cloich Forest Wind Farm ('the Development'). On behalf of EDF Renewables / Cloich Windfarm Partnership LLP ('the Applicant'), Arcus Consultancy Services Ltd (Arcus) would like to present and seek agreement on our approach to monitoring groundwater levels in proximity to turbine 3 (T3).

In the most recent consultation response, dated 16 November 2021, SEPA welcomed the proposal for further Site Investigation (SI) and accepted the proposed borehole locations and SI scope at T3. The Applicant commissioned Natural Power to undertake the works at the proposed T3 location in May 2022, based on the submitted scope.

The purpose of this letter is to provide a short summary of the SI results and an updated Conceptual Site Model for the hydrogeological conditions in the area around T3, and a proposal for the next stages for Supplementary Environmental Information (SEI) submission.

Site Investigation Update

The purpose of the site investigation was to a) confirm the underlying geological conditions, b) confirm the presence of groundwater, c) obtain groundwater flow direction and d) aquifer conditions (including hydraulic conductivity).

Three boreholes were drilled and the details of each borehole are outlined in Table 1 below with further commentary provided where applicable.

Table 1. Borehole installation details

Borehole ID	Drilled depth (m)	Depth to bedrock (mbgl)	Screened section (mbgl)	Groundwater levels (mbgl)	Comment
BH01	7.2	N/A	1 - 5	1.25 – 1.4	No bedrock encountered

Borehole ID	Drilled depth (m)	Depth to bedrock (mbgl)	Screened section (mbgl)	Groundwater levels (mbgl)	Comment
BH02	10.0	N/A	1 - 5	2.4 – 2.66	No bedrock encountered
BH03	6.2	1.2	1.5 - 6	Dry (June/July) 5.4 (May 2022)	Water flush used during drilling (closed system). Drilling terminated at 6.2m depth due to restrictions for transporting water on site.

The SI Factual Report, including borehole logs locations are provided with this letter. Groundwater monitoring was carried out over three rounds between May and June 2022 by Arcus staff using a manual dipmeter.

The main points from the SI Factual Report are:

- At BH01 and BH02, ground conditions included fill/made ground material and underlying superficial deposits (glacial till) with no bedrock encountered beyond 5m depth;
- At BH03, shallow superficial deposits (topsoil and peat) were encountered with bedrock encountered at 1.2m depth. Bedrock was confirmed as sandstone (Portpatrick formation) which was highly weathered and fractured;
- Groundwater flow direction could not be determined as bedrock was not encountered at all three boreholes;
- Shallow groundwater within superficial deposits were encountered at BH01 and BH02 located downslope (although the locations of the borehole were immediately downslope of the track locations which may locally alter near surface flow). The highest groundwater level recorded at BH03 was 5.4 mbgl, however, this covers a limited dataset; and
- In-situ rising head (permeability) tests were carried out at all three locations, reporting permeabilities of between 5.5 x 10^{-08} m/s and 7.4 x 10^{-09} m/s. Based on BGS[1] guidance this is considered to be a very low permeability aquifer.

Updated Conceptual Site Model (CSM)

The SI results allow verification of the CSM provided within the EIA submission (within Technical Appendix 10.1 Private Water Supply Risk Assessment (PWSRA)) with further quantitative information to support this model and shown on Figure 1.

The previous potential pollutant pathway linkage is detailed in the source-pathway-receptor (SPR) model below:

- **Source** – excavation of foundations for proposed turbine at T3 (to 3m depth) which may result in changes to water flow (concrete foundation displaces groundwater) or changes to water quality from concrete pouring and other chemicals used during construction;
- **Pathway** – potential for water or contaminants at T3 to leach a) via unsaturated bedrock or b) directly groundwater to flow via fracture flow through bedrock. It should be noted there is no hydrological connection between T3 and the private water supply (PWS); and
- **Receptor** – the underlying (bedrock) aquifer which may be hydrologically connected to the spring and surface water intake for the Stewarton PWS.

[1] British Geological Survey (2006) Guide to Permeability Indices. Open Report CR06/160N. Available at https://www.researchgate.net/publication/279470462_Guide_to_Permeability_Indices

A review of this CSM based on the site investigation findings in the area surrounding T3 include the following:

- **Source**:
    - **Changes to Water flow –** the turbine foundations proposed for Cloich are 3m deep and 24m diameter. Groundwater levels were either dry or below the depth of the turbine base (although winter groundwater levels will be higher than this). Whilst no wider hydrogeological 'catchment' can be accurately defined, the excavation required and associated dewatering during construction in a conservative scenario would require groundwater levels pumped to 2m maximum, with a groundwater radius of influence during construction limited based on the very low permeability levels provided, with groundwater levels to return surrounding the concrete base post-construction. The placement of this structure within the wider hillslope is unlikely to alter flow.
    - **Changes to Water Quality** – there are no changes to the source in relation to water quality.
- **Pathway –**pathways were previous identified, within the unsaturated zone and within the superficial/bedrock aquifer. There is no superficial aquifer (based on SEPA's WAT-RM-10 guidance) within this area due to the limited depth of superficial deposits at the turbine location. This means the two pathways for any contaminants are via migration within the unsaturated superficial and bedrock deposits (up to 5m), as well as via groundwater flow (bedrock aquifer).
- **Receptor –** whilst there are no changes to our understanding of the PWS, as the bedrock aquifer is also a receptor, groundwater monitoring confirms levels are not at depths which would interact withthe base of the turbine within summer months.

Limitations

The following limitations are noted:

- As the number, location and depths of boreholes were consulted on prior to SI, two boreholes were not drilled to bedrock to provide a groundwater flow direction. Monthly groundwater monitoring would have confirmed a groundwater flow direction;
- No further information has been made available on the source at PWS Stewarton. It is acknowledged that whilst there is an intake location for the surface water abstraction, there is a wider network of pipes within the open forest ride area upslope which feeds this intake; and
- Groundwater monitoring has been conducted over three rounds between May and June 2022, which may not reflect all temporal and hydrological conditions.

Risk Assessment for Private Water Supply Receptors

Based on the updated potential pollutant linkage, with the previous PWSRA identifying the Stewarton PWS as having a high sensitivity, the magnitude for the impact to the supply would be revised from Moderate to Minor with a sensitivity of Minor. This change in magnitude confirms that there is unlikely to be any noticeable change in supply quality of quantity.

Several embedded design measures and good construction practice were included within the previous submission, primarily within the Water Construction Environmental Management Plan (WCEMP). These measures have not changed since the previous submission, however further detail provided on these within the SEI and updated PWSRA on how these pollution sources can be removed.

Applicant Response

The Applicant seeks SEPA's comment on the SI results, including whether they agree the information obtained from the site investigation and updated risk assessment for the PWS is sufficient, and that no further site investigation is required. Following agreement, the Applicant will progress with the SEI submission with groundwater monitoring continuing into August, with these results to be included into the updated PWSRA.

Conclusion

The Applicant would be very grateful for SEPA's agreement on the above in a timely fashion so that SEI can proceed at the earliest opportunity.

Yours sincerely,

Liam Nevins (BSc. Hons MCIWEM C.WEM)

Associate Director (Hydrology)

From:	Planning South East
To:	Rebecca Simister
Cc:	Richard Fisher; Becca Leake; Fiona MacGregor; Liam Nevins;
	RE: PERMS 3371 (SEPA Ref) Cloich Forest Windfarm - Further Information (SEPA 6002)
Subject:	11 August 2022 17:25:22
Date:	image001.png
Attachments:	image003.png
	image004.png
	image005.jpg
	image002.png

OFFICIAL

Rebecca,

Thank you for your email of the 26 July 2022 (containing: Response to SEPA's request for further information; Figure – Groundwater monitoring locations; Groundwater Monitoring data) and follow up email of the 27 July, including the Factual Ground Investigation Report.

We understand that Arcus is intending to submit a Supplementary Information Report to ECU, we will therefore provide our official response once we will be consulted by the ECU and had the time to review the information provided then.

Please note our comments below.

Regards

Silvia

1. Introduction

1.1 In preparing this response, we have reviewed the following documents:

- Ref. 1 – Letter to SEPA Silvia Cagnoni from ARCUS Liam Nevins, Planning Ref: ECU00003288 Proposed Cloich Forest Wind Farm: SEPA T3 Site Investigation Update dated 26/07/2022
- Ref. 2 – Cloich Forest Wind Farm Turbine T3 Factual Ground Investigation Report Ref: 1283415 - Natural Power for EDF dated 22 June 2022
- Ref. 3 – Arcus, 11 November 2021, Cloich Forest Wind Farm. Proposed Cloich Forest Wind Farm: SEPA T3 Site Investigation Requirement, Appendix A.
- Ref. 4 - WRU internal filenote in response to SEPA Planning Ref. 3371 dated 15/11/2021

1.2 Following the execution of site investigations as proposed in [3] and commented by WRU in [4] the applicant's consultant is seeking WRU's opinion on the requirement for further site investigation and monitoring. WRU has reviewed the data in [1] and [2] and offers the following comments.

1.3 The following comments pertain to the groundwater environment only.

2. Groundwater

2.1 The proposed three boreholes have been installed at the planned locations [3].

The borehole drilling has exceeded the planned depth of 5mbGL (m below ground level). The bases of the borehole monitoring installation response zones have been located at 5m depth (BH01-02) and 6m depth (BH03).

2.2 Groundwater levels have been monitored in four rounds between May and July 2022. The data are summarised in Table 1.

Borehole name	Drilling depth mbGL	Installation depth mbGL	Minimum. GW level mbGL	Maximum. GW level mbGL	Elevation mAOD	Easting	Northing
BH01	7.2	5.0	1.4	1.25	360.15	320568	646330
BH02	10.0	5.0	2.66	2.4	385.97	320330	646121
BH03	6.2	6.0	Dry	5.4	405.51	320579	646074

Table 1: Summary of borehole construction and groundwater level monitoring

2.3 BH01 and BH02 were drilled within the superficial geology described as sandy, gravelly CLAY with cobbles and gravel layers consistent with glacial till formation. BH01 and BH02 did not reach the bedrock.

2.4 BH03 was drilled through a thin layer of peat (0.5m) followed by a thin layer of till (0.45m) to 0.95mbGL and within the weathered and fractured bedrock (sandstone/greywackes) to total depth (6.2m).

2.5 The groundwater level monitoring fails to determine the groundwater flow direction as the response zone was within different aquifers. **The groundwater flow can be inferred from the borehole position with a general direction from south to north however this cannot be confirmed with confidence as the hydraulic continuity between the till and the bedrock has not been proven. Further groundwater level monitoring in only these boreholes will not address this shortcoming. SEPA does not require further groundwater level monitoring within the current installations. However, the applicant may wish to continue the monitoring through the winter period to add to the baseline dataset and to track seasonal variations.**

2.6 The groundwater levels recorded in BH01 and BH02 in the four rounds are relatively stable. BH03 is reported with little groundwater in the first round and then dry in the following three measurement. **The groundwater levels were monitored during summer, when groundwater levels are usually at the lower end of the seasonal range. Groundwater levels are expected to be higher during the winter and early spring.**

2.7 Three in situ rising head hydraulic tests were performed; one in each of the three boreholes. The hydraulic tests for BH01 and BH02 resulted in hydraulic conductivity coefficients of the same order of magnitude, 8.8×10^{-8}m/s and 5.6×10^{-8}m/s respectively. These values are within the expected range for till. The hydraulic test in BH03 was performed with very little water within the hole (1.5 litres abstracted) and a small groundwater level recovery (0.16m) which fell well short from recovering to the initial groundwater level. As such there is little confidence that the bedrock permeability, calculated in 7.4×10^{-9}m/s is representative of the weathered and fractured bedrock. **Additional permeability testing could be done during winter period when the groundwater level is expected to be higher or by a different testing method more suited to the geology at BH03.**

2.8 There is a significant difference in the lithology observed in the three boreholes with BH01/02 showing a thick layer of till and a relatively shallow groundwater level

compared with BH03 showing weathered bedrock at shallow depth and a deeper groundwater level. The till formation is discontinuous and does not reach the PWS catchment area. Therefore the groundwater levels recorded in BH01/02 are not related to the PWS catchment area. The deep groundwater levels in BH03, albeit representative of the lower seasonal level, shows that the Turbine 3 foundation will not impact groundwater levels in the BH03 area as the latter is planned to reach 3m depth – i.e. above the seasonal minimum of below 6m.

2.9 **Given the difference in the geological settings between BH01/02 and BH03, the applicant is requested to comment on how this will affect the final location (micro siting) of Turbine T3.**

2.10 **The applicant should inform if during the monitoring period the private water supply at Nether Stewarton was productive albeit to a reduce output as expected during the summer period.**

2.11 **The summer groundwater level in bedrock near the Turbine T3 foundation (BH03 >6mbGL) is well below the planned turbine foundation depth (3mbGL). As such the presence of the turbine foundation in this area is predicted to have a negligible impact on the potential groundwater contribution to the Nether Stewarton water supply yield.**

Silvia Cagnoni
Senior Planning Officer
Scottish Environment Protection Agency

From: Rebecca Simister
Sent: 26 July 2022 14:56
To: Lewis, Paul; Planning South East
Cc: Richard Fisher ;Becca Leake; Fiona MacGregor; Liam Nevins
Subject: PERMS 3371 (SEPA Ref) Cloich Forest Windfarm - Further Information

Good afternoon

In response to SEPA's previous email dated 16th November 2021. As site investigation works have now been completed at Cloich Forest Windfarm at the proposed T3 location, please find the following attached for your review and comment:

- Response to SEPA's request for further information;
- Figure – Groundwater monitoring locations;
- Groundwater Monitoring data.

Please let me know if you have any further queries or require any further information.

Kind regards

Rebecca

Rebecca Simister
Principal Hydrologist
Arcus Consultancy Services Ltd

Web: www.arcusconsulting.co.uk

From: Rebecca Simister
To: Access to Information Enquiries
Cc: Becca Leake
Subject: RE: Action Required: Third Party request for F0194430 - at Appeal
Date: 25 October 2022 08:13:03
Attachments: image001.png

Good morning,

Thank you for your email relating to Cloich Forest Wind Farm. We are happy with those documents being released, these will form part of an Appendix of the SEI being submitted in November to the ECU and SEPA also.

Kind regards

Rebecca

From: Access to Information Enquiries
Sent: Monday, October 24, 2022 4:14 PM
To: Rebecca Simister
Cc: Access to Information Enquiries
Subject: Action Required: Third Party request for F0194430 - at Appeal
Importance: High

OFFICIAL

Dear Rebecca,

SEPA has received a request under the Environmental Information (Scotland) Regulations 2004 (EIRs)/ to provide the following information:

Please provide all emails and written documents, including details of meetings and telephone calls, relating to all discussions held between SEPA and EDF, including EDF's agents and consultants, on Cloich Forest Wind Farm (ECU Reference: ECU00003288) and the Nether Stewarton PWS from 23 November 2021 to present. […] this issue relates to the Nether Stewarton PWS […]

Under the terms of the EIRs it is our responsibility to make the final decision regarding the release or withholding of information which has been requested.

However, where we hold information which has been received from a third party, or in which a third party has direct involvement, we seek feedback from the third party before any decision to release the information is finalised.

Please see attached report labelled **'Copy of Cloich Forest WF - Factual GIR (REPORT - 1283415 - 1 - B) – 1'** which was sent in an email from yourself to SEPA on 27 July 2022. I have attached the email for reference, labelled '**220727**

factual SI Report for T3 from Arcus 6002'. This report has been identified as held by SEPA and containing information within the scope of the request.

We are now seeking your views on the potential release of the report in response to the request and into the public domain.

We would be grateful if you could send us feedback by return email to indicate if you are content the information is released. Alternatively, if you are not content for the information to be released then please provide feedback indicating any concerns you wish us to consider relating to all or part(s) of the information.

Please note, all personal data including names and job titles would be redacted from all information before release under Regulation 11(2).

Please could you provide feedback by **26 October 2022.**

If you have any queries in the meantime, please contact us using the subject reference F0194430.

Kind regards,

Jessica Davidson
Access to Information
Scottish Environment Protection Agency (SEPA)

From: Barker, Anthony
To: Shearer, Scott
Subject: Cloich Forest Wind Farm, Scottish Borders - Enquiry from ECU
Attachments: image001.png
image002.jpg
image003.png

Dear Scott

For the attention of the Energy Consents Unit (ECU)

To begin with, I will start with a brief background to the lead up to this response, for the benefit of Debbie Flaherty of the ECU and others who will get sight of this email, when you relay it to her in response to her 21/12/21 (18:55) email below to you/Scottish Borders Council (SBC).

I can confirm that I am an Environmental Health Officer (EHO) for SBC, whose current role is as a lead officer with regards to private water supplies (PWSs). This basically involves the enforcement and application of the legislative provisions appropriate to PWSs, with the overarching responsibility relating to the wholesomeness and sufficiency of PWSs serving premises within SBC. I do not have any qualifications or detailed knowledge with regards hydrogeological/hydrological matters.

I was most recently involved with the Cloich Forest Wind Farm planning application in 2020, when I responded on behalf of SBC Environmental Health (EH) with PWS comments in relation to the Applicant's (Arcus) "Cloich Wind Farm / Private Water Supply: Methodology / March 2020" and "Cloich Forest Wind Farm / Gatecheck Report / September 2020".

Since then, other than oversight of email exchanges that I was carbon copied into as a result of my previous involvements, I have had no further involvement with the application (case) until December 2021, when I was requested to provide assistance/guidance to the case by an EH colleague. This coincided with developments associated with SEPA's 19/08/21 response (identified below) to the Applicant's submissions dating back to in June 2021, and the proposal to undertake site investigation work in relation to the Nether Stewarton ("Stewarton") PWS. This work/proposal was intended to begin at the start of January 2022, but it has now been postponed pending consideration. The ECU's request for a response from SBC relates specifically to this proposal.

Since receiving the request for assistance from my colleague and the ECU email below, I have undertaken a review of the case and established that there has been a substantial amount of exchanges (e.g. objections) and new submissions since my 2020 involvement. The ECU folder relating to the current (2021) case reference (21/01134/S36) alone contains over 160 documents for potential review.

With these documents in mind, no consultation response with regards PWS matters, specifically in relation to the Applicant's multiple June 2021 submissions, has yet been made on behalf of EH to Planning for consideration. This has been discussed with you, and I can confirm that it is my intention to provide such a response/comments as soon as possible, but this will likely take some time, given the number and length (content) of the documents that it appears on initial review require comments. Hopefully this should not cause too great an issue, since a Supplementary Environmental Information Report will need to be submitted for consideration upon completion of the site investigation (monitoring), which it appears will take at least three months to complete – i.e. the initial monitoring period.

In the meantime, I will endeavour to respond to the ECU's questions below, based on my review and understanding of the current situation achieved thus far.

In preparing this response, I have concentrated on the documents that contain details that I believe are most pertinent to the Stewarton PWS setup and proposed site investigation work, which are as follows. NB. If there are any other documents that I have neglected to review, but which are deemed to be of significant relevance, then it would be appreciated if these could be identified to me for consideration:

1. Arcus / Cloich Wind Farm / Private Water Supply: Methodology / March 2020 / Environmental Health Response / 27 May 2020 – i.e. PWSRA Version 1 ("PWSRA V1").
2. Arcus / Cloich Forest Wind Farm / Volume 3: Technical Appendices / Technical Appendix A10.2: Private Water Supply Risk Assessment / June 2021 – i.e. PWSRA Version 2 ("PWSRA V2").
3. Arcus / Cloich Forest Wind Farm / EIA Report – Volume 1 – EIA Report Text / Chapter 10 / Hydrology and Hydrogeology / June 2021 – i.e. "Chapter 10".
4. Arcus / Cloich Forest Wind Farm / EIA Report / Volume 2a Figures excluding LVIA / Chapter 10 / Hydrology and Hydrogeology – i.e. "Chapter 10 Figures".
5. Arcus / Cloich Forest Wind Farm / EIA Report – Volume 1 – EIA Report Text / Chapter 18 / Summary of Mitigation / June 2021 – i.e. "Chapter 18".
6. SEPA Letter to the ECU / Dated 19 August 2021 – i.e. SEPA's letter/holding objection requiring site investigation (SI) by the Applicant ("SEPA Letter").
7. ARCUS Letter to SEPA / Dated 11 November 2021 / Proposed Cloich Forest Wind Farm: SEPA T3 Site Investigation Requirement – i.e. ARCUS' letter to SEPA confirming the SI details and that Supplementary Environmental Information (SEI) is to be presented upon completion of the SI ("Arcus Letter").
8. SEPA email to ARCUS, Applicant & ECU / Dated 16 November 2021 – i.e. SEPA's comments on the SI proposals ("SEPA email").

Before I respond to the questions below, I thought it appropriate to first provide a summary relating to the supply setup detailed against the Stewarton PWS, along with comments, so that I am hopefully clear as to the information available about the supply. It is taken from PWSRA V2, unless stated otherwise.

Supply Description:

The supply serves 4 premises, and it is identified as being "a combination of sources from surface-water and run-off associated with a minor tributary of Stewarton Burn, near-surface flow and groundwater springs". This minor tributary (i.e. burn/stream) "forms as a defined watercourse at approximately NT 20997 46036 and drains east towards the Stewarton Burn". The supply's only confirmed "source point" (i.e. "the point where water is collected/sourced") is initially described as a "header tank" located adjacent to the burn/stream at approx. grid reference NT 21290 45829. It is then referred to as both a spring and well by way of "A review of the PWSRA 2012 report identified a spring at the same approximate location (NT 213458) adjacent to the stream, comprising a newly covered well with a deep access pipe to a stop cock". Finally, with regards different terminology

used, the header tank is depicted as “Spring and Near Surface Flow Source” in the diagram on page 25 (labelled as Plate 4a, but which should be labelled/is referred to as Plate 10a within the text), and so it is assumed that the header tank has ultimately been determined to be a source point for a spring (rather than being a well chamber) and the burn/stream. Water is described as “reportedly” being channelled into the header tank by an underground network of pipes extending northwest into the “source catchment” (i.e. “the geographical zone of contribution of water to the source point”), with several studies having apparently been unsuccessful in locating this underground network. It also states that “The ground upstream of the well was reported to feature a number of pipes draining the valley, with one plastic pipe collecting water from the stream itself with a second ceramic pipe within the stream bed following the channel upstream”. Finally, a potential groundwater source/spring is also depicted at approx. grid reference NT 20853 46113 in the diagram (i.e. “Spring Source”), and is further described as not being visible (i.e. observed/located) during the site walkover, but that “it is thought there is potential for a groundwater spring at this location due to the presence of potential groundwater dependent terrestrial ecosystem habitats”.

Proposed Infrastructure:

The proposed infrastructure is described as a new access track with excavation depths anticipated to 1m, and excavations of 24m diameter by 3m depth associated with the foundations of turbines 3 and 4.

Hydrogeological & Hydrological Connectivity:

The following two statements detail the connectivity described – i.e. “In relation to hydrogeological impacts, Turbine 3 is considered to be located within the same hydrogeological formation as the spring supply” and **“**In relation to any surface water impacts, the Development infrastructure is hydrologically disconnected from the Stewarton source catchment by the Stewarton Burn and Courhope Burn catchment boundary”. Unfortunately, it is not clear whether the “spring supply” referred to is the spring associated with the header tank or the Spring Source, as described above, albeit the text that follows and conceptual model suggest that it relates to the header tank spring – please see comments below. This hydrogeological formation (connectivity) is then expanded upon, by describing the aquifer feeding the spring as being “present within the near surface weathered zone and secondary fractures and therefore features a relatively high vulnerability to contaminants and changes in flow upslope”, and that potential impacts to the supply (i.e. the Stewarton PWS) “cannot be fully eliminated” due to the “potential for hydrogeological connectivity” and “the absence of intrusive hydrogeological data pending further ground investigation and dewatering information”. It is assumed that the “further ground investigation” described is the proposed site investigation work.

Potential Impacts:

Due to the hydrogeological connection described, there is clearly the potential for impacts on water quality and quantity/yield, with the latter impact being described by way of “there is potential for the presence of turbine foundations and access tracks to locally alter or prevent the flow of groundwater within the wider source zone for Stewarton Farm”. The following statements are also felt to be informative: (i) “In order to determine the potential impact on supply yield, the contribution of groundwater and surface water to the supply requires further consideration.” (ii) “There is limited information about groundwater flow at the ridge, whilst there is the assumption that groundwater flow is generally bound by the watershed, the presence of fracturing … implies groundwater flow via fractures, which may connect to the supply further downslope to the east.” (iii) “The foundations of Turbine 3 extend to a depth of 3 m which is likely to be within the bedrock and likely to locally prevent or obstruct groundwater flow.” (iv) “With this infrastructure located close to the top of the watershed on the north-western slopes (at a topographical high point) it is only likely to divert or alter a relatively small proportion of flow at this height.” (v) “The majority of the surface water catchment (estimated to be over two thirds) is on the south-eastern slope and ultimately fed by rainfall from this eastern side. This portion of surface water input and groundwater flow is unlikely to be influenced by the proposed infrastructure (foundations) on the north-western slope.” (vi) “The contribution source is likely to change in proportion during periods of high rainfall / wet and periods of drought. During periods of lower rainfall and drought, as there little or no rainfall contribution, the supply is likely to be sustained primarily by groundwater flow where the groundwater levels are lower …” (vii) “Considering the potential impact to changes to groundwater flow and yield of supply, whilst there is potential for groundwater connectivity between the supply in the east and the area of works in the west, based on the distance and topography, a large proportion of the hydrological catchment is likely to be driven by rainfall input on the eastern slope with a smaller contribution of groundwater influence from the west.”

Comments:

- To comply with Condition 20(1) of the Scottish Ministers' section 36 consent, the quality, quantity and continuity of every PWS which may be affected by the Development must be secured/protected – i.e. by appropriate avoidance and/or mitigation measures. To achieve compliance, the (baseline) water quality and water quantity/yield of the Stewarton PWS therefore needs to be ascertained (monitored), ideally prior to any works being undertaken.
- In line with “LUPS Guidance Note 31”, SEPA “requires all groundwater abstractions (source points)” within 250m of all excavations deeper than 1m (i.e. turbine bases) “to be identified and assessed for potential risk”. “SEPA also requires the location of all groundwater abstractions for drinking water supplies to be obtained by consultation with local authorities, local residents and a site walkover …” and “SEPA also considers all and any impacts of the Development on surface waters and near-surface flows”.
- From the supply description, other than the implication that the header tank may be fed by groundwater (i.e. a spring) in close proximity to the tank and surface water by way of a plastic pipe and a ceramic pipe somewhere in the burn/stream, no other source points (groundwater abstractions or otherwise) have been identified as they relate to the reported underground network of pipes extending into the source catchment and draining the valley. Given the uncertainty (unconfirmed status) around the underground network of pipes and their source points, and the fact that the described Spring Source is the only other groundwater abstraction ‘located’ during the consultation and walkover, it is unclear if the described “further consideration” required in relation to the “contribution of groundwater and surface water to the supply” includes this spring as a potential source point for the Stewarton PWS. If it does not, then it would be interesting to know why not, since it is within the Stewarton PWS source catchment and in close proximity to turbine 3, as below. Perhaps other undetermined underground source points also fall within the source catchment, where the two turbine buffer zones overlap it.
- Although the Spring Source was not visible during the site walkover, an accurate (i.e. to within 1m), albeit approximate, grid reference has been allocated to the spring, and it is assumed that this is the centre point of the area of ground that was observed to have “the presence of potential groundwater dependent terrestrial ecosystem habitats”. This precise location is thought to be of relevance, in that the diagram on page 25 (Plate 4a/10a) includes the 250m buffer zones for turbines 3 and 4 (black dotted lines), with both turbines’ buffers overlapping the Stewarton PWS source catchment and turbine 3’s buffer boundary being very close to the Spring Source’s plotted location.
- This 250m buffer from turbine bases has been stipulated as an embedded design mitigation measure as it relates to “groundwater abstractions via boreholes” (Chapter 10, Chapter 18), but it has been applied to other groundwater sources such as springs/wells, and perhaps also surface water sources, within PWSRA V2, as per the SEPA requirements specified above. Hopefully the proposed site investigation work will demonstrate that this 250m boundary is sufficient (appropriate) to avoid potential impact on any undetermined hydrological and hydrogeological connections to the Stewarton PWS source catchment.

My responses to the ECU questions follow, below the line.

Kind regards.

Anthony Barker
Environmental Health Officer

Scottish Borders Council
Regulatory Services
Environmental Health
Council HQ
Newtown St Boswells
MELROSE
TD6 0AS

www.scotborders.gov.uk

Question 1: What, in your view, are the potential risks of this site investigation work on the Stewarton PWS?

As alluded to already, appropriate avoidance and/or mitigation measures are required to comply with Condition 20(1) of the consent.

Such avoidance and mitigation measures "are based on the source-pathway-receptor model", and they are "put in place to prevent the pathway from existing, and thus preventing works associated with the Development from impacting upon PWS quality and quantity, of both the source water and end-supply to properties". This basically means that if the "source" (the hazardous substance / event / activity) cannot be satisfactorily controlled by the prevention of the "pathway" (the means by which the hazard will reach or gain access to the receptor), then said source (hazard) should not be permitted as part of the Development, thus preventing the undesired impact on the "receptor" (the PWS).

In my opinion, the drilling activities (source) have the potential to impact upon both the water quality and quantity of the Stewarton PWS, due to the hydrogeological connectivity (pathway) already determined to be present between the area where turbine 3 will be sited and the Stewarton PWS source catchment (receptor). However, said activities (and monitoring thereafter) are obviously being undertaken at the requirement of SEPA via their 19/08/21 letter, in order to establish the extent of this hydrogeological connectivity – i.e. to replicate/establish the (any) potential impacts on the Stewarton PWS by turbine 3.

SEPA have required this work to be undertaken in accordance with specified (appropriate) guidance, and so I will revert to their response with regards any concerns and controls they may deem appropriate to mitigate the risks of the proposed work.

Question 2: Prior to undertaking this site investigation work and assessment is the Applicant required to obtain any licences or authorisations prior to work commencing on site? If so from whom?

No licenses or authorisations are required from SBC EH. The only caveat, is that the works undertaken must not contravene the provisions of the relevant PWS legislation. In simple terms, the Water (Scotland) Act 1980 (as amended) makes it an offence for any person to pollute a PWS (i.e. cause it to be unwholesome) and/or cause it to fail to provide sufficient water to any house for domestic purposes.

Question 3: Is it necessary for this site investigation work by the Applicant be overseen or monitored by either SEPA or SBC or any other authorised body?

The site investigation work would not be overseen or monitored by SBC.

Question 4(a): As far as ECU are aware no water monitoring or sampling of the Stewarton private water supply has been done to date nor has it been proposed as part of these intended works - Is it necessary to have an assessment of the current baseline of the water quality at these properties?

As identified above, to comply with Condition 20(1) of the consent, the quality, quantity and continuity of every PWS **which may be affected** by the Development must be secured/protected – i.e. by appropriate avoidance and/or mitigation measures.

The purpose of the proposed work/site investigation is to establish the extent of hydrogeological connectivity between the area where turbine 3 will be sited and the Stewarton PWS source catchment. The mere fact that it is deemed necessary, indicates that there is the potential for it to affect the PWS.

As such, I am of the opinion that the (baseline) water quality **and** water quantity/yield of the Stewarton PWS requires to be ascertained – i.e. monitored. Ideally, this should be prior to any works being undertaken, but the nature of the site investigation may be such that the monitoring can occur alongside. For example, I am aware of methodologies (pump tests) used in relation to boreholes, which are used to establish data relating to aquifer properties, groundwater levels and ultimately any impacts on groundwater sources – i.e. drawdown or a reduction in yield observed at hydrogeologically connected sources.

Question 4(b): How could a comparison be done in the event of a complaint arising by property owners claiming impacts due to the ground investigation works?

I am the opinion that a comparison cannot be made unless baseline levels are established, and this relates to both quality **and** quantity/yield – i.e. as above.

Question 4(c): Is this something SBC's EHO would be able to answer?

Please see above. For clarification, the Stewarton PWS is classed as an Exempt (former Type B) PWS under The Private Water Supplies (Scotland) Regulations 2006 (as amended). This effectively means that SBC is not required to monitor the PWS for quality or undertake a risk assessment (RA) in relation thereto, unless requested to do so by an appropriate person ("relevant person") associated with the PWS.

I can confirm that SBC has not undertaken a RA of the PWS, and our records indicate that we have only been requested to sample the water quality on a number of occasions (in 2008, 2014 and 2015) at points of use (i.e. taps) within two of the premises served. The monitoring data is therefore of little value, due to the time that has elapsed and the potential for changes to have occurred with the supply setup.

From: Shearer, Scott
Sent: 22 December 2021 09:09
To: Wilson, Craig; Barker, Anthony
Subject: FW: Cloich Forest Wind Farm, Scottish Borders - Enquiry from ECU

Craig/Anthony,

We have been informed by the Energy Consent Unit (ECU) that the applicants are looking to undertake ground investigations to further establish the impacts on local water supply which serves the Stewarton residents. The ECU have got 3 queries about the potential impacts of this which I have highlighted in red below, would it be possible to provide brief answers to these where relevant please?

NB the ECU are not looking for a response until early in the new year and I finish at lunchtime today so we can pick this up in Jan.

Hope you guys have nice break and see you in the new year.

Thanks

Scott

Scott Shearer
Peripatetic Planning Officer
Planning Housing and Related Services
Corporate Improvement & Economy
Scottish Borders Council

From: Debbie Flaherty
Sent: 21 December 2021 18:55
To: paul lewis; Shearer, Scott
Cc: Richard Fisher; Fraser Clarke; Nikki Anderson **Subject:** Cloich Forest Wind Farm, Scottish Borders - Enquiry from ECU

Dear SEPA/Scottish Borders Council (cc EDF/Arcus)

I refer to the proposed Cloich Forest Wind farm application for consent and recent correspondence between the Applicant and SEPA (attached) as set out below:

19 August 2021 - SEPA request the provision of a detailed qualitative and/or quantitative risk assessment for the private water supply (PWS) upper groundwater spring source Stewarton, which demonstrates that the proposals will not have a significant impact on the groundwater flow and groundwater quality feeding identified sensitive receptors through the proposed design, construction and operation of the infrastructure.

11 November - The Applicant's agent Arcus response with covering letter - SEPA T3 Site Investigation Requirement which included Site Investigation Specification – Technical Note Aims.

16 November - SEPA's comments on the proposed scope.

For background, ECU have been contacted on several occasions by Mr James Taylor, the representative of the Stewarton

residents, raising concerns in relation to their private water supply and more recently in relation to the proposed ground investigations now required to inform the additional information requested by Ministers on 10 November 2021. The Applicant has informed Mr Taylor and ECU that they intend to start their site investigations/monitoring boreholes early next year, likely in the first week of February 2022 and they will be monitored for an initial 3 month period.

It would be helpful for ECU's consideration of Mr Taylor's concerns and with reference to the above proposed site investigations, you could provide answers to the following questions:
What, in your view, are the potential risks of this site investigation work on the Stewarton PWS?

1. Prior to undertaking this site investigation work and assessment is the Applicant required to obtain any licences or authorisations prior to work commencing on site? If so from whom?

2. Is it necessary for this site investigation work by the Applicant be overseen or monitored by either SEPA or SBC or any other authorised body?

3. As far as ECU are aware no water monitoring or sampling of the Stewarton private water supply has been done to date nor has it been proposed as part of these intended works - Is it necessary to have an assessment of the current baseline of the water quality at these properties? How could a comparison be done in the event of a complaint arising by property owners claiming impacts due to the ground investigation works? Is this something SBC's EHO would be able to answer?

If a response can be provided early in the New Year this would be much appreciated.

Regards

Debbie Flaherty | Consents Manager | Energy Consents Unit
The Scottish Government, 5 Atlantic Quay, 150 Broomielaw, Glasgow G2 8LU
☎
To view our current casework please visit www.energyconsents.scot

ARCUS

Anthony Barker
Environmental Health Officer
Regulatory Services
Scottish Borders Council
Newton Street
Boswells Melrose
TD6 0SA

5th April 2022

Dear Mr Barker,

Cloich Forest Wind Farm, Scottish Borders – Response to Energy Consents Unit enquiry regarding the establishment of 3 boreholes to monitor groundwater characteristics in relation to private water supplies.

Arcus Consultancy Services Ltd (Arcus) have been appointed by EDF Renewables (EDF-R) to carry out the hydrology and hydrogeology Environmental Impact Assessment (EIA) for the redesigned Cloich Forest Wind Farm (the Development), which should it be consented, would replace the extant consent for a larger number of wind turbines within the Site.

As you are aware there has been significant dialogue with SEPA and the ECU regarding protection of nearby Private Water Supplies (PWS). Our assessment is currently being updated as part of a Supplementary Environmental Information (SEI) submission. This includes providing additional information for the assessment of potential impacts to private water supplies following the objection from SEPA relating to this issue. SEPA requested groundwater monitoring in three locations to establish whether there is a potential pollutant pathway between a proposed turbine location and a private water supply at Stewarton. To establish these three monitoring locations, three shallow (2x5m depth and 1x10m depth) boreholes must be established within Cloich Forest. This is referred to hereafter as 'Site Investigation'.

Arcus are aware that you have been contacted by the Energy Consents Unit (ECU) to review this matter, including current objections to the Development, as a statutory consultee. Your email response dated 4th February 2022 has been provided to us for review and to provide further information and comment as part of the response.

This letter therefore outlines the current stage of the project and PWS investigation, the outstanding approach to the PWS risk assessment, the mitigation proposed for any site investigation works, as well as a response to some of the queries you raised within your email and a response going forward.

Introduction
Your email dated 4th February 2022 details your understanding of the project history, with the EIA submission for the new Development, submitted for planning in 2021. Following submission, SEPA responded with an objection to the Development requesting additional information relating to the location of turbine 3 (T3) and the potential impacts to the PWS at Stewarton. The following key activities have taken place:

- SEPA outlined the requirement for site investigation and further groundwater assessment to understand the potential hydrogeological connectivity to Stewarton and potential changes to groundwater flow (item 6 on your list of documents reviewed).
- Arcus provided a technical note to SEPA outlining the proposed site investigation specification and locations, which they have accepted (item 7 on your documents reviewed).
- Arcus also provided a Hydrology Site Investigation Note (HSIN) which was circulated to consultees and the residents at Stewarton outlining the proposed site investigation rationale and requirements. Please see the HSIN appended to this letter for your reference.

The proposed site investigation has yet to be undertaken following objection to it from the owners of the Stewarton PWS, who are currently consulting with the ECU and stakeholders, including Scottish Borders Council.

Approach to Risk Assessment
As outlined within our initial technical note to SEPA, which is reiterated within the HSIN, our initial risk assessment within the Private Water Supply Risk Assessment (June 2021) (document 2 on your list) identified whilst there was no surface water connection between T3 and the Stewarton PWS source, taking a precautionary approach there is some potential for groundwater connectivity, based on the underlying bedrock units where groundwater flow is primarily via near surface fracture flow. The infrastructure is located 770m north-west and upgradient of the supply intake location. Whilst in our professional judgement we deemed the likeliness of connectivity to be very low due to the low hydraulic conductivity, topography and distance, it could not be ruled out without further site specific information to support this. This would be provided by obtaining site specific information through the drilling of boreholes to monitor groundwater levels and carry out in-situ testing (you refer to this as part of your response to question 4a "*aware of methodologies (pump tests) …. To establish data referring to hydraulic properties*" which is what EDF-R are proposing to carry out to further inform the risk assessment).

It is in the view of Arcus and EDF-R that there is a **very low risk** associated with these works in relation to the proposed drilling of the three boreholes over a period of three days. The works comprise the drilling of three boreholes using rotary drilling techniques to a maximum depth of 10m, using a water flush. Monitoring wells will be installed at each location using inert materials (plastic pipe, sand and gravel) with secure headworks at ground level. Minor works such as these are routinely carried out in sensitive locations, close to drinking water infrastructure, with the appropriate mitigation in place.

It should be noted that SEPA have requested this information in line with SEPA's guidance as the appropriate environmental regulator. We acknowledge that you revert back to their response with any concerns and controls they may deem appropriate, which we would also agree with.

Mitigation Measures
A number of mitigation measures would be in place for the site investigation to reduce the potential for a pollution incident. This would include the presence of an accredited Ecological Clerk of Works (ECoW) throughout the site investigation with appropriate qualifications and experience to supervise the works. The role of the ECoW would be to provide advice about issues during the works, oversee the management of risks on site and ensure that the contractors risk assessments and method statements are adhered to at all times.

In addition, EDF-R have appointed an experienced and competent drilling contractor who will work closely with all stakeholders to ensure the appropriate measures, such as the risk assessments and method statements (available for review), are in line with the requirements outlined within this consultation phase and subsequent risk assessments. The measures include (but are not limited to) the use of toolbox talks, the requirement to keep fuels/oils outside of the groundwater catchment, the use of silt mitigation measures, as well as no refuelling within the potential

groundwater catchment. There are a very limited number of pollutants, as these are removed from the drilling area (with the exception of the rig itself where fuel is securely contained) that the risk is removed. The drilling contractors are trained and experienced in working with sensitive receptors such as private water supplies.

Our approach to mitigation of pollution events, in line with standard hierarchy, is for prevention of sources rather than a reactive approach. Both of these measures above are in line with this approach.

As such, the provision of an ECoW is considered to be the most appropriate additional measure with the risk from pollution being low.

Water Quality Monitoring
We have been asked to comment about providing baseline monitoring at the supplies. Arcus has extensive experience in water quality monitoring for construction projects, including PWS, with experience of SEPA's guidance and in your email relating to monitoring for both water quality and quantity as an appropriate mitigation measure. Based on the information provided already, monitoring is not required because very low risks such as pollution spills are heavily mitigated against.

SEPA's guidance note LUPS-GU 31 states (within Table 1) for groundwater abstractions that a frequency of '*12 months prior to the **construction phase***' is required. This period of monitoring allows for all seasons to be accounted for in terms of low and high flows and different hydrological conditions which impact water quality. It also allows for review of any significant quantitative and chemical changes in baseline conditions, to understand the statistical significance of any deviation and determine whether these are true baseline conditions.

For the **site investigation works**, however, even considering the comments above monitoring not being required (based on very low risk) we feel that there is very little value in monitoring for the site investigation works. This is based on the fact that there is no established complete pollutant pathway. Sampling at one or two events (spot samples) would not be able to consider true baseline conditions and only provides a discrete snapshot in time. It should be acknowledged that any changes to groundwater flow would not be picked up in any close temporal proximity to the works due to the longer groundwater pathway flow times (weeks to months) in the absence of any existing boreholes between the site and the PWS receptor that could monitor any changes. There could also be a number of factors that may attribute to water quality within the wider groundwater catchment. There is also no surface water connection to the supply, meaning the potential for sedimentation effects is minimal.

Residual Risk
In relation to the risk assessment of impacts to the Stewarton PWS, you acknowledge the 'Source-Pathway-Receptor' model which we have adhered to, in line with basic groundwater principles. In this instance (the site investigation), whilst the pathway and receptor remain the same, the source is different in nature i.e. working area, excavation area etc is much smaller.

Your email refers to whether the hazardous substance/event/activity cannot be satisfactorily controlled. In our opinion this can sufficiently be controlled by the mitigation proposed, as there are stringent mitigation measures to control the potential sources of pollution, such as removing these sources from the drilling locations themselves and through the presence of the ECoW and method statements in place. The duration of works (three days) is significantly less than the time required for construction associated with any windfarm construction.

Based on the comments above, it can be concluded that **for the site investigation drilling** there is no complete pollutant pathway in place. Indeed, these minor site investigation works aim to establish definitively whether such a pathway exists or not, so that comprehensive mitigation,

together with appropriate monitoring in advance of the construction phase for the wind farm itself can be conditioned as part of the new consent, in order to protect the residents' PWS.

Extant Planning Conditions
We would like to clarify why planning and S36 conditions of the original Cloich consent are not being discharged by EDF-R as part of this new application. If granted, consent for the redesigned Development would replace that already in existence and new planning conditions would be provided. The proposed Site Investigation groundwater monitoring is to support the EIA for a new application rather than preparation to build the consented development. We would like to make it clear that EDF-R is not seeking to bypass conditions, it is accepted that conditions would be attached to any new consent and they would need to be discharged prior to construction.

Response to SBC
On our review of your response, you have highlighted some queries which we would like to respond to:

- Source point – the orange marker on Plate 4A refers to the header tank and the green marker refers to where groundwater could emerge from the hillside as a source.
- We also acknowledge the uncertainty relating to the underground network of pipes. Earlier consultation has highlighted the potential difficulty in locating these, given these were installed historically with no records showing their location and several studies have not been successful in locating these either.
- Infrastructure buffer – we acknowledge your response on the 250 m buffer as an embedded mitigation design, which SEPA require as an initial offset from abstraction points and we would seek to demonstrate this is sufficient to demonstrate no impact on any private water supplies.

We would welcome further communication to discuss these points if you wish.

Project Approach for 2022
In order to understand whether a potential groundwater connection exists between Turbine 3 and the Stewarton PWS we intend to carry out the monitoring requested by SEPA (based on the comments above), and progress with the site investigation works, which will allow the private water supply risk assessment to be updated as part of the SEI in 2022.

We would welcome the opportunity to have a meeting to discuss the project in more detail if you have any remaining concerns about the site investigation.

Yours sincerely,

Rebecca Simister BSc (hons) MSC C.WEM FGS
Senior Hydrologist

Attached:
Hydrology Site Investigation Note

CLOICH FOREST WIND FARM

VOLUME 3: SEI REPORT TECHNICAL APPENDICES

TECHNICAL APPENDIX A12.1: CONSTRUCTION DEVELOPMENT PROGRAMME

NOVEMBER 20222

Prepared By:

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Appendix 12.1 - Construction Development Programme

Activity	Month																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
	HGV Excluding Concrete																		Total
Site Mobilisation/Demobilisation	60																	60	120
Forestry	545	545	545	545	545	547													3272
Access Track and Hardstanding Construction			692	688	688	688	691												3448
Control Building and Substation, BESS Delivery.				46	24	24													94
Steel Imports etc. for Turbine Foundations				22	22	66	66												176
Electrical Cabling Delivery											9	9	9	9					36
Crane Delivery												27					27		54
Turbine Erection													72	72	72	72			288
Fuel Delivery	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	144
Sub-Total	613	553	1245	1309	1287	1333	765	8	8	8	17	44	89	89	80	80	35	68	**7632**
	Concrete Delivery																		
Concrete Delivery for Turbine Foundations					144	144	144	288	288	144	144	144	144	144					
Sub-Total					144	144	144	288	288	144	144	144	144	144					**1728**
	Staff Cars and Vans																		
Site Mobilisation/Demobilisation	16																	16	32
Substation Escort				8															8
Crane Delivery Escort													4			4			8
WTG Escort													132	132	132	132			528
Staff	2496	2496	2496	2496	2496	2496	2496	2496	2496	2496	2496	2496	2496	2496	2496	2496	2496	2496	44928
Sub-Total	2512	2496	2496	2504	2496	2496	2496	2496	2496	2496	2496	2496	2632	2628	2628	2632	2496	2512	**45504**
Total Excluding Concrete Delivery	3125	3049	3741	3813	3783	3829	3261	2504	2504	2504	2513	2540	2721	2717	2708	2712	2531	2580	53136
Overall Total	3125	3049	3741	3813	3927	3973	3405	2792	2792	2648	2657	2684	2865	2861	2708	2712	2531	2580	54864
Daily Average (26 Day Month) excluding concrete delivery	120	117	144	147	146	147	125	96	96	96	97	98	105	105	104	104	97	99	
Additional 144 HGVs per day for 12 non-consecutive days (total) of concrete delivery					290	291	269	240	240	240	241	242	249	249					

ARCUS

CLOICH FOREST WIND FARM

VOLUME 3: SEI REPORT TECHNICAL APPENDICES

TECHNICAL APPENDIX A14.1: CLOICH FOREST WIND FARM ESKDALEMUIR SEISMIC ARRAY CONSIDERATIONS

NOVEMBER 2022

Xi Engineering Consultants

Cloich Forest Wind Farm, Eskdalemuir Seismic array Considerations

Mathematical Analysis of Seismic Budget Requirements

Client: EDF Energy Renewables

31/10/2022
Document number: EDF-503-v5

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Document Summary

EDF Energy Renewables wish to develop the Cloich Forest Wind Farm within the Eskdalemuir Consultation Zone. This desktop study assesses the vibration impact of the proposed Cloich Forest Wind Farm on the MoD's Eskdalemuir Seismic Array, for use in an Supplementary Environmental Information Report (SEI Report).

Two separate candidate machines have been assessed to inform EDF Energy Renewables on the budget requirement. For each of these machines, this report uses the most up to date information available on the subject matter to assess the likely budget requirement for Cloich Forest Wind Farm for several different scenarios.

Due to the 42Km distance of the site to the Eskdalemuir Seismic Array it represents an efficient use of any available seismic budget.

The SEI Layout can operate within its allocated Eskdalemuir budget based on the assumptions used.

Action	Name	Date	Version	Amendment
Originator	Dr M P Buckingham	22/9/2022	v1	Issue
Checked by	R. Horton	22/9/2022	v2	Review
Checked by	Dr M P Buckingham	22/9/2022	v3	Review
Review	R. Horton	22/09/2022	v4	Release
Issue	Dr M P Buckingham	30/10/2011	V5	Release

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Contents

1. Introduction

EDF Energy Renewables wish to develop the Cloich Forest Wind Farm site within the Eskdalemuir Consultation Zone. This desktop study assesses the vibration impact of the proposed Cloich Forest Wind Farm on the MoD's Eskdalemuir Seismic Array, for use in an SEI Report.

Two separate candidate machines have been assessed to inform EDF Energy Renewables on the budget requirement. For each of these machines, this report uses the most up to date information available on the subject matter to assess the likely budget requirement for the Development for several different scenarios. Based on the data available in reports 'SGV203 Technical report v12.pdf' and 'SGV_204_Tech_Report _v12 Field audit of Selected sites within the EKA Consultation Zone to support Government Policy Decisions' the budget requirement for the various options is reported.

To better understand the results presented below, an understanding of the Eskdalemuir (EKA) Consultation Zone is necessary. The first section of this report provides both a summary history of the EKA Consultation Zone along with brief updates on further work recently undertaken which will inform the Scottish Government Wind Policy (currently under review and if changed, may affect this site).

The parameters, assumptions and scenarios are discussed in the Scope and Methodology Sections. Multiple approaches were used in the analysis of the Candidate Machine, including Different Scenarios, and the removal of Background Noise.

Based on this mathematical approach, EDF Energy Renewables would be able to operate Cloich Forest Wind Farm within the allocated budget (for the consented Cloich Wind Farm) of 0.0064902nm.

Therefore the SEI Layout can operate within its Eskdalemuir budget based on the assumptions used.

2. Background to Eskdalemuir

The Eskdalemuir Seismological Recording Station is located in the Scottish Borders and is a monitoring facility where seismological, magnetic and other environmental parameters are monitored.

The seismometer array at Eskdalemuir (EKA) has two arms, each of ten seismometers, and became operational on 19 May 1962. The array is operated by AWE Blacknest (AWE) and is part of the seismic network of the organisation set up to help verify compliance with the Comprehensive Test Ban Treaty (CTBT) which bans nuclear explosions.

Concerns were raised that vibrations from wind turbines might affect the ability of EKA to operate properly, and the ministry of Defence (MoD) were advised to set a maximum permissible background vibration budget within a 50km radius of the Eskdalemuir array in order to safeguard its effectiveness in accordance with the CTBT. Beyond 50km it was determined that the vibration contribution from a wind turbine is negligible and is not included in the vibration budget. The maximum vibration budget that was deemed to be acceptable from all wind turbines that might be built within 50km of the array was set at a threshold amplitude of 0.336nm. This budget was subsequently agreed by the Comprehensive Test Ban Treaty Organisation (CTBTO) in Vienna.

Xi were commissioned by the Eskdalemuir Working Group (EWG) in 2013 to develop a robust physics-based approach to estimating the worst-case ground vibration produced by wind turbines. Xi developed such an algorithm, which is currently used by the MoD to calculate the worst-case cumulative effect of all wind turbines on EKA; see 'Seismic Vibration produced by wind turbines in the Eskdalemuir region Release 2.0 of Substantial Research Project'. It is this experience that makes Xi uniquely qualified to assess and deliver a solution to mitigate the seismic vibration risk from wind turbines within the Eskdalemuir statutory consultation zone. The Xi algorithm requires the distance to the array, turbine diameter and the tip height to estimate the seismic vibration.

Due to the limited public data available on seismic emissions from wind turbines at the time, a conservative 'worst-case' approach was adopted. This 2014 turbine algorithm currently used by the MoD to allocate budget is effectively two turbines combined to provide a significant safety factor. The budget algorithm is designed with safety factors such that it over-predicts the output of any single turbine.

Xi's work: "Seismic Vibration produced by wind turbines in the Eskdalemuir region Release 2.0 of Substantial Research Project" was reviewed by the Ministry of Defence Subject matter experts (Dr D Bowers) who subsequently presented to the CTBTO (Comprehensive Nuclear-Test-Ban Treaty Organization) and was ultimately accepted by the Scottish Government. Adopting the Release 2.0 of Substantial Research Project algorithm opened up over 1GW of

onshore wind power within the 50km Eskdalemuir zone compared to the MoD's earlier approach.

2.1. Current Developments

The 2014 algorithm currently used by the MoD to calculate the budget (at the time of writing) takes a highly conservative approach. By design, the algorithm includes factors of safety appropriate to the data sample size available at the time, ensuring that the algorithm over-estimates the cumulative seismic vibrations produced by wind turbines and does not compromise the seismic array.

The Eskdalemuir Working Group (EWG) was reformed in 2018 with a view to reviewing the Eskdalemuir Consultation Zone's vibration budget considering current installed developments and improvements in Wind Turbine Generator Technologies.

Xi Engineering Consultants have been engaged by both the Scottish Government and the EWG to audit the turbines within the region to obtain actual seismic measurement data from the wind farms within the Eskdalemuir consultation zone. Through a series of phased work packages (Phases 1 through 4) which culminated in a measurement campaign of several sites within the region and the delivery of the report 'SGV_204_Tech_Report _v12 Field audit of Selected sites within the EKA Consultation Zone to support Government Policy Decisions' in February 2022.

Directly measuring the seismic output of a greater number of turbines in the consultation zone allows the reduction of the safety factor previously applied in the 2014 algorithm. This reduction ultimately allows further wind capacity to be deployed within the region without breaching the 0.336nm absolute seismic budget within the consultation zone.

A further desk-based study (Phase 5) has been commissioned by the Scottish Government following on from the Phase 4 report and reflecting on initial findings from the Onshore Wind Policy Statement (OnWPS) consultation responses. The main aim of this study is to provide Scottish Government (SG) with evidence to help quantify and consider how much capacity could be achieved through future developments within the zone, with these developments directly contributing to SG's ambitions for onshore wind. In the draft OnWPS this ambition was outlined as 8-12 GW of additional installed capacity across Scotland.

Scottish Government commissioned the calculation of what Seismic Impact Limit could be established if a minimum GW capacity between a range of 1-2.5 GW was to be achieved within the zone. A Seismic Impact limit would be the maximum level a turbine could contribute to the budget, the likely outcome for this would be a specific distance at which turbines within the distance would need to actively reduce seismic emissions. This work is likely to be reported at the next EWG meeting in late 2022.

The outputs from the 2022 Phase 4 and Phase 5 work will feed into the Scottish Government Policy review which is underway at the time of writing. It is envisaged that this revised policy will lead to a minimum additional 1GW of further development within the region and likely substantially more sites at greater distance to the array such as Cloich Forest Wind Farm are realised. In the unlikely scenario that there is an exceedance of budget, Cloich Cloich Forest Wind Farm is 42km so this would represent a good use of the potential increased budget.

2.2. Scottish Onshore Wind Policy

The Scottish Government consulted on the draft Onshore Wind Policy Statement. A consultation, which closed in January 2022, specifically references Eskdalemuir and the approach the Government were taking to explore methods for overcoming the current policy, planning and commercial barriers to development within the region.

The draft Onshore Wind Policy Statement included the following four potential policy options which could be adopted in relation to Eskdalemuir:

1. Option 1: There shall be no onshore wind developments constructed within Scotland which lie within 15km of the Eskdalemuir Seismic Array. (Noting that without the final report from Phase 4 measurements, we cannot confirm that 15km is the most appropriate distance to set this at).
2. Option 2: Any onshore wind development within Scotland which lies between 10km and 20km of the Eskdalemuir Seismic Array will be required to demonstrate, to the satisfaction of the Ministry of Defence, that they can sufficiently mitigate the impact their development would have of the array to an acceptable level.
3. Option 3: Combination of the two options above. A hard, no build area and an additional buffer zone where mitigation is required.
4. Option 4: Make no changes. The no build limit remains at 10km and no additional measures are put in place.

While the outcome of the Scottish Government's consultation on the draft Onshore Wind Policy Statement is not known, in recognition of the ongoing Climate Crisis, the SG is looking to maximise the available renewable energy capacity within the region. As distance plays the most significant role in the amount of budget required by any given site, siting wind farms further away from the array allow significantly more deployment within the wider region than an approach that permits wind farms closer in to proceed. One turbine on the border of the 10km exclusion zone would have an equivalent impact to approximately 2,000 turbines at 50km distance.

To counter this distance dependant seismic requirement, and make efficient use of the available seismic budget, or to optimise the potential deployment in the region extending the exclusion zone would offer the most significant increase in potential built capacity.

Results of the EWG Phase 2 work detailed in Xi's 'SGV_202_Tech_Report_v07' showed an increase in the exclusion zone would result in higher additional capacity. By increasing the radius of exclusion from 10km to 15km the additional deployable capacity increases threefold.

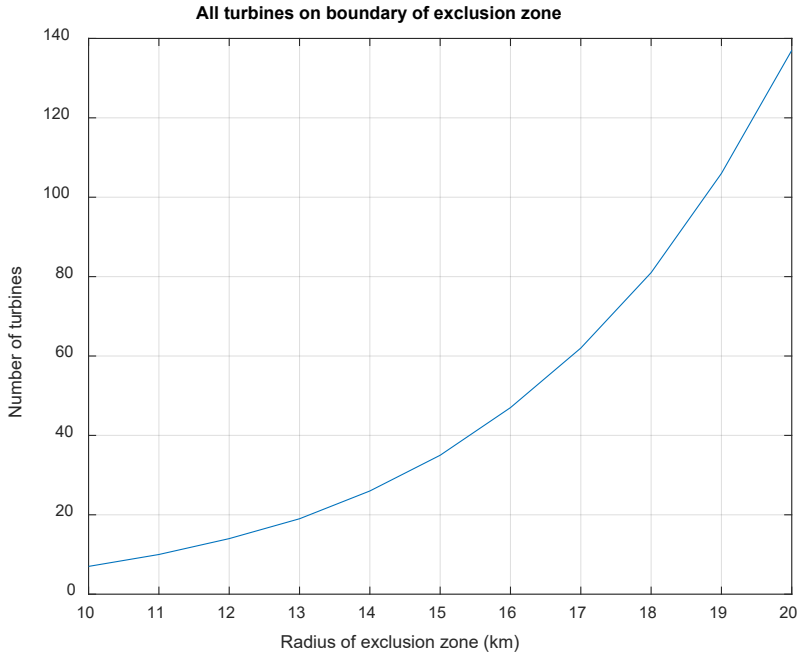

Figure 1 Number of turbines that can be placed on the exclusion zone without breaching the available budget – source: 'SGV_202_Tech_Report_v07'

However, even extending the exclusion zone to 15km the amount of additional capacity is susceptible to a single large wind farm on the boundary of the exclusion zone, and all available seismic budget could be consumed by a single windfarm. Figure 1 shows that a single site of 35 turbines at an extended 15km no go zone would consume all available budget. If option 2 or 3 were to be adopted at a distance of 20km this would represent a minimum of 137 turbines that could be built on the boundary of the exclusion or mitigation zone. If sites were constructed further out this figure would grow exponentially.

This information would suggest that a wider mitigation zone should be adopted to ensure maximum deployment within the region. The Phase 5 work output provides the Scottish Government with Seismic Impact Limit which will prevent a single site close to the array from consuming all the available budget. This SIL would require turbines in closer proximity to the array to be specifically seismically quieter as they have greater impact on the seismic budget. Depending on the level of guaranteed GW the Scottish Government use from the 1-

2.5GW output this will likely create a quiet zone boundary in the region of approximately 20-25km from the array.

The current schedule of the Onshore Wind Policy Statement is winter 2022.

As Cloich Forest Wind Farm has an average turbine distance of 42.8km and has an existing budget allocation relating to the consented development, the potential additional impact of increased turbine size for the SEI Layout would have significantly less impact than turbines closer to the array and the site would not be subject to any SIL that could be imposed by the Scottish Government.

3. Summary

EDF Energy Renewables wish to develop the Cloich Forest Wind Farm within the Eskdalemuir Consultation Zone. The consented Cloich Wind Farm has an existing budget and if the SEI Layout is consented, the Development could operate within this budget.. The Development is situated approximately 42km from the Array, and as such would likely have a minimal seismic signature. This desk top study assesses two candidate machine options, using both the current MoD algorithm, and a multitude of potential seismic levels previously recorded by Xi Engineering Consultants. Based on the data available in report 'SGV203 Technical report v12.pdf' the budget requirement for the two options is reported.

4. Scope of Work

EDF Energy Renewables have revised the consented Cloich Forest wind turbine site to form the SEI Layout. Originally the consented site proposed 18 turbines, which had been allocated a seismic budget of 0.0064902nm by the MoD. The SEI Layout has reduced the turbine number to 12 turbines at the locations in Table 1. EDF Energy Renewables require budget calculations for two candidate machines for the potential site which have been used for the basis of the calculations (see Table 2).

For each of the candidate machines, seven seismic levels have been calculated to reflect a wide range of options and machines and also capture likely future approach to budget allocation within the region.

The aim of this work is to inform strategy in relation to Eskdalemuir in order to develop the site.

5. Methodology

5.1. Site details

The SEI Layout consists of 12 turbines located approximately 42Km for the Eskdalemuir Seismic Array. Specific Turbine locations are shown in Table 1.

Turbine No	Easting	Northing	Distance Km
1	319967	646980	42.5
2	320015	645991	41.5
3	320558	646130	41.6
4	320947	646570	42.0
5	321167	647062	42.4
6	320149	647527	43.0
7	320425	646942	42.4
8	320601	647801	43.4
9	320830	647414	42.8
10	320594	648446	43.9
11	320190	648389	43.9
12	320212	648875	44.4

Table 1 Proposed turbine Locations in Easting and Northing

There are two proposed candidate turbines, 1 x Vestas machine and 1 x Nordex machine. Table 2 shows the Two options analysed and includes turbine dimensions as received from EDF Energy Renewables.

Option	Turbine	Rotor Diameter (m)	Hub Height (m)	Tip height (m)
1	Vestas V136	136	81.9	149.9
2	Nordex N133	133	83.4	149.9

Table 2 Candidate machines for the Cloich Forest Site

5.1.1. Scenarios Assessed

With a view to demonstrating potential required budget, several scenarios have been assessed for each candidate machine. The turbine coordinates and turbine options were coded into MatLab, and calculations were performed to determine budget levels in line with the mathematical approaches in the reports 'SGV203 Technical report v12.pdf' and 'SGV_204_Tech_Report _v12 Field audit of Selected sites within the EKA Consultation Zone to support Government Policy Decisions'.

The scenarios modelled are as follows;

1. Standard EKA algorithm	Using the Current MoD 'worst case' algorithm
2. Craig	Using a scaled Nordex N80 to represent the site
3. Middle Muir	Using a scaled Senvion to represent the site.
4. Clyde	Using a scaled Siemens 2.3 to represent the site
5. Standard EKA background removed	See Background noise removal section
6. Craig Background removed	See Background noise removal section
7. Middlemuir Background removed	See Background noise removal section
8. Clyde Background removed	See Background noise removal section
9. Nordex	Phase 4 scaled data
10. Siemens	Phase 4 scaled data
11. Senvion	Phase 4 scaled data
12. Vestas	Phase 4 scaled data
13. Gamesa	Phase 4 scaled data
14. GE	Phase 4 scaled data
15. Enercon	Phase 4 scaled data

5.1.2. Background Noise Removal

Seismic measurements of wind turbines include ambient seismic noise. This noise is not attributed to the wind turbines themselves, rather it is produced by a combination of natural and anthropogenic sources. The ambient noise may, however, mask lower amplitude wind turbine seismicity (i.e., there may be some component of wind turbine noise, but it may be just below the background noise level, so it wasn't detected). For this reason, the EKA algorithm includes a noise floor based on the measurements of Clyde wind farm.

It has been proposed that a background noise measurement could be conducted before wind farms are built and then a subsequent measurement be conducted once the wind farm is operational. The background noise could then be subtracted from the operational noise giving a truer value of the contribution of the wind farm to seismicity. This approach is common in acoustic measurements of wind farms. To illustrate the affect that such a measurement campaign may have, tables have been provided where the noise floor has been removed from the algorithms such that the seismic contribution of the wind turbines only come from blade pass and structural resonances. This is very much a best-case scenario and is provided for illustrative purposes only. The authors note that the approach of removing all background noise from the algorithm is contrary to the precautionary approach used to design the worst-case EKA algorithm and that it is likely that some turbines generate noise which exists below the noise floor. Working through real world empirical assessments of this will further understanding of how close to this best-case scenario results will be.

6. Results

The following tables (Table 3, Table 4 and Table 5) show the seismic levels of the site and turbine options. The tables have been colour coded to show when the calculation exceeds the current budget allocation of the site 0.0064902nm in red and where the budget is not exceeded in green.

The required seismic budget is between 0.009040nm and 0.003640nm, with the larger diameter Vestas V136 having a slightly larger budget requirement in comparison to the Nordex 133 as would be expected.

The budget range for measurements including background is between 0.009040nm and 0.005193nm. These levels are further reduced to 0.003640nm for the smallest machine using Clyde with no background included.

Turbine Option	Model	Number of Turbines	Standard EKA Algorithm (nm)	Craig (nm)	Middlemuir (nm)	Clyde (nm)
Option 1	V136	12	0.008896	0.007459	0.006842	0.005306
Option 2	N133	12	0.008681	0.007262	0.006677	0.005193

Table 3 Seismic Results of 4 scenarios modelled including Background Noise

Turbine Option	Model	Number of Turbines	Standard EKA Algorithm (nm)	Standard EKA Algorithm Background Removed (nm)	Craig Background Removed (nm)	Middlemuir Background Removed (nm)	Clyde Background Removed (nm)
Option 1	V136	12	0.008896	0.008056	0.006435	0.004945	0.003731
Option 2	N133	12	0.008681	0.007851	0.006246	0.004800	0.003640

Table 4 Seismic Results of 5 scenarios modelled with Background Noise removed

Turbine Option	Nordex	Siemens	Senvion	Vestas	Gamesa	GE	Enercon
Option 1	0.006116	0.005306	0.006842	0.006297	0.009040	0.005848	0.006485
Option 2	0.005976	0.005193	0.006677	0.006153	0.008825	0.005724	0.006333

Table 5 Seismic Results based on Phase 4 calculations

7. Discussion

The mathematical approach used in this document to determine the level of Seismic budget required to build out Cloich Forest Wind Farm is that of the standard EKA algorithm that the MoD currently used within the planning process and a further 14 scenarios representing scaled measurement data from a range of turbines deployed in the Eskdalemuir region.

This analysis shows that the maximum budget required is 0.008896nm, however this is from the original Budget Algorithm and not from measured data. Based on data available to Xi, it is calculated that the SEI Layout can operate within currently allocated budget for the consented Cloich Forest Wind Farm. The budget allocated by the MoD is 0.0064902nm.

As can be seen in Table 3 and Table 5 turbines with a low seismic vibration signatures would be able to be constructed on the site without the need for a before and after background noise measurement. Using low seismic vibration level turbines to build out Cloich Forest Wind Farm could be achieved with a number of machines. Specifically, the Scaled data from a Siemens 2.3MW as deployed at Clyde windfarm, and phase 4 results for Nordex, Siemens, Vestas, Ge and Enercon machines. What must be highlighted is that both of the candidate machines Nordex and Vestas show that the predicted seismic levels are below that of the allocated budget. Table 3 and Table 5 also shows that turbines with a high level of Seismic vibration signature would exceed the allocated budget of the site. Vibration signature is highly dependent on both make, model and size of turbine. Due to these differences a measurement of specific candidate machine is needed to provide confidence that the seismic budget would not be exceeded.

Table 4 shows that upon removing background, both candidate machines could be installed at site without exceeding seismic budget. The same would be true for the candidate machine in Table 5. Again, all turbines vary in seismic signature so care should be taken when choosing a machine. However, if a before and after measurement were conducted onsite, it is likely that most candidate machines could be built out without exceeding allocated seismic budget. It should be noted that the mathematical approach used is very much a 'best case' scenario. However, when a turbine of low seismic vibration can be installed within budget without background noise removed, it is a strong indicator that deploying a before and after measurement methodology with a turbine of appropriate seismic levels will allow the site to be built with most candidate machines.

Recent activity with both the Eskdalemuir Working Group (EWG) and independent legal actions against the MoD on their queueing system for budget allocation means that the use of the current algorithm and queuing process is currently subject to review. Xi Engineering Consultants has engaged with the Scottish Government, EWG and independent developers to further the understanding of the seismic levels produced by turbines and increase the potential development with the Eskdalemuir Consultation Zone. The timescale and output from this work is ultimately subject to decisions by the Scottish Government and the MoD, however current estimates suggest late 2022. It is highly likely that some form of before and after measurement will be adopted to ensure maximum use of the entire seismic budget of 0.336nm for the 50km ring around the Eskdalemuir seismic station.

Xi Engineering Consultants will work directly with developers to ensure that revised plan can meet the original budget allocated by the MoD. Fundamentally, this work requires providing empirical evidence of candidate machine seismic emissions to the MoD to prove that the originally allocated budget is sufficient to build out the site.

8. Conclusion

- The SEI Layout can operate within its Eskdalemuir budget based on the assumptions used
- In a scenario that there is an exceedance of budget, Cloich is 42km from the Array so this would represent an extremely good use of more budget if MW/nm or nm per turbine were considered.
- The site will not be restricted by any potential Seismic Impact Limit that the Scottish Government may impose based on the ongoing Phase 5 work.

CLOICH FOREST WIND FARM
VOLUME 3: SEI REPORT TECHNICAL APPENDICES

TECHNICAL APPENDIX A16.1: CARBON CALCULATOR RESULTS

NOVEMBER 2022

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TABLE OF CONTENTS

PAYBACK TIME AND CO_2 EMISSIONS

Payback Time

Payback Time
Payback Time Charts Input Data

1. Windfarm CO2 emission saving over...	Exp.	Min.	Max.
...coal-fired electricity generation (t CO2 / yr)	125,337	124,872	125,801
...grid-mix of electricity generation (t CO2 / yr)	34,547	34,419	34,675
...fossil fuel-mix of electricity generation (t CO2 / yr)	61,306	61,079	61,533
Energy output from windfarm over lifetime (MWh)	4,087,066	4,071,928	4,102,203

Total CO2 losses due to wind farm (tCO2 eq.)	Exp.	Min.	Max.
2. Losses due to turbine life (eg. manufacture, construction, decomissioning)	50,369	50,369	50,370
3. Losses due to backup	19,618	19,618	19,618
4. Lossess due to reduced carbon fixing potential	980	261	5,892
5. Losses from soil organic matter	5,605	-6,000	15,591
6. Losses due to DOC & POC leaching	341	3	5,438
7. Losses due to felling forestry	28,116	19,498	36,759
Total losses of carbon dioxide	105,030	83,749	133,668

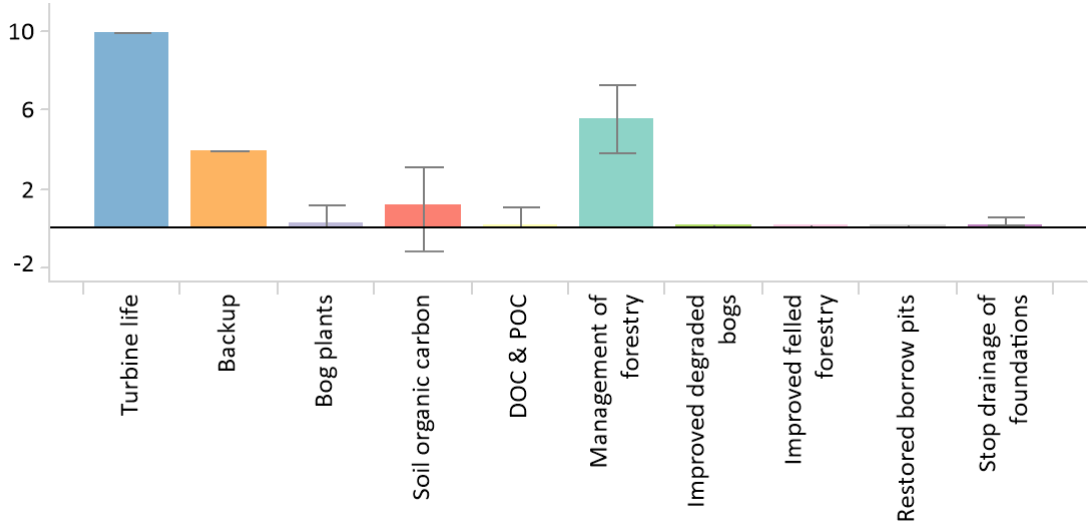
8. Total CO2 gains due to improvement of site (t CO2 eq.)	Exp.	Min.	Max.
8a. Change in emissions due to improvement of degraded bogs	0	0	0
8b. Change in emissions due to improvement of felled forestry	0	0	0
8c. Change in emissions due to restoration of peat from borrow pits	0	0	-1
8d. Change in emissions due to removal of drainage from foundations & hardstanding	425	221	-1,747
Total change in emissions due to improvements	425	221	-1,748

RESULTS	Exp.	Min.	Max.
Net emissions of carbon dioxide (t CO2 eq.)	105,455	82,001	133,889
Carbon Payback Time			
...coal-fired electricity generation (years)	0.8	0.7	1.1
...grid-mix of electricity generation (years)	3.1	2.4	3.9
...fossil fuel-mix of electricity generation (years)	1.7	1.3	2.2
Ratio of soil carbon loss to gain by restoration (not used in Scottish applications)	No gains!	-3.43	No gains!

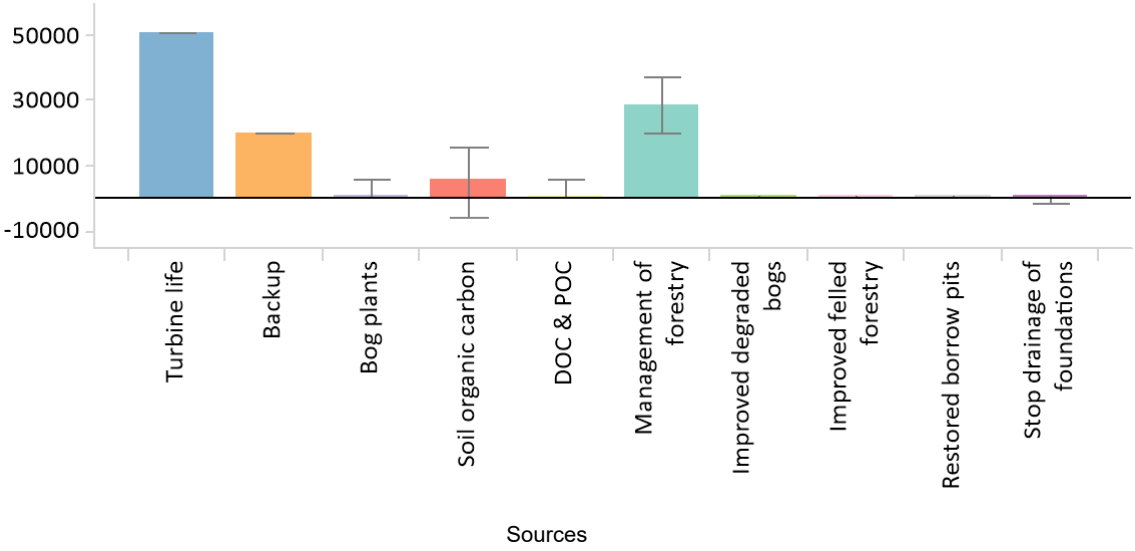
PAYBACK TIME CHARTS

Payback Time - Charts

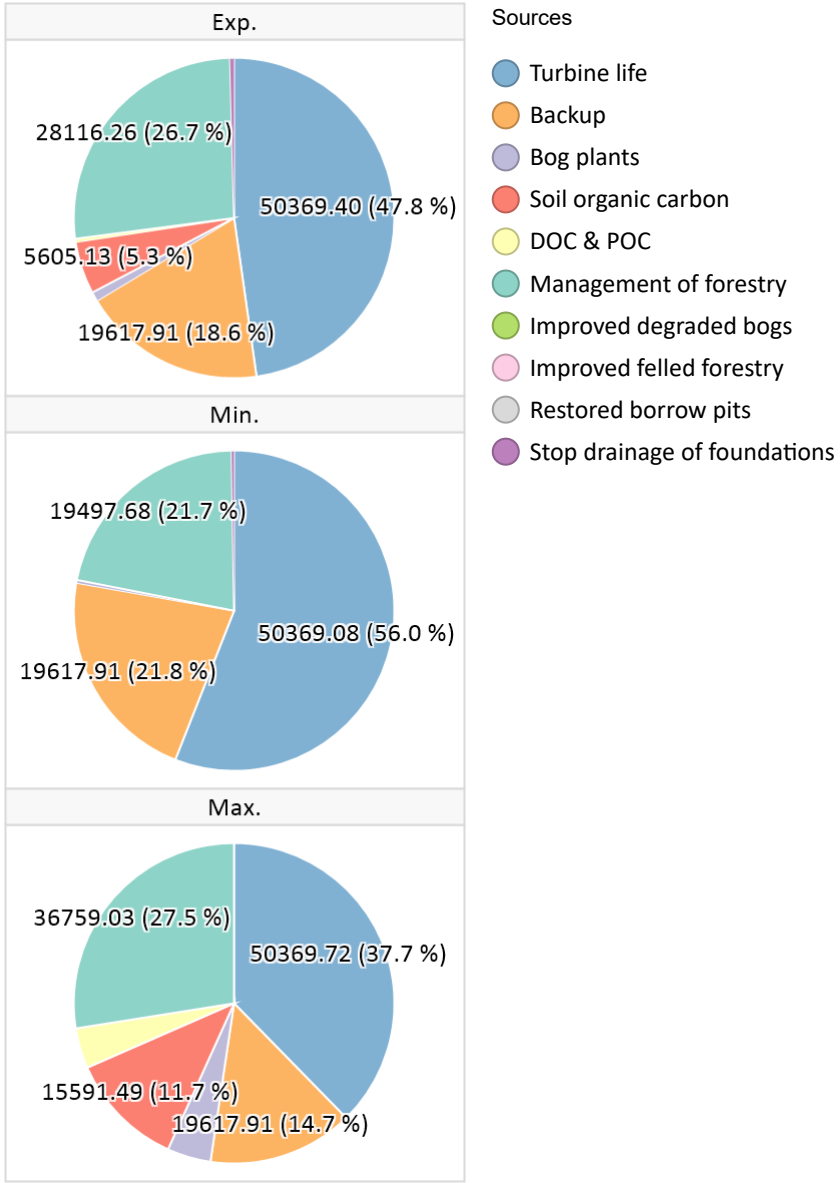
Carbon payback time (months) using fossil-fuel mix as conterfactual



Greenhouse gas emissions (t CO2 eq.)



Proportions of greenhouse gas emissions from different sources



INPUT DATA

Carbon Calculator v1.6.1
Cloich Forest Wind Farm Location: 55.71783 -3.264701
Cloich Windfarm Partnership LLP

Core input data

Input data	Expected value	Minimum value	Maximum value	Source of data
Windfarm characteristics				
Dimensions				
No. of turbines	12	12	12	EIA Report Chapter 3 - Project Description
Duration of consent (years)	30	30	30	EIA Report Chapter 3 - Project Description
Performance				
Power rating of 1 turbine (MW)	4.8	4.8	4.8	EIA Report Candidate Turbine = up to 4.8 MW
Capacity factor	27	26.9	27.1	DUKES 5 year average load factor.
Backup				
Fraction of output to backup (%)	2.88	2.88	2.88	Calculating Potential Carbon Losses & Savings from Wind Farms on Scottish peatlands, technical note, Version 2.10.0, Para 19.
Additional emissions due to reduced thermal efficiency of the reserve generation (%)	10	10	10	Fixed
Total CO2 emission from turbine life (tCO2 MW^{-1}) (eg. manufacture, construction, decommissioning)	Calculate wrt installed capacity	Calculate wrt installed capacity	Calculate wrt installed capacity	
Characteristics of peatland before windfarm development				
Type of peatland	Acid bog	Acid bog	Acid bog	Professional judgement following surveys.
Average annual air temperature at site (°C)	8.15	4.8	11.5	Met Office Climate Averages of nearby Observing Station (Galasheils) https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/gcvurvzxs
Average depth of peat at site (m)	0.26	0.25	0.27	EIA Report - Chapter 9 Geology, Soils & Peat
C Content of dry peat (% by weight)	53.23	19.57	53.24	Scottish Government guidance - Guidance on Developments on Peatland - Site surveys
Average extent of drainage around drainage features at site (m)	10	5	50	Not measured in field directly. Have used guidance values:https://informatics.sepa.org.uk/CarbonCalculator/assets/Carbon_calculator_User_Guidance.pdf
Average water table depth at site (m)	0.1	0.05	0.3	Not measured in field directly. Have used guidance values:https://informatics.sepa.org.uk/CarbonCalculator/assets/Carbon_calculator_User_Guidance.pdf
Dry soil bulk density (g cm^{-3})	0.132	0.072	0.293	Scottish Government guidance - Guidance on Developments on Peatland - Site surveys
Characteristics of bog plants				
Time required for regeneration of bog plants after restoration (years)	5	2	10	Technical estimation - not expected to deviate from standard regeneration timescales
Carbon accumulation due to C fixation by bog plants in undrained peats (tC ha^{-1} yr^{-1})	0.25	0.12	0.31	NatureScot Guidance - Carbon Payback Calculator: Guidelines on Measurements
Forestry Plantation Characteristics				
Area of forestry plantation to be felled (ha)	71	70.9	71.1	Chapter 13: Forestry of this EIA
Average rate of carbon sequestration in timber (tC ha^{-1} yr^{-1})	3.6	2.5	4.7	Scottish Government and NatureScot Guidance

Input data	Expected value	Minimum value	Maximum value	Source of data
Counterfactual emission factors				
Coal-fired plant emission factor (t CO_2 MWh^{-1})	0.92	0.92	0.92	
Grid-mix emission factor (t CO_2 MWh^{-1})	0.25358	0.25358	0.25358	
Fossil fuel-mix emission factor (t CO_2 MWh^{-1})	0.45	0.45	0.45	
Borrow pits				
Number of borrow pits	2	2	2	EIA Report - Chapter 3 Project Description
Average length of pits (m)	140	110	170	TA3.1 Borrow Pit Assessment
Average width of pits (m)	92.5	65	120	TA3.1 Borrow Pit Assessment
Average depth of peat removed from pit (m)	0.25	0.25	0.25	EIA Report - Chapter 9 Geology, Soils & Peat
Foundations and hard-standing area associated with each turbine				
Average length of turbine foundations (m)	24	24	24	EIA Report - Chapter 3 Project Description
Average width of turbine foundations (m)	24	24	24	EIA Report - Chapter 3 Project Description
Average depth of peat removed from turbine foundations(m)	0.21	0.21	0.21	EIA Report - Chapter 9 Geology, Soils & Peat
Average length of hard-standing (m)	50	50	50	EIA Report - Chapter 3 Project Description
Average width of hard-standing (m)	25	25	25	EIA Report - Chapter 3 Project Description
Average depth of peat removed from hard-standing (m)	0.21	0.21	0.21	EIA Report - Chapter 9 Geology, Soils & Peat
Volume of concrete used in construction of the ENTIRE windfarm				
Volume of concrete (m^3)	6840	6839	6841	EIA Report - Chapter 3 Project Description
Access tracks				
Total length of access track (m)	15800	15798	15802	EIA Report - Chapter 3 Project Description
Existing track length (m)	7600	7600	7600	EIA Report - Chapter 3 Project Description
Length of access track that is floating road (m)	0	0	0	N/A to the Development
Floating road width (m)	5	5	5	N/A to the Development
Floating road depth (m)	0	0	0	N/A to the Development
Length of floating road that is drained (m)	0	0	0	N/A to the Development
Average depth of drains associated with floating roads (m)	0	0	0	N/A to the Development
Length of access track that is excavated road (m)	4500	4499	4501	EIA Report - Chapter 3 Project Description
Excavated road width (m)	5	5	5	EIA Report - Chapter 3 Project Description
Average depth of peat excavated for road (m)	0.25	0.25	0.25	EIA Report - Chapter 9 Geology, Soils & Peat

Input data	Expected value	Minimum value	Maximum value	Source of data
Length of access track that is rock filled road (m)	3700	3699	3701	EIA Report - Chapter 3 Project Description
Rock filled road width (m)	5	5	5	EIA Report - Chapter 3 Project Description
Rock filled road depth (m)	0.65	0.64	0.67	EIA Report - Chapter 3 Project Description
Length of rock filled road that is drained (m)	3700	3699	3701	EIA Report - Chapter 3 Project Description
Average depth of drains associated with rock filled roads (m)	0.5	0.4	0.6	EIA Report - Chapter 3 Project Description
Cable trenches				
Length of any cable trench on peat that does not follow access tracks and is lined with a permeable medium (eg. sand) (m)	0	0	0	EIA Report - Chapter 3 Project Description
Average depth of peat cut for cable trenches (m)	0.25	0.25	0.25	EIA Report - Chapter 9 Geology, Soils & Peat
Additional peat excavated (not already accounted for above)				
Volume of additional peat excavated (m^3)	1468	1468	1468	N/A for this Development
Area of additional peat excavated (m^2)	5400	5400	5400	N/A for this Development
Peat Landslide Hazard				
Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments	negligible	negligible	negligible	Fixed
Improvement of C sequestration at site by blocking drains, restoration of habitat etc				
Improvement of degraded bog				
Area of degraded bog to be improved (ha)	0	0	0	None proposed at this stage; however, to be refined post-completion of any Habitat Management Plan.
Water table depth in degraded bog before improvement (m)	0.5	0.49	0.51	Technical estimation
Water table depth in degraded bog after improvement (m)	0	0	0	N/A to the Development
Time required for hydrology and habitat of bog to return to its previous state on improvement (years)	5	4.9	5.1	Technical estimation
Period of time when effectiveness of the improvement in degraded bog can be guaranteed (years)	5	4.9	5.1	Technical estimation
Improvement of felled plantation land				

Input data	Expected value	Minimum value	Maximum value	Source of data
Area of felled plantation to be improved (ha)	0	0	0	None proposed at this stage; however, to be refined post-completion of any Habitat Management Plan.
Water table depth in felled area before improvement (m)	0.5	0.49	0.51	Technical estimation
Water table depth in felled area after improvement (m)	0	0	0	N/A for the Development
Time required for hydrology and habitat of felled plantation to return to its previous state on improvement (years)	5	4.9	5.1	Technical estimation
Period of time when effectiveness of the improvement in felled plantation can be guaranteed (years)	5	4.9	5.1	Technical estimation
Restoration of peat removed from borrow pits				
Area of borrow pits to be restored (ha)	2.25	2.249	2.251	Borrow Pit Assessment TA3.1
Depth of water table in borrow pit before restoration with respect to the restored surface (m)	0.1	0.05	0.3	Technical estimation
Depth of water table in borrow pit after restoration with respect to the restored surface (m)	0	0	0	N/A for the Development
Time required for hydrology and habitat of borrow pit to return to its previous state on restoration (years)	5	4.9	5.1	Technical estimation
Period of time when effectiveness of the restoration of peat removed from borrow pits can be guaranteed (years)	5	4.9	5.1	Technical estimation
Early removal of drainage from foundations and hardstanding				
Water table depth around foundations and hardstanding before restoration (m)	0.1	0.09	0.3	Technical estimation
Water table depth around foundations and hardstanding after restoration (m)	0	0	0	N/A for the Development

Input data	Expected value	Minimum value	Maximum value	Source of data
Time to completion of backfilling, removal of any surface drains, and full restoration of the hydrology (years)	5	5	5	Technical estimation
Restoration of site after decomissioning				
Will the hydrology of the site be restored on decommissioning?	Yes	Yes	Yes	
Will you attempt to block any gullies that have formed due to the windfarm?	Yes	Yes	Yes	Details on gullies will be further refined during restoration.
Will you attempt to block all artificial ditches and facilitate rewetting?	Yes	Yes	Yes	Details on artificial ditches and rewetting will be further refined during restoration.
Will the habitat of the site be restored on decommissioning?	Yes	Yes	Yes	
Will you control grazing on degraded areas?	n/a	n/a	n/a	N/A to the Development.
Will you manage areas to favour reintroduction of species	n/a	n/a	n/a	N/A to the Development.
Methodology				
Choice of methodology for calculating emission factors	Site specific (required for planning applications)			

Forestry input data

N/A

Construction input data

N/A